THE ROYAL ENGINEERS JOURNAL.

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(Telegraphic Address:—"GILBERWOOD, LONDON": Telephone No. 4680 Gerrard.)

MILITARY COLLEGE, RICHMOND, SURREY.

(Inspected by the University of London).

MR. H. F. TRIPPEL and MR. SPENCER MITCHELL

PREPARE FOR ALL ARMY EXAMINATIONS AT

Onslow Hall, Richmond Green, & Shrewsbury House, Twickenham Park

Town Branch—

10, Duke Street, St. James's, S.W.

SUCCESSES JANUARY, 1904, TO JANUARY, 1906.

WOOLWICH.

Place.	Name.
8th	C. Holland.
*15th	H. Smithson.
18th	C. H. Lemmon.
*19th	W. E. Buckingham.
43rd	S. M. Noakes.
46th	V. A. H. Taylor.
50th	H. G. Worsley.
*56th	B. F. Rhodes.

SANDHURST.

6th	G. H. MacCaw.
11th	A. G. Saulez.
*15th	G. I. Carmichael.
23rd	R. H. Koster.
*25th	H. F. Slattery.
30th	J. S. Hicks.
K.I.C.	A. F. Prendergast.
32nd	A. E. Saunderson.
39th	H. A. Studdy.
66th	H. K. D. Evans.
131st	R. G. Moody-Ward.
148th	G. T. Wright.
151st	D. M. King.

INDIAN POLICE.

2nd ... ... W. T. Wickham.

ARMY QUALIFYING CERTIFICATES.

ROYAL ARTILLERY.

Name.	Regiment.
F. G. J. Berkeley	The Yorkshire R.G.A.
A. F. A. Hooper	The Duke of Edinburgh's R.G.A.
G. B. Bosanquet	3rd Bn. The Suffolk Regt.
E. L. Salier	4th Bn. Shropshire Light Infantry.
C. K. Apthorpe	4th Bn. South Wales Borderers.

CAVALRY OR INFANTRY.

W. C. Wilson	6th Bn. Royal Warwickshire Regt.
K. P. Wallis	Royal Monmouthshire R.E.
G. F. Bowes-Lyon	4th Bn. Argyll and Sutherland Highlanders.
G. H. Westbury	3rd Bn. Royal Berkshire Regt.
E. S. Bamford	3rd Bn. Leicestershire Regt.
G. M. Wright	3rd Bn. Royal Munster Fusiliers.
T. H. O. Crawley	7th Bn. Royal Fusiliers.
W. F. Anderson	7th Bn. Royal Fusiliers.
L. F. Hepworth	4th Bn. East Surrey Regt.
W. Grischotti	S.E. of Scotland R.G.A.
S. O. Robinson	5th Bn. Middlesex Regt.
E. F. Robinson	3rd Bn. Shropshire Light Infantry.
*H. H. Clarke	3rd Bn. Royal Welsh Fusiliers.

* Successful under the New Army Regulations.

MILITIA COMPETITIVE.

Place.	Name.
3rd University ...	G. K. Archibald.
4th University ...	H. Wilson.
6th Infantry ...	G. F. Bowes-Lyon.
12th Infantry ...	J. Mallinson.
13th Infantry ...	C. K. Apthorpe.
18th Infantry ...	S. H. Drummond.
39th Infantry ...	L. F. Hepworth.
49th Infantry ...	W. Grischotti.
51st Infantry ...	J. T. Hibbert.
59th Infantry ..	T. F. V. Forster.
W.I.R.	C. F. Hughes.
W.I.R.	F. J. Stevens.

PROMOTION.

Over ONE HUNDRED and NINETY OFFICERS were assisted in "C" and "D."

STAFF COLLEGE, AUGUST, 1905.

ONE Officer received a nomination, and SEVEN qualified.

Telegrams—Trippel, Richmond, Surrey. Telephones—72 and 341 P.O. Richmond, and 884 Mayfair.

NOTE.—Mr. Trippel or Mr. Mitchell can be seen at 10, Duke Street, St. James's, S.W., between the hours of two and five.

N.B.—Special Terms for Sons of Officers of the Royal Engineers.

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The Destruction of Mosquitos, being an Account of the Drainage and other works carried out with this object during 1902 and 1903 at St. Lucia, West Indies, by Major W. M. Hodder, R.E.	1904	2 6
Notes on Steel Concrete, by Major J. Winn, R.E., Assoc. Inst. C.E. 2nd Edition.....	1904	2 6
Notes for Officers Proceeding to India. Compiled by Major A. T. Moore, R.E. (Part I. Outfit, Servants, Amusements, Health, Hints for Ladies, etc.; Part II. Physical Features, Administration, Native Army, History, Languages, Castes, Religions, etc.; Appendix. Shooting Hints)	1904	2 6
Detailed History of the Railways in the South African War, 1899—1902. 2 vols. (Vol. I. Organisation, Military Control, Working and Repair of Cape and Natal Government Railways; Management, Engineering and other Departments of Imperial Military Railways; Railway Pioneer Regiment; Organisation, Equipment and Use of Armoured Trains; Army Labour Depôts; pp. xli. and 275. Vol. II. 61 Photos and 93 Drawings) .....Folio	1904	42 0
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Authors alone are responsible for the statements made and the opinions expressed in their papers.

Barr and Stroud Rangefinder, FQ Type

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

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

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

*THE FRONTIERS OF THE BRITISH EMPIRE.**

By T. Miller Maguire, LL.D.

The true frontier of a power which has command of the sea, with regard to any great Continental power which it opposes, is the coast line of the enemy.

Thus in 1801—1815 the British were able to threaten or bombard or blockade all the leading strategic or commercial points from St. Petersburg to Genoa and thence to Alexandria. Between 1805—1815 our fleets landed forces where they pleased from Java to Ceylon and Mauritius, the Cape, South America, the West Indies, the Potomac, Copenhagen. All through the British had their frontiers across the seas for all purposes of hostile expeditions; and all through the Peninsular War our sailors enabled our soldiers to "take as much or as little of the war as they pleased" from Tarragona to Cadiz and from Lisbon to Bayonne. The fleet facilitated and secured alike the retrograde strategic retreat of Moore in 1809 and the advancing change of base of Wellington in 1813. Nor did our naval power defend our Isles from invasion by a passive defence in the Channel. From this point of view also they turned hostile coasts into the British frontiers.

It is a strange delusion that any lecturer on the Art of War in England would be so foolish as to disparage our naval power even before an audience of soldiers. The Royal Engineers know just as well as any Blue Sea or Yellow Sea or White Sea or any other Sea fanatic that in an empire like ours sea power is vital; and also that it produced precisely the same effect in our wars in the days of Raleigh, Blake, and Rodney as in the days of Nelson.

But let us hearken to a foreign authority on our

COMMAND OF THE SEA.

The following extract from the great work by Capt. Mahan, United States Navy, shows how the command of even distant seas affects the chances of invasion.

* Our best thanks are due to Dr. Maguire for writing out the main portions of a Lecture delivered *ex tempore* at the Royal Engineers Institute on 19th October, 1905. The Lecture was illustrated by numerous maps and photographs, but can be followed on the Navy League map of the British Empire.

"Meanwhile that period of waiting from May, 1803, to August, 1805, when the tangled net of naval and military movements began to unravel, was a striking and wonderful pause in the world's history. On the heights above Boulogne, and along the narrow strip of beach from Etaples to Vimereux, were encamped 130,000 of the most brilliant soldiery of all time, the soldiers who had fought in Germany, Italy, and Egypt, soldiers who were yet to win, from Austria, Ulm and Austerlitz, and from Prussia, Auerstadt and Jena, to hold their own, though barely, at Eylau, against the army of Russia, and to overthrow it also, a few months later, on the bloody field of Friedland. Growing daily more vigorous in the bracing sea air and the hardy life laid out for them, they could on fine days, as they practiced the various manœuvres which were to perfect the vast host in embarking and disembarking with order and rapidity, see the white cliffs fringing the only country that to the last defied their arms. Far away, Cornwallis off Brest, Collingwood off Rochefort, Pellew off Ferrol, were battling the wild gales of the Bay of Biscay, in that tremendous and sustained vigilance which reached its utmost tension in the years preceding Trafalgar, concerning which Collingwood wrote that admirals need to be made of iron, but which was forced upon them by the unquestionable and imminent danger of the country. Farther distant still, severed apparently from all connection with the busy scene at Boulogne, Nelson before Toulon was wearing away the last two years of his glorious but suffering life, fighting the fierce north-westers of the Gulf of Lyon, and questioning, questioning continually with feverish anxiety, whether Napoleon's object was Egypt again or Great Britain really. They were dull, weary, eventless months, those months of watching and waiting of the big ships before the French arsenals. Purposeless they surely seemed to many, but they saved England. *The world has never seen a more impressive demonstration of the influence of sea power upon its history.* Those far distant storm-beaten ships, upon which the Grand Army never looked, stood between it and the dominion of the world. Holding the interior positions as they did, before—and therefore between—the chief dockyards and detachments of the French navy, the latter could unite only by a concurrence of successful evasions, of which the failure of any one nullified the result. Linked together as the various British fleets were by chains of smaller vessels, chance alone could secure Bonaparte's great combination, which depended upon the covert concentration of several detachments upon a point practically within the enemy's lines. Thus, while bodily present before Brest, Rochefort, and Toulon, strategically the British squadrons lay in the Straits of Dover, barring the way against the army of invasion."

Ought not these sentences to be dictated to every school boy and school girl in our Empire?

But sea power ceases at the shore; landing parties and soldiers complete the work of the Navy. Both Navy *and* Army are as necessary for our Islands and for their enormous over-sea territories, for the safety of our own people (40,000,000), our white colonials (12,000,000),

and our darker fellow subjects (350,000,000) as are father and mother to the perpetuity of a family.

"Through sea power we hold the gorgeous East in fee."

Before going to the East I think I had better describe the present strategical position of Canada and the West Indian Islands. My authorities are deliberately chosen, they are all American. Mr. Bancroft, whom I will quote later on, is an eminent literary man and publisher, Colonel Wagner a Regular Army officer, and Capt. Mahan an illustrious Naval officer.

I. PACIFIC SLOPE OF CANADA.

The Pacific Slope of the Dominion may be dismissed from our consideration in a very few words. In one sense, British Columbia is more exposed to invasion than Canada proper, the boundary line being mainly an artificial one; but the roads leading across the frontier are few and poor, the only railroad in the province would not lend itself to the supply of an army operating from the south, and there is no objective in the main portion of the province of sufficient importance to justify military operations of any magnitude. The two points of special importance, Victoria (the capital) and Esquimalt (the great naval station), are both on Vancouver Island, safe from attack so long as England maintains her supremacy on the sea.

ONTARIO.

The southern, or most populous, part of Ontario is, generally speaking, a plain, though it is very undulating, and along the shores of Lakes Erie and Ontario is in many places broken by shelving rocks and precipices. The province is often termed "The Garden of Canada" and is a region of surpassing fertility. Its average yield of wheat, oats, and barley exceeds that of our best States. It produces fruits of various kinds in great abundance, is without a superior as a sheep-raising country, and its exports of cattle and bread-stuffs are large.

The province is generally well cultivated and has fairly good roads. On the whole it is well suited to military operations. The heavily timbered region lies almost altogether north of the probable theatre of operations; and the products of the province would greatly facilitate the supply of an invading army.

QUEBEC.

In the province of Quebec, wheat, barley, oats, rye, and hay are produced in large quantities, and the exports of cattle and beef are considerable. "Dense forests cover enormous tracts of territory"

and the province, as a whole, is heavily wooded. The country has a great number of good wagon roads. Artillery could thus be easily transported; but owing to the mountainous and wooded nature of the province an invading army would, doubtless, require a minimum of artillery and cavalry and a maximum of infantry. The products of this province, too, would greatly facilitate the supply of armies operating in it.

NEW BRUNSWICK.

Except in the mountainous regions already referred to, the surface of New Brunswick is generally undulating. Though the country is not infertile, the agricultural products are not sufficient for home consumption. Hay is produced in great quantities, but the province is not suited to the operations of cavalry or the extended use of artillery, being one of the most heavily wooded regions in the world. The supply of an invading army would receive scanty assistance from the products of this province, and its operations would be impeded by natural features which would lend great advantages to the defence.

NOVA SCOTIA.

Nova Scotia is a more productive province than the one just considered, cereals and fruits growing in abundance. The country contains extensive forests, but its roads are numerous and of excellent quality. The obstacles that would be encountered by an invading army would, however, be found in other natural obstacles than those yet considered.

CANALS AND WATERWAYS.

There is another waterway of less importance perhaps than the Welland and the St. Lawrence canals, but which may nevertheless be of great value to Great Britain, or perhaps to the United States, in case of war between the two nations. Forty-six miles below Montreal is the mouth of the Richelieu. This river is navigable up to Lake Champlain, by means of a dam and lock at St. Ours (14 miles above the mouth) and the Chambly Canal, 12 miles long (32 miles farther up), for vessels drawing 6½ feet. A new canal is proposed from Caughnawauga, about 12 miles above Montreal on Lake St. Louis, to connect with the Chambly Canal, thus admitting of quick water transport from Montreal to Lake Champlain *viâ* St. John's. The Chambly Canal is to be enlarged to the same dimensions as the Welland, and the new canal is to be constructed on the same scale. The possession of the Richelieu canal system would give to the British navy access to Lake Champlain, a fact sufficient to demonstrate its importance.

RAILWAYS.

The Canadian system of water communication is supplemented by an extensive system of railways, the most important of which have a general direction almost parallel with the general course of the waterways. Stretching across the continent from Halifax to Vancouver, with a total length of about 3,600 miles, is the Canadian Pacific Railroad. This road, in *commercial* aspects one of the greatest in the world, is furthermore of great *strategical* value to Great Britain. If left intact, it could, in conjunction with the Pacific steamers, in the space of 40 days, transfer troops from the banks of the Ganges to the shores of the St. Lawrence; and would enable England speedily to place an Anglo-Indian Army anywhere in Canada. But, unfortunately for us, the portion of the road from Lake Superior to the Pacific runs parallel to our boundary and within easy striking distance of it; while the branch from Montreal to Halifax not only lies on the wrong side of the St. Lawrence for safety but a part actually lies within the borders of the State of Maine. Colonel Strange, writing more than a decade ago, says: "I have not taken note of the wilderness between Lake Superior and the Pacific, as it can scarcely be said to contain a military objective; an army could not subsist in it, and in any case we could not defend it unless the Canadian Pacific Railway is constructed."

Since Colonel Strange wrote the railway has been constructed. It now furnishes in itself an objective in the region referred to; and from the very situation of the road, all the efforts of the British Empire probably could not save it from the destructive forays of cowboys from Montana and North Dakota.

That Colonel Strange is right in saying that the St. Lawrence is open to British gunboats, and to them alone, as long as the fortress of Quebec is kept in a defensive condition cannot be denied. The treaty of 1817 limits the naval force to be maintained by the United States and Great Britain to the following vessels on each side, namely:—

On Lake Ontario, one vessel, not exceeding 100 tons burden, and armed with one 18-pr. cannon;

On the upper lakes, two vessels, not exceeding like burden each, and armed with like force;

On the waters of Lake Champlain, one vessel not exceeding like burden, and armed with like force.

Each nation is also forbidden by the treaty to build vessels of war on the lakes.

It would, therefore, be impossible for the United States to place a fleet of gunboats on the lakes without sending them round (by way of the ocean and the St. Lawrence) past Quebec; for we cannot build gunboats on the lakes in time of peace without such violation

of the treaty as to furnish a *casus belli*, and after war breaks out the opportunity for unmolested naval construction is gone.

EFFECT OF THE GEOGRAPHICAL CONDITION UPON MILITARY OPERATIONS.

As a means of forming an estimate of the military value of these various conditions of the physical and political geography of Canada, let us suppose that a war has broken out between the United States and Great Britain. The first question for the Americans—"Shall we assume the initiative, or wait in a defensive position the assault of the enemy?"—is quickly answered. As to the Atlantic Gulf and Pacific seaboards, circumstances plainly demand the adoption of the latter course. As to Canada, the natural aggressiveness of the American people, combined with a confidence born of their traditions, will demand the adoption of a vigorous offensive.

Let us consider the matter from the American point as set forth by Colonel Wagner.

In the selection of an object it is of paramount importance so to direct our efforts as to isolate the Canadians as much as possible from Great Britain and to separate the different provinces from each other. Quebec is the most important objective, for its possession by us would prevent the naval or military reinforcement of the British armies or fleets above that point, and history proves that it is the key to the conquest of Canada. Though we should therefore regard Quebec as our ultimate objective we cannot make it our immediate one. The old line of invasion *viâ* Kennebec and Chaudiere rivers, followed by Arnold, difficult to the last degree for his small force, may be regarded as altogether impracticable for the large army that would now be required for the reduction of the strongest place on the Continent. The route *viâ* Richmond and Athabaska would lend a flank to the attacks of the British and expose our communications from Montreal. The only route is the one adopted by Montgomery, the route *viâ* Montreal; and the reduction of that city must be first effected in order to protect the flank of the army marching down the St. Lawrence. Moreover, that river is desirable for the transportation of heavy ordnance, without which the siege of Quebec would be a farce. Finally the control of the river by vessels of war or heavy floating batteries is necessary, in order that the city may be invested . . . otherwise the investing army would be cut in two by the stream. We are, then, at first, neither in a position to reach nor to reduce Quebec.

MONTREAL.

The capture of Montreal is a necessary stepping-stone to the reduction of Quebec. But there are many other reasons why we should choose Montreal as our primary objective. We have already seen that the Canadian canals give entrance to British war vessels into the Great Lakes. The capture of Montreal would cut Canada in two; it would

give us possession of Beauharnois and Lachine canals, and protect the country above from naval attacks by any vessels except such as might have ascended the St. Lawrence before the surrender of the city; and the ultimate capture of such vessels would be certain. Moreover, it would place us in possession of the metropolis and chief railroad centre of the Dominion, thus causing such embarrassment to the trade of the Canadians as to bring them to a realizing sense of the inconvenience if not the horrors of war. Finally, it would place us in the best possible position for operating in any direction that military circumstances might require.

It seems clear, then, that Montreal should be our first objective, and that we should here assume the initiative promptly and with as large and efficient an army as possible. This army, from the nature of the theatre, should be composed of a large proportion of infantry, with field artillery not exceeding three guns to each thousand men of other arms, and with only enough cavalry for screening and reconnoitring duty. The army should not be encumbered with heavy artillery; for its movements should be made with the utmost celerity, and, once before Montreal, its siege trains could be speedily forwarded by rail and water from Albany. A large force should be detached to seize and occupy Richmond, thus holding an important railroad junction, protecting the right wing of the army before Montreal from attack from Quebec, covering Vermont from invasion, and maintaining communication between the army at Montreal and one in Maine which we will consider later on.

An army operating from Albany as its primary base, with a secondary base at Watertown, should move against Prescott and the Williamsburg canals. A successful passage of the St. Lawrence and the capture of the canals would snap the water communications of the British at an important point; and if the passage were absolutely secured, the army would be in a position to operate against Kingston or to move down the left bank of the river against Montreal. In the latter case, however, the British would have the advantage of interior lines; and the movement against Montreal should not be undertaken unless the army, after masking Kingston with a strong detachment, could still be superior to any force which it might encounter. Otherwise the movement would be an imitation, on the same theatre, of the dismal strategy of Amherst in 1760 and Wilkinson in 1813, the former undeservedly successful and the latter deservedly successful. If the activity of the British military and naval forces on the St. Lawrence should protect Prescott and the canals barring the river, this army could at least defend New York from incursions of the enemy, protect the left flank of the army operating against Montreal, and in case of need be drawn in to the assistance of that force. It would be the part of wisdom to limit the strength of the army in question to the numbers sufficient to ensure the destruction of the canals and the defence of the New York frontier.

Hamilton would be an objective of great importance; mainly as furnishing a base for further operations. In the case of Montreal to designate the object is to name the theatre; but with Hamilton such is not the case. Ontario can be invaded from the west as well as from the east; and an army based on Detroit and Port Huron would have as secure a starting

point as one invading from Buffalo and Niagara. But the operation would not be so decisive. If in the former case we were in complete naval control of Lake Erie, the theatre would give us the advantage of a re-entering base; but otherwise the enemy, if beaten back, would continually cover his line of retreat, would abandon only such territory as was actually wrested from him, and would draw nearer to his reinforcements with each step in retreat. On the other hand, an army invading from the Niagara frontier would at once break the general line of the enemy and a successful battle would probably mean the reduction of the province. A glance at the map shows that if we were to undertake simultaneous movements from Buffalo and Detroit, the Canadians would have the advantage of interior lines with excellent communications. Instead of invading by double lines we should, then, throw our greatest weight on the side of Buffalo; but the Detroit line should not (as we shall see) be altogether neglected, and under certain circumstances it might even become the most important line of all.

A large garrison of regular troops should be continually kept at Forts Porter and Niagara; and at the first sound of war they should be thrown across the frontier, seizing and holding the International Railroad bridges between Fort Erie and Buffalo and the Roebling, Keefer and Cantilever bridges below the falls of Niagara. Pushing on with the utmost celerity, they could then seize the Welland Canal and blow up its locks. If unable to maintain its position on the canal, this force could then fall back and occupy bridge-heads at the bridges mentioned until the main army should begin its passage. Unless the Ottawa and Georgian Bay Canal were completed and in successful operation the destruction of the Welland Canal would ensure the safety of the upper lakes. Lieut. Schenk, in his valuable essay on "Our Northern Frontier," states that within easy striking distance by rail of the Welland Canal, the Canadians have 9,000 militia with 42 guns, completely armed and equipped; but he fails to note that the mobilization of this force would require some appreciable time. Recognizing the value of the initiative, the slowness at best of the militia assemblement, and the superiority of regular troops, it seems probable that a force of two regiments of regular infantry with a squadron of cavalry and two or three batteries of light artillery would, if acting promptly and with celerity, be amply sufficient for the destruction of the canal.

A victory in the Niagara peninsula would almost certainly put us in possession of Hamilton. If defeated we would fall back, covering our line of retreat, to our base. The enemy, if defeated, would doubtless retreat either to Toronto or London. In the former case he would sacrifice all the territory lying between the lakes; and (unless we have read the history of militia wrongly) he would lose by desertion masses of men from that region. In the latter case, he would give up his communications with the forces farthest east; and a second defeat would probably cause the capture or dispersement of his army. In either case, then, the entire railway system between Detroit and Toronto would fall into our hands; we should have a base at Detroit as well as at Buffalo; new levies or other inferior troops could cross at Detroit and Port Huron

to occupy the conquered country and guard the communications; and the victorious army, easily supplied and reinforced, could then safely attack in succession Toronto, Trenton, and Kingston, even though the enemy were in naval control of Lake Ontario. The capture of these important points would doubtless be a matter costly in men, material, and above all in time. If, however, the canals near Prescott had been destroyed in the meantime, the defence of these places would be greatly crippled so far as naval assistance is concerned; and in any event they might be masked while the army pushed on to the capture of Ottawa and the reinforcement of our first army at Montreal or Quebec. The army operating from Buffalo should be composed of the regular proportion of the three arms.

The relations between Russia and England might necessitate the retention in India of a great British military force. But national friendships and enmities are essentially fickle; and arrangements with Russia might enable England to send a formidable Anglo-Indian army against us. *At any rate, unless Great Britain were actually at war with the Czar, we should be obliged to provide against a reinforcement of the Canadian armies by troops from India.* A small army composed of volunteers raised in Minnesota and the Dakotas should be assembled at St. Vincent and sent against Winnipeg, which place should be captured and strongly held, the railroads to the east and south being carefully guarded, and the railway west of the city being utterly wrecked for miles. Raiding parties should be sent from various parts of the frontier of Montana, with instructions to blow up bridges and viaducts and tear up the road to the utmost degree in their power. An attempt should be made to destroy the Canadian Pacific Railway in British Columbia; but beyond sending a small force for this purpose, the operations of our armies on the Pacific Coast would, as we have already seen, be necessarily limited to the defensive.

Thus far we have considered things in a rather favourable aspect for the Americans. Let us suppose, however, that the war, while of nature to be a surprise to us, has been premeditated by Great Britain. Her 146 war-vessels suitable for service on the lakes, while probably not all available for duty in American waters, permit her to assemble a large fleet on the St. Lawrence; a force is posted on the Niagara river, covering the Welland Canal, and strongly intrenched; the St. Lawrence canals are strongly guarded; and a large army in an intrenched camp at St. John's bars the way to Montreal; in other words it is impossible for us to cross the St. Lawrence or the Niagara, and the British navy has free access to Lakes Ontario and Erie. The Detroit route now becomes of paramount importance. Vessels taken from our merchant marine on the lakes, regardless of cost, are sunk in the channel of the Detroit River, and the passage of the British fleet is further barred by submarine mines. If the Ottawa and Georgian Bay canals be completed, similar obstructions are placed in St. Clair River. We thus secure a passage into Canada, which passage will be greatly facilitated by the completion of the tunnel of the Detroit River. Our worst strategic line now becomes our only one. On this we must beat the enemy back upon his natural line of retreat, and drive him upon his reinforcements. The war will be long, bloody, costly and bungling—in fact it will be just such a war as we have carried on

more than once in the past. Our military force must be enormous, because we shall have long lines of communication and they will be everywhere exposed to combined naval and military expeditions—"naval raids," if I may be allowed to coin that term. Still, by sheer dint of superior numbers and resources we should probably be able to reach Ottawa, open new communications *viâ* the Canadian Pacific to Sault Ste. Marie and Winnipeg, and push on to Montreal in spite of the British gunboats controlling the lakes. It would be a case in which "the longest way round would be the shortest way home," because it would be our only way. Even in this case, unless such places as Kingston were masked by very large detachments, their reduction might occupy as much time as the capture of St. John's and Montreal by the first army considered. Our lack of preparation and our want of naval force would place us at a heavy disadvantage.

