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ERRATA.

In order to remedy a compositor's error, the following corrections should be made in the article on *The Influence of Rate on Accuracy of Fire*, published in the June number :—

Page 421, last para., for "feet" substitute the symbol for minutes of arc.
„ 422, first two paras., do. do.

The paragraphs between conclusion 3 and the subhead 'Conduct of Trials' on p. 423 should be read as a footnote.

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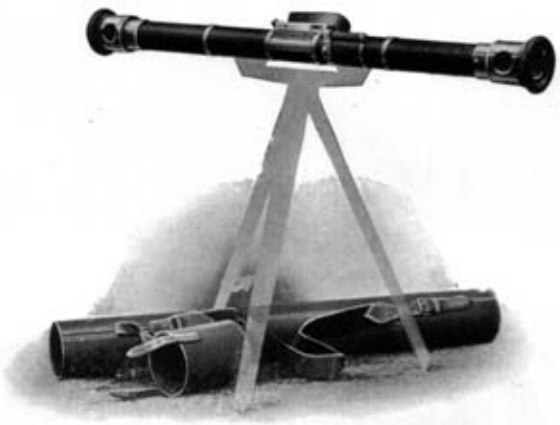


BARR AND STROUD RANGEFINDER, F.Q. TYPE, "INFANTRY," 1 METRE BASE.
FOR USE WITH INFANTRY, CAVALRY, AND MACHINE GUNS.

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

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

Approximate uncertainty of observation:—

5 yards at 1,000 yards.
40 yards at 3,000 yards.
170 yards at 6,000 yards.

Barr & Stroud Rangefinder

SHED FOR DIRIGIBLE BALLOON AT ALDERSHOT.

Showing doors being hoisted into position.

BALLOON AT ALDERSHOT

*SHED FOR DIRIGIBLE BALLOON AT ALDERSHOT.**

THIS building, designed under the supervision of Capt. T. H. Cochrane, M.V.O., R.E., Inspector of Iron Structures, presents several features of interest from an engineering point of view, specially the main doors, which are believed to be the largest in the world.

The photos show the general arrangement of the building, which is constructed of steel framing covered with corrugated galvanised iron sheeting, that on the roofs being 18 S.W. gauge thick and the remainder 22 gauge.

The following are the leading dimensions of the building:—

Total length	160 feet.
„ width	82 „
„ height at ridge	72 „ 4 in.
Width of centre span, in clear	42 „
Height „ „ at eaves	58 „
Do. under tie rod	64 „
Height to eaves of side roofs	22 „
Dimensions of main doorway	32 ft. wide, 64 ft. high.
Cubic capacity of building, measured from floor to ridge, and inside the sheeting	605,500 cub. ft.
Weight of steelwork in framing, exclusive of main doors	146 tons.
Weight of sheeting exclusive of main doors ...	31 „
Total	177 tons.
Weight of main doors including sheeting and guides, about	22·75 tons.
Cost of building, exclusive of foundations and of main doors, but including erection, glazing, small doors, etc.	£2,475.
Cost of main doors, including their guides and erection	£562.
Cost of building per cubic foot, excluding foundations and main doors	0·98 pence.
Do. including main doors but not foundations	1·18 „
Cost of framework and sheeting of building erected complete, exclusive of foundations	£14 per ton.

* Communicated by the Director of Fortifications and Works.

These prices cannot safely be taken as a guide for similar work in future; the contracts were entered into when the cost of steelwork was very low, and it is moreover believed that the contractors lost upon the work.

GENERAL DESCRIPTION OF BUILDING.

The centre span of the building is carried by rolled stanchions $14'' \times 6'' \times 46$ lbs., spaced $43'\ 2''$ apart across the building, and $12'\ 6''$ apart longitudinally, and each in one length of 44 feet. The trusses for the main roof are formed of $4'' \times 4'' \times \frac{7}{16}''$ T rafters and ties, lattice braced with $3'' \times 3'' \times \frac{3}{8}''$ and $2\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{3}{8}''$ steel angle diagonals. These trusses are bolted to the tops of the stanchions, the tie bars being curved to a radius of 21 feet, and the spandrels carried up vertically $14'\ 10''$, thus giving 64 ft. clear height in the centre and $57'\ 10''$ height at the eaves.

Each side roof forms a lean-to to the centre span, and is carried by inclined lattice girders, formed of $4'' \times 4'' \times \frac{3}{8}''$ steel T top and bottom flanges with $2\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{5}{16}''$ steel angle diagonals. These girders are fixed at the upper ends to the main stanchions at a height of 35 ft. from the floor, their lower ends being carried by $12'' \times 5'' \times 32$ lbs. H stanchions 24 feet long. The $12'' \times 5''$ stanchions are stayed at their upper ends by raking braces, formed of $10'' \times 4\frac{1}{2}'' \times 30$ lbs. rolled steel joists, which are carried out 14 ft. on either side of the building, their lower ends being secured to heavy anchorages buried in the ground. (The cost of these anchorages, which were provided by the War Department, is not included in the figures given above).

A wind pressure of 50 lbs. per square foot was allowed for in designing the building, and with this the total horizontal pressure on a $12'\ 6''$ 'bay' of the building is nearly 15 tons. A portion of this thrust—that due to the horizontal pressure on a main roof—is assumed to be transmitted by the roof truss to the stanchion on the lee side; the remainder is calculated to be exerted against the raking braces referred to above and their anchorages. The tension on each brace is then about 26 tons and the vertical pull on its anchorage about 20 tons.

One end of the centre span of the building is finished in the form of a six-sided apse, with a view to economising material and also to stiffening the building longitudinally.

Longitudinal stiffeners, formed of $7'' \times 3\frac{3}{4}'' \times 18$ lbs. steel joists, are fixed between the main stanchions at two points in their height.

The sheeting on the roofs is carried by angle steel purlins $4'' \times 2'' \times \frac{3}{8}''$, that on the sides being fixed to $5'' \times 3'' \times \frac{3}{8}''$ steel angle stringers. Both purlins and stringers are secured by angle cleats.

The building is lighted by 16 windows, $12' \times 5'$, on each side and by 8 in the end opposite the main doors.

MAIN DOORS.

These doors (see *Plates*) when open leave a clear space of 32 ft. wide and 64 ft. high; each door closes one half of the opening.

Owing to their great size some difficulty was experienced in preparing the design, and several schemes—including folding doors of various types, and doors on the revolving shutter principle—were considered; but on any of these plans the cost of the doors themselves and of the structure to carry them would have been excessive. Eventually simple sliding doors were resorted to, and these have worked out very satisfactorily.

Each door is 63′ 11½″ high, 16′ 1″ wide, and weighs 8½ tons. Allowing for a wind pressure of 50 lbs. per square foot, the total pressure on each door is arranged for thus:—A vertical steel girder, 2′ 6″ in greatest depth, is carried down the centre from top to bottom, and this girder is made of sufficient strength to withstand the whole wind pressure on the door. Three horizontal girders are fixed at equal distances on either side of the centre girder, and act as cantilevers to support the light frames running along the two vertical edges of the door. Intermediate steel angle stringers are inserted to carry the sheeting, and diagonal braces are fixed to keep the framework square.

The central girder and the two edge frames are connected to a box girder at the bottom, in which are the bearings of the axles of two double-flanged wheels which carry the whole weight. These axles are fitted with vertical capstan heads, in which bars can be inserted for moving the door horizontally. The bottom wheels run on a girder rail having an angle riveted on the outside, and two clips fitted to the bottom of the box girder prevent any possibility of the door lifting should its horizontal movement be suddenly checked. (See *Fig.* 2, *Plate* II.).

The head of the door is fitted with three horizontal rollers, one attached to the central girder, and the others near the outer ends. These top rollers are guided in a channel formed on the underside of a heavy lintel girder, which is carried across the doorway and extends to 25 ft. on either side of the centre; the overhanging ends are stayed to the main framing.

As shown in the general elevation in *Fig.* 1, *Plate* II., when the doors are open their further edges extend about 10 feet horizontally beyond the upper part of the building. It would have been both costly and unsightly to carry the top guide so far; but, by placing the main girder of each door in the centre, it was possible to greatly reduce the overhang of the guide, the centre roller and the one on the inner edge sufficing to steady the door when open.

The doors are sheeted on the outside with corrugated iron No. 22 gauge.

The doors were built up horizontally face upwards on timbers laid on the ground, and were then each hoisted into position by means of tackles as fully explained in *Plate* I. A steam winch and portable boiler were used to provide power for the main fall. The operation of building the doors on the ground and preparing the tackle, etc., extended over some weeks. The actual hauling into position occupied only twenty-five minutes per half door. The photos show the doors in process of hoisting. The top guide was not fixed until after both doors had been got into position.

Since the doors have been erected they have been exposed to severe gales without damage, and they run so easily that each door can be moved by one man.

*COMMUNICATION SERVICES.**

By Bt. Lt.-Col. Sir E. Percy C. Girouard, k.c.m.g., d.s.o., R.E.

"Sitting on the Lines of Communication" is an expression not infrequently heard in our army—a term carrying with it the covert suggestion that these duties involve periods of long inanition and leisure, if not protracted repose.

Too often one also hears that a Campaign is a question, leaving aside Field Operations, of Supply and Transport. In the House of Commons the late Prime Minister described a war on the North-West Frontier of India as mainly a question of Supply and Transport. It would seem to me that all wars have been and will be largely dependent for success upon these services; but I would prefer to say that they would be largely dependent upon the efficiency of Communication Services, which include the lesser Supply and Transport services.

To those who have sat upon Communications the task has neither appeared nor proved a light one; it has too often been a thankless duty; nor has it always carried with it due recognition of services well executed. The more appealing and striking employment with Troops in the Field too frequently overshadows these services, which are so vital to the eventual success of great Field Operations and Campaigns.

The want of knowledge displayed upon Communication Services in the Field must be largely attributed to the fact that our army organization in peace makes but little provision for the organization of Communication Services as a whole, or for imparting to the staff and troops even a general knowledge as to their working in war.

Communications in war begin at our very Home bases of supply; they may cross seas, and include:—

Sea-transport, disembarkation, and the establishment of bases,
The protection of long lines of rail or road or canal,
The administration of martial law,
The governance of conquered territories,
The technical working of railways, waterways, roads, animal transport, telegraphs, posts, hospitals,
The distribution of supplies and stores,
The maintenance of remounts.

* Lecture delivered to the officers of the 2nd Division, Aldershot Army Corps, March, 1906.

In fact they cover every technical and administrative function up to the advanced bases of the Field Armies, with the superimposed duties of military governance and protection.

From a common base of supply, *i.e.*, the efficiency of the home organization, through these communications flow the men, the food, the warlike stores, the equipment, which go to make a conflict possible. Restrict any of these concomitants of war, and you at once correspondingly affect the value of the Army in the Field; paralyse any one of them, and failure is in sight.

Given, however, a sufficient and uninterrupted flow, the fighting force will depend for its success, as it rightly should, upon its purely fighting merits, the morale and training of its officers and men, and its organization and equipment for war. The sufficient flow can only take place if the organization of the Home base is efficient; the uninterrupted flow if the Communications are equal to meeting every strain placed upon them.

The sufficient flow as I have stated will depend upon the efficiency of Home or War Office organization. This is a matter which vitally affects the whole success of warlike operations, and there is one aspect of it which needs consideration before actually taking up a study of Communications in the Field. Leaving aside the question of the supply of men, for this depends finally upon the male population, I should like to draw your attention for one moment to the other elements of Supply which make war practicable—the sufficiency of supply in stores, equipment, food, and animals, all equally necessary to the progress of the Field Armies.

In one respect our South African War compared more than favourably in efficiency with any other. The army was well fed and well clothed; its reserves of warlike stores maintained; and, considering the distance and the final preponderance of mounted troops in the field, it was well horsed. But in allotting credit for this great achievement I think a primary error of judgment was made by the Army generally in assuming that these facts were due entirely to the endeavours of the departments who administrated for these wants in South Africa. Such was not the case.

I do not wish to detract from any of the great departmental services rendered in South Africa, but in any true appreciation of the working of Communications it is imperative to allot to these services their legitimate value. The departments in South Africa were distributing not producing departments. Their successful management is all the more to their credit, considering how under-manned and in some cases inexperienced many of their staff necessarily were.

But their success must not be confused so as to include other factors which were vital to it but not in their control. It depended upon the primary success of the sea, rail, and road transport; but more particularly upon the organization that obtained from all over the

world stores and animals which these departments eventually distributed to the army in South Africa, in fact the organization which ensured, or tried to ensure, a sufficient flow of supplies.

The problem of Supply in South Africa itself thus became a matter of demanding in good time, from the War Office, a sufficiency of stores and animals for delivery at coast ports and of the distribution of these stores and animals to the various selected depôts throughout the theatre of war. The task confronting the authorities at the War Office was more complex, as to their lot fell the duty of acquiring and delivering in South African ports the stores and animals for distribution.

The difficulty experienced by the War Department in providing stores during the early stages of the war is too well known to require reiteration; but too much stress cannot be placed on the necessity for laying down adequate reserves in peace time, so as to enable the Department to tide over the initial phases of a great campaign.

Prior to the Boer War, stores for three Army Corps were authorized. Within these limits troops were equipped and despatched over-sea with commendable regularity and with an entire absence of friction.

The trouble came when forces beyond the authorized Army Corps were hastily called out. There were men in plenty forthcoming; but stores, supplies, and equipment had to be got at short notice from "the Trade."

During such an emergency the post of Director of Army Contracts was no sinecure. His is the purchasing department at the War Office for all army stores, the military departments at the War Office merely indenting on him for their requirements.

Requisitions, marked urgent, for engineer, ordnance, medical, and Army Service Corps stores poured into the Contracts Branch for immediate delivery. It soon became painfully evident that "the Trade," on whom the Contracts Branch relied for stores, were incapable of delivering the quantities demanded unless granted time, which the military departments were not prepared to concede. To tide over this difficulty military stocks from over-sea were temporarily depleted, and orders for early delivery of stores were distributed as widely as possible among civilian firms.

In regard to the purchase of stores from merchants in the United Kingdom and the Colonies, two factors stand out with great prominence:—

(1) That the stocks ordinarily available on an emergency are extremely limited, and

(2) That merchants and manufacturers require time in which to meet sudden and large demands and to procure additional personnel for their business.

"The Trade" in England is very elastic and very enterprising, and when a campaign has been in progress some months it can readily

meet the demands of the army. But it is in the initial stages of war that the difficulty arises. As time is an all-important factor in the warfare of to-day, the question of our unpreparedness in the matter of stores during the early stages of the Boer War cannot be too prominently borne in mind.

Another point it may be desirable to touch upon is the difficulty experienced in regard to the efficient inspection of supplies purchased over-sea for direct delivery in South Africa.

Supplies obtained from Canada, Australia, etc., were only too frequently rejected at Cape ports as being unfit for issue; and it is a question whether the authorities in these Colonies should not be asked to train their military officers during peace time to inspect and pass (prior to despatch from the country) supplies sent over-sea for the Imperial Forces during war. To leave this duty to a civilian, locally engaged and paid an inadequate salary, is to court disaster.

The provision of horses and mules was perhaps more difficult at the outset than any other supply service. Here the sources of supply were mainly thousands of miles away from both England and South Africa. The provision of animals for the mobilization of the force originally detailed for Field Operations was estimated to take at least three months in execution. Financial and diplomatic reasons dictated that no purchases should be made one moment earlier than was necessary (in point of fact purchase began the day war was declared).

It would therefore appear that, unless we are permitted to take time by the forelock or else resort to requisitioning in England, the provision of horses will inevitably delay for many months the field operations of any army proceeding over-sea.

Here then were perhaps the weakest and most dangerous factors in the provision of a sufficient flow of the 'sinews of war.' Their strength for another campaign will probably be enhanced by the vast experience gained. The credit accorded was not perhaps commensurate with the work effected. With those who kept the supply and remount services at headquarters going in such a way that the wants of 200,000 men were met must remain the greater part of the credit for saving the situation. Yet I doubt if any of us even know who they were, or where they were.

If the warlike operations are taking place in a distant country the provision of Sea-Transport becomes necessary. This duty devolves upon the Admiralty and has usually been admirably executed. It is not intended in this paper to further mention it, except in one respect.

For this service vessels from various outside sources are taken up as troop or store ships. To secure regularity in embarkation and disembarkation and the prompt loading and unloading of stores—in fact to ensure the best value being obtained from the sea-transport—Naval Transport Officers are stationed at all ports concerned in the

operations. These officers, whatever their rank, have absolute discretion in the technical working of their service, and cannot be over-ruled by military officers of any rank, except under very exceptional circumstances. The *King's Regulations* tells us that—

> "When there is a Naval Transport Officer on board, he is the medium of communication between the Officer Commanding and the Master of the Vessel, but he has no direct authority over officers or troops. As the Representative of the Admiralty his concurrence should be obtained in all arrangements made other than those which are purely military.
>
> The Commanding Officer should assist him in carrying out the duties imposed upon him by the 'Instructions for Officers for Transport Service.'"

The Naval Transport Officer is thus the intermediary between the army and the civil sea-transport service and staff. His duties are in a measure analogous with those of the Land-Transport Officer, *i.e.* the Railway Staff Officer, who should be the intermediary between the army and the civil technical staff of any railways utilized in operations, and who should thus secure the efficiency in railway working or Land-Transport which the Naval Transport Officer is designed to produce in the much simpler problem of sea-transport.

Now we arrive at what we have usually had to consider as communication services in the British army—namely those concerning operations abroad, or Communications in the Field.

The duties are manifold, but are susceptible of division into two great sections :—

1st. The Technical working of Communications.

2nd. The Military organization and protection of Communications.

Under technical services are to be included :—

(1). The Supply Services :—
- (i.). Supply of Foodstuffs.
- (ii.). „ warlike Stores.

(2). The Transport Services :—
- (iii.). Animal Transport.
- (iv.). Railways and Waterways.
- (v.). Remounts.

(3). Transmission of Correspondence :—
- (vi.). Posts.
- (vii.). Telegraphs.

(4). The Medical and Veterinary Services, and finally

(5). The Accounting and Audit Services.

The Supply Services will be, as previously pointed out, mainly distributing departments. Their success is dependent on the efficiency of the Transport Services and on the completeness of their own internal organization. Their principal duty is the establishment, at convenient places upon the chosen Lines of Communication, of Depôts from whence the Field Army and the Communication Troops can be fed.

Of all communication services, technical or military, probably the Transport Services are the most important for the success of a campaign.

As pointed out the main difficulties of the Supply question are those which take place at the Home bases. Thereafter the success of these services depends almost entirely upon the success of Sea and Land Transport. The Sea-Transport has been considered, and has never for our nation proved a difficult one. It has, however, frequently been otherwise with our Land-Transport, the real backbone of communications, the life of the operating forces who feed from its advanced or other bases.

Whether using wheeled or pack transport as in India, boats as on the Nile in 1885, canoes as on the Red River, or carriers as in West Africa—it was the weakest point in the Transport Service which told the most in all endeavours of these campaigns.

Every effort had rightly to be directed to giving the main line of Transport on Communications the highest efficiency, for upon it depended the life of every department of the operating army. To interfere with it, except for grave military reasons, or to make it subserve local military requirements, had the inevitable result of dangerously affecting its general value.

In South Africa the great backbone of communications was the Rail Transport service. It was the first time in our history that such had been the case. In Egypt in 1885 rails had been used as an adjunct, but there the backbone was whale boats and camel transport. In Egypt in 1896 railways were constructed and the campaign was made dependent upon their actual progress of construction.

South Africa was the first of our wars in which existing railways were entirely used as the backbone of communications, and this too with a force of greater numbers than any we had previously put in the field and operating over a greater extent of country than in any previous campaign. Upon the uninterrupted flow of men, stores, supplies, and animals along these main lines of transport was to depend the ultimate success of the operations. Everything pointed to the necessity of adopting every measure to secure the best working results from the railways.

In all Continental countries there are elaborate regulations for the use of railways in war, whereby the Technical Working Staff are in war entirely withdrawn from direct dealings with the army. An

intermediary Military Staff is formed, not as technical railway workers but as protectors to the technical staff who are naturally unversed in army organization. The necessity for such a Military Staff had been clearly rendered imperative as a result of the Franco-German War, when its non-existence on the French railway lines led to complete paralysis of railway working from Paris to the frontier within one month of the declaration of war; the Civil railway authorities had within that time become completely disorganized by the vast number of contradictory orders received from the War Minister, the Departments of the Army, and the Commanders in the Field; there was no central Military controlling body, such as the Germans had, to collate the demands of the War Department and the Generals; all worked at cross-purposes; and the railways consequently failed to guarantee the uninterrupted flow necessary for the supply of the army.

When the South African War broke out no such regulations existed in the British army organization. We had, indeed, laid down in our *Queen's Regulations* certain duties for (so called) Railway Staff Officers, duties concerned mainly with the discipline necessary for the entrainment and detrainment of troops, etc., at a particular station. But there were no regulations dealing with railways as a whole, in order to secure the best working results throughout their mileage.

Regulations and an organization were perforce improvised. By the majority of troops who came in contact with it this organization was but imperfectly understood, and certainly very little appreciated; its workings were presented to them by the acts, officious or otherwise, of a body of 160 Railway Staff Officers, whose function appeared to many to be merely obstruction to particular wishes. To those, however, who had organized the various railway lines in such a way that its best working could be ensured, the efforts of these Staff Officers meant the assurance, under very great difficulties, of the supply of the army throughout South Africa for three years.

Compare these duties with Sea-Transport. A ship laden with 1,000 men or with army stores leaves Southampton for a journey to Cape Town. A Sea-Transport Staff Officer directs embarkation and disembarkation. Whatever his Naval rank, can you call to recollection any desire upon the part of the troops to disobey his commands? Supposing that ship during its journey to stop at ports five miles apart, and to be frequently subjected to constant delays and interruptions. How long would it take to disorganize such a service?

A Railway service is infinitely more subject to disorganization than Sea-Transport. A railway train, unlike the ship, must adhere to a line of steel rails. If in its progress the Railway Staff Officers are looked upon as intolerable nuisances of junior rank, what must be the result in rail efficiency? If the store-ships were invariably retained as store-houses when they arrived at the bases, how long could the

British Mercantile Marine hold out? Yet how frequently were train loads of supplies, stores, or ammunition, held up for days, weeks, and I will say even months, loaded with stores. Yet unlike the Marine, these were the Railways' only ships; there were no others to hire.

To accentuate the difficulty of working in South Africa the railway service did not, as is the case with foreign organizations, have one great General of Communications to look to for orders; they had at one time no less than fourteen.

I have heard officers with much staff experience doubt the utility of the Railway Staff Officer and the controlling Staff behind him who did their best to secure an uninterrupted flow along the backbone of communications. These officers have said, "Why not allow the Army to deal directly with the Civil or Technical railway Staff?" They can have given no thought to Continental experience and disasters. They cannot even have allowed their thoughts to rest upon that far simpler problem Sea-Transport.

The Civil Technical Staff upon Railways in war require every moment of their time to devote to ensuring the technical working. Their want of knowledge in army organization, their very status as camp followers, precludes any possibility of their being enabled to devote themselves to anything but their technical duties.

Since the South African War the necessity of regulating railways for military use has been legislated for. Elaborate regulations have been prepared, and it will be to the thorough knowledge of and obedience to these that we must look for much of the success of railway working on a large scale in any future campaign abroad dependent on this form of transport.

The other technical duties upon Communications in the Field I do not propose to dilate upon. Remounts is the remaining transport question, and here it is again mainly a question of organization for distribution.

The Postal and Telegraph sections frequently involve a loyal co-operation and working with the existing civil organizations and the railways. Such co-ordination would appear to have been particularly successful in South Africa.

The Medical Service I leave to wiser heads than my own, except in one particular where they at one time seriously encroached upon railway efficiency in South Africa, viz., the weight per bed allowed for Station Hospitals. It is not my intention in any way to attempt to say what this should be, but the divergence which existed in South Africa demands attention. The ordinary Army Hospital required about one ton per bed, but many of the Special Hospitals from three to even ten tons, surely an unreasonable latitude and one which was bound to produce ultimate comparisons between the values of hospital accommodation.

The Accounts Services on communications do not openly affect the

army generally, but to officers who have control of great spending departments their efficient organization is of vital importance. In South Africa general audit may have been present, detailed audit and review of contracts were conspicuous by their absence. This is now I believe remedied to a large extent. A proper system of audit in the Field will be appreciated by the supply and spending departments, as the greatest safeguard to themselves at the time and as a protection against the inevitable outcries which arise subsequently, when in the light of every-day practice it is difficult and sometimes impossible to justify expenditure only too necessary in time of war. Provided therefore that audit does not hinder military efficiency, its own efficient working in war must be welcomed as a valuable ally.

Having sketched the duties and relative importance of the Technical organization of communications services, I now propose to turn to the Military organization which renders these services capable of collectively doing their best for the Field Armies.

The primary necessity in communication organization is that there should be one supreme head, and that his headquarters should be placed as close as possible to the Generalissimo of the Armies. It is not necessary for the communication head to be present by the side of the generalissimo when the latter is actually in the field, though there are occasions when this is desirable (such for instance as the simultaneous advances from Bloemfontein to Pretoria and Ladysmith to Standerton, when the General of Communications and his subordinate in Natal could with great advantage have been present at the fronts).

Generally speaking, when the Commander-in-Chief was actually in the Field the communications would be represented by attached Staff Officers. In any general check or halt in the operations the General of Communications, with his staff, would immediately establish himself at the headquarters of the army.

Under the General of Communications would be administered all the above-mentioned Technical Departments up to the advanced bases from whence the Field Army Transport took its supplies. The protection of these communications and the troops allotted for them, the governance of conquered territories, and the administration of Martial Law (a subject not very clearly understood) would form a second great section of his duties.

How far actual operations against an enemy acting in rear of advanced bases should be entrusted to the Communications Organization is a debatable question. Personally, as a technical soldier realizing that the success of communications must depend upon uninterrupted attention to the technical duties, I would prefer to see Communications restricted to the working and protection of communications, leaving the Field Army to detach forces to deal with any hostile body which might find its way behind the general line of operations. The

constant raids which occurred in the American Civil War and in South Africa are not usually practicable in European warfare. In South Africa, as many will remember, divided authority in dealing with raids —namely a General of Communications, a General from the Field Army, and a rather vague Colonial defence—was not productive of the best results.

Lines of Communication as an administrative department has no peace organization, nor would there appear to be any necessity for one. The necessity for an executive or thinking organization for communications is, however, patent. This is the greatest missing link in our General Staff organization. Its absence led to much confusion in South Africa; the G.O.C. Lines of Communications at a very early stage became, *nolens volens*, a glorified Base Commandant; by 1900 were to be found under the Commander-in-Chief's direct orders eight to ten G.O.C.s of Communications sitting on the lines of railway and three Military Governors administering indefinite areas; the relations of these two sets of commanders with each other and their further relations with the Field Army and the supply and transports departments were neither happy nor productive of good results.

The defect can only be attributed to a senseless adherence to regulations or ideas, which implied that the General of Communications should be at the base. If the three sea bases in Cape Colony had been confided, as they should have been, entirely to Base Commandants, and if the General of Communications had been able to establish his headquarters close to the Chief of the Staff, except when the latter was actually in the Field, it is difficult to conceive that the hybrid organization of Communications which grew up in South Africa would ever have seen the light of day.