We will suppose, however, that the canals have been seized as already indicated, and operations carried on as already described. Thus far it may, I think, be safely claimed that the military geography of Canada has favoured the Americans quite as much as it has their adversaries. But in the eastern theatre the geographical balance, so to speak, is heavily against us. Morever, it is important to remember that reinforcements from India can reach the St. Lawrence *viâ* the Pacific Railway in 40 days.

I have dwelt enough on these points. I need scarcely say that this is a mere strategical discussion, not a bit *doctrinaire*, and entirely void of the slightest pretence to practical or party political value at this, or any other given, moment. We must eschew alike metaphysics, and dialectics, and party politics in this hall; and indeed it seems as if they were all three becoming identical—and thus disastrous, as being an attempted combination of incompatible elements.

II. WEST INDIAN ISLES.

Now for the strategic position of the West Indian Isles, so celebrated in the annals of the British Army from the days of Cromwell to the celebrated rush of Nelson for their preservation. Let not our garrisons be hastily removed. These isles are of vital importance, as I wrote a few days ago, quoting Capt. Mahan, to the *Morning Post*.

The importance of these Isles and of the surrounding seas has been recognised by all competent geographers for centuries; they have been the keys of international strategy since the days of the Emperor Charles V.

The Caribbean Sea and the Gulf of Mexico taken together form an inland sea and an archipelago. From the Caribbean, Great Britain, although her rivals had anticipated her in the possession of the largest and richest districts, derived nearly 25 per cent. of her commerce during the strenuous period when the Mediterranean contributed but 2 per cent.

Capt. A. Mahan, in his *Interest of America in Sea Power*, page 277, says: "The Caribbean is pre-eminently the domain of sea power"; and again, page 280, "In the Caribbean, likewise, the existence of numerous

important ports, and a busy traffic in tropical produce grown within the region itself, do but make more striking the predominance in interest of that one position known comprehensively, but up to the present somewhat indeterminately, as the Isthmus. It is in the political fact that on the Pacific coast are the outposts to the exposed pioneers of European civilisation that is to be found the great significance of the future canal across the Central American isthmus, as well as the importance of the Caribbean Sea, for the latter is inseparably intwined with all international consideration of the Isthmus problem. Wherever situated, whether at Panama or Nicaragua, the fundamental meaning of the canal will be that it advances by thousands of miles the frontiers of European civilisation in general and of the United States in particular; that it knits together the whole system of American States.

AUSTRALIA AND CANADA.

The West Indies cannot be considered apart from Canada and Australia any more than we can consider India apart from South Africa. With the opening of the Panama Canal the Dominion's Pacific seaboard will be brought nearer to her Atlantic seaboard by thousands of miles. The intervening South American Continent, which has now to be doubled to establish sea communication, will be cut off. That is to say, the interest of Canada in the projected waterway is the same as her neighbour's. Nor is this all. Australia will have an alternative route to the mother country nearer than that by way of the Suez Canal, and New Zealand will gain a great deal more. In short, the ocean highway, which will be created by cutting through the Isthmus of Panama, will not only be vital to us in our trade with the Far East, but it will link the Dominion and Australia more closely with ourselves. A war in the Western Hemisphere is not impossible, neither is a war in which it may be of the utmost importance for us to maintain uninterrupted communication between the Pacific and Atlantic. How have we provided for such a contingency? By permitting the United States to construct the Panama Canal as a national undertaking, instead of in partnership with this country; by letting Hawaii slip through our fingers, when the natives were eager for our protection; by giving up without equivalent Greytown and other strategical positions commanding the Isthmus.

I understand fortunately that if the Mother Country proposes to cut the West Indian Islands adrift Canada is prepared to take them over.

PANAMA CANAL.

President Roosevelt is subject to no delusions. His views are clearly expressed as follows:—

"We have necessarily undertaken to police the seas at either end of this great waterway, and, as a result, the United States has a

peculiar interest in the preservation of order for the peaceful passage of commerce along the coasts and among the islands of the Pacific and the Caribbean Sea.

"We can help the nations in the vicinity of the canal by a wise and generous assistance, so that by-and-by they can stand alone more securely than they now do. If, unhappily, they should decline such help, this would be bad for them and bad for us, and would ultimately probably cause the United States to face humiliation or bloodshed."

III. AUSTRALIA.

Leaving aside our American and West Indian frontiers, in which no very considerable change has taken place in living memory, let us turn to Australasia, Africa, and India. The first is a creation of the reign of Queen Victoria; and a splendid property is this mighty island daughter of ours, and greater she must become. Its far-seeing statesmen bitterly resented the folly which allowed two strong European powers to approach its shores, and they show a strong and clear perception of its strategic position. They are quite convinced that, being on the flank of America, Asia, and Africa, their country's strategic potentialities are immense; and they view the sudden and portentous awakening of far eastern states, not with apprehension, but with a keen interest which will soon assume important developments.

But it is in Africa and in Asia that our frontiers have been so advanced and complicated that they are conterminous with every variety of civilisation, of military organisation or disorganisation, with all the colours and all the creeds of mankind.

RAPID CHANGES IN OUR STRATEGIC SITUATION.

With regard to several very important, indeed vital, considerations, the position of the United Kingdom is altered now as compared with its position at the time of the Accession of Queen Victoria.

In the first place the British Islands were then absolutely an insular power, that is to say they had an absolutely undisputed command of the sea. No other Power had a Navy worthy of the name; no combination of Powers would have dreamed of attacking the British Empire. That is not so now. Fortunately, after much pressure, the Admiralty authorities a few years ago put our naval house in order, and consequently, with regard to the command of the sea, we are again able to "speak with our enemies in the gate"; but other Powers have developed navies quite fit to fight and ready to fight. That is one particular in which our relations with the world at large have changed since the Accession of Victoria.

Another serious consideration is that when Her Majesty came to the Throne we were practically the only colonising Power. No

other Power thought of expanding into Asia, except Russia. No other Western Power was trying such a thing. France had given it up altogether; it had never entered the head of any Bavarian, Swabian, Styrian, or Austrian; the Brandenburg Royal Family was not then master even of North Germany. *Now* we march with continental peoples in many a portion of the world. The boundaries in black can be clearly traced on the large Navy League map. The boundary of Russia in Asia touches Britain on the Pamirs, is very near Britain at the top of Afghanistan; France touches Britain north of Burmah; Germany in South Africa; and so on. That alters our position strategically to a very considerable extent. Having such powerful military nations as neighbours, instead of being bounded by semi-civilised or barbarous people, is a strategic change of serious import.

Moreover, during our period we have ceased to be able to live on the produce of our islands. In 1837 England and Ireland could feed their people; in 1899 we imported three-fourths of our bread stuffs, I think two-fifths of our meat stuffs, and nearly all our luxuries; and where would we be if for a moment we lost our command of the sea or our reputation as a military Power.

So, having regard merely to the relations of England with other Powers, the strategical geography has changed in Her Majesty's reign in such a fashion as would require hours to describe.

IV. AFRICA 1859 AND NOW.

I have a map of Africa in 1859—what a *terra incognita;* from 5 degrees of Latitude N. to 30 degrees S. is a blank. European powers occupied a mere fringe of that weird Continent:—Ancient Egypt, the coast of the old Roman provinces along the north from Alexandria to the pillars of Hercules, a few trading and fever-stricken settlements along the West Coast, Cape Town and Natal and their environs, were practically all. The vast Sûdan, the Congo Basin, all Nile land, and the great Lake land south of the first Cataract were given over to Mahommedan or Pagan anarchy.

Look at the map now. Observe thriving communities and larger trading cities. See how we touch Abyssinian and French and German territory; follow our numerous explorations and annexations; consider the Zulu and Boer wars, the raids on savagery in Ashanti and Bida and all along the Niger and up to the sources of the Nile; the bridging of the Zambesi and the railway past its magnificent falls, and the road from Mombasa through the forests and highlands of Uganda. Where commercial and exploring adventurers set their feet the British soldier is certain soon to follow—to plant the Union Jack and protect the natives. But let us not deceive ourselves. Germans and Italians, French and British, have almost reached the

limits of their superiority over the black and brown and yellow races of mankind. Modern armament, modern drill, modern skill, combined with the native hardihood and slimness and physical prowess of the coloured races, may soon restore the balance.

V. ENGLAND'S DEPENDENCIES IN ASIA.

England's dependencies in Asia comprise, besides the Indian peninsula and the adjacent islands, the Straits Settlements and islands, the Malay peninsula and island, Hong Kong and the Keeling islands. The Maldive islands are nominally connected with Ceylon, and the islands of Singapore and Penang with the Straits Settlements, while Burmah is the southern entrance to China. All these possessions are peninsulas and islands, and most of them in the tropics; for unlike Russia, England has not gained large accessions of inland territory, her object being trade and strategic stations rather than colonization. Thus Aden, on the way to India, serves commercially Arabia; at Singapore unites the commerce of the Malay peninsula, Australia, and India; the military-commercial station of Hong Kong guards the British interest of northern and western China. The Englishman in Asia is merchant and dominator, not a settler.

England can enter China through India as well as by the eastern ports. The British gateway to China is Burmah. A railway from Burmah to the navigable waters of the Upper Irrawaddy and Yangtse will place western and southern China and the vast interior under British control. The British possessions adjoin the Chinese Empire on the south-west, as the Russian possessions adjoin on the north. Here then are the two great dominating powers in China, Russia on the north and Great Britain in the central and southern parts. The railway from Mandalay in Upper Burmah to Kunlon ferry on the Salween river is a move in this direction. The route from Bhamo, as the commercial highway from Burmah to western and central China, was long held by the Indian government in high esteem.

NORTH-EAST BURMAH.

Before this hasty rush along the fringes of our Empire takes us to the north-west frontier of India I may be allowed to dwell on one of the most remarkable incidents in the marvellous history of our Empire, I mean the railway linking the north-east of Burmah with the south-west of the Chinese Empire. As it is an engineering feat of rare device, and as a former member of your Corps, Colonel A. G. Begbie, very kindly sent me the maps and plans, I may be excused for mentioning the bridge over the Gokteib Gorge on the railway which runs to Maymyo in the hills of the Shan States and thence to

Kunlon Ferry on the Mekong. Here was an old trade route long before the days of Marco Polo, but the toils of the travellers and bearers of baggage up and down the steps of the steep sides of the enormous gorge were exhausting to the last degree.

NORTH-WEST INDIA.

We now come to our Indian Empire. From the 19th of October, 1805, till the disastrous retreat of Napoleon from Russia in 1812, his fiercest foe was the United Kingdom of Great Britain and Ireland. England saved herself by her fleet on the 21st of October, and then saved the rest of the world by example. It is extraordinary to see the developments of our frontiers in every part of the world, which, largely through the antipathy of Napoleon and our desire to thwart his action, were so far-reaching, for he did not confine his ideas of conflict merely to Europe.

There is not the slightest doubt that his incursion into Russia was as much based on his desire to get a good line to India as to any antipathy to Russia itself. All through his career, and particularly in the years 1807–8, he had a persistent notion of reviving that Indian and Colonial Empire which he believed the English had filched from France. He could see the advantage he would gain if he could go from Vienna through Turkish and Persian Territory, from Salonika across Asia Minor, into the Valley of the Euphrates and up the Persian Gulf. He knew full well that the possession of India is doubly important in regard to international policy and in regard to the command of the seas.

Napoleon went in 1798 to Egypt simply to get at India, not that he had any particular desire for Egypt, but because he knew, as Alexander the Great knew, that the possession of Egypt commanded the Red Sea. Alexandria, the Levant, and Syria were the keys of Mesopotamia, and from the Euphrates and Tigris to Afghanistan and Lahore was an easy journey for the young Greek hero from Macedonia. If Alexander could get to the Punjab, why should not the Corsican hero reach Delhi in due time?

So decided was Napoleon about the value of the Levant and of the Sicilian Strait and of the isles of the Mediterranean, and their relation to the Eastern Empire, that he declared in 1801 that he would almost as soon see the British in the Faubourg St. Antoine of Paris as in Malta. He persistently strove to influence Persia against the English; and no doubt French emissaries abetted the risings of Tippoo Sahib and the Mahratta States (1799—1805) and drilled their troops.

If Napoleon could have won sea command he would have hemmed in the United States from the Mississippi basin, all of which, from New Orleans to near the Canadian frontier, then belonged to France,

just as at the same time Florida, Texas, Mexico, and Arizona, and the whole Pacific Coast south of Vancouver's Island belonged to Spain. But fearing lest England might annex New Orleans in consequence of the loss of sea power by the French, Napoleon saw it was no use remaining in the Mississippi basin, and he sold it for £3,000,000 to the United States, who have gone on extending their frontiers ever since. He said, "I give you the command of a large portion of the world with that bargain." Such was the situation in the United States of America. If you want to look up the subject of the frontiers of Canada at your leisure—and it is a most interesting study both for strategical and topographical reasons—you should study the selected papers of the Canadian Military Institute, 1893.

Our Indian frontier on the north-west was advanced in a notable degree from the close of that tremendous upheaval the Indian Mutiny till 1897; and indeed the process is still continuing and increasing our responsibilities. It matters little what the topographical character of a frontier may be. The defence of a state is the man of the state—not wealth or mountains, not allies or fortresses—men of brains and muscles and force of character—nothing else constitutes the true defence of nations.

But the limit of the so-called North-West Provinces has long been an anachronism. It was so when Kashmir and the Punjab and Scinde, the limit of the range of Alexander's operations, were practically annexed (1843—1849). The campaigns of Afghanistan (1878—1880) and of Chitral (1895), not to mention that making of a frontier by Durand and the agreement as to the Pamirs, have brought our frontier across the Indus, and we hold all the issues from Central Asia to that river, the Bolan, Gomal, Kuram, the Khyber, Dora, Nuksan, Baroghil, and Darkot passes. Such is our present commanding position on the northern and eastern slopes of the "Roof of the World" and the Hindu Kush and the Paro-pamisus and the thrones of Solomon. Nor can these issues be turned from the south without the aid of sea power in the Persian Gulf; nor from the north-east except through the Mustagh and Karakorum ranges and through Tibet, a very difficult enterprise and never attempted since the days of the Golden Horde of Chingiz and his immediate successors.

Napoleon and his dreams passed away, but a new power, against which that "myriad-minded" man had warned Europe in vain, soon began to bestride the whole north of Asia like a Colossus.

Russia moved not only to the Pacific but towards India. We were told in 1856 that there was no chance of Russia reaching the Oxus for a few hundred years; yet her soldiers were at Khiva and the Jaxartes before 1876! We were told in 1878 that Russia could not reach Merv till 1950; she was in Merv in 1884.

It appears that politicians have decided that any violation of Afghan territory will be a *casus belli*, and strategic speeches on the

dangers from Russia have made this a burning question in spite of Japanese victories, and it has been suggested that the Japanese alliance will save India for our Empire! I cannot take any political or strategic side before this audience. The facts are simple. It is obvious that, if Russia could maintain 400,000 men in Manchuria by one poor line of railway, it can maintain 400,000 men on the frontier from the Jaxartes to Persia by the aid of two good lines of railway. Termez, on the Oxus, is within four days' short marches of Balkh, and from Kushk Post to Herat is not much more; yet these places are rail heads, and men like Alexander, Tamerlane, Baber, and Roberts declare that these routes are the roads to Delhi.

Look at the map—it is perfectly clear—and geography is the handmaid of strategy, or perhaps its mother.

History supplies another guide, and I will conclude this long lecture by stating how India has been invaded with some twenty-five distinct operations directed against its enormous wealth and its disunited and ill-prepared communities.

ALEXANDER THE GREAT.

We are not acquainted with the real reasons which induced Alexander to pass through Káfiristán on his way from Bálkh to India; but, of course, in selecting this route he had to cross a mass of mountain ranges, to pass through terrible gorges, and to get over mountain streams and ravines without number, whilst there lay open to him the very practicable route along the Kábul river. However this may be, the circumstance is important in proving that regular troops can make their way from Bálkh to India, not only by way of the Bactrian-Kábul and the Khyber routes, but also by tracks within the very heart of the Hindu-Kush mountain range. It is very likely that Alexander wished to reach India without encountering races distinguished for their wild and warlike propensities.

CHINGIZ KHÁN OR ZENGHIS KHÁN.

The Mongol army went into winter quarters in the mountain province of Buiya-Katavar, near the sources of the Indus, whence, in the spring of 1223 A.D., Chingiz Khán moved forward with the intention of marching through Tibet into Mongolia. Being checked in his advance in this direction by the natural difficulties of the country, he ordered his army to march toward Peshawar; and, in all probability, the route he then took was by the valley of the Kábul river. In the autumn of the year 1223 A.D., Chingiz Khán passed through Bálkh. His Indian campaign may be said to have finished here, for, after various wanderings in Central Asia, he returned, in the autumn or winter of 1224 A.D., to his own country, Mongolia.

The campaigns of Chingiz Khán and of his generals present a striking picture of rapid raids carried out in various directions. They were, indeed, a series of tempests, of which history gives no other examples. The Indian campaigns of Chingiz Khán are especially remarkable for the rapidity with which they were undertaken. Thus, setting out from Mongolia in the autumn of the year 1218 A.D., by the end of the year 1221 A.D. Chingiz Khán stood, as a conqueror, on the banks of the Indus. This means that, in a little over three years' time, his main body marched not less than 3,333 miles, whilst, during the same time, the detachments sent out under the sons of generals of Chingiz Khán traversed more than 5,333 miles.

The campaigns of Chingiz Khán also teach us how much may be done with cavalry mounted on small horses, taught—as Mongol horses are taught—to endure long and rapid marches, with only under-foot pasturage for food until the summer heat enables them to be turned out to graze on the rich grazing grounds of a mountainous country.

TIMUR OR TAMERLANE.

On the 13th (25th) December, 1398 A.D., Timur was joined by his left wing at the bridge of Fulkubli, close to the town of Samáne. This wing, which had marched from Kábul, crossed the Indus at Attock, and thence advanced victoriously through the Punjáb, capturing many towns and forts as it passed along. On the same date Timur's main body also came up. He then crossed the Jumna by the Fulkubli bridge, and the next day appeared before Delhi, the capital of India.

By the 4th (16th) January, 1399 A.D., Timur's Imperial Standard was waving on the walls of Delhi. The capture of Delhi and the destruction of Sultan Mahmúd's army placed in Timur's hands a considerable portion of the country. Two days were spent in the pillage of Delhi; and on the 18th (30th) January Timur marched down the Jumna and appeared before Muttra, which fell after an assault on the 26th January (7th February). From Muttra Timur directed his army towards Toglokpur in the Ganges valley. From this point he marched in a north-easterly direction. On the 8th (20th) February he recrossed the Jumna; on the 21st March (2nd April) he recrossed the Chenáb, and on the 24th idem (5th April) he reached Hebgán on the frontier of Kashmir. On the 25th March (7th April) Timur quitted his army and started for his own capital, Sámarkand. Within two days he had recrossed the Indus, and on the third day he had arrived at Bannu. On the 2nd (14th April) he rode to Nagaz or Nargazi—the modern Kuram—where he halted for 24 hours in order to superintend the fortifying of this place, to which he attached great importance in a strategical sense.

From Nargazi he rode on to Kábul, and thence he crossed by the Shibr (or Shibrtan) pass of the Hindu-Kush to the town of Kesh (or

Shahr-i-Sabz), his own birthplace. From Kesh Timur reached his capital (Sámarkand). Thus ended his famous campaign against India.

NÁDIR SHÁH.

On the 13th (25th) April, 1740, Nádir Sháh's standard was once more unfurled on the walls of Kandahár, whence he had started on his campaign against India, the interval between his departure from, and his return to, this place being two years and seven days. During this period his forces had traversed the following distances :—

	Miles.
From Kandahár to Kabul	316
„ Kabul to Pesháwur	195
„ Pesháwur to Delhi	567
„ Delhi to Kabul, or a little north of that city ...	800
„ Kabul to Dera-Ismail-Khán	335
„ Dera-Ismail-Khán to Dera-Gházi-Khán... ...	135
„ Dera-Gházi-Khán to Larkhána	267
„ Larkhána to Umarkoti	140
„ Umarkoti back to Larkhána	140
„ Larkhána to Shikárpur	67
„ Shirkápur to Kandahár	356
Total	3,318

During this period (about two years) Nádir Sháh's army, either on the line of march or in battle array, hampered with a huge transport train, and with a considerable complement of artillery, had passed through difficult gorges, ascended lofty mountains, traversed almost trackless deserts, and effected the passage of wide rivers. The return route through the Panjáb was, moreover, accomplished during a season of fierce heat.

On the 18th (30th) April it marched out of Kandahár, and on the 15th (27th) May arrived at Herat, after traversing a distance of 380 miles in 28 days.

If, then, we take Ispahán as the starting point, we shall see that Nádir Sháh's forces had traversed 4,667 miles in about three and a-half years.

This feat was accomplished by large masses of men of strangely diverse nationalities, welded together in one compact whole by this remarkable Turkumán, who had, in a comparatively short space of time, substituted for a mere rabble, devoid of all military organisation and discipline and even lacking in martial ardour, a highly effective military force.

VI. CONCLUSION.

Whether the Empire, the frontiers of which have been our theme, be a magnificent growth or (as some say) a malignant one, our military men have not been the motive power of either its expansion or retention, nor have they provoked wars or been agents of strife. The expansion has been principally, and for 200 years altogether, a matter of commercial and naval enterprise. Why were India, North America, the Cape, Mauritius, and the West Indies acquired and kept at the cost of so much blood? For wealth, for trading purposes, and for these purposes only. "He who possesses power over the ocean has the trade of the world," said Raleigh. "The wealth of both the Indies is incidental to command of the seas," said Bacon. During the great wars, "our shops were bursting with opulence into our streets," said Burke.

What were the objects of the East India Company, the Hudson's Bay Company, and other great Chartered companies? Dividends. The merchant adventurers sought in all their travels for the "utmost wealth of Ormus and of Ind." Lust of power, love of conquest, religion, or civilisation had nothing whatever to do with their enterprises. Singapore, Ceylon, Hong Kong, Newfoundland, Demerara, were acquired and developed for trade purposes and for these only. The soldiers seized and preserved them. Officers and privates have often been even more ruthlessly exploited than the natives themselves; but they did their duty, and the results were all these acquisitions, and yet they got all the hard knocks and much of the abuse in cases of failures generally due to political incompetence. But the people who did most work certainly got least in return. The dividends were in inverse proportion to the pay of the troops, yet their labours are writ large on that map of Empire on your walls.

I have thus shortly traced some of the most significant questions of present importance and of historic interest relating to the greatest of all Empires past and present. Wherever in modern times the British soldiers have marched, wheresoever a serious crisis of advance or retreat, of triumph or of isolation, has marked their chequered careers, by many an ancient city, by many a foreign strand, in the waterless desert or amidst everlasting snows, or in the more deadly luxuriance of tropical swamps and forests, the aid of your Corps has been ever welcome, and helpful—*Ubique, per mare et terras.*

For me to be allowed to lecture to such an audience is not only a great privilege but also a distinguished honour.

THE ATTACK OF ENTRENCHED POSITIONS.

By Capt. J. E. E. Craster, R.E.

"It will seldom be advisable to endeavour to come to close quarters and break through the enemy's defence at every point. The better plan is to outflank at least one of the enemy's wings; to seize localities from which a searching and sustained fire may be developed against a weak point of the position; to strike at that point heavily, unexpectedly, and in the greatest strength possible; and elsewhere to establish bodies of infantry so close to the enemy's line as to hold him to his ground and prevent him from either changing front or from reinforcing the troops defending the point of attack."*

The last sentence of this paragraph describes an operation which must come first in chronological order. Before either turning the enemy's flank, or assaulting a weak spot in his defences, it is necessary to establish infantry close enough to the whole of his front to hold him to his defences. No hint is given as to how close this must be; but it seems certain that the retaining force should be everywhere within effective, and at some points within decisive, range, or even within assaulting distance of the enemy's position, during the whole time that the turning movement is taking place—a matter of several days. It is impossible for the retaining force to remain so near the enemy's trenches, day after day, and night after night, unless they themselves are protected by entrenchments.

The attacking force must, in the first instance, advance against the enemy's position in widely extended lines, for this is the only formation in which troops can manœuvre under heavy fire. They should be supported by artillery and also by long range infantry fire, if the latter can be brought to bear. The advancing troops should not waste time in firing, because they cannot hope to establish a superiority of fire over the defence. A widely extended line exposed in the open cannot be expected to subdue the fire of an entrenched force; the object of the retaining force should be to get as close to the enemy as possible, and then establish themselves, that is entrench. On the other hand it must be remembered that the first line is always much exposed to local counter-attacks, and that in order to resist these it should be as strong as possible. It is necessary therefore to satisfy two conflicting conditions; if the first line is

* *Combined Training*, 1905.

very strong it will suffer unnecessary losses, if it is too weak it will give way before a counter-attack.