In reality the Chief of the Staff, cut off from his proper helper the General of Communications, rapidly organized a Communications Staff within his own sphere. Here were to be found Directors of Railways, Supplies, Transport, Telegraphs, Remounts, and Medical Services.

The General of Communications should have been moved to Naauwpoort when the Commander-in-Chief took the field in February, 1900, and to Bloemfontein shortly after the Field Army arrived there in March, 1900, and fully established himself at each place. This would have solved all difficulties. He would have had with him the six Directors just mentioned.

The Chief of the Staff when in the Field would have been accompanied by attached officers of the Communications Staff, to transmit orders until the Communications again came in actual contact with Army Headquarters.

On the occupation of Pretoria the Communications Staff would have again moved forward to join Headquarters, leaving behind

them organized communications and a Military Government for the conquered Orange Free State.

At Pretoria the Natal Communications would have come into touch with those of the Cape side, and been absorbed. Subsequently the Transvaal Military Government would have been established.

On this system the Headquarters of Communications would only have separated from Army Headquarters when the latter was actually in the Field. The Commander-in-Chief and the Chief of the Staff would have been relieved of work which should never have been thrust upon them. The General of Communications, given a competent staff, would have been placed in a position to freely inspect in all directions and branches. Military governance in the conquered States and martial law throughout South Africa would have been reasonably and similarly administered. The Lines of Communications would have been adequately, but not extravagantly, protected; the technical services co-ordinated and endowed with every possible aid to success; and the uninterrupted flow of communications ensured.

SOME CONSIDERATIONS IN THE DESIGN OF FORTIFICATIONS.

By Capt. C. E. Vickers, R.E.

L'art de la fortification doit tendre à se transformer.—*Viollet-le-Duc.*

I.

To judge by recent signs and tokens, it would seem that an uneasiness is abroad as to whether the ideas on fortification current in this country are sound. That is as it should be. The art of fortification, like anything else which undergoes evolution, must be in a constant state of change; and we ought constantly to be reviewing conditions, accumulating experience, testing materials and methods of construction, comparing and attentively studying what is being done in other countries.

Naturally the great epochs of change succeed wars, for it is only the supreme test of war which can afford proof of the soundness or unsoundness of fighting methods. The recent war between Russia and Japan, then, which has seen one great siege, gives cause for some reflections on the functions and design of fortifications; and it may not be out of place to offer some remarks on the considerations which obtain in their design. It has been done before and will be done again.

The object of field fortification, we are told, is to strengthen ground so that it may be held by a comparatively limited number of defenders, and thus release a greater proportion of the army for field operations; the definition is only a partial one, but it will pass. Field defences can, however, be put at comparatively short notice where they may be wanted, for they do not take long to construct and it is always possible to add improvements if labour is available.

It is otherwise with permanent works. These are usually erected at leisure, and, in analogous manner to more hasty defences, form pivotal points to the mobile forces, to support them and give them shelter when necessary. But their positions relative to one another—and almost every detail of their arrangement—depend on considerations less ephemeral.

But in all forms of fortification work the conditions are constantly changing: the power of weapons, the calibre, striking velocity, and nature of the projectiles, and the amount of fire likely to be brought to bear in the attack all change: and as they change the design of the works must follow suit. Furthermore, and indeed this is a ruling

factor, the circumstances under which the works are likely to be used change from time to time as the policy which dictates their construction becomes altered.

Consider for a moment how national policy affects fortifications. In the first place it determines whether the forces of the State are to be used mainly for offensive or defensive purposes—who is to take the initiative in fact— ; whether fighting, when it comes, is intended to take place on foreign soil, on the sea, or at home, or in any combination of these conditions. Again, it must determine in what way the land and sea forces are to co-operate. Upon the schemes of action of the Navy depends what ports are required to be defended as bases—that is, harbours in which a fleet can lie secure for repairs, refitting, taking in supplies and men, and so on,—as coaling stations, signal stations, auxiliary bases, and so forth. Again, certain ports need to be defended in order that, during war, commerce may be protected under their guns and hostile vessels be prevented doing damage to trade. All this is but passive defence it is true; but a feeling of security is a material something worth having.

All this is apart from the question of landing hostile troops, against which of course the first line of defence must be on the sea. Thus, before even we begin to decide what armament we require at any particular place, we must have made up our minds what force is likely to attack it, how many vessels and how they are likely to be armed, how concentrated an attack they are likely to bring to bear and how long it is likely to last.

Like many other problems this one admits of numerous solutions in each case—because there are so many unknown or variable quantities—and of no proof at present. There is not a plethora of information to go by, and consequently these things have to be settled on an empirical or academic basis—occasionally influenced by the desire to bring the price within the reach of the national purse. Study has to be made of maps and charts, distances, steaming and coal capacities, foreign shipbuilding programmes, and so on, to say nothing of the information available as to hostile plans of attack.

It is only too clear that ideas on the subject of scales of attack and defence must be changeable. The distribution of a Navy like ours does not remain always the same. Alterations in the power of other navies, a change in the political kaleidoscope and a new alliance, an exchange of territory, a new ship canal—and the port which was needed as a base yesterday is to-day relegated to limbo, so far as strategy is concerned, and to-morrow comes back to its old scale of importance.

In coast defence the likelihood of attack depends in a great measure on the strength of the inducement, for the ultimate object of any fighting force must be to deal as damaging a blow as possible to its opponent and eventually to reduce him to terms. On the sea then

the object must be to destroy the hostile fleet, or to delay the return to the fighting line of any vessels once damaged. Hence dockyards are a strong temptation as objects of attack and shipbuilding ports come much within the same category.

In each case the geographical situation and the accessibility are important factors, as they go far towards determining the risk run by the attacking vessels. Whether it is worth while to risk depleting magazines in attacking a defended place is again another question, depending upon the inducement, the risk of meeting an enemy afterwards, and the possibilities of early replenishment.

Then again there is attack by light craft, either aimed at shipping or at effecting a landing to damage defences, machinery, dockgates, and so on.

The possibilities in all these directions must in fact be weighed and the probabilities deduced therefrom before the necessary scale of defence can be settled; and when the armament has been settled its siting and emplacement is the next consideration.

II.

The foregoing remarks are intended to indicate how the nature of defence works depends throughout on considerations of policy, that is certain premisses as to the nature of attack likely to be brought against them.

Now, along with any design must go dispassionate criticism of that design, if good results are to be attained; and "design" must be understood to include the general dispositions of the defence. A most effective criticism is that from the point of view of the enemy, putting oneself in his position, and examining as he would do to find the weak points where an attack would have the best chance of success.

The attack of a Fortified Region, to have any serious hope of success, must be preceded by reconnaissance, and the more thorough this is the better. Reconnaissance does not wait until war breaks out; if it did Intelligence Departments would have little to do. The collection of information about the personnel, the matériel, and the fixed defences of other nations goes on all the year round. Ergo, those other nations, as a countercheck, aim at making information as difficult to obtain as possible. All said and done, however, the intelligence about defences falls into a different category to that regarding personnel and matériel. One can do a good deal to prevent their being photographed or sketched, it is true. The defender has the disadvantage of being more or less fastened to the position he has chosen to take up, but he can impose upon the attacker a certain ignorance as to the manner in which it is occupied, in detail at least. Stratagem and deception are not entirely confined to those circumstances when armies grope for one another in a semi-obscure theatre of war.

Supposing, then, a fortress is to be reconnoitred, how is the officer or scout detailed for the purpose to put his information into assimilable *form*? It needs some salient points on which to hang.

Some of the first things which a man would seek for in reconnoitring would naturally be those points which are most prominent to view and most readily identified. In fact, it strikes one that no amount of written reports, sketches, and photographs can be as useful as an actual acquaintance with the ground. Indeed, it is not given to everyone to read plans so as to acquire from them at once a clear mental conception of the surface depicted. The artillery, too, have a fondness for good points to range on, so that a country which affords few conspicuous marks renders effective practice much more difficult to attain. It is impossible to do much good by shooting at the sea, unless there is something floating on it on which to line the sights.

III.

With lengthened ranges and smokeless powder it is evident that invisibility becomes of constantly increasing importance; and siting, shape, and exterior appearance all need more and more careful thinking out. Clearly we must from the outset endeavour to deceive the potential enemy—we neither want him to know where our works are and what they are intended to do, nor how they are arranged inside. We must not then underrate him, and we should at least give him credit for being as clever as ourselves; for as a nation we do not pride ourselves principally on being clever.

The modern heavy gun and mounting is a complicated affair. It is intended for use at very long ranges; consequently it must have an accurately determined platform and elaborate arrangements for rangefinding and direction of fire, while the telegraphic arrangements for directing the working of a fortress need much thought. The gun is practically tied to one spot, and consequently the battery in which it is placed must be defensible by infantry at close quarters. The possibility of one work being taken and used against others, or even against the objective it is designed to protect, must be foreseen and guarded against. But of course the ruling consideration is the attainment of the best field of fire.

In saying that the gun is tied to one spot I would not hastily rule out the idea of providing alternative emplacements for medium guns, connected to one another by rail, so that the gun may be transferred from the one place to another according to the exigencies of the situation. The notion does not seem to have taken practical shape up to the present, but it may be remarked that there are difficulties in devising a really satisfactory rail mounting and in ammunition supply, as well as in the organization of arrangements for rangefinding and so on. Guns mounted on rails were certainly used with a measure of success in South Africa, where the railway gauge is narrow enough.

Continental opinion as regards frontier defence seems to be turning against the idea of elaborate fixed defences and armoured gun emplacements—the cost of keeping these up cannot, indeed, be neglected,—and it may be said that every fortification work is foreordained to alteration sooner or later. It might sound easy enough to devise some sort of emplacement that would suit as a foundation to any sort of gun; but practically the foundation itself is a small component of the structure, and the accessories need a measure of remodelling with each change in the purposes they have to fulfil.

With changes in tactics and in effective ranges, to say nothing of building operations which change the face of the country, it may well happen that the line of defence changes in the course of years; the positions which were once fortified lose their importance and others must be sought. Is there any way then of cheapening our designs without sacrificing strength?

It must be borne in mind that permanent works cannot be considered as standing alone. Just as artillery on the field of battle does not operate by itself, but requires an escort and is usually used in combination with the other arms, so the permanent defences of fortresses or defended places must be supplemented by troops. The troops consist of the field army and also the garrison of the fortress itself, aided by field works and movable armament or guns of position, for which emplacements, trenches, etc., if not constructed in advance, will be prepared on the outbreak of hostilities, schemes to suit any conceivable contingency having been thought out and elaborated in peace time.

IV.

The economical design of a defence work must be of the nature of a compromise. We might conceivably legislate for the most severe form of attack, reckon to make all parts which could be reached by fire so strong or so thick that even a series of heavy shell striking in succession in the same place would not penetrate; but is this worth while? The stronger we make the work against this form of attack the more it will cost; but no purse is bottomless, and we want to do as much fortification as we can with the money we have. There is such a thing as subdivision of risk, in this case meaning more redoubts, batteries, lines, or forts constructed. Besides, it may be argued that the combination of circumstances under which a bombardment in form of one of our fortresses would take place is almost out of the range of practical politics. Let *reasonable* measures of safety and sufficient but not extravagant thicknesses of cover be the rule.

Putting aside for the moment the question of what nature of attack is to be expected, and passing over the consideration of striking forces and burst effects—some people have gone to the trouble of backing up their arguments by portentous calculations of the weight of metal

which might be launched against us per minute by a hypothetical enemy,—we ought to consider in the first place and in a general way what is the best means of preventing our works, whether mounting guns or not, from being put out of action. Obviously, the lesser the target the smaller the chance of hits. The most vulnerable objects are the guns themselves and their magazines—the personnel at all events is movable. The guns, if mounted *en barbette*, must stand above the parapet, while arrangements to shield thoroughly the guns as well as the men working them are both costly and cumbrous. The magazines may be protected by thick walls, by sinking in the ground, or by screening behind natural ground. Concealment is in fact the Key-word.

It is better to go down the hill and forego a certain amount of command than to shew against the sky-line: if there are good reasons for this in field works the reasons are so much the stronger in the case of permanent structures where there is less possibility of correcting an initial error in shape. But why should we not have dummies with intent to deceive? It has been done successfully enough with entrenchments.

Much may be done by planting trees or bushes to make screens or backgrounds and to diversify the surroundings of the gun. For instance, gorse bushes, once induced to take root, should straggle well.

Of course, in siting magazines the consideration of prompt and direct ammunition supply to the guns goes a long way towards determining their precise disposition. Still a battery is not like a ship where every inch of space has to be considered; and in a fort, just as in a field work, the natural soil, properly used, is just about as good a protection as anything. It should not be beyond the wit of man to devise a conveyor that would carry the shell or cartridges a longish way without needing much effort to work it.

The cost per foot cube of a strongly protected magazine is considerable, and what makes magazines costly is usually the amount of passage room which must be allowed in order to make the contents accessible. The entrance must also permit of the shell and cartridges being brought in conveniently in bulk. Where the store is sunk to give cover and protection an open "area" is consequently as a rule necessary; and such an "area" has to have retaining walls and a floor, all of which cost an appreciable amount in addition to the cost of the excavation itself. Now if the magazines were protected in front by natural ground or by a bank of earth, so as to be entered from terreplein level, much building work would thereby be saved. One can generally pile up a lot of earth for the same price that it costs to excavate a much smaller number of yards in rock or to put in a much smaller quantity of first-class concrete; and revetting need not be expensive. If the natural ground is compact too the less we disturb it the better.