In open ground a single row of trenches will not be sufficient. The first line of the retaining troops should have a second, and perhaps a third, line entrenched behind it, from which it can be supported if necessary, and on which it can rally if driven back. The men in the first line, who must dig lying down, will only be able to excavate a number of isolated holes; possibly the second and third lines will not accomplish much more. These isolated holes must be connected and converted into a trench on the first opportunity, usually after nightfall.

It may, perhaps, be thought that the retaining force should not attempt to take up its position till after dark. Though it might thus escape with fewer casualties, it could not establish itself with so much certainty, it would have less time to devote to its defences, and it might find that owing to faulty siting its trenches were untenable in daylight. In order, however, to render the period of exposure as short as possible, the troops should not move forward till an hour or two before sunset.

It is extremely desirable that the trenches should be connected by covered approaches, thus rendering it possible to relieve the men in the first trench during the daytime, and, what is of more importance, to reinforce them or withdraw them unobserved. At the battle of Nanshan the Russians had constructed three tiers of trenches, but had not connected them. Nearly all their casualties occurred when they were attempting first to reinforce and subsequently to withdraw the men in the front trenches. The Russians believe that, if their trenches had been connected, the Japanese would have been repulsed.

The form of trench adopted for the various lines must depend on the time available, the nature of the soil, and the proximity of the enemy. But as the first trench will be exposed to very oblique, if not enfilade, fire, it should be traversed, recessed, and furnished with head cover. If time and materials are available, a certain amount of overhead cover should be provided in each trench.

It will not be easy to prevent the communication trenches from being enfiladed. The old form of zigzag approach, that was always lined on a point beyond the enemy's flank, is impossible when the flanks are miles apart. The adoption of a wavy trace would probably render the trench fairly safe. The great object to be attained in the communication trenches is cover from view, so that all movements of troops can be carried out unobserved. Good cover from fire is desirable, but not essential.

By the time the retaining force of infantry have firmly established themselves, the point on which the assault is to be delivered will have been selected. Other things being equal, a salient is the weakest

point, because a cross fire can be brought to bear upon it. As regards other conditions a position on or below the front crest of a fairly steep hill, with a narrow valley in front, seems to offer the best chances of success. It should then be possible to support the assault with fire from two or three tiers of trenches, cut in the opposite side of the valley. The enemy's reinforcements will be much exposed in moving forward over the crest; and as the ground falls away from in front of their trenches, the defenders must expose themselves a good deal before they can fire down on the assaulting force.

The greatest care must be taken that the preliminary arrangements shall not indicate the point selected for assault. It would be foolish, for instance, to construct the trenches so that they all faced the threatened point. On the other hand, it should be possible, during the night before the assault, to align the loopholes of the trenches so that the fire of the retaining force should be made to converge towards it; this could be done without the enemy detecting the fact. Unless some precaution of this sort is taken the troops will fire at the nearest target, that is straight to their front, instead of trying to enfilade a distant point of the enemy's position. Perhaps a better method would be to make two loopholes to each recess, one facing straight to the front for use in case of a counter-attack, and one in the angle of the recess facing the point of assault.

The question of how the assault should be delivered is almost outside the scope of this article. It should be carried out over as broad a front as the artillery can sweep, and the assaulting force should be given as great depth as possible. Line after line should be sent forward until the enemy's position has been effectually pierced and the assaulting troops are too firmly established to be driven out by a counter-attack. The more rapidly the assault is carried out, the more likely is it to succeed.

The whole duty of the artillery during the attack is to support the infantry. As a rule the guns should be silent unless the infantry are on the move or lying exposed in the open. During the preliminary phase, therefore, the guns must keep down the enemy's fire as much as possible, so as to allow the retaining force to establish itself with comparatively little loss. When once the infantry are properly entrenched, the artillery should reserve its ammunition until the assault. The bombardment of empty, or half empty, trenches is a harmful proceeding, as it inflicts no appreciable loss on the enemy, and merely incites him to improve his defences till by the time the assault is ready they are as shrapnel-proof as human ingenuity can make them.

The greatest care must be taken in selecting the artillery positions to support the assault; every gun that can be brought to bear must be employed. The object to be attained is to bring an enfilade, or at least a very oblique, shrapnel fire to bear on every part of the

defenders' position from which he can molest the assaulting force. To do this it may often be desirable to push single guns quite close up to the enemy's lines. These guns could never fire straight to the front; but should be placed in sunken splinter-proof shelters, and should fire through a small embrasure cut towards the point of the enemy's position which they are required to enfilade. The effect that one modern quick-firing gun could produce under such conditions should amply repay the time and trouble involved in making the shelter, and should compensate for the possible loss or destruction of the gun. When the gun was firing rapidly the ventilation of the splinter-proof would be very difficult, and this point should not be overlooked.

During the preliminary operations every effort should be made to locate the enemy's artillery, his rallying position, and his field redoubts, if he has constructed any. The only means of doing this will be by the use of balloons, kites, and (before long) flying machines. If possible, howitzer batteries should be established within range of any defences that lie in rear of the point of assault. As soon as the assault has been delivered, fire should be concentrated on these works.

In conclusion it must be admitted that the system of attack which has been described will involve an appalling amount of spade work, especially in open country. In the light of recent battles, however, it seems to be the only feasible method of carrying out the attack as advocated in the *Manual of Combined Training*. If this is correct, then an entrenching tool must form part of every soldier's equipment, and he must be carefully taught when, where, and how to dig.

MULTI-CYLINDER PETROL ENGINES.

By 'CRANKSHAFT.'

A CONSIDERABLE amount of discussion and correspondence has taken place lately in the Press as to what is the best number of cylinders to employ in petrol engines for use in motor cars and launches; and there is a possibility of a special race being organized to elucidate this point. It is generally agreed that either a four or a six-cylinder engine is the most suitable; but in a few cases eight cylinders have been used; and it must be remembered that a two-cylinder engine (of special design) won the Tourist Trophy Race.

Advocates of the six-cylinder engine maintain that it is much smoother running, owing to the more even torque produced and its excellent balance; and that the strains set up in the various parts (and consequently the amount of wear that takes place) are much smaller for the same power. Whereas those in favour of the four-cylinder engine say that the gain in smoothness of running by the adoption of six cylinders is not sufficient compensation for the extra weight, space, and complication entailed; that the four-cylinder engine gives very fair crank effort and balance; and that it has been found very satisfactory in general use.

The question of crank effort and balance is susceptible of mathematical calculation, and will be further dealt with hereafter. As regards the question of weight, since four working strokes in one engine correspond to six in the other, it follows that the power of each in the latter case is smaller, the strains set up are smaller, and consequently the various parts can be made lighter. Also, owing to the torque in the six-cylinder engine being more even than that in the four-cylinder one, a lighter flywheel can be employed; but on the other hand there is the weight of the two extra cylinders, etc. As regards complication, figures have been published in one of the newspapers, showing that a well-known make of four-cylinder engine consists of 776 parts; and that the increase on a similar powered six-cylinder is less than one-quarter. Hence it appears that the six-cylinder engine is both heavier and more complicated than the four-cylinder of the same power, but that the increase is by no means proportional to the number of cylinders.

CRANK EFFORT.

The crank effort (*i.e.* the moment exerted by the connecting rod to turn the crank) depends principally on the magnitude of the force transmitted by the connecting rod. Apart from the angularity of the connecting rod, this force is due to two main factors:—(*a*) the pressure in the cylinder, owing to the firing of the explosive charge or otherwise, which can be ascertained by means of the manograph or indicator; (*b*) the force required to overcome the inertia of the moving parts. At the beginning of a stroke the piston is at rest, and considerable force must be used to start and accelerate it; as regards useful work, this force is negative, and must be deducted. After the crank has turned through nearly 90°, the piston tends to go on moving, but has to be brought to rest by the end of the stroke; consequently a positive force is exerted, and must be added to that due to the firing of the explosive charge. These forces can be calculated accurately when the weight of the reciprocating parts and speed of the engine are known.

In the ordinary petrol engine the Otto cycle is employed, giving one working stroke or impulse per cylinder in two revolutions. *Fig.* I. gives a crank effort diagram for a single-cylinder engine. The turning moment is shown in inch-pounds: it rises to a maximum of about 3,200 in the working stroke; during the exhaust and admission strokes, it is alternately negative and positive; and during the compression stroke, it is negative all through: hence a heavy flywheel is required to carry the engine round between the working strokes. This diagram has been calculated for a cylinder of 4″ bore and stroke, giving about 5 b.h.p. at 1,000 revolutions per minute: the indicator diagram gave a mean effective pressure of 84 lbs. per sq. in.

In a two-cylinder engine the cylinders and cranks may be arranged in various ways. If the cylinders are placed side by side, the cranks should be in line, *i.e.* at 360°; this will give an impulse every revolution; and the torque produced will be regular, though varying between wide limits and at times negative: but if the cranks are set at 180°, two impulses will occur in one revolution and none in the next, which is not a satisfactory arrangement. If the cylinders are opposed to one another on opposite sides of the crank shaft, the cranks should be set at 180°, in order to get an impulse each revolution.

In a three-cylinder engine the cranks should be set at 240° to each other: this will give three impulses in two revolutions, evenly spaced: the turning moment is regular, but a considerable amount of negative work has still to be done.

Fig. II. gives the torque diagram for a four-cylinder engine of about 20 h.p. It is obtained by combining at proper intervals four diagrams the same as *Fig.* I. The cranks are set at 180°, and four impulses

TORQUE DIAGRAMS.

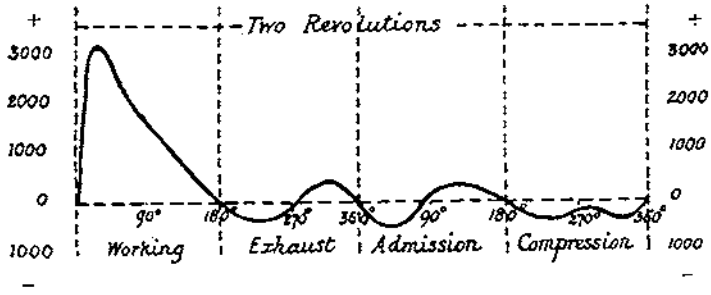


Fig. I. 5 h.p. Single-Cylinder Engine.

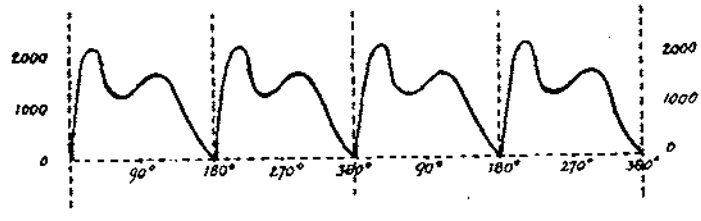


Fig. II. 20 h.p. Four-Cylinder Engine.

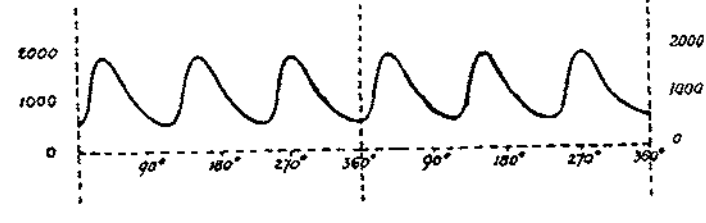


Fig. III. 20 h.p. Six-Cylinder Engine.

occur in two revolutions. It will be observed that the crank effort is never negative, but that at the end of each stroke it drops to zero at the dead centres. After the crank has turned through nearly 90°, the crank effort increases again; this is due to the inertia of the piston now acting positively and assisting the motion of the crank.

Fig. III. gives the torque diagram for a six-cylinder engine of the same power as that shown in *Fig.* II. The cranks are set at 120°, and six impulses occur in two revolutions. It will be observed that the turning moment is always positive and never drops to zero (*i.e.* the mechanical imperfection of "dead centres" is obviated): it varies between about 600 and 2,000 inch-pounds, whereas in the four-cylinder engine the limits were 0 and 2,250. The average turning moment during the cycle of operations is 1,210 inch-pounds in each case.

BALANCING.*

A perfectly balanced engine is one in which the relative movements of its parts have no tendency to make it vibrate as a whole: *i.e.* the reactions of the forces required for the acceleration of the moving parts neutralize each other in every phase of the motion, so that no resultant reaction is felt by the bedplate of the machine.

There are two sets of forces acting on the crank shaft which have to be balanced:—(1) The centrifugal forces due to the rotating parts, such as the cranks and crank pins; (2) the forces due to the reciprocating parts, such as the piston. The connecting rod has a motion partly rotating and partly reciprocating. For purposes of calculation it is usual to treat it as though one-half its weight was concentrated at the crank pin and rotating with it, and the other half as concentrated at the gudgeon pin and reciprocating with the piston. This is not absolutely correct, but the results thus arrived at are sufficiently accurate for all practical purposes.

The method of balancing the rotating parts consists in the addition of balance weights of suitable dimensions, so placed that the centrifugal forces set up by them are equal and opposite to those produced by the cranks, etc.; and however complicated the crank shaft may be, or whatever the number of cylinders, the centrifugal forces produced can be completely balanced by the addition of suitable balance weights.

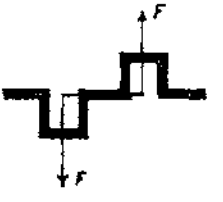
The case of the reciprocating forces is much more complicated, and it may be stated at once that it is impossible to balance a weight that is reciprocating by one that is rotating: hence, to secure perfect balance in an engine, it is necessary to have more than one cylinder, and to arrange the reciprocating parts in such a way that they balance

* For an exhaustive treatment of this subject consult Prof. Dalby's *Balancing of Engines*, 1902.

each other. If the connecting rod was infinitely long, the motion of the reciprocating mass would be simple harmonic : the acceleration of the mass would be always directed towards the middle of its path, and would be proportional to its distance from the middle of its path. As however the connecting rod is not infinitely long, and consequently the acceleration of the reciprocating mass is not the same on each side of the centre of its path (being greater at the end remote from the crank), the method of balancing the reciprocating parts is subdivided into :—(1) primary balancing, working on the assumption that the connecting rod is of infinite length, (2) secondary balancing, which takes account of the definite length of the connecting rod.

Consider now the case of a single-cylinder vertical engine. If no balance weights are added, the reciprocating parts will produce longitudinal forces acting vertically, and a vertical hammering action will be caused. Suppose then that rotating balance weights are added, of such a size and so placed that the centrifugal forces caused by them are equal to the longitudinal forces exactly at the end of the stroke : the result will be that a vertical hammering action is converted into a horizontal one, as the horizontal forces produced by the balance weights themselves will now be unbalanced. So a compromise must be effected, and only a portion (generally one-half) of the reciprocating mass balanced : this will convert a large vertical vibration into smaller ones both vertical and horizontal.

In a two-cylinder engine where the cranks are placed at 360°, the case is exactly the same as that of the single-cylinder engine, except that the reciprocating masses are greater. This applies equally to the type of engine with the cylinders side by side and to that in which they are opposed on opposite sides of the crank shaft. But if the cranks are placed at 180°, the pistons are moving in opposite directions in the two cylinders : consequently the reciprocating forces largely neutralize each other, and a good primary balance is obtained.



A couple is however produced by the longitudinal forces in the two cylinders, which tends to rock the engine about a transverse axis. As regards secondary balancing also, when the cylinders are side by side as in a vertical engine, the result is not satisfactory because the motions of the two pistons are not exactly the same. *Fig.* IV. has has been drawn to illustrate this point : it has been calculated for a two-cylinder vertical motor, the bore and stroke being 4″, running at

ACCELERATION DIAGRAMS.

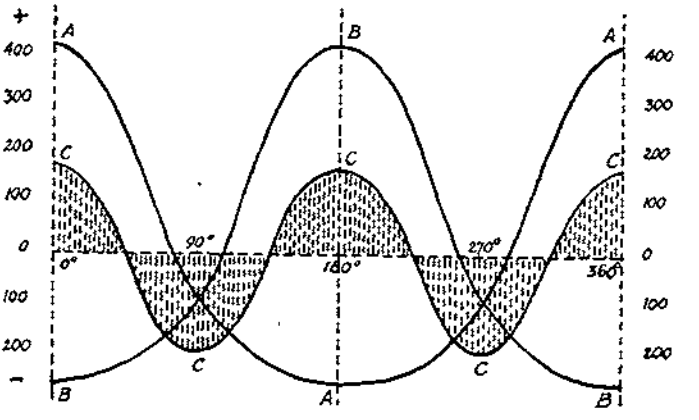


Fig. IV. Two-Cylinder Engine.

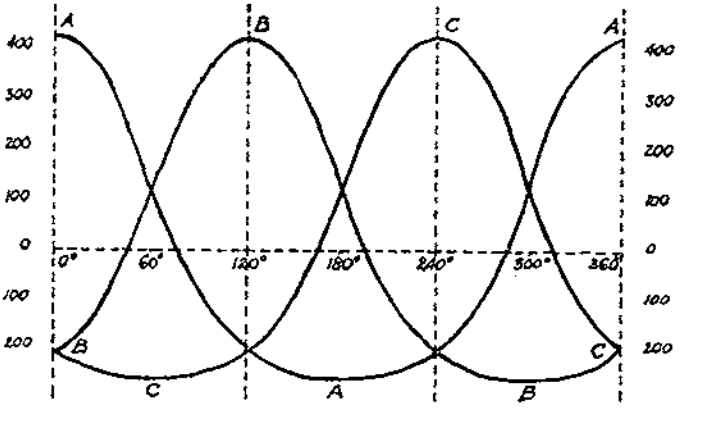


Fig. V. Three-Cylinder Engine.

1,000 revolutions per minute, the weight of the reciprocating parts in each cylinder being 6 lbs., and the connecting rod being four times the length of the crank. The line AA shows the forces due to the reciprocating parts in one cylinder, and the line BB those in the second cylinder, in relation to the angle turned through by the crank. The line CC, which is drawn by compounding the other two lines (and the shaded portion of the diagram) shows how an up and down thrust results, with a period twice that of the engine.

In a four-cylinder engine with cranks set at 180°, the couple produced by the longitudinal forces in one pair of cylinders will balance that produced in the other pair of cylinders, and there will be no tendency for the engine to rock. But otherwise the case is the same as that of the two-cylinder engine, there being a good primary balance and indifferent secondary balance.

In a three-cylinder engine the cranks should be set at 120° to each other: the longitudinal forces in the three cylinders will then balance one another, and a good primary and secondary balance will be obtained. In *Fig.* V. the lines AA, BB and CC represent the longitudinal forces in each cylinder as before; and it will be found that the sum of these at any point is zero. But, as in the case of the two-cylinder engine, a couple is produced which tends to rock the engine about a transverse axis. By employing six cylinders the rocking couple in one half of the engine can be arranged to balance that in the other half of the engine, and so a completely balanced engine can be obtained.

SUMMARY.

A single-cylinder engine cannot be correctly balanced, and gives a very uneven turning moment.

The best form of two-cylinder engine is that in which the cylinders are opposed and cranks set at 180°.

The three-cylinder engine is well balanced, but the turning moment varies largely.

The four-cylinder engine is well balanced, and gives a satisfactory turning moment.

The six-cylinder engine gives much the best results both as regards balancing and turning moment.

NOTES ON RAILWAY CONTROL IN WAR.

By 'R. Esso.'

To one who does not concern himself with such matters I suppose a Railway is a thing which runs itself. There are time-tables and ticket-offices and places where goods are collected and loaded up, and everything seems so regulated and organized that there is apparently no particular reason why it should not carry on just as much while war is in progress (so long as it is uninterrupted) as under any other circumstances. It is plain enough that, if engines and carriages and wagons are destroyed or taken away by the enemy, there will be so many fewer to make up trains; and that, if the line is blown up or bridges are smashed, something must be done to join up again before the trains can be got through; and, again, telegraphs have something to do with the working. Indeed, it is clear that means must be provided to secure the restoration of the tangible entity called the Railway System during war; and, of course, there must be men, possibly men to replace employés who have decamped or joined the enemy, or have been removed, or even killed. Then, what about the directing body—the management? In peace the managing body, the directors, heads of departments being their executive, decide all questions of policy, settle what facilities are to be offered to customers, and broadly speaking decide how "Transportation" is to be manufactured and sold.

In war the conditions are a good deal changed. The working plan of the system is determined by the general plan of campaign; the lines have to convey troops as required by the Commander-in-Chief, to furnish their supplies from the Base, to bring them to the theatre of war, and probably to move them about in it.

But, in order that this may be done to the best advantage—a civil organization cannot be expected to be familiar with military requirements, procedure, and terminology—a "rapport" must be established between the scheme of operations and the working of the railways. Programmes and Working Instructions cannot be drawn out, except perhaps for the initial stages—the mobilization—as they can in peace-time, and the preparation of such programmes is normally an elaborate process. When the stage arrives at which the progress of events cannot be forecast there will be an insistent need for some organization separate from the *civil* or *working* staff to co-ordinate

railway work and military operations. It is essential that there shall be no hitch about carrying out movements when required, and that special requirements be *foreseen* and provided against.

Again, as mentioned above, the normal organization of a railway does not lend itself to rapid changes of plan. Distribution of rolling stock and engines has to be arranged some time in advance; particular stations are laid out for the principal loading and unloading places; running of empty stock involved by reason of the upset of the normal balance means loss of power—a serious consideration when there is a press of traffic. In South Africa, to quote an illustration, the arrangement of minor moves from unequipped stations presented such difficulties that, for Cape Colony at least, it was found worth while to compile a little book called "Entraining Facilities," which contained particulars of all railway stations and sidings, and to issue it to the principal officers in command of Columns and of Posts on the Line of Communication.

There must be some department which can look ahead and forecast with some degree of accuracy what services will require performing, and also say at any moment what the line is capable of doing, so that more may not be counted on; but the Commander-in-Chief must be kept informed, so that he may be able to decide how at any moment the railways can best be utilised. It may seem quite easy, but it may be a hard problem to keep the supply traffic running so as to ensure a sufficient output from the communications and at the same time undertake troop moves upon whose successful execution large combinations depend.

In fact, there must be a Military Controlling Staff, and an efficient and experienced one. The necessity for such a staff has been shown time and again. Its absence was all of a piece with the "ordre, contreordre, désordre" on the French side in the Franco-German war; and even in South Africa, up to the stage when it became fully recognised that there must be a complete chain of control of the railways, great difficulty was experienced in attaining the best results. It is not sufficient to intimate to the railway management what is required to be done at any moment. Apart from the fact that different orders given in different places may clash, military orders must be translated into their equivalent in movements on the lines, and must take into account both the existing situation and the probable future course of events. Again, it is inexpedient that plans of operations should be communicated direct to a civilian body—one might as well publish them in the newspapers!

We arrive then at the inference that a military body is required, independent of the operating force of the army and associated with the railways, with whose general system of operation they are familiar, to act as a controlling agency—in fact to form a buffer between the railway and the army.

The regulations laid down in various countries for the working of railways in war agree as to the essential principle that there should be a close association of the Military and Technical element in this body; that, in fact, the actual working should be under the supervision of certain "committees"—one calls them so for want of a more apt term—in each of which one constituent should be Military and correspond with the army, while the other should be of the railway Technical staff and give all necessary instructions to the railway officials for the carrying out of the measures decided on in conference.

Evidently it is desirable that these military officers should be conversant with railway working and management (more particularly with the system under operation), for they are liable to be called upon at short notice to say what can be done under all sorts of contingencies towards complying with unusual but urgent requirements.

In fact, Railway Staff Officers, as they were called in the South African War—in another war they may perhaps be called something else—require a special training. But the time to get that training cannot without risk be left till war breaks out, particularly when one remembers that the South African system of lines was comparatively simple. It is not necessary to enumerate the duties a Railway Staff Officer has to carry out; suffice it to say that they are sufficiently plentiful, arduous, and as a rule thankless.

The course of the campaign will necessarily greatly affect the functions which the railways have to fulfil. The line controlled, in any particular instance, may be a Line of Communications pure and simple, possibly altogether outside the theatre of war and practically secure from attack, simply acting as a conveying agency between the collecting area and the base of the Field Army; or it may be a communication line not altogether secure from raid, but operating outside the actual theatre and not having to carry out operation moves. It may, again, be in the theatre of war, and required to carry out at short notice strategic or operation moves, and subject to sudden variations of the lines of supply, that is where there is more than one route from the base or bases. Which case it is entirely modifies the manner in which control is exercised, but not the principle of organization. On the Siberian Railway during the late war part of the line was directed from the Ministry of Communications, part from Army Headquarters at the front, and in some respects the divisions of the system overlapped.

Whether the line is worked by a friendly personnel or whether, having been captured, it is worked by an imported staff, is immaterial so far as the control of its operation is concerned. In both cases the railway officials in arranging transport are intended to have direct dealings with the intermediary staff and not with the troops and departments. Experience has shown the necessity for an organization

homologous (excuse the word, it savours of Euclid or of French railway rates!) to the pre-existing technical departments and principally to the traffic department, with which naturally the transport of troops and munitions is mainly concerned.