It seems that a leading principle to be kept in mind in making designs should be the restriction of bombproof cover to those parts where it is essential to protect something. Magazines must be well covered, and must as a rule be near the guns. If only the space admits, it may be much simpler and cheaper to build up a mound of earth and put such accommodation as is to be provided for the gun detachment in the battery behind it, connected by tunnel if need be, than to sink shelters and stores in the ground with the object of making them secure. Besides, anything sunk in the ground entails so much more difficulty about drainage and ventilation. It ought not to be forgotten that condensation is best obviated by frequent change of air.

The worst of it is that a defence work once built—even if defence lines do not change—is bound to be re-armed and re-armed again as designs of guns and mountings change; and this fact cramps us greatly in devising our economies. A castellated structure, for instance, has not the plasticity—in the hands of the designer—of an earthwork, and in some places it is almost impossible to get command enough without making the structure conspicuous.

It is a pity that the nature of the base upon which a gun-carriage works cannot be standardised. If it could the whole affair might be taken out and another substituted when the time came to put in a new kind of gun. That would be less tedious than having to cut out the concrete foundations, after they have hardened and set into the ground, because the arrangement of the holding down bolts does not suit the new mounting. Moreover, new foundations take a long time to set, and during the interval we cannot do anything towards making the gun ready for action, no matter how urgent the case.

To revert to the question of invisibility: while invisibility is opposed to ostentation, its attainment needs to be borne in mind right from the time when the project is first begun till the contract is finished and the battery is handed over. We do not need regularity; irregularities are a great help to concealment; symmetry may look nice on plan, but has no particular utility any more than it would have in the plans of a field redoubt. After a land war we have become emancipated from the tyranny of the sealed pattern angular shelter trench (whose dimensions had to be learnt so that they might be checked by rule and rod). It is time that we considered whether heavier works might not follow a similar line.

Nice regular slopes have certainly a neatness such as might delight the drill sergeant's heart, but they are apt to cause the untimely revealment of the existence of a defence work. Let us reserve them for "Quakers."

The side of a mountain has a way of being rugged now and then. Let us put aside our ruler and put in wavy contours; a hollow or so would make convenient place to plant shrubs, where the blast's fiery

breath will leave them unscathed. Creepers are pretty things, and one can imagine them judiciously trained so as to take away from the grim businesslike look of a battery. We do not require it to look grim, and would much rather it resembled a common object of the seashore. What *looks* like a mouldering ruin may quite efficiently harbour modern ordnance.

Look-out posts, position-finder cells, electric light shelters, etc., may very possibly be made to masquerade as something else, and that sort of treatment is much cheaper than making them bullet-proof, particularly if we are not sure whether the missiles will be limited to bullets. Indeed, if the contents are portable, two or three bathing-box affairs are better value than one strong box.

So far it has been seen that invisibility or concealment of works is not so very difficult; but what about the guns themselves and the men who work them? It seems to be accepted that a direct firing gun, to gain sufficient rapidity of fire, must stand up above the parapet, and this implies that from some point of view or other it will show up considerably in profile. (I have left out of mention batteries of high-angle guns, as their concealment should in most places present comparatively small difficulty). The gun can be painted certainly, and that would doubtless be a satisfactory expedient enough if the sun always remained in the same place, but shadows have an awkwardly characteristic appearance. The thing then is to alter the shape so that it does not look like a gun. Dummy guns and pasteboard may yet be adjuncts not to be despised. The men manning a gun are not actually exposed so much as might seem, and only part of the detachment needs to be above the parapet line in any case. In coast defence at least fire from shrapnel need not be expected. Here again the main thing is concealment from view. Even if the battery has been identified it will discourage the enemy from wasting ammunition if he cannot see what to aim at.

We have not considered high-angle batteries. Well, the concealment of such works should be simple, and when concealment has been attained the risk of being hit is correspondingly diminished. Why then go to great expense in providing bombproof cover in such places against the chance of a shot? It is like the anklets worn by the White Knight's horse, which were doubtless very efficient against the bites of sharks. A high-angle battery, concealed behind rising ground, needs only light buildings for the ammunition and stores and adequate foundations for the mountings. Of course the mounting is apt to be rather more elaborate than a direct fire one, and that would involve more "works" cost also, but generally speaking batteries for indirect fire ought to be cheap.

Armoured concrete as a method of construction should without doubt afford a means of effecting large economies. In the first place, where stresses or shocks have to be borne, it will be possible to build

the concrete in any convenient shape, rounding off the waste space of corners, for instance, and gaining additional strength there. Where buildings have to be kept low a thin armoured slab makes a very advantageous roof. Simplicity should be remembered, however, or centring may prove costly. With armoured concrete the necessity to use compact masses is no longer what it was. For instance, now that cracking need no longer be feared, foundations for gun mountings can be spread out, so utilising the weight of the concrete to greater advantage; and it is worth remembering that a comparatively thin slab of concrete will set much more rapidly than a large lump, of which the heart remains green for a considerable period, during which any great shock might cause distortion and consequent upset of levels. It even seems worth considering whether some skeleton system, to embrace and utilise the weight of a mass of earth, might not be devised.

Facility in putting in the foundation might be a considerable gain when time is of importance; and, after all, if the gun be mounted, it may be possible to devise some protection for the ammunition afterwards, when it is a case of extemporising a battery. It will be remembered that the Japanese used heavy howitzers on concrete block foundations at the siege of Port Arthur.

Occasionally roofs are required to be thick to guard against fire from above, while the walls can be protected by the natural ground or by earth. Here again armoured concrete can be employed to advantage, particularly as binding the whole structure into one mass.

In walls, roofs, etc., liable to attack, though little reliable information on the subject is available, it seems reasonable to suppose that, as the armouring can be devised so as to brace the mass together, it will minimize and localize the effect of an explosion. With unarmoured concrete, on the other hand, the actual weight of the mass, when disintegrated by a violent blow, may lead to its downfall.

Revetment walls must almost necessarily occur in many defence works. It is in such places that armoured concrete particularly lends its aid towards the reduction of cost; for a revetment wall on this system can easily be designed so as to have a flat foot upon which the weight of the superincumbent earth may rest, and this can be tied by ribs to the front face, each portion or panel being made only just thick enough to resist deformation, as the upsetting moment is balanced without difficulty.

There is a great deal more to be said about economy in design, as those who have had more experience than the writer are well aware, but one may perhaps venture to put forth suggestions in the hope that they may bear fruit some day.

THE NATION AND THE MILITARY SPIRIT.

By 'BUSHIDO.'

"Peace is the dream of the wise; war is the history of man."—*Segar.*

SIR IAN HAMILTON would probably re-write this, saying "Peace is the dream of the decadent"—and perhaps he would be right.

May it not be that we have suffered too long in England from false ideas and mistaken ideals, generated from the fallacy that peace in itself is an unmixed blessing and that war, in the words of General Sherman, is "Hell"?

This question is so admirably argued in the first chapter of *A Staff Officer's Scrap Book* that it would be a work of supererogation to discuss it further here. We may assume that the Darwinian theory as to the survival of the fittest is as true of nations as it is of individuals, and that the fittest nation is the one that is best able to hold its own on the battlefield. The fighting instinct, denounced by theorists of the "peace at any price" school as barbarous and uncivilised, is really, when properly controlled and directed, an invaluable national asset; an asset to be fostered and encouraged, and one that, when allied with its complementary virtue of patriotism, will ever bring forth great and lasting results.

"From the nursery and its toys to the Sunday School and its Cadet Company every influence of affection, loyalty, tradition, and education should be brought to bear on the next generation of British boys and girls, so as deeply to impress upon their young minds a feeling of reverence and admiration for the patriotic spirit of their ancestors." (Ian Hamilton).

It must never be forgotten that, though the English have been called a "Nation of Shopkeepers," and though it has been a pursuit of trade through many generations that has made them the leading commercial power of the world, yet it is not by commerce but by the triumphs of her land and sea forces in thousands of fights against every kind of enemy that the British Empire has been built up and consolidated.

What could better impress upon the minds of the young a feeling of reverence and admiration for the patriotic spirit of their ancestors than the study of the individual lives of the great English naval and military commanders and of the history of the Wars of the Nation.

I say advisedly the history of the Wars, for it is the military and naval history of the nation that is its truest history from the point of

view of world politics. The so-called Histories of England are too often either records of the lives of the Kings and Queens, not infrequently degenerating into mere *chroniques scandaleuses* of the Court, or more or less accurate descriptions of the evolution of the social and political internal fabric of the nation, whilst the wars are referred to chiefly as disturbing elements in its growth. Such histories are very interesting and necessary to the scholar, the politician, or the courtier; but the true history of the British Empire is the history of its wars and conquests, its struggles by sea and land with multitudinous enemies, and it is from this that we must draw inspiration and encouragement for future achievements.

By teaching history from this point of view we should be instructing the young in the theory of the great and vital art of war and in the principles of national politics; and at the same time we should be kindling in them the spark of ambition to emulate the deeds and maintain the prestige of the heroes of our earlier days. What man or boy could read Napier's famous description of "the majesty with which the British soldier fights" without a thrill of pride to think that he too is a Briton and may become a soldier!

But patriotic enthusiam, however ardent, is not in itself sufficient to bring victory. To quote from Colonel Henderson:—"Energy unaccompanied by knowledge is of little worth. A man ignorant of the channels into which he should direct it expends it uselessly, its effects are not apparent except for evil, and without the aid of discipline neither native resolution nor patriotic enthusiasm will outlive the hardships and fatigues of a campaign."

At present a great effort is being made to arouse an interest in rifle shooting in Great Britain and to make us a "Nation of Riflemen." Supposing this movement to be successful, and supposing also that the English nation catches the spirit of enthusiastic patriotism so strikingly shown by the Japanese, we shall then be still only half way towards our object.

Discipline, obedience, organization, training, the lesson of self-abnegation—all these are necessary to produce an army; and these can be acquired only by long years of patient effort directed on lines carefully thought out beforehand.

The idea that even England itself could ever be defended against a powerful, well-equipped and properly-trained invading army by a *levée en masse* of its inhabitants, even were the latter enthusiastic to the highest degree and all skilled in the use of the rifle, is ludicrous to anyone who has a real knowledge of war.

The military instinct must be developed in the whole nation; and the more military matters are studied by the nation at large, the more will the knowledge be brought home to the "man in the street" that making war is no child's play or simple matter. The better the whole subject is understood, the more will the soldier and his

profession be honoured by the nation, and the less we shall hear of those unjust and harsh criticisms that are now showered so freely upon our gallant troops whenever they encounter the slightest reverse. To ensure continuous improvement criticism is necessary; but it should be made only by those who have themselves been successful in the field of war and who know what are its real difficulties.

Criticism from a superior, upon whose judgment and experience the soldier knows that he can rely, only excites in him a determination to learn his work more thoroughly and to avoid errors in future so far as in him lies; but criticism from irresponsible and ignorant amateurs arouses a spirit of resentment and disgust that may seriously affect the morale of a whole army.

The constant complaints as to the "inefficiency" of the British Army are due chiefly to the fact that the military profession is not honoured as it should be. The cure lies in educating the Nation up to the level of its soldiers, and in making every Englishman understand what is the meaning and value of patriotism, military ardour, discipline, organization, and self-denial.

The British soldier must be treated as the embodiment of the patriotic spirit that has built up the Empire and that maintains it against all the world, and not as a sort of hireling of a debased profession, who is maintained as a necessary evil merely in order that when danger threatens it may be averted from the sacred money-making system of the country.

RUBEROID AND URALITE AS ROOF COVERINGS.

Report* by Capt. S. G. Faber, R.E.

Durability.—As regards durability nothing definite can be stated. Hitherto the roofs have proved satisfactory. It is probably not incorrect to assume a life for Ruberoid of anything from 20 to 50 years, while Uralite is probably as durable as slate.

Weight.—Both materials, and more especially Ruberoid, are far lighter than ordinary roof coverings, *vide* Table of Cost below. Additional economy can therefore be effected by a reduction of the scantlings for roof timbers, trusses, etc. Where long transport of building material is necessary, very appreciable economy would result by employing these light roofing materials.

Breakage.—With Ruberoid there can be no breakage; with Uralite the liability to breakage is about equal to slate.

Fire Resistance.—Ruberoid is not very inflammable, though it will burn. From the fireman's point of view it is probably superior to corrugated iron. Uralite is nearly perfect in this respect.

Appearance.—The chief drawback to Ruberoid is its similarity to felt, and its temporary appearance as a covering. The appearance of Uralite is good.

Comparative Cost.—A Table of Cost is given below.

OPINION.

It is therefore considered that at out stations :—

(1). For buildings, where appearance is immaterial, Ruberoid could satisfactorily be employed instead of corrugated iron, etc.

(2). For more permanent buildings, where appearance is of importance, it is recommended that Uralite be used instead of slates. It is now obtainable in ordinary slate sizes; and at stations to which slates have to be shipped considerable economy could be effected by the use of Uralite instead of slates.

Uralite has been used for the roof of the electric light engine house in the British barracks at Khartoum. It was found brittle to handle, and considerable loss by breakage occurred in transport to site and in fixing. The roof has been fairly satisfactory; but in heavy squalls of rain it has leaked rather badly.

* Communicated by the Director of Fortifications and Works.

RUBEROID AND URALITE AS ROOF COVERINGS.

Comparative Costs.