The lines of communication of an army are an agency for supplying the fighting force with men and material as required, and for keeping the army free from encumbrance by removing personnel such as prisoners and sick and, generally speaking, all material not required with the fighting force. It is evident that the line of communication acts as an administrative agency and must in all things conform to the needs of the operating army. The railways, then, must be primarily directed from Army Headquarters, where the Director of Railways will receive his orders from the Commander-in-Chief; and the chain of organization will be completed by the representatives of his department in each railway district being attached to the staff of the Officers Commanding in those districts, and being directly over the Railway Staff Officers at stations or in control of sections of line.

The functions of the Director of Railways are of several different categories. They fall under three principal heads:—(1) Reconstruction; (2) Working, where lines are taken over or working staff has to be supplemented; (3) Control proper, together with the administration of the troops and employés required in connection therewith. The rapid reconstruction and efficient working of the lines are much dependent on the harmonization of military and working requirements; hence the controlling staff must be in close touch with the officers supervising reconstruction and working (whether the latter is undertaken by the Director of Railways or whether the normal civil employés are retained).

The officer associated with any particular system, having general control of the traffic, is concerned to a great extent with civil traffic. It is obvious that measures must be taken to ensure the advantageous utilization of such carrying capacity as is available. We may take it for granted that, after military needs are fulfilled, there will not be an over-large balance for the civil population—assuming of course that the country depends a good deal on the railways for supplies, as most countries do nowadays. There is likely to be some sort of Permit system, and the officers who issue permits will need to be acquainted through some organization with the needs of the districts to which they are attached; and must be able to ensure that supplies intended for the civil population do not fall into the hands of the enemy. Of course if the enemy gets the chance to hold up trains that is another story. The problem of Civil Supply control is in fact a large one, too large for more than a passing mention; it must suffice to remark that the issue of permits needs to be done in communication with the staff controlling the general working of the railways, so that military and

civil demands on the railway output shall be accurately and equitably adjusted to one another and with due regard to political exigencies.

It is difficult to disentangle altogether the question of Control from that of Working. The Director of Railways in many possible cases is likely to be concerned with both, so that I would now turn to another side of the subject. The R.E. Library has recently acquired a book called *The Strategy of Great Railroads*. The title sounds a likely one, as possibly dealing with the great lines which have a military importance. As a matter of fact it has about as much to do with the military use of railways as Ruskin's *Notes on the Construction of Sheepfolds* has to do with farming, but it supplies some material for thought for all that. The book consists mainly of a study, cast in the form of a series of magazine articles, of the way in which the great systems (or rather combinations) of lines in the United States have been built up with a view to strengthening their position in different regions; the analogy is perhaps more like the way in which one nation prepares its forces against another in peace and arms its Ports and coaling Stations against the day of war.

There have been combats incidental to this strategy, not altogether diplomatic; they have been waged with stock and share, with rates and tariffs, with bills and franchises (concessions). The combatants have been financial magnates who wield the destinies of vast enterprises and range from sea to sea with their commercial activities.

For Railway business is a very manifold and complex affair, more, much more, than laying down rails and causing trains to run along them. The overcoming of great physical difficulties is not all, nor even is the perfecting of machinery to make greater and greater economies. Strategy of a kind there is in the direction of the Operation side, for example, particularly when the normal movement of trains is upset and revision of train workings has to be undertaken. Single-line working on a poorly equipped line produces a more plentiful crop of daily puzzles than most things, what with keeping balance of rolling stock, making efforts to comply with demands, and avoiding the production of blocks. Many contingencies have to be provided against and all sorts of supply and administrative problems constantly solved. All this of course is worse in War, and there is more hurry for the solution.

To the mind of the present writer there is a very clear distinction between the Management as such of a railway property and the Working of the business. The latter is, under the General Manager, in the hands of the various heads of departments—executive officers who maintain the line and the buildings, make the trains run, buy the stores, work the telegraphs, and so on, but who have comparatively little to do with the actual functions of Management. Again there are the various officials who are concerned with the commercial side of the undertaking, with whom the public has to deal and who collect

the revenue. I do not propose making more than a passing reference to accounts, but may remark that in any financial system there must be in principle a clear line of demarcation between the making of the bargain with the purchaser, the receipt and accounting for cash, the authorization of expenditure, and the accounting for that expenditure—particularly as to the last two items. Authorization of expenditure is one of the functions of management, but accounting and audit of accounts is of the nature of a check, and is a subsidiary operation, very important, it is true, but merely following on the initial act.

As regards the Working of Railways in War, the idea that actual working and management would usually be undertaken by a *military* body is disappearing. A railway is not like other forms of transport, which are used simply where they are wanted and can be turned to other use when the war is over. A railway, being constructed in one place, has the elements of permanency—more especially as the idea of using light temporary lines has been relegated to remoteness. No, we may reckon that any railways we may use in war will—as regards their principal lines at all events—stay where they are laid down; and if they are constructed for the purposes of the war will usually remain afterwards with the idea of developing the country after peace has supervened.

We may as well recognise then that the line, even if during war it is used merely to convey military traffic, which is improbable, will sooner or later have to handle commercial traffic, and, that being so, that its management should be adapted to an eventual change. It must not be simply a concern which has to be worked at so much cost, but must keep accounts of its receipts as well as its expenditure. For the matter of that, the vouchers which would record what is carried would be of great value for tracing purposes and so on, as well as providing the foundation of a system of accounts analogous to those used under peace conditions—not that railway accounts are free from complexity! Even in war time a watch has to be kept on the working cost of the railway, especially if the system to be operated, whether taken over by capture or otherwise and in whatever way it may be staffed, is a large one. Even if the line utilised for military purposes is under civil management the army has a strong interest in its economical working, for the cost of military transport will in some form or other form part of the cost of the war. Naturally, the waging of war is not a thing where cost is the first consideration—to limit the scope of action by mere money considerations would put a stop to all generalship—but there are the strongest reasons for economising where economies can legitimately be effected. Thus the Military Controlling Staff has a good reason for making any efforts it can to secure that the methods of operating the railway are sound. But it cannot do this efficiently without some acquaintance with the

economics of working. Now, when I say economics, it is as well to endeavour to remove the possibility of misapprehension. In this connection it does not mean an abstract and abstruse study of figures and statistics, but it does mean a knowledge of the methods by which the commercial management is carried out, the way in which watch is kept over the expense of working as compared with the receipts from week to week, and the way in which the financial aspect of schemes, modifications in practice, train workings, and so on are considered. Not many officers have the chance of seeing anything of the interior working of our English railway systems; and those who do commence as a rule with no more than a rudimentary knowledge of the mechanical processes of working, and very possibly leave off with no more than that knowledge somewhat improved. Really, management cannot be learnt from the outside, except from a manager (and he is hard to get at as a rule), unless the learner has at least some previous familiarity with the subject. This is no paradox; the bearing of the remark lies in the fact that training on an English railway is, under existing conditions, of little use until one has a clear idea what to learn. It is the same in learning most trades, but the time for learning what we want to know can only be short.

The "outdoor" business is easy enough to understand; that is mainly a matter of close observation and an enquiring mind. Again, the system of arranging trains is not difficult to assimilate, though actual practical work is a matter of long experience, and the complexities of train rules and the principles underlying them are not grasped in a moment, otherwise these subjects would not have stimulated such a large outflow of writing as streams from the press. The "indoor" affairs, that is the practical business management, are not so easy to get hold of, particularly as railways, like many other commercial concerns, are a little inclined to be secretive about their reasons for adopting any particular policy.

Railway economics are at all times a pretty thorny subject, and it takes a good deal of reading to get much grasp of them. They have perhaps aroused more public interest of late; witness the newspaper storm which was raging not so long since round the Big Wagon question, and the arguments for and against the use of ton-mileage statistics.

The question of railway Rates for the carriage of merchandise is a perennial one: you can see a good deal about it in the writings of Acworth, Pratt, and others. In America, for instance, the agitation for some form of Government control is getting strong, partly because there railway management is not as conservative as over here; partly because the President has taken a hand in the game; partly because rates, rebates, and concessions are some of the instruments by which the "Trusts" maintain their dominant position in the trade of the country. On the Continent, rates are to a great

extent regulated by Government, with the result that (1) they can be used to influence trade, (2) changes are almost intolerably tedious to arrange. In this country the agitation about statistics is probably entangled with the rates question, for a fresh generation is constantly arising which cannot understand why the cost of carrying goods has so little to do with the amount charged for the service, or why the exact cost cannot be stated.

But how can one talk with knowledge about these railway problems unless he have some insight into the way in which railway accounts are kept and the way in which rates are made! Still less can one expect to deal with the management of a system unless he understand something of them at least.

The expression "deal with" is used advisedly, for I am thinking of the position of the controlling authority in the case where the railway in a theatre of war is still being run under civil or semi-civil management, but is employed for the transport of troops and munitions of war. It is unlikely that civil traffic can be altogether suspended. In many countries, under present conditions of civilization, the stoppage of railway traffic would be attended with disastrous results to the civil population—it is well known how the upset of railway traffic in Russia during the late war has reacted on the economic situation—and so long as civil traffic is carried many of the complex problems of commercial working must exist, and cannot be neglected by the officers employed in the controlling branch.

No one who has ever thought seriously about the matter is likely to deny that, if we had war in England, we must either have a proper system of military control over the working of our railways, or else suffer a general reign of chaos and confusion. The existing body which might be supposed to blossom into a central controlling organization is the "War Railway Council"; but this is essentially a peace concern. Control of the railways in war, like command of an army, is a 'One man show,' and a council like this, with military, naval, and civil constituents, is more adapted for academic discussion of questions in peace than for dealing with sudden developments in war—its machinery is too cumbrous and yet insufficient; in war, moreover, its members would severally have their hands full enough with their own proper affairs. The war organization must be something with a head and body; decentralization is essential, or the amount of business to be tackled will soon be sufficient to choke it. For all that, the presence on this peace council of members representing the commercial world is a guarantee that the commercial aspect of working will not be neglected.

"An army marches on its belly." True enough, but nowadays an army does not always march; that is, it is not likely to be connected with its base by march route only. It is more like a sort of crawling animal with a striking head (the fighting force) at the end of a long

and vulnerable neck (the line of communications). So much depends on the communications and their efficiency as to make their good organization a most essential factor in the success of the campaign.

Of course it is not right to argue from one or two campaigns only, but the fact remains that both in South Africa and in Manchuria the lines of communication worked with smoothness and efficiency, consequently we hear comparatively little about them; but in both cases the railways played a great part.

In another campaign things may be started at greater pressure, events may move more quickly, and then woe betide the General whose communication service is the less efficient.

Casting our eyes over possible theatres of war, how many can we think of where the railways will not be the main agencies by which the opposing armies will be supplied. Further back I alluded to the "Strategy of Great Railroads" and the matter of control of railway systems. In war we must have and will have a military control of railway working, so that at least the same word crops up in both connections.

Now, is it likely that the financial magnates who control great railway systems are unacquainted with the practical business of management? Or do they rely on their assistants for technical points? I think not. The analogy to the position occupied by the Director of Railways and his staff is sufficiently near. If they are not acquainted with the practical business of management—and you see I have distinguished between management and purely executive work—it is sufficiently certain that, bar miracles, they will not get the maximum amount out of the railways. It is not to the point to argue from the experience of a couple of recent campaigns or from what has been done by exceptional men. Another time the conditions may be of an entirely fresh kind.

NOTES ON THE COBHAM OPPIDUM.

By Bt. Col. O. E. Ruck, R.E., F.S.A., Scotland.

This Pre-Roman defended British Oppidum site is typical of a similar class of Celtic and Brigantian works—usually in the form of Hill Forts—to be seen elsewhere in England and Wales, Scotland, and Normandy.

A work very similarly designed is to be found in Castel-y-gaer, Llwyngwril, Merionethshire, consisting, as at Cobham, of a lunar defence on north-east side of similar ramparts, fosse, and outer mound, facing antient British Road passing across the front. The rear of Castel-y-gaer, like Cobham, is undefended, owing to the natural steepness of the approach to the top plateau from that side; the fosse runs out in the same way to lower ground on both sides, as at Cobham. But on the inside of the inner rampart (per contra) at Castel-y-gaer may still be seen the perimetrical founds of an antient masonry wall, thus differentiating the type from Cobham, and pointing clearly to a later date of construction. This variation is what might have been expected, looking to the historical evidence; for, it was not until even so late a date as A.D. 48 that Ostorius Scapula began to pave the way for the defeat of the formidable tribe of the Silures of Wales, which, with the capture of Caractacus, took place A.D. 50.

The Cobham Oppidum works, on the other hand, may safely be attributed to an earlier date; possibly before the famous Roman Raid in B.C. 43 under Claudius Plautius, whose historical crossing of the river Thames between Higham and East Tilbury—where an antient ford is reported to have existed—is even at the present day a subject of local tradition.

What makes the oppidum at Cobham somewhat exceptional is the excellent state of preservation of the curious pits and causeways in the fosse, which are common to many hill forts; these are supposed to be connected with the immediate defence of the main entrances, enabling armed men to quickly advance to and return from the outer ramparts and guard the entrances.

A doubtful point in the Cobham oppidum is the defence of the west side. In other cases a defended annexe for cattle in British works, or for camp retainers in the case of Roman Forts, is frequently to be found on the protected flank away from the most probable direction of the main attack. The mound where the water gauge now is may have been such an annexe, but the remains are too vague to form a definite opinion on this point.

The only piece of possible Roman reconstruction work in the Cobham oppidum is the straight trench on the west side of the Park railings. Enquiries have been locally made as to whether this straight work is comparatively recent; but no information being obtainable as to its probable date of construction, nothing can therefore be authoritatively laid down as to this matter.

Earthwork structures of kindred type may often be seen, scattered over the fair surface of Great Britain. Often, however, the theories to which they have given birth have shown a great want of the simplest knowledge of military science. Those who have the advantage of being in the Corps of Royal Engineers are therefore fortunate in being able to bring to bear the practical knowledge gained in their profession, and thus emulate the example our pioneer of scientific military archæology, Major-General William Roy, R.E., who, in his "Military Antiquities of the Romans in Britain," A.D. 1793, originated a distinctly new line of research. As with other subjects initiated by us, great developments have resulted at the hands of faithful disciples and followers.

Considerable light can be thrown on many obscure points connected with these antient fortifications, until recently imperfectly understood, by a correct interpretation from a military point of view. Taking the Cobham Oppidum as a case in point, can anything be gathered from an inspection of the work and its surroundings as to the tactical and strategical fitness of those who designed it, presumably the military engineers of the Cantii? A comparison with modern practice at once supplies a ready answer. It can!

The evidence required was supplied quite recently during a staff ride. Various officers under examination for tactical fitness in command of a large force defending the heights north of the Medway against a pushful invader crossing from the south side, having omitted to watch and guard against a turning movement over the fords near Wouldham, retired on the Cobham heights only to find themselves already forestalled by the invaders, who had crossed the Medway and stolen up the Cuxton valley and through the screening woods of Cobham Park. But it was not so with the Cantii tribal engineers. For, from a study of the antient works themselves, it will be seen that their tactical technical advisers, when throwing up the main work at Cobham Oppidum, craftily designed two flanking subsidiary works commanding the Cuxton valley, one of concentric trenches in Cobhambury Wood, the other slightly in echelon of polygonal trace in Henleys Wood near Camer. The works are there now, and ocular demonstration will bear witness to the soundness of their judgment in guarding against a possible outflanking movement. Thus once again is proved the continuity of those eternal principles of fortification which the flight of time appears only to serve in indelibly branding upon our transient memories.

MEMOIR.

MAJOR L. P. CHAPMAN, R.E.

THE Corps has suffered a severe loss by the death of Leonard Palmer Chapman on the 18th February, 1906.

Born on the 22nd June, 1865, he accompanied his parents to New Zealand at an early age, and passed his boyhood there. He was educated at Christchurch, passed into the Royal Military Academy in 1883, and received his commission in the Royal Engineers on the 9th December, 1884.

After the usual course at the School of Military Engineering he was ordered to India, and joined the "Queen's Own" (Madras) Sappers and Miners at Bangalore. With that distinguished corps he soon saw active service, taking part in the Burmese War and the Chin-Lushai Expedition. During the former, at Fort White in 1889–90, with only 5 years' service, he commanded a company of Sappers and Miners, and acted as Commanding Engineer of the northern column under the late Colonel Skene, 42nd Gurkhas. For these services he received the Indian Frontier medal with three clasps.

In 1893 he joined the Military Works Department, and was employed in various grades at Mhow, Fort Sandeman, Quetta, Naini Tal, and Aden, until he was advanced in 1903 to the onerous position of Commanding Royal Engineer at Bombay.

Comparatively young for so responsible a post, he came to it with no lack of the necessary qualifications. He was, in fact, more than usually fitted for independent administrative and executive work. His was always a clever, active brain; varied experience had given him breadth of view; constant application had brought thorough professional knowledge. Those who worked with him know how much he helped them by his clear insight, tact, common sense, sound advice, consideration for subordinates, and genial manner towards all with whom he had to deal.

But of late years his physique was not what it had been in his early manhood. Constant overwork had gradually sapped his vitality, and he suffered much from weakness of the lungs. Early in 1906, after he had been ill for about a month, it was found necessary to operate for appendicitis. He survived the operation, but had not sufficient strength to rally after the shock.

So passed from among us one of whom it may be truly said that he never had an enemy. In private life he was universally popular, and took an interest in all games. He will long be remembered for his unfailing good temper, his cosmopolitan knowledge, and his sympathetic nature.

The esteem in which he was held at Bombay was clearly demonstrated by the attendance at his funeral of a vast crowd of mourners, including all sorts and conditions of men from the Admiral of the East India Station down to the native menials of the Military Works Office.

He was buried at Sewree Cemetery on the 19th February under peculiarly sad circumstances; for his young widow was then lying at the crisis of an attack of enteric fever, ignorant of her bereavement and forbidden to be told of it for many days.

TRANSCRIPTS.

THE ENGINEERS OF THE RUSSIAN ARMY.*

By CAPT. BVTÉ. DU GÉNIE DOUCHY.

ORGANIZATION.

THE Russian Engineer troops are divided into:—

1. Field Companies.
2. Fortress Companies.
3. Technical Units.

Technical Establishments.

Under the last heading are included:—

(1). The *Electrical School.* This is intended to provide a certain number of officers and non-commissioned officers of the sappers with a practical knowledge of electricity, and to adapt new discoveries to military requirements.

(2). The *Electrical Section*, to which is attached the *Balloon Park.* The Electrical Section does no teaching, but carries out experimental work. The Balloon Park forms a school of instruction for officers who are temporarily attached to it; in addition it carries out experiments, and manufactures and repairs balloons.

Fortress Troops prior to 1904.

In Russia the Fortress Troops, whether infantry, artillery, or engineers are quite distinct from the field troops. Before the war the Fortress engineers consisted of:—

11 Fortress companies and 4 skeleton detachments.
11 Companies of submarine miners.
7 Telegraph sections.
6 Balloon sections.
2 Siege parks.
7 Carrier-pigeon establishments.
2 Companies of river miners.

Field Troops prior to 1904.

The Field Troops consisted of:—

In Europe and the Caucasus.

25 Battalions, viz.:—one guard battalion, one grenadier battalion, 21 battalions numbered from 1 to 21, and two others called the first and second Caucasian.
2 Reserve battalions.
8 Bridging battalions.
7 Field parks (one in the Caucasus).
4 Railway battalions.

*Translated and abridged by permission from articles in the *Revue du Génie Militaire* of November and December, 1905, and January and February, 1906.

In Central and Eastern Asia.

1 Turkestan battalion (3 field and 1 telegraph company).
1 Transcaspian battalion (2 field and 1 telegraph company).
1 West Siberian company, with a telegraph section.
1 East Siberian brigade of 2 battalions (each including 1 telegraph, 1 bridging, and 4 field companies).
1 Kwantung company, with a telegraph section.
1 Trans-caspian brigade of 2 railway battalions (6 companies each).
1 Ussuri brigade of 2 railway battalions (4 companies each).
1 Trans-amur brigade of 4 railway battalions (3 companies each), employed before the war on the Manchurian lines.

The Russian units in Asia are always maintained on a war footing. There are therefore 1,200 to 2,000 men per battalion, according to whether it has 4 or 6 companies.

Sapper and Railway Brigades.

In peace time the field units in Europe are organized in seven Sapper brigades (numbers 1 to 6 and the Caucasian) and one Railway brigade. The bridging battalions and field parks are allotted to the various brigades. The composition of the Sapper brigades is not uniform. The Railway brigade is composed of 3 battalions only (Nos. 2 to 4); the other battalion (No. 1) was, before the war, attached to the first Sapper brigade.

PEACE STRENGTHS (EUROPE).

All the engineer units in Europe are maintained on a peace footing, even in the frontier districts where other arms are maintained at their war strength; it is doubtful, therefore, whether they could mobilize in time to take the field with the other troops.

The *Guard Sapper Battalion* consisted before the war of 1 telegraph and 4 field companies, and its peace establishment was 26 officers and 647 men. The other *Sapper Battalions* had 1 telegraph and 3 field companies, and their peace establishment was 22 officers and 513 men. The two *Reserve Battalions* consisted of 3 companies each, and their peace establishment was 19 officers and 453 men. In addition each battalion had a supernumerary section.

Field Companies.

The peace strength of a *Field Company* was 4 officers, 12 N.C.O.s, and 108 sappers (some are now on a higher establishment).

Bridging Battalions.

The 8 *Bridging Battalions* consisted of 2 companies each. The peace strength of a battalion was 12 officers and 277 men.

Field Parks.

The *Field Parks* were divided into sections, one section being allotted to each army corps. Nos. 2, 3 and 4 field parks had 5 sections each, Nos. 1 and 6, 3 sections, No. 5 and the Caucasian field park had 2 sections each. There are two officers and a small detachment with each park.

Railway Battalions.

The 1st *Railway Battalion* was a skeleton battalion only; its strength was 8 officers and 98 men. The 2nd, 3rd, and 4th had 4 complete companies and 1 skeleton company each. The strength of a company was 4 officers, 12 N.C.O.s, and 111 men. The strength of a battalion was 25 officers and 623 men.

Mobilization.

On mobilization the brigade staffs of all but No. 6 Sapper Brigade are abolished. The brigades are broken up, and the 25 battalions join the 25 army corps.

The battalion commander becomes in war time the commanding engineer of the army corps.

War Strengths (Europe).

Field Companies.

The war strength of a *Field Company* is 4 officers, 20 N.C.O.s, 217 sappers, and 3 tool waggons.

The first two companies of a battalion are each attached to a division, the third company joins the corps troops. Nos. 1 and 2 Companies each have bridging equipment (carried on 6 three-horse waggons) capable of making 70 feet of mixed bridge (trestles and pontoons). The third company has no bridging material.

Telegraph Companies.

The *Telegraph Companies* on a war footing had two air line sections, with 17 miles of wire each, and one field cable section with 23 miles of cable. The war strength of a company was 7 officers, 54 N.C.O.s, and 155 men, with 52 three-horse or 48 four-horse vehicles. The office equipment was sufficient for 12 telegraph and 6 heliograph stations.

The Sapper Battalions have all their equipment and vehicles with them during peace.

Reserve Battalions.

On mobilization the *Reserve Battalions* of sappers were increased to 6 companies each, and also provided a detachment of N.C.O.s and men to form a nucleus for a depôt battalion. The reserve companies when mobilized have the same strength as the field companies, but they had, till recently, no bridging equipment. Their waggons and equipment are stored with the reserve battalions during peace time. The reserve battalions are not detailed to any special units; they would probably not join the reserve army corps, but would either reinforce the first line troops or be allotted to the lines of communication.

Depôt Battalions.—On mobilization 4 *Depôt Battalions* are formed, 2 to each reserve battalion. They are composed of 4 field companies, 1 telegraph company, and 1 submarine mining company. Eighteen captains and eighteen subalterns are withdrawn from the first line battalions, and posted to the four depôt battalions. The remaining officers are drawn from the engineer establishments and reserve of officers.

The staff of a depôt battalion consists of 17 officers and 277 men. Its total strength is 1,650 men.

The duty of the depôt battalions is to train reservists, and to forward them to the field and fortress companies as required.

Bridging Battalions.

The *Bridging Battalions* on a war footing consist of 2 companies only. Their strength is raised to 12 officers, 580 men, 495 horses, and 122 waggons, of which 102 carry bridging equipment.

Each battalion has 245 yards of floating bridge and 51 yards of trestle bridge. The equipment is divisible into four sections, consisting of 65 yards of mixed bridge each.

The bridging battalions are not detailed to the army corps, but are placed at the disposal of the general staff. They are in fact 'army troops.'

Field Parks.

On mobilization a section of a *Field Park* is attached to each army corps. Each section on a war footing consists of 1 officer, 45 men, 12 four-horse or 19 three-horse vehicles, and 48 to 62 horses.

Each section carries 2,700 shovels, 552 axes, 72 mattocks, 16 saws, 120 picks, cordage, small tools, topographical instruments, sandbags, augers, wire, bridging stores, demolition stores, and a little telegraph material.

Railway Battalions.

On mobilization each *Railway Battalion* in Europe has 2 construction and 2 traffic companies. The fifth company forms the nucleus for a reserve railway battalion of 1 construction and 3 traffic companies. The war strength of a railway battalion is 25 officers, 1,112 men, and 42 waggons (only 17 for a reserve battalion).

RECAPITULATION.

PEACE STRENGTH (EUROPE) PREVIOUS TO 1904.