Material.	Description.	Net area covered in feet super.	APPROXIMATE COST. Material only. For whole area.	Material only. Per 100 sq. ft.	Boarding or Battens.	Labour per 100 sq. ft.	Total Cost per 100 sq. ft.	Annual Maintenance per square.	Weight in lbs. per 100 sq. ft.
	s.		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		
Ruberoid ...	½ ply at 17/4 per roll	882	4 8 0	0 10 0	1 0 0	0 4 0	1 14 0	Nil.	42 without boards. 292 with „
Uralite ...	7/64" at 4d. per foot super, strips & nails	180	3 17 0	2 2 9	Nil.	0 7 0	2 9 9	Nil.	120†–240* without battens. 245– 365 with „
Slates ..	Bangor ...	—	—	—	—	—	2 17 0	Nil.	800 without battens. 925 with „
Tiles ...	4" plain ...	—	—	—	—	—	3 5 0	Nil.	1,800 without battens. 2,000 with „
Corrugated Iron ...	18 S.W.G. galvanized	—	—	—	—	—	3 5 0	9d. to 1/8	253 without boards. 503 with boards.

† Colonial roofing. * Laid as slates.

MEMOIRS.

Surgeon-General C. Sibthorpe, I.M.S.

Old officers of the Queen's Own (Madras) Sappers will have seen with regret the announcement of the death, on the 4th May in Dublin, of Surgeon-General C. Sibthorpe, late of the Indian Medical Service, who served with them in by-gone days in Afghanistan, Burmah, etc.

Devoted to his profession, exceptionally skilful and gentle, he was immensely popular with all ranks for his imperturbable good temper and cheerfulness. These qualities were never more *en evidence* than during the terrible occupation of the Khyber Pass, followed by the ghastly "March of Death" in 1879, when, with death from cholera, fever, and the Afridi knife of hourly occurrence, the strong masterful character of the man was seen at its best. Always genial and kind-hearted, his management of our mess was above all praise, and comforts were always to be found in it that were nowhere else procurable.

Everyone liked Sibthorpe, and perhaps, after all, no better epitaph can be written. Lucky is the young officer who goes on service with such a medical officer in charge of him and his men.

W. D. Conner,
Colonel, late R.E.

Lieut.-General Sir T. L. J. Gallwey, K.C.M.G., Colonel Commandant, R.E.

Thomas Lionel John Gallwey, son of Major John Gallwey, Deputy Inspector General, Royal Irish Constabulary, and formerly of the 16th Regiment of Foot, was born at Farm Hill, Killarney, on the 20th July, 1821. His mother, Bridget Ellen, was a daughter of Mr. Neptune Blood, of co. Clare.

Gallwey passed into the Royal Military Academy, Woolwich, at the age of 14 years, and while he was there the famous attack of the Cadets on the booths at Charlton Fair took place, a riot in the delights of which he shared.

Passing out from Woolwich in March, 1839, he obtained a

Commission as 2nd lieutenant in the Royal Engineers; after the usual course at the Engineer School, Chatham, and nearly a year at Woolwich, during which he was promoted 1st lieutenant, he proceeded to the West Indies for a tour of service. During his sojourn in Dominica, an epidemic of yellow fever broke out, in which he nearly lost his life; but his naturally healthy constitution pulled him through. Coming home in June, 1845, he was quartered in Ireland, and during the famine of 1847 and 1848 he rendered special service under the Board of Works. In the latter year he married Cerise, daughter of Mr. John Eyre, of Eyrecourt Castle, co. Galway; but she survived her marriage for a very short time, dying in childbirth in the following year.

From Ireland Gallwey, now 2nd captain, was sent in September, 1849, to Canada; he was stationed at Montreal, and served there as Brigade Major, R.E., during the whole period of the Crimean War. The only troops remaining in Canada were the Staffs of the different Commands, and they had to pass their time in absolute idleness while their comrades and friends were fighting for their country in the Crimea. In 1851 he married his second wife, Alicia Dorinda Lefanu, daughter of Major Macdougall, formerly of the King's Own Borderers, and by her he had a family of two sons and three daughters. In December, 1854, he was promoted 1st captain.

He left Canada in July, 1858, after nearly nine years there. On his return home he was stationed at Portsmouth, where he was employed on the construction of the forts at Brockhurst and East Hill, Fareham. In April, 1859, he became brevet major, and in April, 1862, lieutenant-colonel, R.E. In August of the latter year he was appointed a member of the Ordnance Select Committee, on which he served until April, 1865. During this period, in 1864, he was appointed a member of a special commission with the Federal Army in the Civil War in the United States. He bore a striking resemblance to General Blake of the Confederate forces, and this caused him to be treated with great suspicion and to be "shadowed" wherever he went. He had the greatest difficulty in establishing his identity, even the British Ambassador, when appealed to, telling him that although he himself was quite satisfied he was Colonel Gallwey and not General Blake yet he was powerless to convince anyone else of the fact.

In April, 1865, Gallwey was sent to Canada again, as Commanding Royal Engineer, and remained at Quebec until the autumn of 1868, when, as a brevet colonel, he was selected to be Director of the Royal Engineers Establishment, Chatham, the title of this appointment being altered in the following year into Commandant of the School of Military Engineering. During his seven years' tenure he was promoted colonel, R.E., and this period covered many important changes at Chatham; among them the R.E. Institute was established and Sub-marine Mining became a recognized portion of the work of the

Corps. He identified himself in the closest manner not only with the Staff of the School, but also with all the young officers. He took the greatest interest in all games, especially in cricket and football, and it was during his time that the R.E. Cricket XI. and R.E. (officers') Association Football Club were at the zenith of their fame; and many of the best players in both games which the Corps has ever possessed were then introduced to the public.

On leaving Chatham in October, 1875, Gallwey went to Guernsey for a year as Commanding Royal Engineer. He was then transferred as Colonel on the Staff, R.E., to Gibraltar, where he remained until March, 1879, having in July of the previous year received promotion to major-general. His large experience of fortification work in Canada, at Portsmouth, and on the Ordnance Select Committee, etc., stood him in good stead at Gibraltar, and so satisfactory was his work at that station that he received the personal thanks of the General Officer Commanding, Lord Napier of Magdala, conveyed by command of H.R.H. the Field Marshal Commanding-in-Chief through the Deputy Adjutant General, R.E. While at Gibraltar he was also appointed to act as agent to the Sultan of Morocco for the fortification of Tangier, a post of great interest and of considerable pecuniary advantage.

After being on the unemployed list for a year and a-half Gallwey was appointed Inspector General of Fortifications in succession to the late Field Marshal Sir Lintorn Simmons; but he only held this post for two years; for in June, 1882, shortly after his advancement to the rank of lieutenant-general, he was offered and accepted the Governorship of Bermuda which had become vacant by the death of Lieut.-General Sir Robert Laffan. He remained at Bermuda for six years, until his retirement for age in August, 1888, and this portion of his life was perhaps the happiest. Very fortunate in his home life, and ably seconded in all social functions by his wife and family, he made Government House the centre of hospitality in the islands; there, besides public functions, there was much entertaining on a small scale and practically open house for officers of both Army and Navy. So popular was General Gallwey with the civilians that on his approaching retirement they petitioned the Colonial Office for an extension of his already long term of Governorship, but this was refused on account of his having reached the limit of age.

In 1884 he received the reward for Meritorious Service, and in the New Year's Day Gazette of 1889 he was appointed a K.C.M.G. In 1895 he was made a colonel commandant of the Corps. His total service was 49½ years, of which 24 were spent abroad.

General Gallwey was possessed of such a happy, bright, cheerful nature that he invariably won the affections of all those with whom he was brought in contact. Without guile, thinking no evil, invariably looking on the bright side of things, he made few enemies and

multitudes of friends. In all social matters he was closely backed up by Lady Gallwey, a woman of a particularly sweet and lovable disposition, who was his constant companion throughout their long married life of nearly 54 years.

His chief characteristic was perhaps his love for sport and games. A keen fisherman and a good shot, he had plenty of opportunities for both in Canada and at Gosport, where the newly purchased land round the forts was then unlet. In games he associated himself with whatever country he was in; in Canada he won the championship for curling, in Bermuda for American bowls. But cricket was his favourite, and he took the greatest interest in Corps matches, as indeed in all Corps matters, and in county cricket until the day of his death. At the age of 70 he took to golf, and played regularly for ten years on Wimbledon Common, near which place he then lived.

In 1901 Sir Thomas Gallwey moved to Eastbourne. Two or three years later his health gradually began to fail; in the spring of 1905 Lady Gallwey died, and he himself passed away peacefully on the 12th April last at the ripe age of eighty-four.

He leaves behind him one son, Lieut.-Colonel H. L. Gallwey, C.M.G., D.S.O., Governor of St. Helena; one unmarried and two married daughters, the latter being the Countess of Wharncliffe and Mrs. Irvine, wife of Colonel J. L. Irvine, R.E.

Of General Gallwey's time as Commandant at Chatham Colonel Hon. A. Parnell writes:—"The opinion I then formed of him—and I have some reason to believe that it was shared by all ranks, officers, N.-C. officers and sappers—was that he was exceptionally fitted for his post. He seemed to have a genius for doing the right thing at the right time and in the most pleasant way, and the result was that everyone under him was happy and contented.

In discipline, instruction, mess and social matters, and in sports and games of all kinds, his active influence was universally felt. He was an excellent racquet player and a lover of cricket, in which, when younger, he had been a good performer."

And Colonel E. D. Malcolm:—"I served with him first in Canada, building the Point Levis Forts; and when I was under him again at Chatham he was an old friend. As an old friend I was granted a full share of his confidence and knew, as perhaps no other except Frank Marindin, how great was his love and enthusiasm for his "boys," whose names he made a point of knowing in not more than three days after each batch joined, and whose careers he followed with the closest individual attention.

Sure always of most considerate support, the years I passed with Gallwey as my chief, though the hardest as to work, were by far the happiest years of my service."

And Colonel W. Merriman:—"He was one of the kindest and best of commanding officers, of a genial disposition with a desire to do his

best for everyone and everything. He always gave me the opinion of a man who carefully weighed out every point of a subject, and then expressed his views concisely in the fewest of words both in speech and writing. He was what one would call 'easy going,' but strong and firm, without fuss and flurry, leaving details to his Staff.

His keenness and love of games was unbounded, and the S.M.E. at Chatham are very much indebted to him for the upkeep of their reputation in sport of all kinds. At that time he himself used to play cricket and racquets and he could hold his own with the cue and with his gun at the covert side. I think it was during his reign at Chatham that the matches at billiards, racquets, and boat racing between the R.A. & R.E. were started.

He was one of my kindest and best of friends."

Of the period at Gibraltar Colonel Parnell says:—"Colonel Gallwey was an excellent man for this important post also, having through his previous service had much experience in fortification and gunnery; and during his three years of command at the Rock he introduced new designs, and greatly developed the defences, especially the iron ones. I believe that Lord Napier of Magdala, who was then Governor, held the highest opinion of his Chief Engineer's capacity. With the Gunners, who are, as it were, on their native heath at the Rock, Colonel Gallwey was ever on the most harmonious terms, a matter of no small importance in such a place. The time was then a little critical, as, in the period of 1878 before the Congress at Berlin was agreed to, we might any day (as I now understand) have found ourselves at war with Russia.

One of his characteristics that must have struck everyone who served under him, and especially those in constant intercourse with him, was the remarkable manner in which he managed to bring out the powers and valuable qualities of his subordinates, and the generous way in which he recognized their efforts. He worked hard himself, but he never made the mistake of doing the duty of those under him as well. His great *esprit-de-corps* as a Sapper was also a marked trait in his military career; and as I.G.F. at the War Office he was certainly in the position of all others for which he was suited.

If it had ever been the good fortune of Sir Thomas Gallwey to have served in the field, his fine qualities of head and heart would have shone with even greater lustre."

Of Bermuda Colonel R. M. Sandford writes:—"I served under General Gallwey as Commanding Royal Engineer and Member of the Executive Council, when he held the dual post of Commander-in-Chief and Governor. In both capacities our relations were most cordial; nor could any subordinate desire to serve under a more able and genial commanding officer. I entertain the warmest memories of the many social kindnesses which my daughter and I were constantly receiving from him and his family."

TRANSCRIPT.

THE VALUE OF PORT ARTHUR TO THE RUSSIANS.

Translated by permission from an article by Col. du Génie Clement de Grandprey in the March, 1906, number of the *Revue du Génie Militaire.*

The Conduct of the Defence.

On the day after the declaration of war, the Emperor of Russia asked General Dragomiroff for a plan of campaign. The old soldier answered:—"Evacuate Port Arthur, fall back on Kharbin, Lake Baikal, the Ural if need be, but do not accept battle until you can oppose the Japanese with an army double the strength of theirs." This advice was in line with the Russian traditions of 1812, and it can hardly be criticized when one remembers the unfinished state of Port Arthur, its lack of garrison and supplies, and the fragility and length of the thread connecting it with Russia.

At the time nobody supposed that the Japanese, after torpedoing the Russian fleet during the night of the 8th-9th of February, 1904, would allow three months to elapse before cutting the Trans-Siberian Railway and six before laying siege to Port Arthur.

At St. Petersburg it seemed too much to ask that the Russians should abandon the visible sign of their power in the Far East. Moreover they estimated the Japanese army below its real value. Port Arthur was therefore retained, and nothing was neglected which could bring it to a high degree of strength. The Russian engineers amended the original scheme of defence by fortifying the heights around 203 Metre Hill and increasing the number of works east of the Lun-Ho. During the ensuing months the railway was ceaselessly bringing up men, supplies, and ammunition. When cut off, Port Arthur had a garrison of 45,000 or 50,000 excellent troops, with some of the best officers in the army at their head; they were well found in everything, and resolved to fight to the last.

It is a question whether Port Arthur had a good or evil influence on the issue of the war. From a naval standpoint there can be no doubt as to the answer. For ten months the Russian fleet found in Port Arthur a solid base where they could repair damages. Had the harbour been undefended, the Russian fleet would have been forced on the 9th of February either to fight the Japanese with small hope of victory, or, since Vladivostock was closed by ice, to try and reach a neutral port where they would be disarmed. If the Baltic fleet could have arrived in front of Port Arthur by the 1st December, the Japanese fleet would have been

forced to raise the blockade to avoid being caught between two fires, and the united Russian fleet would have had an incontestable superiority in numbers.