Unit.	Officers.	Men.	Horses.
8 Brigade Staffs	32	48	—
25 Battalions of Sappers 1st line (one had 5 companies)	554	12,959	113
2 Reserve Battalions of Sappers	38	906	18
8 Bridging Battalions	96	2,216	96
7 Field Parks	14	227	7
4 Railway Battalions (one a skeleton)	83	1,967	32
Totals	817	18,323	266
Or including the troops in Asia, about	1,200	36,000	1,000

WAR STRENGTH (EUROPE) PREVIOUS TO 1904.

Unit.	Officers.	Men.	Horses.	Carts.
25 Battalions of Sappers (1st line)	654	28,035	8,050	3,085
2 Reserve Battalions	62	3,072	160	64
4 Depôt Battalions	68	6,600	48	—
8 Bridging Battalions	96	4,640	3,960	976
25 Sections of Field Park	25	1,125	1,386	391
7 Railway Battalions (3 reserve)	175	7,784	442	219
Totals	1,080	51,256	14,046	4,735
Or including engineer staffs and troops in Asia, about	1,700	72,000	16,000	6,000

Inspector of Engineers.

The Inspector of Engineers in each military district becomes on mobilization Inspector of Engineers for the corresponding army. He is placed under the orders of the Chief Staff Officer, but has the right of communicating directly with the Army Commander.

The duties of the Inspector of Engineers are:—

(1). The organization of important defensive positions.

(2). The construction and repair of important roads and bridges within the zone of operations (not on the lines of communication).

(3). The maintenance of telegraphic communication between headquarters and the various army corps, and between headquarters and the base.

It will be noted that, though the Inspector of Engineers is responsible for the maintenance of telegraphic communication, he has no telegraph companies under his immediate orders. The latter, being an integral part of the sapper battalions, are under the orders of the army corps commanders. This fault became apparent during the war, and is now being remedied by the formation of army telegraph troops, as will be explained later.

Commanding Engineer of an Army Corps.

The Commandant of a Sapper Battalion becomes, on mobilization, Commanding Engineer of the army corps of which his battalion forms part. He commands in person the field company, the telegraph company, and the field park, which form part of the corps troops. If there is a bridging unit with the army corps, he commands that also, unless it amounts to a whole battalion, when it is left under the command of its own commandant. The Commanding Engineer is placed entirely under the orders of the Chief Staff Officer, unless the army corps is detached, when he has the right of communicating directly with the army corps commander. The Russian sapper officers consider that he should always have this right.

Russian Comments.

Many Russian military writers consider that the bridging material with an army corps is insufficient, and advocate that the third company (corps troops) of each Sapper battalion should have the same equipment as the divisional companies.

TRAINING.

Sappers.

The Sapper companies are separated in peace time from the units of the other arms with which they would co-operate in war. It is considered that this is necessary, in order that they may be given a more complete and technical training. The instruction is supervised by a member of the Engineers Committee, who holds the appointment of Inspector General of Field Engineers.

The technical instruction of the Russian sappers is good; but the infantry and engineers have not sufficient practice in working together, and the commanders of the larger units (divisions and army corps) do not know how to utilize their sappers.

During the winter the sappers cannot carry out any practical work; their instruction is therefore limited to theoretical teaching and work in the model sheds.

Camps and Manœuvres.—In May instructional camps for all arms are formed, as few men as possible being left behind in barracks. In camp each arm is trained by itself for a time; then mixed forces of all arms are formed, and manœuvre together for a few days. Finally larger units (divisions and army corps) are formed, and leave camp for the 'small manœuvres.' These last for two or three weeks, and are followed by 'grand manœuvres.'

Comments on Manœuvres.—The result of these manœuvres has been, from the Engineers' point of view, far from satisfactory. The sappers have either been employed on work which should have been carried out by other arms, or they have been treated as a spare company of infantry, or else they have been forgotten altogether. The reasons for this failure appear to be—the commanders of the larger units do not know how sappers should be employed, there is no time to carry out any but insignificant works, and the sappers are not allowed to expend either money or stores.

The fact that the commander of a sapper company is dismounted seriously impairs his efficiency.

Bridging Units.

Details of Training.—During the annual camp the field companies and bridging battalions practice both hasty and semi-permanent bridging. Bridges of the latter type are constructed of wood, and necessitate the employment of smiths and carpenters. After a sapper has been instructed in entrenching, demolitions (and bridging?) he is detailed to learn some particular trade. In each field company there is a detachment of 20 men of selected trades, who are trained for railway work. They are exercised on light railways laid in proximity to the annual camps and, to some extent, on the lines near their garrisons.

Telegraphs.

In the telegraph companies a minimum of 70 N.C.O.s and men are trained as operators.

Railway Troops.

The Asiatic railway troops are permanently employed on the Asiatic railways. They are experts, but cannot be considered as available for mobilization. The 1st European Railway Battalion is only a skeleton unit; the 2nd, 3rd and 4th are employed each year on construction work, but get no practice in traffic duties.

The Russian Engineer officers consider that the railway battalions should be exercised on a line from 75 to 100 miles long, working at high pressure.

OFFICERS.

Training.

Theoretically the officers for the Russian sappers are drawn from the Nicolas Engineering School, but for many years the output of this institution has not been sufficient. The remaining vacancies are therefore filled by officers from other military colleges. The latter are posted to the sapper companies without having to pass any special examination; after a year on probation their appointments are confirmed, if they obtain satisfactory certificates.

The number of officers posted to the sappers every year amounts to from 80 to 150, of whom only from 60 to 90 come from the Nicolas School. About half of the officers obtained from other sources leave the sappers before completing the probationary period.

During an officer's third year of service, he is allowed to compete for the Military Engineering Academy. There are about 170 candidates each year for 45 vacancies. The ordinary course lasts for two years, but most of the pupils are allowed to go through a supplementary course which lasts another year. At the end of the third year those who have been most favourably reported on become 'Military Engineers' (as distinct from sapper officers); the others are sent back to the sappers.

The Staff College.

In addition 6 or 7 officers are admitted each year to the Staff College. At the end of the course, some are posted to the general staff and the rest are sent back to their companies. An officer once on the staff never reverts to duty with the sapper companies.

Unpopularity of Service with the Sappers.

The changes among the subaltern officers with the sappers are very frequent. Those who fail to enter the Academy do their best to obtain other employment. Some try to enter the Guard; others apply for instructorships to cadet corps; others go to the commissariat, or to the sapper companies of the St. Petersburg garrison; some even obtain transfers to the cavalry.

System of Promotion.

The chief causes of the unpopularity of service with the sappers are the slowness of promotion and the large amount of extra work as compared with the infantry. There are some captains of 28 years' service in the sapper battalions. The normal rate of promotion is to first lieutenant after 4 years' service, and to captain after 8; all subalterns are promoted after 12 years' service. Promotion to the rank of Lieut.-Colonel is only given when there is a vacancy.

In addition there is accelerated promotion. This is given:—

(1). To selected officers, in the proportion of three per cent. of the vacancies.

(2). To officers who have served with the Guard on reversion to their own battalion, or to officers who have completed a course at one of the academies. If an officer completes two or more such courses, he is allowed to accumulate these advantages. Officers promoted under the second heading are usually Lieut.-Colonels at from 30 to 35 years of age, Colonels at from 34 to 38, and Brigadier-Generals at from 42 to 46. At this latter age the ordinary sapper officer is still often a captain.

Russian military writers consider that the conditions of service must be ameliorated, before a sufficient number of officers of the right quality can be obtained for service in the sappers.

Military Engineers.

The Military Engineers never serve with troops during peace, and it therefore appears desirable that they should be posted to sapper companies from time to time.

DUTIES OF ENGINEERS IN WAR.

Defensive Positions.

In taking up a defensive position, the general line is selected by the staff assisted by the commanding engineers of divisions and army corps; the exact site of the trenches is fixed by the infantry. The sappers are employed on the defence of villages and woods, the construction of obstacles, field redoubts, and blindages. Gun epaulments are constructed by artillery, assisted by infantry from the reserve. Communications are made by infantry working under the guidance of sappers.

Telegraphs. The duties with regard to telegraphs are to connect the army headquarters with the main telegraph system of Russia, the army corps with army headquarters, and the divisions with the corps headquarters. These duties are stated in the order of their relative importance. The commander of the lines of communication takes over the field lines in rear of the army, and replaces them by permanent lines, forwarding the field material again to the front. Telegraph lines are maintained by the units that have erected them.

The telegraph companies work in three parties; one party laying and operating new lines, one removing or operating old lines, and one resting. The normal rate for erecting air lines is said to be 2 miles an hour, but this is the maximum attained on manœuvres. Cable is laid at from 2 to 2¾ miles an hour.

Railways. On the declaration of war all the Russian railways and railway material are placed at the disposal of the Minister for War.

For railway repairs there are available, (*a*) 20 men per field company who have been trained in railway work, (*b*) the construction companies. It is doubtful whether the former (*a*) would be really available for employment; and as regards the latter (*b*), there are only 11 construction companies in Europe, of which 3 belong to the reserve. (By way of comparison it may be stated that Germany has 63 construction companies). There are 17 European traffic companies, of which 9 belong to the reserve. The civilian railway staff in Russia is not organized for employment in war.

All Russian writers agree that Russia has too few railway troops.

INCREASES DUE TO WAR IN FAR EAST.

EUROPEAN UNITS.

Fortress Troops. In 1904 one new fortress company was raised. On mobilization this forms 2 companies for employment in the Baltic fortresses.

Submarine-Mining Companies. The submarine-mining companies in the Far East were raised from 3 to 5 (one at Port Arthur).

Fortress Telegraphs. An extra fortress telegraph section was formed at Port Arthur.

Fortress Balloons. Two new fortress balloon sections were formed, one at Vladivostock and one at Port Arthur; the latter never received its equipment. In February, 1905, the new balloon section at Vladivostock was expanded to a company (a new balloon unit). In April another fortress balloon company was raised at Warsaw.

Strength.—The peace strength of the new fortress balloon companies is 7 officers, 137 men, and 12 horses; and the war strength 12 officers, 188 men, and 92 horses. They have 9 spherical balloons, 9 elongated balloons, 2 elongated balloons for wireless telegraphy, 100 small balloons for signalling, and 3 gas generators employing caustic soda and aluminium.

Siege Park. An engineer siege park, composed of two sections, was formed at the end of 1904 for the Far East. Its war strength is 4 officers, 485 men, 402 horses, 320 two-wheeled carts, and 37 baggage carts.

Carrier Pigeons. Carrier pigeon establishments have been increased from 7 to 10.

The Vistula company of river miners was mobilized for service on the lower Amur, and became the Far Eastern Company. It is not known whether a new company was raised to take its place. River Miners.

Orders were issued for the formation of a new army corps in Finland during 1905. This would entail the formation of a twenty-sixth sapper battalion. In view of the political situation it is doubtful whether the order will be carried out. Field Engineer Troops.

In August, 1905, the formation of 10 new sapper companies was ordered. These are allotted to battalions 3, 4, 10, 11, 14, 15, 18, to the 1st and 2nd Caucasian battalions, and to the Guard battalion. Each of these battalions therefore now consists of 1 telegraph and 4 sapper companies, except the Guard battalion which has 5 sapper companies. The remaining battalions still have 1 telegraph and 3 sapper companies each.

Strength.—The new companies are to be kept permanently at war strength, viz., 239 men for the guard, and 337 for the other companies. The telegraph companies of the enlarged battalions are also to be maintained at war strength, viz., 253 men; this is an increase of 44 on the war strength of the other telegraph companies.

Mobilization.—On mobilization the 10 new sapper companies and the 10 higher establishment telegraph companies form 2 companies each. Out of these, 20 sapper and 10 telegraph companies are detached from their battalions and allotted to the reserve. It seems probable that they will eventually be formed into battalions of 1 telegraph and 2 sapper companies each, and attached to the reserve divisions.

After some intermediate changes, 3 new reserve battalions, each containing 1 telegraph and 2 sapper companies (with bridging equipment), were formed in August, 1905; and 1 telegraph company was added to each of the 2 original reserve battalions. On mobilization the number of reserve companies in a battalion is not doubled as formerly; the 5 battalions therefore furnish 12* field and 5 telegraph companies. Reserve Battalions.

In December, 1904, the 1st Bridging Battalion was raised from 2 to 4 companies, supplied with a new bridging outfit, and sent to the Far East. Bridging Battalions.

Before 1905 there were no reserve or depôt bridging units; now a third company has been added to the 3rd, 4th, 5th, and 7th Bridging Battalions. On mobilization these new companies are doubled, and form 4 reserve bridging battalions of the same strength as the first line battalions, viz.:—13 officers, 632 men, 496 horses, 56 waggons carrying half-pontoons, 32 waggons with superstructure, and 20 baggage waggons.

Ten new field park sections were formed in 1905. These were attached as follows:—1 to each of parks Nos. 1, 2, 3, and 5, and 2 to each of parks 4 and 6 and to the Caucasian park. Field Parks.

The 3rd Railway Battalion was mobilized and despatched to the Far East, and its fifth company formed the 3rd Reserve Railway Battalion. Railway Battalions.

* The two original reserve battalions have still 3 field companies each.

This also was sent to Manchuria, and joined the Trans-Amur Railway Brigade.

Since October, 1904, railway troops have been separated from engineer troops.

ASIATIC UNITS.

Sapper Battalions.

At the commencement of the war there were nominally in the Far East only the two Siberian battalions and the Kwantung company. As a matter of fact a third battalion had been already raised. Each battalion consisted of 1 telegraph, 1 bridging, and 4 field companies.

A fourth battalion was raised in February, 1904, to form part of the 4th Siberian Army Corps. It was composed of 1 field park section, 1 telegraph company, and 2 field companies.

A fifth and sixth battalion were formed in June, 1904. They were similar in composition to the fourth battalion, but the fifth had double the bridging equipment. It is probable that the last two battalions were formed by drafting units from Europe.

Telegraph Units.

Each army corps had originally a telegraph company forming part of the corps troops. It was soon found, however, that 'army telegraph troops' were required as well. To this end an East Siberian telegraph battalion was formed in August, 1904, consisting of 4 companies with a total war strength of 26 officers, 1,074 men, 745 horses, 160 telegraph waggons, and 85 baggage waggons. Each company was composed of four air-line sections.

A second telegraph battalion having the same establishment was formed in January, 1905.

At the same time 3 independent telegraph companies were formed in Europe for wireless telegraphy. Each company had an establishment of 10 officers, 426 men, and 258 horses, and had 6 Marconi installations.

In May, 1905, two mounted telegraph units were formed; one a half-squadron, strength 4 officers, 106 men, 113 horses, and 16 waggons; the other a sotnia, strength 4 officers, 101 men, 132 horses, 11 waggons, and 23 pack animals. These units were formed at St. Petersburg. They carry telegraph, telephone, and visual signalling apparatus, and 24 versts of cable; and are attached to the headquarter staff. They are expected to lay from 7 to 12 versts of cable per hour.

In May, 1904, a new telegraph company was formed in Turkestan.

Depôt.

In June, 1904, a depôt battalion was formed at Omsk. In March, 1905, this battalion moved to Kharbin, and was formed into a second reserve telegraph company, with a strength of 4 officers and 275 men.

Bridging Units.

In February, 1904, there were 3 bridging companies in Siberia, forming part of the three East Siberian Sapper Battalions. When the 4th, 5th and 6th East Siberian Battalions were formed, they were not given any bridging companies, because it had been decided to organize these as independent units (army troops).

An East Siberian Bridging Battalion of two companies was formed in March, 1904, and provided with bridging equipment on double the usual scale. At the end of 1904 the 1st European Bridging Battalion was sent to the Far East; and orders were issued for the formation of the 2nd and

3rd East Siberian Bridging Battalions, of the same strength as the 1st, but with only the normal amount of equipment.

In May, 1904, orders were given for the formation of a bridging company in Turkestan.

In addition to the new sections of field park that were raised for the new East Siberian Sapper Battalions, a section of the 3rd European Park was sent out to the Far East. Field Parks.

In May, 1904, an Engineer Park of two field and two siege sections was formed in Turkestan.

The 4 battalions forming the Trans-amur railway brigade were raised to a strength of 6 companies each before the end of 1904. In February, 1904, the Transcaspian railway brigade had been given another company, but it subsequently transferred 2 companies to the Trans-amur brigade. It is not known whether their places were taken by new companies or not. Railway Troops.

In May, 1904, a Siberian field balloon company was raised. Its strength was 5 officers, 193 men, and 138 horses. It had 4 spherical balloons, with a capacity of 640 cub. mètres each. Balloon Units.

In June, 1904, an East Siberian Field Balloon Battalion of 2 companies was raised by taking men from the European fortress balloon sections. The strength of this battalion was 11 officers, 340 men, 287 horses, 133 two-wheeled carts, and 42 waggons. Its equipment was 8 spherical balloons, 20 signalling balloons, and 2 gas generators (one for pack transport). The balloons took half-an-hour to fill.

In November, 1904, the field balloon company was raised to a battalion of the same strength and with the same equipment as the first battalion.

In April, 1905, a third balloon battalion was formed, strength 15 officers, 677 men, and 333 horses. This battalion has some elongated balloons.

RECAPITULATION OF NEW UNITS (EXCLUDING PORT ARTHUR GARRISON).

Fortress Troops.
1 Fortress company (forming two on mobilization). Baltic.
1 Submarine-Mining company. Far East.
2 Fortress Balloon companies. Vladivostock and Warsaw.
1 Siege park. Far East.
3 Carrier Pigeon establishments. Europe (?).

Field Troops.
10 Field companies (forming 20 reserve companies on mobilization). Europe.
4 Sapper battalions (in all 3 field parks and 1 bridging, 10 field, 4 telegraph companies), Far East.
10 Telegraph companies, establishment augmented (forming 10 first line and 10 reserve telegraph companies on mobilization). Europe.
2 Telegraph battalions (each of 4 companies). Far East.
3 Wireless Telegraph companies. Europe.
1 Telegraph company. Turkestan.
1 Reserve telegraph company. Far East.
1 Mounted Telegraph half-squadron. Europe.
1 „ sotnia. Europe.
3 Reserve Sapper battalions (each of 1 telegraph, 2 field companies). Europe.

2 Bridging companies. Europe.
4 Bridging companies (forming 4 reserve battalions, each of 4 companies, on mobilization). Europe.
3 Bridging battalions (each of 2 companies). Far East.
1 Bridging company. Turkestan.
10 Field Park sections. Europe.
4 „ „ Far East (including 3 above).
2 „ „ Turkestan.
2 Siege Park sections (fortress unit?). Turkestan.
12 Railway companies. Trans-amur.
1 Railway company. Trans-caspian.
3 Field Balloon battalions (each of 2 companies). Far East.

The chief point to be noted is the enormous increase that had to be made in all the technical units. On the other hand, the normal proportion of field companies, three per army corps, was apparently sufficient.

J. E. E. CRASTER.

COAST DEFENCE IN THE UNITED STATES OF AMERICA.

THE *Army and Navy Journal* of 10th March last contains portions of the Report by a Board appointed to revise the work of the Endicott Board of 1886. The new Board, of which the Secretary for War was president, included the Chief of Staff, the Chief Signal Officer, and the Chiefs of Ordnance, Engineers, and Artillery, as well as five other senior officers representing the Navy and Army.

The Board indicate the change in conditions since 1886 which have necessitated a revision of the coast defences, but record their view that the principles of defence so clearly stated by the Endicott Board are unchanged.

The following are extracts from the above-mentioned portions of the Report:—

"Since 1886 our territorial limits have been enlarged by the addition of the insular possessions. They are distant from the great centers and sources of supply and cannot be held unless their principal ports are fortified before the outbreak of war. It is clear that the defense should be provided with as little delay as possible. Naval bases and coaling stations must be protected by fortifications and, in addition, Manila, Honolulu and San Juan are of sufficient military importance to deserve adequate defense.

The United States has secured a valuable possession, the canal zone, and is to expend large sums of money for the construction of the Panama Canal, a waterway of vital strategical and commercial importance to the United States. While it may appear that the ultimate defense of the canal must rest with the Navy, the fleet should not be tied so closely to it as to lose its offensive power; moreover, it is readily conceivable that control of the sea in the vicinity might be temporarily lost, either on the Atlantic or Pacific coast, making land defenses necessary and advisable, since the cost of fortifications would be but a small percentage of the damage which could be quickly inflicted upon the plant and operation of the canal.

After the canal is completed, the capture of or damage to either entrance might prevent the passage of war vessels between the Atlantic and Pacific oceans, though the concentration of the two fleets might be of vital importance to the national welfare."

"The Board, after carefully weighing the relative commercial and strategic importance of the ports and harbors of the United States and the insular possessions, modifies and revises the list of ports submitted by the Endicott Board as requiring defense. The revised list below is arranged in geographical order:

HOME PORTS.

Kennebec river,	Delaware Bay,	Mobile Bay,
Portland,	Baltimore,	Mississippi river,
Portsmouth,	Entrance Chesapeake	Galveston,
Boston,	Bay,	San Diego,
New Bedford,	Hampton Roads,	San Francisco,
Narragansett Bay,	Potomac river,	Columbia river,
Eastern entrance to	Cape Fear river,	Puget Sound,
Long Island Sound,	Charleston,	Lake Ports,
Eastern entrance to	Savannah,	Kiska Island.
N.Y.	Key West,	
Southern entrance to	Tampa,	
N.Y.	Pensacola,	

INSULAR PORTS.

Guantanamo,	Subig Bay,	Pearl Harbor and
San Juan,	Manila Bay,	Honolulu.
Guam,		

ISTHMIAN AND CANAL PORTS.

Colon,	Panama.

While the military needs of the coast as they exist to-day can be determined and provided for, the growth of the country, the construction of railways or other lines of communication may give, hereafter, a commercial and strategical importance to other ports which they do not possess at present.

Increase in gun power and the efficient operation of the disappearing gun carriage, giving an increased rate of fire, have caused considerable changes in the details of defense recommended by the Endicott Board, viz.: the omission of turrets, armored casemates and gunlifts, and a reduction in the number and caliber of guns. The cannon now mounted in seacoast defenses are the following: High-power guns;—12-inch, 10-inch and 8-inch; the rapid-fire guns;—6-inch, 5-inch, 4·7-inch, and 3-inch; and the 12-inch mortar.

A demand for heavier armament and better armor protection has led to a marked increase in the tonnage of battleships. Battleships of 18,000 tons and upwards, mounting twelve to fourteen 12-inch guns with a great increase in armor protection, have been projected. Land guns must keep pace with such advance."

"The 12-inch gun can now fire two aimed shots in less than a minute, manual labor being used for loading and operating the gun and carriage; it is believed that this rate will not be materially diminished if the 14-inch gun mounted on a disappearing carriage of the same type as that now employed for the 12-inch gun, loaded and operated by the same means, be adopted. For the 16-inch gun, however, mechanical devices must be resorted to for loading and operating—a very decided disadvantage. The cost of the 14-inch gun with the required energy is but slightly in excess of the cost of the 12-inch gun with an equal energy at 8,700 yards.

For these reasons the Board recommends the adoption of 14-inch guns mounted on disappearing carriages for the defense of the channels above enumerated. The 14-inch projectile will carry a bursting charge of high explosive more than fifty per cent. in excess of the charge of the 12-inch projectile.

The Board is of the opinion:—

1. That the gun defense of a port of first importance should consist of guns of not less than 12-inch caliber, 12-inch mortars, and suitable rapid-fire guns for the defense of the mine fields.

2. That 10-inch guns are sufficient to cover channels liable only to cruiser attack.

3. That 6-inch guns should be used for the protection of places subject to naval raids and the special care of mine fields at distant ranges.

4. That 3-inch guns be used for the protection of mine fields at ordinary ranges.

These conclusions of the Board are based on the following considerations:—

1. Improvements in range finding equipment, the development of a system of electrical information, and the use of search-lights at night which have increased the effective range of guns ashore to such an extent that fire from the batteries will be begun at ranges upwards of 12,000 yards, whereas two miles was formerly considered the effective limit.

2. The little injury done to armored vessels, except by projectiles of large caliber, in the naval engagements between Japan and Russia.

3. The naval opinion that first-class fortifications will not be seriously attacked by anything less powerful than battleships."

"The reason the Endicott Board recommended so many mortars for coast defence was that they attacked an armored vessel in its most vulnerable part—the deck. Their special role was to prevent the occupation of anchorage areas by hostile vessels from which either the defenses or the protected ports might be bombarded. It was not anticipated that they could be effectively used against moving vessels, but by the improvement of the range finding system the usefulness of mortars to the defense has been very greatly increased and their fire is now effective against moving as well as stationary targets. o o o

There is no fixed rule for determining the number of guns required to give an adequate protection, and in arriving at a conclusion as to what should constitute the defense, the following considerations have been accepted which tend to diminish the number recommended by the Endicott Board without decreasing in any way the protection to the harbors:—

1. The development of a system of range finding, fire control and direction, much more efficient than could be anticipated at the time of the Endicott Board, which gives the land gun a very great advantage in accuracy of fire over the gun afloat, especially at the longer ranges.

2. The increased power developed in guns of a given caliber.

3. The adoption of the disappearing carriage for the higher caliber guns, thereby attaining an increased rate of fire.

4. Ships engaged in an attack on a fortified position must have ample room in which to turn, and as war vessels are being constructed larger and of deeper draught, the defenses required for narrow and shallow channels, whether natural or dredged, may be diminished since the heavier ships are excluded.