Port Arthur rendered services not less valuable from a military point of view, since during the second half of 1904 the garrison, never exceeding 50,000 men, kept occupied 150,000 Japanese. Imagine Kouropatkin's army reinforced by 50,000 men, and that of Oyama by 150,000, other things being equal; the battles of Liao-Yang and the Sha-Ho, which were fought with the strengths about equal, become decisive victories for the Japanese. Nobody can accuse a fortress of being useless when for six months it is equivalent to 100,000 men. Such a place gives the field armies remarkable freedom of action. That Kouropatkin did not know how to take advantage of it cannot be laid to the blame of Port Arthur.

Let us glance at the conduct of the defence, in order to make a few criticisms.

During the period preceding investment the Russians, having lost Kenzan, took up and fortified too extended a position, one nearly nine miles from the fortress. The result was to reduce to three days the time taken over the distant defence. This assertion sounds like a paradox, since between the interruption of the Trans-Siberian railway on May 6th and the evacuation on the 29th July of the Feng-Huang-Shan hills, which became the main artillery position of the attack, there is an interval of more than two months and a half. In reality, up to the 26th July the Japanese only undertook, at long intervals, field operations for the purpose of securing Dalny, where they wished to form their base. They confined themselves to disembarking material, and only on the 26th July, when their concentration was complete, did they start to besiege Port Arthur. On the third day of the attack the Russians fell back to avoid being cut off from the fortress, and offered no resistance amongst the Feng-Huang-Shan hills. It was on to these hills that they should have crowded their defences. They ought to have had no fear of being cut off from Port Arthur, and this position, with a wide open plain to its front and its flank supported by the artillery of the fortress, was much harder to attack than the broken ground on which they finally established themselves. The desperate defence of 203 Metre Hill leads one to think that the Russians might for months have retarded the opening of the siege, had they more clearly realized the importance of contesting with the attacker his artillery positions.

The artillery duel was not of long duration. The arrangement of the works with a high parapet for heavy guns, the lack of cupolas, and the antipathy or ignorance shown by the Russians in the matter of indirect fire, all prevented them from replying effectively to the Japanese artillery. Against this we must set the wonderful use which they made of machine guns. The assault of the 24th August against the crest of Wang-Tai was repulsed by machine guns. In the attack against the forts, no matter how long or how fierce the bombardment or how great the ruin produced by explosions, the Japanese invariably found their rush checked by machine and quick-firing guns.

The concrete of the bombproofs did not resist the 11-inch shells. The

Russians did not expect the Japanese to have any piece of over 6 inches calibre. At the beginning of the siege they tabulated the results of a certain number of shots from a 6-inch, and found that one round produced a crater 25 inches in diameter and 8½ inches deep. A second shot striking the same point increased the diameter to 42 inches and the depth to 14½ inches. The thickness of concrete is uncertain; the figures obtained from reports vary from 16 inches to 5 ft. 10 in. Photographs of entrances to casemates in the northern forts give the impression of thicknesses of 3 ft. 3 in., but one cannot be sure that the floating of cement covers only concrete.

For a long time Port Arthur communicated with Chefoo by wireless telegraphy; one pole was set up on Lao-Tieh-Shan, and the other in the courtyard of the Russian consulate at Chefoo. But in September a Japanese shell broke the pole on Lao-Tieh-Shan, and it was impossible to repair it. Nevertheless the fortress was at no time quite without communication with the outside world. Many Chinese junks ran the blockade. In December a large vessel called the "King Arthur," full to the hatches with provisions, managed to reach the harbour. When Stoessel wished to forward an important despatch, he used to send it to Chefoo by a torpedo boat, which would allow itself to be disarmed on the accomplishment of its mission.

A ballooning plant intended for Port Arthur was seized at sea by the Japanese at the time of the declaration of war. Attempts to improvise one inside the fortress were unsuccessful. Had the place possessed some captive balloons the conveyance by road of the 11-inch howitzers would have been very difficult, if not impossible; their emplacements would have been located, the Russian artillery could have made sure of hitting them, and the whole aspect of the siege would have been changed.

A girdle railway was not used; the ground presented too many inequalities to admit of its construction. Behind the Chinese wall ran a well-concealed road, rendering easy the movement of troops.

One cannot help praising the fine defence of semi-permanent works, such as Fort Kouropatkin, and especially 203 Metre Hill; but it will not do to assume from this that the days of permanent fortification are past. There is a world of difference between the behaviour of the northern forts and that of the semi-permanent redoubts. The latter were taken very shortly after the enemy came to grips with them; he had but little trouble in crossing the ditch and parapet; and if sometimes he was unable to hold on to the interior of the work, it was because he was driven out by reserves whose approach was covered by the artillery of the permanent forts in rear. On the other hand, in the case of the three permanent forts which became the objective of a regular attack, a long time elapsed after the enemy established himself above the counterscarp before the final assault. For the North Fort of Tung-Chi-Kuan-Shan it was fifty-four days, for Erh-Lung-Shan fifty-eight, and for Sung-Shu-Shan sixty-one. What better justification could be found for a well-flanked ditch between a solid escarp and counterscarp? Had 203 Metre Hill been crowned by a work similar to the three forts mentioned above, we may be sure that it would not have been taken on December 5th.

To sum up, the experience of Port Arthur would have been more conclusive from a technical point of view if the fortress had been supplied with armoured defences. In the absence of complete information it is impossible to estimate at its exact value the lesson of the siege; but, so far as we can see, we are justified in saying that it is calculated to increase the confidence of those charged with the defence of our fortresses, since these are stronger than was Port Arthur. The destructive effect of artillery appears to have been overestimated. A determined defender can, as in the past, force the assailant to attack him inch by inch. Therefore instruction in the use of saps and mines ought to be restored to the place it once held in the training of Engineers.

Above all things, the siege of Port Arthur is a lesson in energy. Through the energy of both sides the contest was sustained for six months, and scenes were witnessed which recall ancient times. The dynamite hand-grenades answer to the Greek-fire of the middle ages, and the defence of the traverses on the Chinese wall brings to mind the fighting for the possession of the covered way in bastioned fortresses. Therefore the officers of the twentieth century have still something to learn from old-time sieges where a great deal of energy was shown, as at Rhodes, Malta, and Candia, and in the Spanish wars. In fact, the chief object in the improvement of armament has been to kill people from a distance. If the adversaries decline to allow themselves to be destroyed or demoralized, the distance separating them will be gradually reduced, and the conditions will approximate to those of ancient times.

THE CONDUCT OF THE ATTACK.

The strategy of Oku before and after the battle of Nanshan is probably the most brilliant episode in the Russo-Japanese war. It is the only one which recalls the methods of Bonaparte at the beginning of his career. The conception is the same, the execution slower. Had Bonaparte disembarked on May 5th he would have struck his first blow before the 26th.*

In Nogi one sees the same prudence. He did not move against Port Arthur until July 26th, by which time his army and siege train were organized and he had the certainty of a continual stream of supplies.

Unhoped-for good luck allowed him to occupy the Feng-Huang-Shan hills without fighting, and here he found good artillery positions against the centre of the fortress as well as a screen behind which to establish his depôts at his leisure. He tightened the investment on the flanks, opened fire with every available gun, and, when he thought he had subdued the fire of the Russian artillery, delivered a furious assault† which lasted six days (August 19th to 24th) and failed. On this subject something has

* Throughout the war the Japanese combined timid strategy with tactics of unparalleled audacity.

† The reasons which decided Nogi are uncertain. Mention is made of a formal order from Tokio, and of a request from Oyama, the Commander-in-Chief, who wished to have Nogi's army available for crushing Kouropatkin. It might be simpler to blame the influence of German ideas which, owing to the successes of 1866 and 1870, are much quoted in Japan and moreover harmonize with the racial spirit of the offensive.

been said of the failure of the artillery. The word seems a little severe and premature. It would be fairer to speak of a failure on the part of the Japanese artillery, since the siege train at the time was too weak both in numbers and power. The other causes of the check were—

(*a*) The high defensive value of Russian soldiers, who, behind entrenchments, are equal to the best troops in the world.

(*b*) The arrangement of the defences in successive lines; behind the two Panlung redoubts was the Chinese wall, and behind the Chinese wall the ridge of Wangtai.

(*c*) The use by the Russians of machine guns in numbers hitherto unknown.

(*d*) The abandonment of the western attack after the capture of 174 Metre Hill on August 20th, thereby allowing the Russians to concentrate their reserves upon Wangtai on the 22nd, 23rd, and 24th.

Nogi had to make up his mind to undertake the lengthy works of a regular siege. He selected for attack the sector of permanent forts lying on the north side of the place and extending from East-Chikuan to Sung-Shu-Shan. This was taking the bull by the horns, for on this side the defences were more solid than on the east and west. But here he had already got a foothold by the capture of the two Panlung redoubts, and here success had been almost within his grasp, since a portion of his troops had for a brief space occupied the ridge to the west of Wangtai and had maintained themselves for a whole day at the foot of the northern slope. Wangtai was an observing station similar to 203 Metre Hill. From it at a short distance one saw the dockyard and the old town. Nogi was justified in hoping to obtain possession of it by keeping his supports closer up than on the 23rd August. Moreover, the chosen sector was the nearest to the railway bringing up the ammunition. To attack the eastern sector from Tung-Chi-Kuan-Shan to the sea, or the defences on the west bank of the Lun-Ho, would have entailed inconvenient movements of material.

The permanent forts to the east were practically equal in strength to those in the north. But the slopes were steeper, and the sea, bounding Signal Hill and Hsiao-Ku-Shan, prevented the works from being turned. The western sector was much weaker. Had Nogi expended against this sector an amount of energy equal to that which he vainly employed against the northern front, he would probably have succeeded sooner. At the end of August the defences at 203 Metre Hill were not of the solid nature to which they afterwards attained. Probably this strengthening was effected during the month of September. The Russians would have been compelled to fall back on the permanent forts of Yi-Tzu-Shan and Ta-Yang-Kou, behind which there was no Chinese wall nor any ridge similar to Wangtai. In trying to envelop them, the Japanese would have struck the very weak work of Ya-Hu-Tsoi,* which could have

* This is not correct. They would have struck Cha-Kua-Tzu Fort, the best finished of any in the fortress.—A. B.

been taken with less trouble than the Panlung redoubts, since it was not so well supported by the neighbouring works. From that onwards all the defences of the place could have been taken in reverse.

It would appear that Nogi never found the weak spot in the armour of Port Arthur. He advanced against the northern forts by sapping and mining, and interrupted the work in order to launch against them three assaults, which, like the Manchurian battles, lasted several days. They show the remarkable feature of producing each time a smaller result. The storming columns started from parallels closer each time to the objective; the assault was prepared by a well-served artillery, which at the end of the siege had nearly double the power it had at the beginning; nevertheless they could never reach the foot of that same Wangtai which was within an ace of being taken on August 23rd. The Russians, who could receive no assistance either in men or material, had restored the balance by multiplying defence works on the sector attacked.

To sum up, *no permanent work could be taken without the help of mines.* Direct assault succeeded only against semi-permanent works such as the Panlung redoubts and 203 Metre Hill. From this we must conclude that an assault has little chance of success against a permanent fortress, even against one unprovided with armour. The heavy artillery of the attack subdued that of the defence with more or less trouble, but the passive obstacle was left intact, and the only hindrance to quick-firers and machine guns being brought up to check a rush was caused by the *débris* brought down by the bombardment. In order to prevent the Russian machine guns from being brought up, the Japanese kept up the fire of their artillery to the point of hitting their storming columns, a thing of which no European army is capable; it simply cannot be done.

It has been said that in case of war between Germany and France the Germans, after having bombarded our eastern forts, would take them with a rush. This assertion does not harmonize well with the example of Port Arthur. The German siege train contains a 4·7-inch gun, a 6-inch howitzer, and an 8-inch mortar. None of these pieces, of which the last must have a previously prepared platform, has a destructive effect comparable to that of the 11-inch howitzer of the Japanese. If in three months this 11-inch howitzer failed to destroy all the bombproofs and to annihilate the defence, the German weapons are not going to do it in three days. Let us therefore provide our forts with determined garrisons, solid bombproofs, and plenty of machine guns, and we may rest certain that the German artillery will leave us time to get the machine guns into positions from which they will stop the assaulting columns.

A. BANNERMAN.

REVIEWS.

DRAINAGE PROBLEMS OF THE EAST.

By C. C. JAMES, M. INST. C.E., F.S.I. — (2 vols., viz., text and plates. 10 × 6½. 20s. *Times of India* Office, Bombay).

THE success of *Oriental Drainage*, which has for some time been accepted as a text book in the Training Colleges in India, has induced the author to re-write it under the title of "Drainage Problems of the East," embodying the result of riper experience and continued research.

Sanitation in Eastern lands is conspicuous by its absence; and it is only of very late years, and even then but slowly, that any real effort has been made to introduce modern sanitary ideas and to provide those up-to-date systems of sewerage and drainage which are amongst the first duties of every Municipal body.

It will be admitted that in this respect Bombay may be regarded as the foremost city of an Eastern Empire, and, with its huge area and mixed races, it is second to none in the scope it presents for adapting Western progress to Eastern conservatism and prejudice. The author, who for the last 15 years has superintended the sanitation of Bombay, is therefore in a position to lay down the requirements of such a system and to give very mature advice as to how it should be carried out.