5. If the armament will compel the enemy to land in order to effect its capture, it has fulfilled its function, and any increase in armament thereafter is an unwarrantable expense in material and personnel. * * *

The Board has recognized the claims of the Navy to command all seagoing defenses, and also the general inadvisability of assigning naval units to particular stations, yet the Board believes that the military defenses of certain important ports should be supplemented."

"It is the power of determining the range from the gun and the ability to apply all of these corrections quickly and accurately, combined with stability of platform, which gives the land gun its great advantage over the gun afloat, a superiority which increases rapidly as the range increases.

The expense of installing a proper system of range finding, fire control and direction which will accomplish the results desired is but a small percentage of the cost of the guns, carriages and emplacements which the system is designed to serve. An efficient system for any harbor can be elaborated only after the most careful study of the particular locality. * * *"

"Because of the effect of beams of light on each other, and on other auxiliaries of defense, experiments have demonstrated that the proper number and locations of searchlights in each harbor are matters that can be determined only after repeated local trials, and as a consequence the preparation of an estimate of the cost of perfected searchlight apparatus for all of the defended harbors which is more than a fair approximation, is impracticable.

A service of security and information must be provided to guard the coast against sudden hostile attack, and steps have already been taken to this end by both the Army and Navy, including the co-operation of the two services. Wireless telegraphy will form an important feature of the system for communicating with ships of the Navy and with suitably equipped scout boats employed for the purpose. * * *"

A REPORT ON HALIFAX, NOVA SCOTIA, BY ONE OF WOLFE'S ENGINEERS.*

The recent abandonment of Halifax as a permanent Naval station and dockyard, and the transfer of the Fortress to the Dominion Government, open a new era in the history of this once famous Imperial stronghold.

The establishment of the Dockyard in 1759—"the year of victory"—when Wolfe decided the fate of the North American continent on the Heights of Abraham, marked the opening of the first chapter in its Imperial History.

It was from Halifax that Wolfe started on his victorious expedition—one of the most memorable in the history of the Anglo-Saxon race, for it decided that the civilization of North America should be English and not French in its character; and it was to Halifax that the unsuccessful Imperialists and Loyalists retired after the Revolutionary War, on the evacuation of New York in 1783.

Although thus used as a base for victorious armies and a refuge in defeat, Halifax itself has never been the scene of actual warlike operations. The nearest approach to actual war was the entry of the *Shannon*, escorting the *Chesapeake*, after her victorious 14-minutes' action with the latter vessel on the 1st June, 1813. Perhaps even a closer approach to actual war occurred on an August night in 1864, when the Confederate cruiser *Tallahassee* ran out at night by the almost unnavigable Eastern Passage, and escaped the Federal Gunboats lying in wait for her off Chebucto Head. The graves of Captain Taylor Wood of the *Tallahassee* and of two officers of the *Shannon* are local memorials of these two famous naval exploits.

Rudyard Kipling's description of Halifax in the "Song of the Cities" is, however, perfectly correct in the impression it conveys of the absolutely peaceful existence that the Fortress has had for close on 150 years.

> "Out of the mist my guardian prows put forth;
> Behind the mist my virgin ramparts lie.
> The Warden of the Honour of the North,
> Sleepless and veiled am I."

To the student of Fortification, Halifax offers many interesting points.

* Communicated by Major B. R. Ward, R.E.

From the original Stockade Lines alluded to in the following report, through the Bastion and Polygonal Systems—for the Citadel of Halifax, constructed at the close of the 18th Century, shows examples of both these styles—right up through the various systems adopted during the 19th Century, from Martello Towers to the most recent types of emplacements, Halifax forms a perfect museum for the military engineer.

Many reports have been written about Halifax in this connection, but probably none more interesting or by an abler hand than the following one by Hugh Debbieg, Captain and Chief Engineer under Major-General Amherst in 1761.

It has been my duty at various times during my two years service at Halifax to examine and catalogue various old military documents which have accumulated at the Headquarter Office and in the C.R.E.'s office during the military occupation of Halifax. As the last station in the Dominion to be occupied by British Troops, the documents from other formerly-occupied military stations, such as Montreal and Quebec, have drifted here. These have now been catalogued, and despatched for the most part to Ottawa, where they have been deposited with the archives of the Dominion Government.

Most of the documents that were in existence before the Revolutionary War of 1775 to 1783 have disappeared. The records from 1783 onward are fairly complete. A few older documents have, however, survived, and of these the most interesting is this first report on Halifax by a military engineer. It is interesting at the present time, when so much attention is being directed to Halifax in connection with its transfer to the Canadian Government; and it is also interesting as having been written by one of our most famous Engineers.

Hugh Debbieg, whose biography, by Colonel R. H. Vetch, C.B., R.E., appears in the Supplementary Volume, No. 2, of the *Dictionary of National Biography*, was born in 1731 and died in 1810 as a General of Royal Engineers. His biographer writes of him in 1759 as "a man after Wolfe's own heart, resolute and daring, giving little heed to rule or system where they interfered with his views of the best mode of attack" (p. 125). He served under Wolfe as Assistant Quartermaster-General throughout the campaign of 1759; but during the siege of Quebec he temporarily gave up his appointment on Wolfe's staff to take his share of the engineer duties. "He was with Wolfe when he fell, and figures in West's celebrated painting of the incident" (p. 125). After the capitulation of Montreal, on the 8th September, 1760, he accompanied the army to Halifax, Nova Scotia, where he acted for a time as Chief Engineer. Both historically and professionally his report on Halifax is well worthy of preservation and study. His subsequent career as an Engineer was highly distinguished, both in peace and war.

B.R.W.

REPORT ON HALIFAX, NOVA SCOTIA, BY CAPT. HUGH DEBBIEG, CHIEF ENGINEER, DATED 29TH MAY, 1761.

A REPORT of the Particulars relating to the fortifying of this Place, made according to Instructions from the Hon'ble Board of his Majestie's Ordnance dated 23rd May 1758 and by order of his Excellency Major General Amherst dated 14th September, 1760.

By a Report made of this place dated 12th April 1759, it appear'd that all the Fortifications which had hitherto been raised (a few Batteries excepted) were of a temporary kind, and intended as a security only against the sudden Incursions of Canadians and Indians with small Arms, and were then unfit even for that purpose from the decay'd condition they were in.

It is unnecessary to repeat the several particulars relating to them mention'd in that report; it is sufficient to tell, that nothing remains now at Halifax, which can be consider'd as a Fortification or as any part of one, so that the Business is not (in Terms of the Instructions) "to form "a general Design for the repairing or reforming each Fort and its "Buildings" but to form Designs of a Fortification intirely new. There have as yet been no particular Directions for this purpose and the Designs that are made, may possibly not tally with the Ends proposed, for according to the uses and services that may be expected from a Fortification, it is obvious that the Designs ought to be calculated as nearly as possible. These Services may be comprehended under Designs of three different Classes;

Halifax may be fortify'd for three different purposes;

The first only to protect the Inhabitants of the Town from the sudden Incursions of Canadians & Indians, such as the original Design was, and in that Case Stockade Lines with some Block houses properly placed with Ditches to the whole, may answer the purpose without going to more Expense.

1st.

The second may be a Design to secure a Post which shall prevent an Enemy, from taking Possession of or settling upon the Harbour, without bringing a considerable Armament; for this purpose, a Fort capable of containing from 500 to 1,500 men, such as was mentioned in the Report of 1759, might answer.

2nd.

The third may be a Design of more general and extensive use, that is, a Repository of Sea and Land Service Stores for a Fleet and an Army, with proper Arsenals for their preservation and a Garrison, sufficient for their Defence in time of War, from three to five Thousand men, which can afford to send small Detachments to other parts of the Province or even to the continent if occasion should require.

3rd.

The first of these Designs seems now to be no longer wanted therefore need not be spoke to.

The 1st not necessary.

The second is of a limited use and will scarce answer any purpose from which considerable Advantages can be drawn; the smallness of the Garrison will not admit of its giving much assistance without tho' wanted, and the smallness of the Fort will not admit of its containing more Stores within it than will be necessary for its own Defence and these perhaps with Difficulty.

The 2nd. of a limited Use.

The 3d. of an extensive use.

The third Design seems to merit our chief or perhaps our only Attention, and the next questions are, whether such a Fortification is wanted in North America? and whether Halifax is a proper place for it. As far as an Engineer may speak to the first of these, it may be answer'd, that one such place in North America must be of great service both in War and peace, in War as a place of Rendezvous to make up Fleets and Armies, and to supply their Wants occasionaly without losing the time of sending to Europe, and in peace, not only as a ready check to any future attempts of an Enemy, but likewise as an additional weight to keep our own Dominions in proper subordination.

Halifax proper for the 3d.

To the other Question, Whether Halifax is a proper place for a Fortification of this Importance? It is answer'd, that the Coast of Nova Scotia, by all accounts, affords the best or rather the only Harbours in North America fit for a numerous Fleet with water for large Ships, and is by far the most commodious Coast for protecting and carrying on that fix'd object of our Attention the Cod-Fishing.

I have had a Description, which shall be annex'd, of all the Harbours along the Coast from a person reputed a good Pilot who has used them for many years. It appears by his Description which is confirm'd by others, that Halifax Harbour is by far the most spacious of the whole, and is in all other respects equal to the best and superior to most of them. It has no large Rivers runing in to it and is therefore the less lyable to have Banks and Shoals form'd within it; The situation of it is centrical, and may have ready communications to the most fertile parts of the Province; It keeps open throughout the Winter, and has a peculiar advantage in the Remarkableness of its Coast which is easier distinguish'd than any other by ships coming from Sea, and this Advantage is now assisted by a Light-House lately built on Sambro Island.

The objections against Halifax.

Halifax with these Advantages as a Port, labours under several difficulties for being fortify'd which must be taken likewise under consideration, they are as follows.

1st. The Entrance of the Harbour is too wide to be defended from the Land, so as to prevent ships from geting in.

2d. The situation which must be chosen must occasion a great deal of extraordinary Expence which is that of cuting down the Citadel Hill and demolishing a great part of the Town.—

3d. That situation will be attended with the Disadvantage of a Hollow Way or Gulley which may facilitate an Enemys Approach.—

4th From the declivity of the Ground towards the Harbour, a considerable part of the Works will be liable to be enfiladed by Shipping.—

5th The Dock Yard lately built and at a considerable Expence cannot be surrounded by the Fortifications nor receive any Defence from them.

6th The Expence of fortifying will be very great, as Handicrafts Labour and most sorts of materials are at an exorbitant price.—

7th The Barrenness of the Land round the Harbour, must be a great hindrance to its supplying the Garrison, or any Forces that may be assembling, with proper Refreshments.—

There may be several other objections made but they are of so little Consequence that they are not worth mentioning, and these perhaps may

be remedy'd so as not to leave reasons sufficient for giving up or laying aside so publick and so usefull an Undertaking.

The 1st Objection viz. The Wideness of the Entrance is a fault more common than is generaly imagined for there are very few ports free from it even of those that are thought so, and the best method of hindering Ships from geting in to a Harbour whose Entrance is not narrow enough to be shut up with Booms, is by mooring Hulks or floating Batterys carrying a good number of Guns, in the Channels and to prevent their laying before the place, the only method is by bringing a superior Fire upon them, and from different points if possible, and this I think very practicable here.— Objections answer'd.

The 2d. Objection viz. The Expence of cutting down the Citadel Hill and demolishing the Houses. There is no Remedy to this objection for there is no other situation upon the Harbour, that is not either commanded or at too great a distance from the Water to give the Anchoring Ground any Defence. It must be observ'd, that not only the Houses standing in the Line of the Works, but likewise all the Houses within Canon Shot of them, must be demolish'd. Some of them as I am inform'd have been built at the Proprietor's risk without any Grant and these need not be paid for, unless the Government pleases. Others which have been built by a Grant must be paid for, probably according to the Decision of Apprizers, and what the value of them may amount to, there is no judging with any Certainty, the Houses are all Wood, and many of them rotten and decay'd, consequently of little value. The Expence of removing or demolishing them will be a triffle for such as are left by the Proprietors will be carry'd off by the Soldiery and poorer Inhabitants for Firing. There must be some reasonable time given to the Proprietors of these Houses to procure other Habitations; there is room enough for them to build, and at a sufficient distance from the Works, both towards the Bason and towards Point Pleasant. The hithermost Bank of the N. W. Arm will likewise be extremely commodious for such as get their Livelyhood upon the Water.

All the Lands upon the Peninsula have already been given away to Individuals, but all upon condition of being given back when required for his Majesty's Service and receiving a reasonable allowance for the Expence of clearing the Ground. This cannot be consider'd as an Extraordinary Expence because if it had not been done, it woud be to do.—

It may perhaps be objected that the Inhabitants if removed so far from the place will not receive proper protection from it, to which it is answer'd that the Experience of latter times has exploded the Custom of fortifying places for the sake of the Inhabitants, because their Extent must generaly be such, that they are scarce ever fortify'd or garrison'd in any due proportion as they ought to be, on account of their great Expence, and very seldom hold out above a few days for that reason, and there are few situations so perfect as to admit of inclosing a great Extent of Ground without undergoing some capital disadvantage that may hasten the loss of the place when besieged, which would be the case here if the Works were extended beyond certain Bounds. And all that

is proposed to be contain'd within this place is, such a Garrison and Arsenals as have been already mentioned, the publick offices and officers of the Government, and only as many Inhabitants as there may be room for without crowding or incommoding These, and the rest must take their chance and be contented in so good a Neighbourhood.—

The 3d Objection was that of a Hollow Way which may facilitate the Approach of an Enemy. This Hollow way is the Trough or Gulley of fresh Water River behind the Windmill Hill, express'd upon the Plan, it is considerably too deep to be filld up. and the properest thing to be done, is to keep as far from it as the Ground will allow. It is the less dangerous as this Hill is above 100 feet lower than some parts of our Works will be. There are likewise a few more Hollows but they are of little Consequence, for they may be filld at a small Expence.

The 4th objection is that the Declivity of the Ground will make a part of the Works lyable to be enfiladed by shipping. This objection may be remedied in the usual way by Traverses but it is more than probable, that ships cannot be very troublesome in this respect, untill they have silenced our Batteries towards the Water, and when that happens there will be little more for them to do, and for that reason the Anchoring Ground cannot be too well defended, nor too much Fire made to bear upon it from the Land.—

The 5th objection is that the Dockyard lately built at a great Expence, cannot come within the Works without making them too extensive and even untenable. The Ground where the Dock stands is so much seen into all round, that the power of Art cannot make it secure. These objections were made in Spring 1759, when that work was begun but were not regarded. After laying out so much money there, it may appear extravagant to throw that Dock aside, and go to the Expence of making another within the Works now designed or within reach of its Fire, if so, the most advisable thing that occurs is to build magazines for the most valuable stores within the Works, and let Masts and Timber of all sorts which may be readily replaced, if lost, remain in the Dock, as they now are, which may be inclosed with a Wall of Masonry in place of its present wooden Fence, to secure it from petty Incendiaries.

The 6th objection was the great Expence of Fortifying on account of the high prices of Handicrafts Labour and most sorts of materials. This objection is not peculiar to Halifax but must take place perhaps equaly in any other Harbour upon the Coast. The value of Labour can be reduced by employing Troops, and no other Way, both as Artificers and Labourers. There will be abundance of Difficulty to make them do enough for their money, when fixed at low wages, for notwithstanding all that officers and overseers can do, they will be so artfully lazy that with apparent diligence they will scarce do two pence worth of Work in a day. This may be remedied in Works that can be done by Task, but in such as cannot, it must and will certainly take place less or more, let officers and overseers be ever so attentive and Judicious.

With regard to materials and transporting them, it must be expected that two or three years Experience will give more insight towards procuring of them in a cheap manner, than anything that a Stranger can strike

out with all the Intelligence he can pick up amongst the Workmen and people of the place, whose Informations are often, if not always attended with some selfish View, that conceals part of the Truth, or rather whose abilities are so confined that they must be contented with doing things as they can tho' at a disadvantage. Therefore all that is to be done at present is to give an account of what materials can be got, from whence, and at what price, which account shall be annex'd.—

The 7th and last objection was the barrenness of the Ground round Halifax to supply any considerable number of people with proper Refreshments. It is agreed that this soil is the worst upon the whole coast, but it is allow'd at the same time, that after a few years Cultivation, it will feed Cattle and yield milk and vegetables enough for any Garrison, especially during the Summer which used to be the scarcest Season, and what it cannot be supply'd with during the winter either within itself or from Lunenburg, it may have at reasonable rates from Boston and the neighbouring parts of the Continent; and when there is a practicable road opend to the back part of the Country which is very fertile and now settling, I can see no danger of the Garrison's being in any sort of want of any refreshments that are necessary. It is not pretended that the soil round Halifax is fit for Corn or ever will be, without an immense Expence, but if it had, the same ground that produced Corn, will in the neighbourhood of such a place as this must probably be in a few years, be converted much more advantageously to Grass and Gardens, for they can never feel a want of Corn in the Neighbourhood of so many Corn-Countrys.

Two Methods of fortifying Halifax.

Supposing these objections answered so as to leave no doubt about fortifying Halifax with such a Fortification as has been mentioned, fit to contain a Garrison—from 3,000 to 5,000 Men, the next thing that occurrs, is the manner of doing it which may consist of two Methods. The first is in one continued Line consisting of Bastions and Curtains with as many outworks as may be judged necessary. The second is with a Citadel upon the most commanding Ground, and the remainder to be enclosed with Bastions and Curtains &c. as in the first method or with Bastion Redoubts join'd with slight Curtains as proposed in the Report of April 1759.

Their Advantages and Disadvantages

Each of these methods has its peculiar advantage and disadvantages. The advantages of the first are, that it is less expensive, and that part of it, which takes up the Ground, where the Citadel must stand in the second Method, will consist of extensive Works that will Yield a more respectable Defence towards the Country than a Citadel can. The disadvantages of this method are, that it can be capable of little or no defence untill the whole is finished, and then the Garrison must always be strong, for if it shoud be attack'd with a weak Garrison, there is not that resource which a Citadel affords. The same advantages and disadvantages are revers'd in the second method, for the Citadel when finished, will of itself be fit to make a considerable Defence and will protect the carrying on of the other Works afterwards as conveniency will permitt, and in case of leaving the place with a small Garrison upon an Emergency. The Citadel as has been observd before, will be a great addition to their security. The Citadel has the advantage likewise of being less lyable to be surprized and of giving a good deal of Defence to the

Harbour which the other method can not. The principal disadvantage with Regard to a Citadel, besides the Expence, is the small Extent it must have on account of the Ground which is the Defect of the Citadel proposed upon the Area of the 40 ft. Line in the Report of 1759., and this cannot be remedyd without the additional Expence of cuting the Hill a good deal lower down and destroying the two upper streets of the Town to give it a proper Esplanade.

The advantages and disadvantages of each of these methods being stated, the Choice may be the more readily determined, the sum of them is, that the first Method will be considerably the Cheapest, and with a compleat Garrison, equaly strong if not the stronger than the other. The Second Method will yield a Defence in less time and may occasionaly be trusted with a smaller Garrison, and will have a greater Command of ye Harbour.

Precautions for Planing the Works.

In planing the Works it must in general be observed for either Method, that the Poligons going up from the water to the south End of the Hill must have their Lines of Defence ranged so as to throw off the Enfilade of George's Island; and those going up to the north End, so as to throw off the Enfilade of the low Ground where the Dock stands, both these Enfilades will take place unless they are carefully avoided, and it is for this reason, that the contour of the Figure is fixd upon in the manner laid down, keeping at the same time the Command of the Ground. It must be likewise observed that the Poligons upon the Citadel Hill of the first Method, are kept considerably within the 40 ft. Line, to have the Ravelins the more Spacious; This for a Citadel cannot be done because it will augument the Fault it already has which is that of being too small.

Precautions for the Profiles.

The Profiles must vary in different parts of the Works and the Heights must be kept so as to give each part a proper Command of the Ground without and no more, so that the Counterscarp shall cover the scarp as high as possible; but if there are Casemates, this rule must be broke through, then the Ramparts must be high enough to make room for their being Bomb-proof otherwise they will be of little use, and this is a Reason why a Citadel must be very Expensive, for it must be casemated, and the Ramparts of it must consequently be rais'd higher, than those of a Simple Line, not but Casemates will be of great use in all Fortifications, for it is a Defect to want them, but Citadels in particular never ought to be without them.

The Parapets above the Cordon I think will be best of Sod, it is easiest repair'd and least hurtfull in time of service, and for the more convenient repairing of it, the Sod-work may be kept three or four feet within the Cordon which will leave room for Fascine-work clear of the Masonry for a new facing.

LINE TO the Water.

Its Advantages.

The Line towards the Water has a Ditch, counterscarp places of Arms and a Glacis before it, contrary to the usual Method, the advantages of which are, that the place is the less liable to be insulted or surprized from the Water and the Parapets are so covered with the Counterscarp that the fire of Shipping can have but a small Effect upon them in proportion to those that are exposed from top to Bottom as Sea Batteries Commonly are.

There are peer-Heads run out for the conveniency of shipping for loading and unloading stores and there may be a very good Careening Wharf where ships of any Burthen may be careen'd.

It is allow'd that some share of the strength of a Fortification must depend upon the goodness of Workmanship and Materials; good Workmanship may with proper care be procured any where, but the Materials are commonly taken as the place affords them, and the best or cheapest made choice of according to the consequence of the place. The different Materials used for the Facing or Revetment of a Fortification are, Sod, Timber, Brick or Stone. The Facing is that part which of all others requires most Firmness and Duration, and while that stands good, any other want may be easily remedy'd. Each of these Materials have their advantages and Inconveniencies. Materials for Revetments or Facings.

Sod is chosen either for cheapness or want of other materials, but it is of short duration especially in Countrys where the Frosts are violent and of long continuance; and it is in all Countrys the most lyable to surprizes. Sod. Its Disadvantages

Timber is chosen in woody Countrys for Cheapness and Dispatch, in which respect it answers at first, but in the End, I think none lyable to greater disadvantages. When the Timber rots which commonly happens in twelve or fifteen years at farthest, the whole drops, probably about the same time, and perhaps when its Services are most wanted, and the Expence of repairing it then, is to a trifle equal to the first Cost, for it cannot be done properly without taking down the whole almost as low as the Foundation, so that after a period of forty or fifty years, it will probably cost more than if it had been built of the most durable materials at first, and all subsequent Repairs become a dead Loss; Annapolis in its present condition is a proof of this Assertion. It may be farther observ'd that Timber Revetments are easier demolishd by Howitzers than any other, and may suffer by Fire. Timber. Its Disadvantages

Notwithstanding these objections to Sod and Timber, it is not meant that the use of them shall be intirely excluded, on the contrary, for some certain parts of the Work, they may be made use of with advantage, for Sod-work is by all means the properest in Parapets above the Cordon for the reasons mentioned on page 16th, and even that is as much as can be compleated at Halifax, where most part of the ground has been so lately cleared, that very little sod has as yet acquired a sufficient texture for purposes of that kind. Sod & Timber proper for particular parts.

Timber may very safely be used in retaining Walls within the Works and sunk parts of the Counterscarp as are to be rais'd to a small Height. Timber with dry stone, must likewise be used in the Counterscarp along the Water and in the Peer-heads, where its Decay will be of less dangerous Consequence and may be easier repaired; for it would be a very great Expence to do this Work in Brick or Stone as they must be laid in Terrass.

BRICK-WORK is of Shorter Duration than Masonry and much more Expensive, it is therefore seldom used where stone can be got, but for some uses it is absolutely necessary, such as Fire-places and Partitions in dwelling-Houses, Arches of powder-magazines, Casemates and other subterraneans that are to be used for dry stores or occasionaly for lodging places. Brick-work necessary for particular uses.—

Masonry preferable to all other Materials.

From what has been said of these materials, it is obvious that Masonry must be recommended for the Facings of the Works, for tho' it will at first be very expensive, yet as the place is supposed to be intended for duration, it must in the End answer both for economy and service far beyond any other; it must be observed, that from the long severe Frosts of this Climate, Masonry is apt to suffer in a few years, unless it is properly taken care of; this is to be done by building it with as little Slope as possible, and rough casting it every three or four years, especialy the parts most exposed to the north and west; it has likewise been a practice, to cover it with a casing of thin Boards, but the other method is probably more effectual and less expensive; a few years Experience must shew which is preferable. One most necessary Precaution is, to begin and end the Works, so as to let the Mortar dry, without leting the Frost get in to it.

Disadvantage attending it how to be remedied.—

Everything that occurrs worth observing upon this subject, being now mentioned, the Description of the Harbours, and the account of Materials promised in pages 4th and 11th shall be inserted.

A DESCRIPTION of the Harbours upon the east Coast of NOVA SCOTIA from the GUT OF CANSO to the HARBOUR OF FOURCHU shewing the number of large ships that each may contain by Thomas Fryar Pilot.

Large Ships.

GUT OF CANSO 200

Entrance easy and wide at both Ends. Anchoring very good all along from ten to twenty Fath's. water, but the Currents are strong.

Remarks—There is Plaster of Paris in the Straits of the Gut on Breton-Island side.

CANSO, MILFORD OR CHEDABUCTO 40

Entrance difficult. Anchoring very good in the Bay and likewise in the Harbour when well known.

ISAAC'S HARBOUR ... ... 7 or 8

Entrance rocky but deep. Anchoring good within.

WHITE-HEAD HARBOUR 100

Entrance very rocky. Anchoring good when well known and the Harbour very well shelter'd.

TORBAY—Open to the Sea, full of Shoals and Rocks and very wild.

COUNTRY HARBOUR 200

Entrance rocky. Anchoring good in 10 Fath's. water but the ground is somewhat foul and must be well known; this Harbour runs a good way up the Country.

LISSCOMB HARBOUR 70

Entrance a mile wide. Anchoring good in between 8 and 10 Fath's. water.

Remarks—Starboard side going in, is high Land, the Larboard is low Land there is none of the Land clear'd.

Large Ships.

Beaver Harbour—Not fit for Ships to go in but good anchoring without.

Popes Harbour 60

Entrance is half a mile wide. Anchoring very good in between 7 and 8 Fath's. water. The Ground muddy.

Remarks—The east side of the Entrance is a high head of white Rocks, the other side low Islands.

Tangier—Not fit for Ships.

Owls Head— Do.

Great Jedore—For a 20 Gun Ship only.

Remarks—Little Jedore in the neighbourhood is excellent Land and was well settled.

Halifax ... ... 400 or 500

Entrance easie when known and is half a mile wide in the narrowest part. Anchoring very good and well shelter'd.

Remarks—This is reckond the best Harbour and the worst Land on all the Coast.

Margaret's Bay 200

Anchoring good in 7 Fath's. water and in all weathers and good holding Ground. Entrance four miles wide, and bold—from side to side.

Remarks—The Land round is very good but none cleard, the Timber is good.

Mahon Bay—Not fit for large ships.

Lunenburg or Malisgash—Not fit for ships above 20 Guns.

La Heve ... ... 30 or 40

Entrance easie. Anchoring very good.

Remarks—good Land all round.

Port Medway or Maltois—Not fit for shipping.

Remarks—Good Land round it.

Port Senior or Ressignol—Not fit for shipping.

Remarks—The Land round is good.

Port Mutton—Not fit for shipping.

Port Hebere or Port Aux Ours—Do.

Port Roseway or Port Razior 100

Entrance very good. Anchoring very good in between 8 and 9 Fath's. Water.

Remarks—The Land round of a moderate Height and very good—No Settlements.

Cape Negro or Rabadousse 100

Entrance good. Anchoring good in 5 Fath's. Water.

Remarks—The best part of the Harbour is high up. The Lands round are good and of a Moderate Height. No Settlements.

PORT LA TOUR	Not fit for Ships.
CAPE SABLE East passage	
CAPE SABLE West passage	
PUGNICO	
FOURCHU	

Prices of Materials and Workmanship at Halifax in Nova Scotia at the Beginning of the present War—

CARPENTERS MATERIALS.

	Halifax Currency £	Sh	D
TIMBER Fir, Pine or Spruce from 9 In. Scantling and upwards per Ton of 40 ft. Cub.	0	15	0
TIMBER Ranging from 6½ to 9½ In. scantling per Cd. ft. runing	0	15	0
TIMBER Joisting of 4 by 4½ Inches Scantling per Cd. feet runing	0	4	6
Clap Boards ... ... per M	3	0	0
Boards ... ... ft.-Supr. „	1	18	0
Shingles ... ... „	0	12	0
N.B. That Ton Timber of Fir Pine or Spruce is now sold from 18 to 22 shillings per Ton, and Oak Timber from 50 sh. to £3.			
CARPENTER per Diem	0	4	0
Do Apprentice	0	2	0

MASON'S OR BRICKLAYER'S MATERIALS.

Rubble stone walling laid in Mortar one foot high and two feet thick per Rod running...	0	12	6
N.B. The same Quantity of Work costs at present 29 Sh.—			
Laying Bricks in Walling ... ...per M	1	0	0
Do in Chimneys... ... ...per Do	1	5	0
Do in Funnels of 2 stories ... ...per Do	2	0	0
Do Arches of Magazines ... ...per Do	3	12	0
Lathing & Plaistering with two coats ... per yd. Supr.	0	2	2
Bricks Standard at a Wharf ... ...per M	1	16	0
Do New England ... ...per Do	1	0	0
N.B. The Bricks are in general very bad, & those of New England are very short of the Standard			
Lime ... ... per Hhd. of 10 Bush.	1	8	0
N.B. Lime is now above 30 Sh. per Hhd.			
Sand ... ... per Hhd	0	2	6
Laths ... ... per M	0	8	0
Hair ... ... per Bush	0	2	0
Mason or Bricklayer ... ... per Diem	0	5	0
Do Apprentice ... . Do	0	2	6
Labourer ... ... Do	0	2	6

Smith's Work is never below 5d. per lb. for rough forged Work and is often sold for 6d & 7d. filed Work and Screw Work runs from 15d to 30d

		Halifax Currency £	Sh	D
Painting	Outside with two coats ... per Yd.	0	0	7
	Inside sizing Priming & finishing ... per Yd. Supr.	0	0	10
Glazing	Squares of 8 & 10 ... ... per Sqr	0	0	4½
	Setting & Putty	0	0	2½
	Per Single Sqr Glass & Setting	0	0	10
Wateridge	Lighters of 18 Tons ... Per Diem	0	7	6
	Do of 10 Do	0	5	0
	Stones for Masons landed at Wharf ... Per Ton	0	2	0
	Do round for filling in ... Per Do	0	1	6

Carting.

	To the Parade £	Sh	D	Upper Street £	Sh	D	Citadel Hill £	Sh	D
Boards ... ... per M	0	3	0	—	3	9	—	5	—
Tun Timber per Tun	—	1	8	—	2	—	—	2	6
Shingles ... ... per M.	—	—	4	—	—	5	—	—	7
Clap Boards ... per M	—	1	8	—	2	—	—	2	6
Load of other Materils ...	—	2	—	—	2	6	—	3	—

N.B. The proportion of Halifax Currency to Sterling, reckoning the Dollar at 4Sh. 8d is, as 15 to 14, that is, £15 Halifax Currency, is equal to £14 Sterling.

Upon comparing the foregoing prices with those commonly given in England, it will be found, that Timber excepted, they are in general, about Cent per Cent higher, and Lime in particular above 500 per Cent. The only practicable method of reducing them, has been pointed out in page 10, viz. by employing Troops, and this is to be understood only for Workmen's Wages, and the Materials that are to be had upon the Spot or in the Neighbourhood, such as Timber in all its articles, Stone, Sand, and Clay for Bricks; but as to foreign Articles that must come from Europe or the Continent, the only method for reducing them is by having them from the first hand.

Iron & Iron Work to be got from Europe. —

By these Articles I mean Iron and Iron Work of all sorts, Tools included, Glass, Paint, and Lead, & to get them, at the best hand, I believe they must be got from Europe, for most of those that are to be got in this country come from thence, and are sold at a high rate.

Lime.

With regard to Lime, if it is got from the Continent, it cannot probably fall much in its Price, and for this reason, there ought to be no Experiment left untry'd to get it nearer at hand, & the Sea Coast of the Province ought to be search'd narrowly from Bay Verte to Cape Sable, and if it is not to be found there, it must be got from Spanish River in the Island of Cape Breton, or from St. John's River in the Bay of Fundi, the former of which I believe is the readiest Navigation, if we keep that Country.

With regard to the Articles that are to be found at Halifax & in its neighbourhood, I shall only say a few words, as the Engineers to be employd there will probably after a short Experience, discover more than I have hitherto been able to learn.

Stone.— The stone hitherto chiefly used came from Chebucto Head, which is both Slatey and metalick. There is another kind at Cape Sambro', resembling the Moor Stone in England that seems to be much better in all Respects, it is very hard, and must Last for Ages; this makes it difficult to work; but there will be no occasion to work more of it than is necessary for the Cordon Angles & Gateways; The rest of the Work may be done in rough rubble of this Stone for two or three feet of the outside, and of the best of the common Stone for the inner side and Counterforts. The common Stone that seemd to me the best, is on the west side of the narrows towards the Town, there is likewise a tolerable good Vein that runs through Doctor Breynton's Field; there is enough of it to be found sufficiently good for that Purpose, without going out of the Harbour.

If it is thought necessary to have free stone for any particular use, there is enough to be got in several parts of the Bay of Fundy and from the Island of Cape Breton, opposite to the Isle just au Corps.

Sand.— There is neither Pit nor River-sand at Halifax in any quantity so that they have hitherto been obliged to use Sea-Sand. This is to be found both coarse and fine, in the north east passage & in several places. It has been proposed to gather magazines of it heap'd up in a commodious manner so as to let it receive a Year's rain and snow, to wash the Salt out before it is used, which must certainly improve it, for outside Work especially. I've been informed of a small vein of sand which runs through the Governor's Garden & Padock, about three feet broad and as much in depth, this might be open'd with little trouble for the Experiment's sake.

Clay.— Clay for making Bricks will become a very necessary Article and is to be found in several places, particularly in Cornwallis's Island, where there were Bricks formerly made, and about Fort-Sackville. There is likewise a Vein of very pure Clay found at Chester last Winter, which is said to be of a finer and better kind than is Common.

Timber.— The greatest part of the sizeable good Timber about Halifax, is now almost run out, or so far from the Water that they often prefer going to Lunenburg, Chester and along that Coast to supply their Demands. Chester-Timber of all sorts, is reckon'd the best in the Country. There still remains about Halifax, a good deal of Hemlock, and small Timber the former of which is reckond best for wharfing and rough Works, and the latter will be very necessary for scaffolding & other little occasional Uses. It is to be observed that Timber is much the more Durable for being fell'd in the Fall of the year when the Sap is down, at which Season there ought to be a Number of Men appropriated for that Business.

REVIEWS.

GERMAN OFFICIAL ACCOUNT OF THE WAR IN SOUTH AFRICA.—Vol. II. March, 1900, to September, 1900.

(15s. John Murray).

The second part of this valuable contribution to military literature has been translated by Colonel Herbert Du Cane, and the volume in no way falls behind its predecessor which was translated by Colonel Waters.

The account covers two distinct periods and phases of the South African Campaign. In the western theatre of operations, under Roberts, it tells the story from the defeat of Cronjé at Paardeberg to the surrender of Pretoria. On the eastern side it carries Buller's Natal Campaign from Colenso to the Relief of Ladysmith. The further combined advance to Koomati Poort is lightly touched on.

While not wishing presumptuously to criticise the conclusions arrived at and the lessons inculcated by the "thinking department" of the Great General Staff of Germany, one cannot help noticing the predominance of their application to European warfare, and that sometimes not sufficient allowances are made for the peculiar geographical conditions of the country and the character and organization of the Boers.

Criticising Lord Roberts' strategy the authors say:—"His plans for Poplar Grove were typical of future actions, and consisted solely in threatening the enemy's flanks or rear and thus, while avoiding bloody but crushing blows, compelling him to evacuate his positions; to push him back was sufficient. The occupation of the country and of the towns, not the destruction of the living hostile forces, became the objective of the operations, and manœuvres took the place of battles. Weighty reasons must certainly have decided a general like Lord Roberts to adopt this mode of warfare in such exceptional circumstances; reasons connected with the difficulty of maintaining the army at its proper strength, the peculiarities of the Boers, and the great extent of the theatre of war must have specially influenced him. It is, however, difficult to justify it when viewed from the standpoint of European warfare."

The last sentence breathes the spirit of the criticism throughout the book; and we cannot help feeling that it would have been more interesting and instructive if the staff had told the German war student how the campaign could have and ought to have been prosecuted, and how it

would have been prosecuted had the Germans and not the English had the management of it.

Probably the authors consider that, as the German student is not likely to have to fight on a large scale except in European warfare, it is not much use to dwell on the peculiarities of the South African situation, but that more may be gained by gauging everything by the standard of German methods. Keeping this idea in view we also may hope to gain from the German criticisms much that may be of value in European warfare. Reasons for strategical or tactical want of success on either side are not always given, but the actual historical facts are marshalled in such a plain, logical, and generally accurate manner that they may perhaps be said to carry their own explanations.

We gather that the German Staff considers Kelly Kenny's conduct of the action of Driefontein as worthy of all praise, in fact almost the only pattern battle of the war. "The tactics which he employed there were, however, based substantially on the same principles which the German regulations, evolved from the experiences of the campaign of 1870–1871, have laid down for the attack for a long time past." The German officer is to study this battle as an exemplification of the principles so highly esteemed in Germany. How the great staff at Berlin must have smiled when they saw Kelly Kenny one of the first of the successful South African leaders to be cast aside after the war by his unappreciative country, 'to make way for new men with new measures.'

The criticisms on Buller are firm and judicial, though couched in language of leniency and kindness. His dejection and vacillation in his communications with White are brought to notice. His conception of the Spion Kop operations is thus pithily summarized:—"He divided his troops into two portions of unequal strength, and placed the stronger, to which was entrusted the principal task, under the command of his subordinate, Warren, while he contented himself with the *rôle* of a spectator." . . . "It could therefore hardly fail to result that the enterprise was moulded by Warren's independently-formed decisions into grooves in which Buller's train of thought ran but ill. If he wanted to avoid this result he should, from the very beginning, have given orders precisely determining what Warren was to do, with details as to time and place, or he should have taken the direction into his own hands. He would not make up his mind to that, but tried subsequently, by somewhat unfortunate interference, to acquire an influence over the course of events; it was hardly to be expected that this would serve any good purpose." Here we have the essence of the cause of failure.

The tactics of Vaalkranz call forth the by no means severely-worded remark that:—"The practicability of Buller's plan must from the very first appear open to doubt by reason of the *terrain*" . . . "If the Boers occupied Doornkloof and the heights surrounding Vaalkranz on the north and east in good time, the Vaalkranz operations were altogether devoid of purpose or prospects."

The extraordinary reluctance of the commander of the Natal Army to push home victory and reap the fruits of success is pointed out in a few words, in the case of Vaalkranz on 5th February, at Cingolo on the 17th,

at Green Hill on the 18th, and finally after the crowning success at Pieter's Hill on the 27th. The terribly false tactical situation in which the Natal Army was placed on the left bank of the Tugela on the 21st to 25th February, and the false economy practised by both Buller and Roberts in trying to gain decisive victories without suffering losses, are all pointed out clearly but calmly.

It is pleasant to see that the animus against England, which was shown during the war by the German press, finds no echo in the judgments and criticisms of their military leaders.

The historical accuracy of the accounts of the operations comes out in strong contrast to the unreliability of the majority of publications that have hitherto been produced; many of the latter seem to have been written as indictments of or apologies for certain persons or measures, and are therefore bound to be unreliable.

The "Tactical Retrospect" at the end of the book is chiefly a dissertation on the failure of the British to realize that fire action, fire effect, and the combined employment and mutual dependence of the two fire-producing arms, the artillery and infantry, are now, more than ever, the essence of war. It emphasizes the opinion that manœuvring was wrongly substituted for fighting and the maxim forgotten that success is best attained by the destruction of the live force of the enemy. "No matter what may be the nature of the country, no enveloping movement can be effective and decisive unless made in combination with an energetic frontal attack, and a flank attack should always arrive at its destination when the enemy is thoroughly occupied with what is proceeding in his front."

Individual marksmanship, clear appreciation by each man of the task before him, and self-reliance are the lessons to be learnt from the Boer riflemen. "Only those men in the ranks who can think and act on their own initiative will be able to extract the full value from the employment of their weapon. . . . Fortunate is the army whose ranks, released from the burden of dead forms, are controlled by natural, untrammelled, quickening common sense."

We shall wait eagerly to see what the German Staff will have to say in its next volume about the conduct of the later or guerilla phase of the war and the blockhouse system. No instructive work has yet appeared on this subject.

And now for a few words of adverse criticism. The least satisfactory feature of the volume is the maps. The hill shading leaves much to be desired; it is confused and smudgy and does not give a proper representation of the nature of the country or of the relative tactical values of the hill features. The sketch of the Spion Kop heights depicts the Brighton Downs rather than the rugged scarps of the Drakensberg.

Photographs do not represent the 'human' value of slopes and hills, and are generally misleading for tactical pictures.

When will publishers recognize that for the comfort and convenience of the reader maps should be bound and folded with their lower edges level with the bottom of the pages, and not with the top edges of both coinciding? This is mere common sense.

G. H. SIM.

THE SALAMANCA CAMPAIGN.

By CAPT. A. H. MARINDIN, BLACK WATCH.—(7s. 6d. H. Rees, Ltd., London).

This book contains a carefully compiled and well-arranged analysis of the tactical movements which led to the Battle of Salamanca, in which the French Army under Marshal Marmont was defeated by Lord Wellington on 22nd July in the Peninsular Campaign of 1812.

It is evidently intended for the use of officers preparing for examination in this particular subject; the author disclaims all attempt at detail, and states that his intention is to provide merely the framework which the student can fill in from the narratives of Napier and others. For this modest purpose the author is to be congratulated on performing his task well, and his book will doubtless supply a want by affording to many a means of "getting up" a sufficient knowledge of their subject without the necessity of analysing for themselves and noting the salient points and tactical deductions which the systematic study of standard authorities should supply.

Whether a compilation which may be thus used to facilitate "*cramming*" for any particular examination possesses any permanent value is another matter, and one worthy of a passing notice. However good an author's intentions may be, his readers are not bound by them, and in an age in which short cuts to all branches of knowledge abound there will always be found students, who for a special purpose will welcome such aid as this book affords, without serious reflection as to the amount of knowledge of the subject which they will afterwards retain as a guide in their future professional career.

The evils of indiscriminate cramming have only very recently been emphasised by General Sir John French in a speech in which he pleaded for more solid co-operation between civil and military institutions in advancing the serious education of the British officer. The study of military history is no exception in this respect. On correct deductions from and appreciations of the tactical successes and failures of past campaigns may depend the lives of soldiers and the honour of the flag. The junior officer of to-day becomes in due course the general of some years hence, and it is well therefore not to trust entirely to any one work, however excellent, which affords easy steps to any branch of this important subject.

The book itself is a handsome and well-printed volume, though rather unwieldy in size (royal quarto) and better suited for the desk than the armchair.

The text, printed on one side of the sheets only and with generous margins, affords ample space for notes or sketches, and is interleaved with an abundance of excellent maps. These include four copies of a map of the Peninsula (scale, 90 miles to 1 inch) and eleven prints of a map of Salamanca and the country north and east (scale 6½ miles to 1 inch) showing clearly the successive movements and positions of the opposing forces during the whole of their manœuvres. As the author himself

points out the latter maps have the great defect of not showing any hill features, and the absence of these and of the forests south-east of Salamanca, which played an important part in the struggle, greatly detract from their value for tactical study. The names on these maps and those mentioned in the text do not always agree in spelling: (Deuro—Douro, etc.). Two large scale maps, from a special survey made by Major Mitchell after the action, show the stages of the final battle and give a good idea of the features of the ground and the dispositions of the troops.

The campaign of 1812 is well worth studying as it was destined to be the turning point of Wellington's fortunes in the Peninsula.

After a patient struggle of two years against superior forces of the enemy in Portugal, as well as against the indifference of the Home Government and the inertia and incapacity of his Spanish allies, he recognised the advent of a favourable opportunity for an advance across the frontier, and promptly seized on it. Securing his communications with the sea and to the south by the captures of Ciudad Rodrigo and Badajos in the early part of the year, Wellington skilfully made a movement on interior lines between strong hostile forces, on either flank, which if united might easily have crushed him; and crossing the Agueda he reached Salamanca on the 17th June.

Although greatly outnumbering the forces of the Allies, the French armies were kept from co-operation by the mutual jealousies of their commanders and by their insubordinate disregard of the orders of Napoleon, who, occupied with his advance on Moscow, was already beginning to feel the drain of the "Spanish ulcer," which, in concert with the snows of Russia, was destined to liberate Europe and to send its conqueror as a fugitive to Elba.

Their uncertainty as to the ultimate objective of Wellington's advance was also a potent factor in keeping the French Marshals apart; and thus it happened that a total French force of 230,000 men was unable to check, except for a few months, the advance of 60,000 Allies under Wellington and their eventual victorious march through the Pyrenees into France.

On reaching Salamanca Wellington found the army of Marmont occupying three forts on the west with the main body in a strong position to the east of the city.

Laying siege to the forts, which held out for some time, Wellington placed his forces between Marmont and the city, and the two armies stood facing each other, neither apparently willing to force on a general action.

Marmont, who expected reinforcements from Caffarelli's Division in the north, retained his position until the forts were about to fall, without however taking any steps to relieve them, and then retired towards the Douro.

Wellington, having taken the forts, promptly followed him, and then commenced the remarkable series of marches and countermarches to the Douro and back, in which these two masters of tactics, with nearly equal forces, strove to outflank and outmarch each other.

The several steps in these interesting tactical movements are well brought out by the author and are illustrated by a number of maps showing ly positions of both forces.

These manœuvres resulted in Wellington again taking up a position at Salamanca to guard his communications with Ciudad Rodrigo, which were threatened by Marmont who was marching round him to a strong position south of the city.

The Allied forces could thus retreat no further, and Wellington, seeing a general engagement to be imminent, arranged his forces *en potence*, his left thrown back on Salamanca and the right on his line of retreat to Portugal.

The battle was commenced in the afternoon of the 22nd July by a struggle for two rocky hills in the centre of the field, called the Arapiles, the northern being captured and held by the English and the southern by the French.

The action was decided in a short time by the too great eagerness of the French Marshal to advance to his left flank before his whole force was in position, thus leaving a gap which gave Wellington the opportunity for the great counter-attack from his right for which the battle is celebrated.

The French centre was thus broken and thrown back by the Allied cavalry, and a general advance taking place, the enemy were everywhere repulsed and put to flight. They were closely pursued and driven across the Douro, and on the 12th August Wellington entered Madrid.

Described by a French officer as the "beating of 40,000 men in 40 minutes" the battle of Salamanca affords a specially interesting subject for study, as it was the first decisive victory gained by the Allies in the Peninsula.

The author concludes with notes of the several points in the tactics of both forces which have called forth much criticism in the past and will no doubt continue to do so in the future.

The earnest student is here afforded much scope for ingenuity and research in clothing the dry bones of an analysis with the picturesque details of Napier and other historians and in working out his own solutions of the problems.

Whether Marmont should have relieved the forts at Salamanca; why neither commander offered to attack the other in the first instance; why Wellington did not attack the French as they were crossing the river at Tordesillas; why Marmont in the battle advanced his left so far, and what would have been the result had he not been wounded—are all points that are worth discussing and forming an opinion on.

Should it be objected that Wellington, when he first met Marmont, showed overmuch caution, it must be remembered that, with the exception of 12,000 men under Hill who were watching Soult in Andalusia, he had with him all his available force; that he was dependent on his communications with his sea base for reinforcements and supplies; that his intention was to advance still further from that base; and that he was opposed by the most able and energetic of the French generals.

Napoleon laid down the rule, though he did not always observe it, that no general should attack unless he foresaw 70 per cent. of the chances of victory in his favour, and Wellington may well be excused under the circumstances if he declined taking any uncertain risks.

W. R. PURCHAS.

NOTICES OF MAGAZINES.

Journal of the Royal United Service Institution.

March, 1906.

Field Fortification in the Light of Modern Warfare.—A lecture by Bt. Lt.-Col. G. M. Heath, D.S.O., R.E.—It is an axiom that the *object* of field fortifications is, by strengthening the ground and thus economizing the numbers of the defenders, to increase the force available for offensive movements; the men thus economized may be used for offensive action many miles away from the defended position. Such fortifications permit of strategical action, as, for instance, when a commander, who is numerically inferior to his opponent, utilizes a portion of his troops to hold one of the hostile columns while he throws an overwhelming force on the remainder. Tactically, field fortifications are useful only for purely passive defence and the material protection given to the men in the trenches; for counter-attacks on the defended ground close to a position are seldom likely to be decisive.

As regards *siting* the first requisites for the engineer are a good eye for ground and a knowledge of fire effect. The former can only be cultivated by practice out of doors. The practised eye will at once recognize the strong and weak points of a position, and a thorough knowledge of fire effect—the art of obtaining the best possible results from guns and rifles—will enable the engineer to put his defences in the proper place. For decisive action the best site for a trench is where the best fire effect will be obtained; this effect—provided you can see your enemy—results from 'grazing' fire, which in many parts of South Africa, India, and Manchuria can be best obtained by occupying the level ground at the foot of hills. The trench should be sited so as to procure a great depth of dangerous space for the attacker, 500 or 600 yards if possible.

To meet the objection as to difficulties of withdrawing from such forward positions, Colonel Heath says 'Do without; in an action you really mean to fight out, you do not want to withdraw; any reliefs necessary can be carried out at night.' In the absence of communicating trenches or other cover for the same purpose, reinforcing will be impossible wherever the trench is, unless against all rules it is on the sky line, or unless it is on a rear crest (sometimes the most favourable position). Supporting troops can of course be placed above the main fighting line, but they themselves must also be in good fire positions.

A great disadvantage of a trench high up is the facility which it affords to the enemy for covering his attacking infantry with artillery fire until they are close up to the position. Generally speaking too much importance is attached to high ground; as a whole a position need only be high enough to enable the defender to see the enemy's movements while screening his own.

Invisibility is fairly easy to obtain by careful siting and screening, the latter art being particularly worthy of study. Trees and bushes are often better left standing; for instance, in the Kentish orchards one can often obtain a good field of fire under the branches while at the same time being screened by them from artillery fire.