The first volume, which contains the letterpress, is divided into two parts. The first part contains a comparison of various systems of drainage and sewerage suitable for large Eastern towns, with details of materials, public conveniences, house connections, sewage disposal, surface and subsoil drainage, and the generation of gas from liquefying tanks and its utilization for lighting, power, etc. The second part describes the drainage systems employed in various large cities of the East, while the second volume contains plans illustrating the letterpress.

It is not proposed to review the major portion at length; the treatment is clear and concise and essentially of a practical nature proved by use in a populous and congested city. The chapters on Sewage Disposal, Filtration, and Tank Gas call, however, for more extended notice, for they embody experiments which have been carried to, at any rate, as complete a success as has been done, it is believed, in Europe.

In the suburbs of Bombay, at Matunga, is situated the Ackworth Leper Asylum, maintained chiefly by Municipal funds but of late years very largely self-supporting. Some years ago Mr. James was appointed

Secretary to the Committee of Management; and it is there that he has experimented with the sewage of 400 people with such success that the system is now being extended to deal with the sewage of some 10,000 inhabitants of the richest and most fashionable quarter of Bombay.

The Asylum was not connected with the main drainage scheme of Bombay and the question of the sewage disposal of the lepers presented some difficulty. A sewage farm was inaugurated and at first the sewage was deposited in a crude form. This was found not to work; the ground got "sick," the crops failed, and a nuisance was created; it was evident that the sewage must be broken down in some way before being used on the ground. Various experiments were carried out. A Stoddart's filter with crude sewage has been very successful on a small scale, but the greater part of the sewage is treated in what is generally known as a "Septic Tank." It may be mentioned incidentally that the author does not accept this nomenclature, but for logical reasons prefers to call it a "Liquefying Tank."

In England this system has not up to the present been everywhere attended with altogether conspicuous success, and a number of experiments were necessary at Matunga before an effluent sufficiently good to use for irrigating the fields was found. The equable temperature of Bombay was, however, in its favour; and eventually a very satisfactory result was obtained with an eight hours flow through the tank and a dilution of about 5 gallons of water per head, the effluent being slightly turbid with an analysis showing a purification of 81%, or about 50% better than the ordinary purification obtainable in England. The effluent is odourless, and indeed the absence of any objectionable smell in the whole installation is most noticeable.

The author gives a plan of the Liquefying Tank and details as to its construction, rate of flow, proportion, etc. An important point to note is the very long period that the tank can go without being cleaned out; only three times in eleven years has it been cleaned, and the solid matter removed was almost entirely mineral in its character with a very satisfactory analysis.

Many very useful hints are given too as to the management of the Tank, the result of very careful observation. An Appendix contains a most interesting report of similar experiments carried out at Lawrence, Mass., U.S.A.

After passing through the Liquefying Tank the effluent is submitted to ærobic treatment in filters. Of these a number have been experimented with. The contact beds give very good results, and so does a Stoddart's filter unenclosed by walls, with a rotating distributor; but the Stoddart's distributors were not a success. Tipping troughs, Adams' patent rotating distributor, and the "Fiddian" distributor are all good.

The effluent, after passing through the contact beds or through an open filter of clinker with rotating distributors, is perfectly clear and sparkling, with a wonderfully good analysis. It may be noticed that the same may be said of an installation at the Parsi Sanitarium on Malabar Hill, where the sewage of 200 to 400 people, after treatment in a "Macerating Tank," is filtered in Stoddart's walled filters, the distribution being by

tipping troughs. Contact beds appear to be the best filters for large installations; but a Stoddart's open filter of clinker with rotating distributors appears to be the best for small or private installations, or when space is not available.

The most interesting part of the book is that treating of "Tank Gas." As the sewage passes through the Liquefying Tank and decomposes through the action of the unærobic bacteria, a considerable amount of gas is given off, which can be seen baffling up through the scum. An analysis gives about 50% nitrogen, 45% of hydrogen and marsh gas, and 5% of carbonic acid gas, the exact proportion varying according to the conditions of the sewage.

Mr. James, instigated by the experiments made at Exeter, has utilized this gas and his experiments are rather more successful than in England. By covering over some of the partitions of the Liquefying Tank and drawing off the gas into gasometers (after removing CO_2 by passing it through lime in a purifier) he has been able to run a small gas-engine, which drives a pump raising water from a sump at the Liquefying Tank up to the level of the contact beds and filters. He also lights the whole of the Asylum compound, using incandescent mantles, while a large amount of the cooking for the inmates is now done with the gas produced. A full report is given of this very interesting product of sewage decomposition and of the manner in which it affects the purification of the sewage in the Liquefying Tank. The large proportion of nitrogen is somewhat against its use; but experiments are now being carried out, which, it is hoped, will very considerably diminish the percentage present.

In a Mill installation at Bombay, where some 6,000 hands are employed and where water is expensive, the gas generated is used for working an engine, which, after pumping the water to filter level, again raises the filtrate to the flushing tank so that the same water does duty again and again.

To those who have followed modern improvements in sewage disposal the book must be full of interest. To those who know but little about such things it will seem extraordinary that such simple methods should not have been employed before now in Indian cantonments, thereby not only lessening the danger of epidemics and increasing the general health of the troops, but conducing to a very material saving of expenditure. The prime cost of installation must of course vary with localities; but the plant, given a reasonable scope of ground, is of the most inexpensive description, the cost of water for flushing is reduced to a minimum by utilizing the gas, and the working expenses for the manufacture of gas do not exceed the cost of 1 c. ft. of lime to each 3,000 c. ft. of gas, plus the wages of a couple of men to regulate the gasometers.

It is unfortunate for India that the author has now left to take up the sewerage of Cairo under the Egyptian Government, for much still remains for experiment and research. But the investigations already carried out are enough to show that the right lines have been followed and that the system is practicable and economical. The extension of the system to Malabar Hill, Bombay, by which the sewage of 10,000 people is to be

treated, the works for which are now well in hand, gives a proof that sufficient advance has been made to justify an extended use.

To officers of our Corps, both at home and abroad, to whom some knowledge of scientific sanitation is of importance, the book fulfils a long-felt want. Should it stimulate Government to take up in earnest the question of modern sanitation in our cantonments and bazaars in India, it will have conferred an incalculable blessing on our Army.

G. C. KEMP.

THE RUSSO-JAPANESE WAR.—VOL. II. 1905.

By CAPITANO LUIGI GIANNITRAPANI.—(9 × 6. 14 lire for 2 vols. Enrico Voghera, Rome).

The second volume of Capt. Giannitrapani's study of the great war in the Far East covers the military operations carried on in the year 1905. It has received the same favourable criticism on the part of the Italian and other Foreign press as was awarded to the first volume. The descriptions of the fighting are followed by important "Considerations and Deductions" relating to the employment of the several arms, to the working of the transport and other services, and to other questions of a general character; these considerations and deductions in fact constitute a synthesis of the whole work.

I.—GENERAL CHARACTERISTICS OF THE WAR.

An examination of the great battles which have been fought during the war would seem to establish, as it were, the physiognomy of the tactics of the war.

In particular the character of slowness is apparent in all the actions, in the great battles fought out to their completion, in the combats of army corps as well as of inferior units, even in those of brigades. The advance is slow and difficult; both attackers and defenders are, as it were, rooted to the ground; the final result is arrived at generally after several days fighting on the same position.

The visibility of the enemy on the field of battle is reduced to a minimum, and the apparent *vacantness* of the battle field has often been noted by those who have taken part in several of the engagements. This fact of being unable to discern the enemy is a phase very different to what was presented in the last great wars of the Nineteenth Century, and it excites in both the adversaries a feeling of uncertainty and distrust which shakes the nervous system more than fatigue.

The actions are not restricted to the hours of daylight. Frequently—as in the battles of the Sha-ho, Sandepu, and Mukden,—the attacks take place at night while during the day the infantry rest behind their defences.

The long duration of the battles without being able to discern the enemy and while remaining continually under fire, and the uninterrupted actions by day and night, produce complete exhaustion in the two adversaries at the end of the struggle, and hence the failure of an active pursuit on the part of the attackers has frequently been noted.

The employment of numerous field guns together with batteries of medium calibre was usual in all the great battles; sometimes heavy artillery followed the general advance. The employment of heavy artillery and of fortified camps increased during the course of the war, and reached its maximum at Sandepu and Mukden, where there was in fact a war of positions and the adversaries fought round small improvised fortresses.

The relative positions of the two combatants altered little during the course of the war. The Russians, having assumed a defensive strategy, were always constrained to assume defensive tactics, although they tried to take the offensive at Wafangu in July, 1904, and at Sandepu in January, 1905. With the Japanese a strategy of offence was consistently followed by offensive tactics. Consequently there is a great analogy in all the great battles, an analogy increased by the resemblance of the features of the ground and by the repetition on the part of the attacking forces of enveloping manœuvres.

The book recalls some of the more evident characteristics of the tactical actions of this war, which naturally result from an examination of the facts. Some of these are due to the evolution of armaments and tactics, others to the topographical conditions of the theatre of operations and to the moral qualities of the two belligerents; but it is not possible to affirm that such characteristics will predominate in future wars.

CONSIDERATIONS ON THE EMPLOYMENT OF ENGINEER TROOPS.

The special conditions of the ground on which the two Russian and Japanese Armies were required to operate, and the great development of field fortifications and of the means of communication, have given a notable importance to the work of the engineer arm during the field operations.

The importance and necessity of a strong proportion of engineer troops was certainly foreseen and provided for in the Japanese army. In time of peace not only was there a company of pioneers for 4 infantry battalions, but to every infantry regiment was attached an engineer section (non-commissioned officers and some old soldiers), especially charged to instruct the infantry in the execution of fortification works, and to march at the head of the columns in order to execute any work that might be necessary to facilitate the passage of the troops.

The Russian army (not taking into account two brigades of railway engineers) entered on the campaign with a weak proportion of engineer troops. For each army corps there was only 1 battalion, consisting of 3 companies of sappers and 1 company of telegraphists. During the course of the war it was found necessary to increase considerably the technical troops, creating especially new units of pontoniers, of

telegraphists, and of balloonists. The experience gained in the war has induced Russia to make a similar large addition to technical troops in European Russia.*

Pontoniers.

The deficiency of roads in the Far East, and the want of bridges over the larger rivers and water courses in the theatre of war, caused much work on the opening out and keeping in repair of the communications and in the construction of bridges. In the winter season, however, when the soil and the water courses were frozen, the country was open to the free passage of the troops.

The work of the Japanese pontoniers was especially noted in the crossing of the Yalu in April, 1904; and that of the Russian pontoniers in organizing the communications between the two banks of the Tai-tse before the battle of Liao-yang and between the two banks of the Hun before the battle of Mukden.

Railway Engineers.

The work executed by the railway engineers of both combatants was of great importance. On the Russian side, besides the immense work of maintaining the Manchurian railway and the Vladivostock line, a diversion of the former railway was made south of Mukden.

On the Japanese side long military lines were constructed, of which may be noted the Korean railway from Fusan to Vigiu and the horse railway from Antung to Feng-huan-cheng. The railway engineers and sappers also constructed and kept in repair the Decauville railway for transporting materials in rear of the position on the Sha-ho, and the whole of the railway from Port Arthur to Tiehling was restored after its destruction by the Russians.

Sappers.

But the most important work assigned to the engineers of the two armies during this war was the direction and partial construction of field and semi-permanent fortifications, the organizing of the defences in the several localities, and the construction of the communications required for the fortified positions.

The extended use of field fortifications by the Japanese, although they were always animated by a marked offensive spirit, was the natural consequence of their regulations, which prescribed that—for the artillery as well as for the infantry—defences of earth works should be made use of in all circumstances of combat. These regulations, largely applied at manœuvres in peace time, imprinted on the troops habits of method and prudence in accordance with their national character. In this description of work—simple field works—the engineer troops were only employed in directing, since the infantry and also the artillery were provided with the tools required for their execution.

A heavier duty was exacted from the Japanese pioneers on the semi-permanent fortifications executed during the long pauses in the autumn and winter of 1904—1905 and the summer of 1905. This duty consisted of the completion of improvised entrenchments, which, although not presenting any special features in their construction, had an important value in being singularly adapted to the nature of the ground and in invisibility to the enemy.

* See "The Engineers of the Russian Army" in the *R.E. Journal* for May, 1906.

In the middle of the summer the defences of villages were also undertaken by the usual methods, which were facilitated by the high walls of mud that usually surround the Manchurian dwellings.

It should be noted that both sides made use largely of accessory defences, especially of barbed wire and trous-de-loup. Abattis could of course only be used in the vicinity of villages where there were trees. For clearing a passage through such defences the Japanese invariably attached to all their columns detachments of pioneers provided with explosives, detachments which frequently fell victims to their heroism. The use of mines as accessory defences in field warfare seems to have been very limited on both sides.

The activity of the Russian sappers may be explained by the fact that the Commander-in-Chief desired to organize defences in the several localities in order to cause delay to the enemy at successive points. Works were carried on contemporaneously in the spring of 1904 at Ta-shih-chiao, Hai-cheng, Liao-yang, and on the passes in the mountains to the east, and at Mo-tien-ling. This vast extent of fortifications could not of course be executed by the few companies of sappers that were in Manchuria, and recourse was had to the infantry troops.

The situation of the Russians being assumed to be one of strategical defence, their entrenchments on the battlefield had a more marked character of strength and preparation than the works of the same kind executed by the Japanese.

Telegraphists.

One of the chief characteristics of the war is certainly the systematic and continuous use of telegraphy and telephones as a means of communication, not only between the troops of the various commands but also between the troops of the same command, during the development of the tactical actions. The imperious necessity of adopting such a system of communication on a large scale was attributable in great measure to the difficulties of the ground and to the want of proper roads, which prohibited the employment of cyclists and automobiles in carrying orders. Even cavalry in many cases could not be utilized owing to the extent of the area covered by the enemy's fire.