Preparatory bombardments, unaccompanied by any coincident infantry attack, are simply waste of ammunition against properly entrenched positions. The correct use of attacking artillery is to cover their infantry as far as possible up to the position to be assaulted.

Natural obstacles on *flanks* are often illusory, *e.g.*, the sea at Nan-Shan. In nearly all cases flanks must be protected by men in suitably placed trenches or by a mobile reserve.

When time admits the preparation of a *second position* to cover a possible retreat should not be neglected.

As regards *head cover*, since the object of the artillery fire of the attack is to keep down the heads of the defending infantry while the attacking infantry is advancing, the main object of trenches should be to allow the defenders to use their rifles with good effect in comparative safety whilst under this artillery fire. Therefore over-head cover, or at least head cover, should be provided whenever possible. One sheet of corrugated iron, at a slope of 1 in 4 downwards from the line of fire, is practically proof against howitzer shrapnel; a thickness of two sheets is absolutely safe.

In arranging details the offensive power of the rifle should never be sacrificed for protection. With this in mind *loopholes* are best made in long shallow slits. The proper way of testing a loophole for minimum size is to pull out the bolt of the rifle and look through the barrel; it is not sufficient to look over the sights.

Obstacles are useful at all times, but especially against night attacks. They must be under the close fire of the defenders, that is within 100 yards; for they are little use at a greater distance than a man can see at night. If the principle is accepted that counter-attack will not take place on the ground immediately in front of the trenches, obstacles may be in a continuous line. Land mines were much used in the late war in the Far East, but they appear to have had little real effect against the attack.

The *illumination* of the foreground at night is very important. Search lights, properly worked so as not to show up your own side, are probably best. For the attackers search or other lights can be rendered ineffective by smoke screens, except in a high wind; bags stuffed with straw are effective for this purpose.

The *assault of trenches* in front and by day can only be carried out by the attackers producing such a heavy covering fire at decisive ranges that the defenders, if not actually driven out, are paralysed. Covering troops should, if possible, entrench themselves, and can then remain in forward positions for a long period. This entrenching should be carried out at every successive advance.

Portable bullet-proof *shields* may be carried up to positions occupied by covering troops and afford some protection until a trench can be dug; but their weight (8 lbs. per square foot) will render their employment very limited.

Tools for serious work must consist of separate pick and shovel, and to be serviceable must unavoidably be somewhat heavy. Portable (light) and combined tools are unsatisfactory. When not likely to be required tools can be carried in carts or on mules, but in action these may be destroyed or may not be where wanted; therefore all infantry going into action must be provided with a proportion of tools and these they must carry on their persons.*

The principles of field fortification, both in attack and in defence, were well exemplified at the battle of Shu-shan-pu, south of Liao-yang, where the position, though only 4½ miles long, was strengthened by every device known to modern engineers. The trenches, 4′ 6″ deep, narrow, and assimilated to the natural ground, were in two tiers, one high up though well below the sky line, the other low down to give full effect to the flat trajectory of the rifle. Covered ways led to splinter-proofs cut into the reverse side of the hills. The whole front was cleared for fire, and all the actual approaches were closed by obstacles. The guns were skilfully masked, and trusted to indirect fire. On the right a high hill was used as an observatory, and was connected by telephone to the batteries. A light railway ran from the rear of the position to Liao-yang.

This position was assaulted three times without success, and the Russians then evacuated it for some reason unknown. The Japanese Sappers, in clearing obstacles on the left flank prior to the last assault, lost 75 per cent. of their numbers in 8 minutes.

In conclusion the lecturer referred to the necessity for a closer touch between engineers and other arms, not only in defence works, but in simple forms of bridging, camp arrangements, water supply, etc. Various speakers in the subsequent discussion also testified to the importance of such co-operation. Lieut.-General E. P. Leach, V.C., C.V.O., C.B., R.E., urged that the field training of Infantry Battalions should be carried out simultaneously with that of Engineer Field Companies, and mentioned recent instances of such combined work in Ireland. Colonel H. W. Smith-Rewse, C.V.O., R.E., gave evidence of co-operation in the Eastern Command. The chairman, Major-General Sir Reginald C. Hart, V.C., K.C.B., K.C.V.O., R.E., said it was the earnest desire of the Engineers to come into closer touch with the other arms.

General Hart also reminded the audience that it is an error to look upon field fortifications as a *substitute* for men. Decisive victory cannot be expected from mere passive resistance, though the ultimate object may be furthered by defensive action, as instanced by the Lines of Torres Vedras. Field works must be subservient to the troops and not the troops to the works. The only way to ensure proper tactical relations is to choose the ground most suitable to the troops and then see how field fortifications can be made to improve it.

As regards the attack, the Japanese might have avoided some severe checks and the loss of many lives if they had more often resorted to deliberate attack. Night assaults are of doubtful utility; the best plan is to get as close as possible by night, then entrench, and attack by daylight, when everyone can see what he is doing and the covering troops and guns can keep down the fire of the defenders.

* A very light tool for work in the attack, backed up by heavy picks and shovels on pack animals or in carts, may be a possible solution of the difficulty.

PRIZE ESSAYS.—The prize and commended essays of the Special Military Essay Competition—"The best, least irksome, and least costly method of securing the male able-bodied youth of this country for service in the Regular or Auxiliary Forces as existing, and for expanding those forces in time of war"—and of the usual Gold Medal Essay Competition for 1905—"In the event of war with one or more naval Powers, how should the Regular Forces be assisted by the Auxiliary Forces and the People of the Kingdom?"—have been published in two separate pamphlets, price 1s. net each, and can be obtained from C. Gilbert-Wood, Granville House, Arundel Street, Strand, W.C.

A. T. MOORE.

NATURE.

March, 1906.

THE SYSTEM OF THE STARS.—By Agnes M. Clerke; second edition (p. 507).—This work is so good that every student of astronomical physics should be familiar with it; it has been revised so completely that scarcely a page of it remains the same as in the original edition published fifteen years ago. In this period much new work has been accomplished; the number of known nebulæ has increased from 8,000 to 120,000; the discovery of terrestrial helium has led to the recognition of a new stellar type, having helium rays prominent in their spectra; numerous stars have been proved by the spectroscope to be close couples, one in six being so constituted. From spectroscopic observations it has been possible to determine that the solar system is moving towards an apex in right ascension 277° 30′ and declination +20° at the rate of 12½ miles a second, the probable error of the result being less than one mile a second. The motion of nebulæ in the line of sight shows that there is no difference, in this respect, between nebulæ and stars and has thus removed a difficulty offered to the view, that stars arise from a condensation of nebulous matter. Finally the large number of variable stars found in certain globular clusters, the phenomena presented by such temporary stars as Nova Aurigæ and Nova Persei, and the structure and distribution of nebulæ in the Milky Way, can only be simply and sufficiently explained by the existence in space of clouds of obscure particles, alone or associated with luminous matter, demonstrating that space may include as much dark material as bright.

Until a few years ago, nebulæ were believed to be masses of glowing gas at a high temperature, but the author is now able to write that they are not excessively hot bodies, being luminous through electrical excitement; gaseous nebulæ are, in fact, reasonably believed to be at a temperature not much above absolute zero; they are not, then, incandescent but rather luminescent, their light is independent of thermal conditions. The tendency of all nebulæ to assume spiral forms demonstrates, in itself, their close affinity, though some do not give the characteristic spectrum of hydrogen and helium.

Electric and thermal effects cannot be distinguished from one another;

stars having the smallest number of chemical elements represented in their spectra are probably the hottest, while an increased number of lines in other spectra is probably due to the existence of an increased number of chemical elements as the result of lower temperatures, the inferior position in the temperature scale being indicated also by the reduction of the relative length of the spectrum, increase of the relative intensity of red radiation and general absence of enhanced lines. No writer on astronomy has a more facile pen than Miss Clerke, and the amount of reading and careful analysis involved in the preparation of this work must have been very great.

W. E. WARRAND.

RAILWAY GAZETTE.

February 23rd, 1906.

LARGE LOCO. BOILERS.—By G. J. Churchward.—This is an exceedingly interesting paper, illustrated by a number of diagrams of recent designs. It is astonishing to see the variations in the amount of heating surface provided. Wide fireboxes, hitherto little introduced in this country, seem particularly prone to tube troubles, mainly no doubt because the mass of the fire is so much nearer the tube plate, the depth of the box being reduced so as to get a pair of trailing wheels under it. The wide box burns poor coal with facility and economy; but waste occurs if the engine is kept standing much, because the grate area is so large.

With the high pressures now used the problem of water circulation and the keeping up of a flow of water to the tube plate has been increased in difficulty; and the precise arrangement of the tubes, so as to leave ample room for the feed of water down the spaces of the firebox, is of great importance. Experiments have shown, however, that the exact direction of circulation may be entirely changed by altered firing.

Experience of long tubes has been quite satisfactory, and if the diameter is not too great they enable the boiler to be forced without bad effect.

After all the main noticeable point in present-day designs is the recognition of the fact that plenty of boiler power is more likely to solve the working problem than increased size of cylinders.

TREATMENT OF GOODS TRAFFIC: TRANSHIPPING.—The establishment of a central Transhipping Shed at Crewe on the L.N.W.R. seems to have been a marked success. Stations which cannot make up through loads send their consignments to Crewe, whence they are forwarded in loads combined so as to save haulage. The effect is generally to substitute one transhipment and a two days transit in the case of small lots for a number of transhipments with corresponding delays and damages.

In connection with the transhipping a system of bonus payment of men according to the amount of goods handled has answered very well.

Of course the geographical situation of Crewe is the essential feature in the scheme.

March 2nd, 1906.

OPERATION OF ELECTRIC RAILWAYS DURING A SNOWSTORM.—Experiments on the New York Central Railway to ascertain the most satisfactory

arrangement of the conductor rail. There were about 13 inches of snow between the rails at the time.

Various arrangements of unprotected, hooded (rail upright), and hooded (rail inverted) third rails were compared. The inverted or under-running rail was found to give much the most satisfactory results, in all other arrangements trouble being experienced through the formation of ice.

RAILWAY EDUCATION.—Proposals for a College to improve on the haphazard methods by which railway business must be learnt. Of course, in America there are Colleges for most things, from advertisement writing to locomotive firing (this last by correspondence).

The list of "Subjects of the Curriculum" is however interesting, particularly perhaps to R.E. officers who have to do with railway matters. It comprises:—railway Construction, Maintenance of Way, Economic Theory of railway Location, railway Terminals, Plans and Specifications of railway structures of all kinds, railway Accounting, Station Returns, the construction and use of railway Statistics, Organization, handling of Traffic (Freight and Passenger), Signalling and Train Service, Motive Power equipment, Car equipment, Ratemaking, Government Control of railways, Passenger Department, Freight Department, railway Finance, Telegraphy, Corporation Law in its relation to railways, Railway Liability, Law of Carriers.

C. E. VICKERS.

RIVISTA DI ARTIGLIERIA E GENIO.

February, 1906.

THE BATTLE OF MUKDEN.—Capitano d'Artiglierio Giannitrapani contributes an excellent description, illustrated with photographs and with maps on a scale of 1 : 168,000.

According to the most reliable information obtainable the complete list of the losses sustained by the Russians during the entire period of the battle, viz., between the 21st February and the 11th March, amounted to 96,500 men. This figure is indeed enormous, and if our calculations have a foundation of truth it amounts to about one-third of the effective forces engaged. The losses are subdivided in the official documents as follows:—

Officers	Killed and prisoners	...	645
	Wounded and sick...	...	1,812
	Total	...	2,457
Men	Killed ...	...	14,000
	Wounded	...	56,000
	Sick ...	...	5,000
	Prisoners	...	19,000
	Total	...	94,000

The total of prisoners, which is considerably less than in the exaggerated list published shortly after the battle, includes about 2,000 sick and wounded who were found in hospital at Mukden.

Thus the Russians left about 17,000 men in the hands of the enemy, and of this total about 15,000 were made prisoners on the 10th and 11th March, but especially on the 10th, from the rear guards of the 2nd and 3rd Army Corps.

The captures of war material made by the Japanese were less important. Thanks to the early removal of their heavy artillery only 58 pieces of field artillery were lost by the Russians. The large magazines for provisions and forage around Mukden were as far as was possible destroyed by fire. According to official reports the Japanese captured at Mukden 60,000 rifles, 150 ammunition carriages, 200,000 artillery projectiles, 25 millions of cartridges, 2,000 horses, 23 carriages with topographical maps, 1,000 carriages containing clothing, and a large quantity of railway material for the field railways.

Regarding the losses of the Japanese a complete list is not yet known, nor their distribution. The list given amounts to 41,000 men, and represents about one-eighth of the forces engaged at the commencement of the battle. In comparing the losses sustained by the two combatants it is necessary to bear in mind that the Russians appear always to have maintained the strength of their units during the battle, replacing the gaps from time to time with troops moved forwards from the regimental depôts which were in the theatre of war.

When we compare the losses suffered by the Russians at Mukden with those sustained in former battles of anything approaching the same scale, we become convinced that although Mukden may exceed the registers of history in the numbers engaged, in the extension of the fronts, and in duration, it certainly does not exceed them in actual losses. At Sedan the French losses—only during the battle—amounted to about one-third of the effectives; and that battle was decided in a few hours, whilst the combats around Mukden lasted 18 days.

An examination of these lists confirms previous notions regarding the number of losses by death and wounds in modern battles in contrast with the always increasing efficiency of cannon and rifles. Tactics are changed contemporaneously with armaments. The objects of the changes are to mitigate the effect of exposure to an enemy's weapons by appropriate formations, by utilization of the cover offered by the ground, by the avoidance of frontal attacks as far as possible, and by the systematic use of field fortifications.

The series of military operations which have passed into history under the name of the Battle of Mukden affords copious information of every kind; and although documents and particulars are still wanting, the history of the battle will present for a long time a profound tactical and technical study. Besides its military result in placing the enemy's army out of action for some time and delivering a great territory, the battle was of great political importance. For nearly all the yellow races it consecrated the defeat of Russian influence in Asia; and for the Chinese, the capture of Mukden, the holy city, the cradle of its dynasty, was a deliverance from a barbarous invasion.

On the 20th March Marshal Oyama, after a triumphal march through Mukden, handed over the city to the Chinese magistrates; and by this act of rare courtesy showed that the Japanese were equally valiant warriors and able politicians.

TO THE NORTH POLE BY DIRIGIBLE BALLOON.—The idea of reaching the North Pole by balloon, which seemed to have been abandoned after the unfortunate issue of the André expedition, has now been renewed by the American explorer and journalist Wellman.

Mr. Wellman is known in connection with two Arctic expeditions, carried out by ordinary methods, which were fertile in noteworthy results. He passed two summers and one winter in the 80th parallel of north latitude and in 1899 succeeded in reaching the 82nd parallel. Well acquainted with the meteorology and climatic conditions of the boreal regions, and with matters of importance for the enterprise, he communicated his ideas to the *Chicago Record Herald* and to a group of American gentlemen with a taste for scientific questions.

In its main lines Wellman's project may be stated thus: to travel in the ordinary way *viâ* Spitzbergen and Valden Island to a point as near as possible to the North Pole, between the 80th and 81st degrees of latitude; and thence to endeavour to reach the Pole in an automobile balloon. The distance to be travelled in the balloon, going and returning, will be about 2,000 km. In event of its being found impossible for the balloon to reach so far, an automobile sledge will be used.

The principal dimensions of the balloon are in the proportion of 1 to 3, that is 16 mètres in diameter and 48 mètres in length. It will have a volume of about 6,000 cubic mètres, and will carry five persons in the car:—a pilot, a mechanician, a doctor in charge of scientific observations, a sailor, and Wellman himself.

Taking into consideration the atmospheric conditions likely to occur in July and August (the time at which the exploration would be made) and supposing the temperature to be from – 37°F. to + 37° F., the height of the clouds being from 400 to 500 mètres, the explorer intends to travel at a low altitude and consequently renounces the idea of great velocity. He would perhaps attain a velocity of 25 km. an hour with a 50 H.P. motor. In the event of this motor or the screw becoming out of order, he would be able to make use of an auxiliary motor of 25 H.P. and a small screw. The two motors and the two screws could be worked at the same time, by which means it may be possible to attain a velocity of 30 km.

Mr. Wellman's idea is to have everything ready by June, and to find himself at this time at his base of operations where he also intends to instal a station of wireless telegraphy. If the preliminary trials regarding the dirigibility and the management of the apparatus should be successful he would undertake his journey towards the Pole during this summer; otherwise, profiting by the experience acquired, he would work at the necessary modifications during the winter and postpone the expedition to the following year.

E. T. THACKERAY.

CORRESPONDENCE.

ORGANIZATION OF R.E. UNITS FOR EMPLOYMENT WITH CAVALRY.

DEAR SIR,

In my article on the above subject in the February number of the *R.E. Journal* there are two misprints which I should like to correct.

(1). The title of the photo should read "Tool Wagon" instead of "Double Tool Cart." The vehicle consists of a limber and a wagon, and it does not split into singles.

(2). On page 86, in the summary for a Squadron, R.E., the "Horses, Riding," should read 10, 6, and 48 instead of 10, 8, and 66.

On reconsideration I have to suggest that each Troop should have 2 more riding horses, namely 1 for the S. & C. Smith (Farrier) and 1 for a Draught Branch N.C.O., so as to have the Troop intact with 24 horses, or 3 Sections of 8, which would admit of a Section being detached as such for work with each Cavalry Regiment of the Brigade (see first para. of page 87).

This alteration would give a 'Higher Establishment' Squadron 58 riding horses for the rank and file and a 'Lower Establishment' one 32, and would produce a total under that head in the last para. of the article of 122 "Horses, Riding."

Yours sincerely,

C. DE W. CROOKSHANK,

Capt., R.E.

Pretoria, 25. 2. 06.

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Scale 1 Inch = 100 Miles approx.

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	Miles.
Kabul to Herat	490
" Peshawar	195
" Thal	160
" Kandahar	310
" Termez, viâ Bamian	340
Herat to Meshed	200
" Kushk Post	80
Kandahar to Chaman	70
" Sukkur	420
" Ghazni	220
" Herat, viâ Farah	410
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" Dehra Ismail Khan, viâ Gomal P.	285
Perovsk to Orenburg	600
" Tashkend	365
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Samarkand to Termez	270
Charjui to "	200
Moscow to Baku	1,200
Baku to Krasnovodsk	210
Krasnovodsk to Merv	580
Khiva to Merv	300
Merv to Kushk Post	175
Baroghil P. to Peshawar	320
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" viâ Bikanir	1,350
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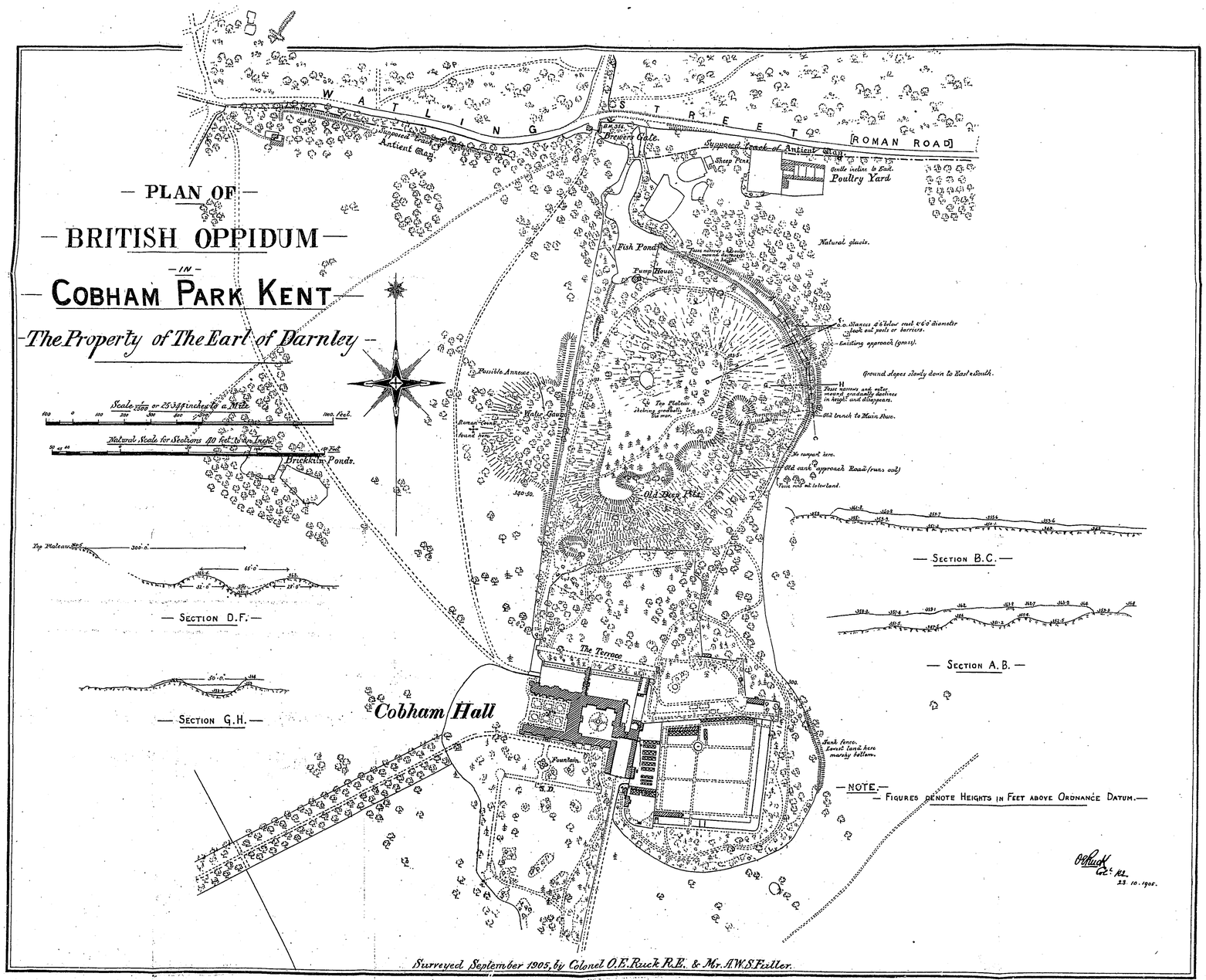

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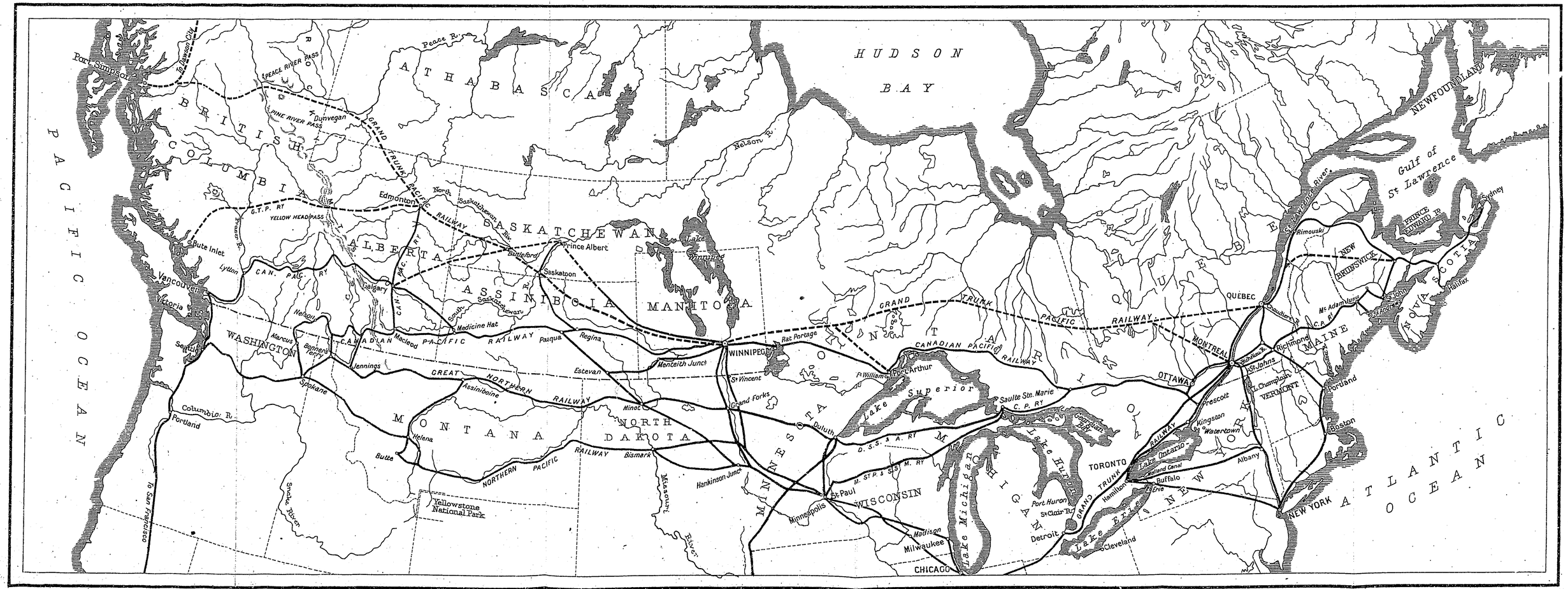

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