Naturally, the favourable development of this technical means of communication contributed to the long pauses, and to the battles of position which are characteristic of this war; it may indeed be that the system of concealed telegraphs and telephones was a cause of the long pause on the lines of the Sha-ho during the autumn and winter, 1904—1905.

It would be advisable for the telegraphists of foreign armies to study this very extended employment of telegraphy and its use under every condition of warfare. It should be noted that, with the employment of this means of communication on a vast scale, it was possible for the commander of the Japanese armies to direct the operations during the entire development of great battles, in the same manner that a chess player seated at a chess board can quietly calculate his moves.

The telephone, on account of its simplicity, was even more frequently used, especially by the Japanese, and orders were issued with the greatest rapidity between the commanders of infantry brigades and regiments and

those of batteries of artillery. The telegraph was used between the higher commanders where it was necessary to leave records of the orders transmitted.

To every Japanese division was attached a company of telegraphists, who erected an aerial line during the advance of the division. Each army corps also had a special unit of telegraphists which connected the divisional lines with headquarters.

The system of telephonic communication in the Russian forces cannot be said to have worked well. In a Russian report it is mentioned that this system, by its facility for speaking information as to what was to follow, produced a dangerous infraction of superior authority, an infraction which caused embarrassment to the commanders and produced frequent counter orders.

Wireless telegraphy was used by the Russians, who in March, 1905, organized three companies provided with the Marconi apparatus.

The Russian officers who took part in the war affirm that it is essentially necessary that telephonic apparatus should form part of the material of mobilization, not only for the general staff but also for infantry regiments and batteries of artillery, in the proportion of three or four stations and 10 kilomètres of wire for each regiment and divisional staff, and three or four stations with 6 kilomètres of wire for each group of batteries or for isolated batteries.

The matériel for the telegraphist companies should however remain exclusively at the disposal of the general staff of the army corps.

On the Russian side, in the last months of the war, special detachments of mounted telegraphists were attached to the Commander-in-Chief and to the commanders of army corps, some with equipment in wagons, others with pack transport, each detachment carrying 66 kilomètres of wire, 10 telegraphic instruments, 20 telephones, and 10 heliographs.

Balloons. Information is scanty regarding the use of balloons by the Japanese, who seem to have relied for the most part on observatories in elevated positions and on their perfect system of organized espionage.

The Russian reports agree in affirming the great utility of the balloon service and also of photographs taken from the balloons, because the observers knew well beforehand the nature of the observations they had to make. In these reports it is recommended that a balloon equipment should be attached to each army corps.

The rate of movement of the balloons seems to have been slow, the velocity being about 4 k.m. an hour in ordinary weather, and 6 k.m. when the wind did not blow in a contrary direction.

At a height of 1,000 mètres in normal weather observations could be made with a radius of 8 k.m. At night bivouac fires could be seen at a distance of 20 k.m., and to utilize this fact the Russian balloonists during the long pause on the Sha-ho made some night ascents.

The above brief considerations would seem to throw sufficient light on the great importance of engineer troops in the preparation for and in the development of actions in the field, by utilizing the art of fortification and employing the various technical resources which science has made to

progress in late years. It is probable that the conditions of the theatre of a war on European soil would not render necessary the employment of engineer troops on such a large scale as was indispensable in Korea and in Manchuria. But it is certain that the use of field and semi-permanent fortification will be largely resorted to in the wars of the future, as much in the attack as in the defence; and it would be idle to reiterate that the extensive employment of telegraphists and balloonists will become an absolute necessity.

E. T. THACKERAY.

NOTICES OF MAGAZINES.

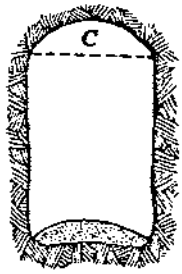
KRIEGSTECHNISCHE ZEITSCHRIFT.

IX. Year. 7th Number.

CORRUGATED IRON MINING CASES.—These consist of two bent sheets of corrugated iron, joined together at their upper ends by a hinge. The lower ends are strengthened with angle iron. When in position, the lower ends are held apart by a transverse bar of T iron (*Fig.* 2). The edges of the angle iron fit into slots cut in the ends of the web of the T iron.

In order to get the case into position, it is necessary to hollow out the floor of the gallery (*Fig.* 3). This hollow is filled up again with newly excavated earth after the case is in position.

Fig. 1.



The advantages claimed for this system are:—(1). That in making a square gallery, the earth always falls from the roof till a rough arch is formed (*Fig.* 1). It is therefore more economical to excavate the gallery with a pointed arch section in the first instance. (2). The excavation of the portions marked *a* and *b* in *Fig.* 4 is avoided. (3). The triangular cases are more easily placed in position than the old square cases. (4). As a result of these advantages a higher rate of progress is attainable.

Fig. 3.

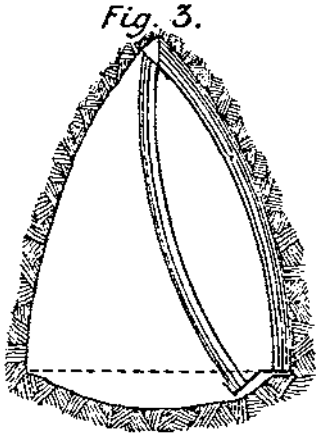
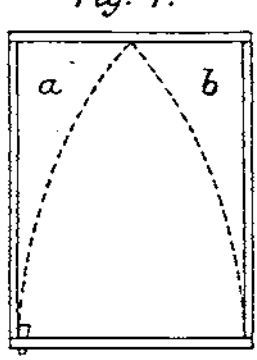
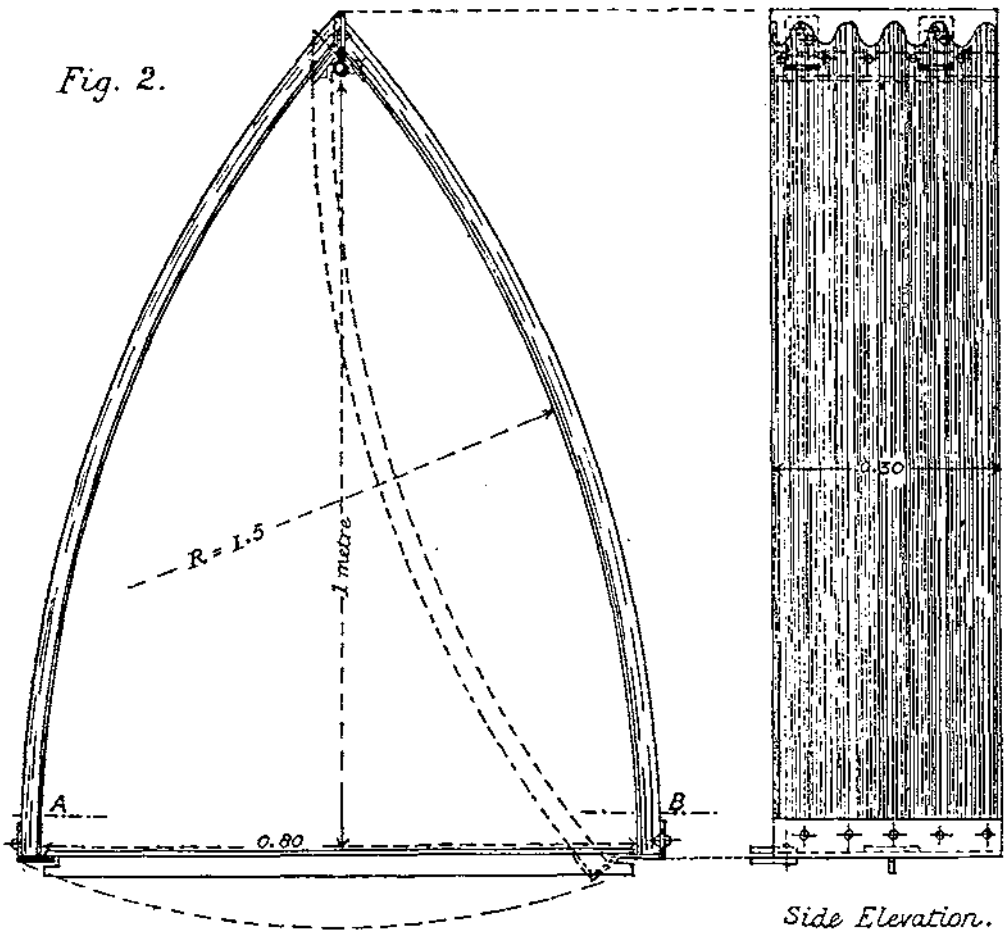


Fig. 4.



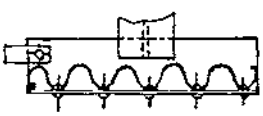
J. E. E. CRASTER.

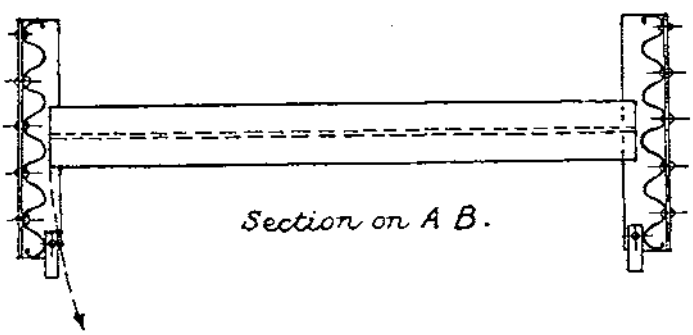
Fig. 2.



End Elevation.

Side Elevation.





Section on A B.

BULLETIN OF THE INTERNATIONAL RAILWAY CONGRESS.

June, 1906.

RAILROAD STATISTICS.—By A. A. Goodchild, Canadian Pacific Railway.—Mr. Goodchild is Auditor of Stores and Mechanical Accounts on the Canadian Pacific system, and naturally lays more stress on the methods of connecting expenditure on stores and on locomotive power with the output of work done than on the reduction of ton-mile and train-mile statistics to comparative tables. Some of his general remarks are interesting. As he very pertinently points out, statistics based on either ton, train, or locomotive mileage fail to furnish any information as to the financial benefits gained by outlays of capital for reduction of grades, or to supply any basis for arriving at savings in cost of transportation effected by introduction of larger capacity locomotives and cars.

The unit advocated is a "100 per cent. capacity unit," *i.e.* 20,000-lb. drawbar pull. In terms of this is shown the amount of power each superintendent has to dispose of, and against it is set off the actual amount of work performed.

A further unit suggested as an "operating unit" takes into account the speed attained, and is obtained by dividing the number of ton-miles per 100 per cent. capacity by the actual time of running between terminals.

Most systems on the American continent divide their traffic into east-bound and west-bound; but Mr. Goodchild suggests a further classification showing such traffic as is in the direction of the balance of traffic as distinct from that of returning power. A somewhat similar suggestion was made in the article on the use of statistics, by Mr. Marshall of the N.E.R., which was recently reviewed in these columns.

Subsidiary figures, which need to be carefully watched, are the per centage of loading and the figures of stores and fuel consumption. Some suggestions are put forward for securing the correct booking up of oil, coal, etc., and samples of the forms used are given.

Statistics would also no doubt be kept of delays on the road brought about by causes over which the train men have no control; and I believe that much attention is now being given to the economical design and operation of freight yards and terminal stations, for the study of which there is little doubt that comparative figures should be of value.

C. E. VICKERS.

REVUE DU GÉNIE MILITAIRE.

May, 1906.

TELEPHOTOGRAPHY FROM BALLOONS.—The writer of this article describes the methods by which it is possible to plot on a plan the exact positions of earthworks and batteries which have been discovered by means of a

telephotograph taken from a balloon. His whole argument rests on the supposition that earthen parapets of a height of about two feet six inches can be identified as such in a telephotograph taken from a balloon at a distance of four to six miles. He does not, however, show that this has been done, and our own experiments in telephotography do not justify us in supposing that it is possible.

THE USE OF INDUCED CURRENTS IN MILITARY TELEGRAPHY.—As the result of various experiments, the writer has ascertained the most suitable form of vibrator for military telegraphs. He has chosen a polarised vibrator, which requires a current of 100 milliampères, and which should be adjusted to give about 3,100 vibrations per second. The best form of induction coil was found to be one with a resistance of 15 ohms in the primary and 500 ohms in the secondary coil. Any ordinary telephone receiver may be used for reading the signals; but the best form is one that can be attached to the ear, so as to exclude all outside sounds. It is possible to use the same wire for both ordinary and induced current messages, as the vibrator currents do not affect the ordinary sounder, and the vibrator signals are more audible on the telephone receiver than those from the direct current apparatus. The arrangement can however be improved by adding a separator.

J. E. E. CRASTER.

REVUE GÉNÉRALE DES CHEMINS DE FER.

April, 1906.

THE CHANNEL TUNNEL.—By M. A. Sartiaux, Chief Engineer, Northern Railway of France.—This article contains an interesting review of the history of this project and an outline of the method of execution proposed by the author. The original proposal dates from 1872, and at no stage does it appear to have met with opposition in France; but, by reason of military objections, it never attained to anything beyond a preliminary investigation in this country.

M. Sartiaux commences by considering the nature of geological formation likely to be encountered, and comes to the conclusion that a sufficiently regular and uniform stratum of grey chalk underlies the Channel to make the tunnel physically quite possible. He proposes to drain the tunnel towards each end by a subsidiary inclined passage, communicating at intervals with the bore and leading into a sump from which the water would be pumped without difficulty.

Actually a considerable length of trial gallery (1,840 mètres) was excavated, at a rate approaching 500 mètres per month, from the French side.

The author does not say what nature of lining he would propose; but considers that it would be preferable to have two tunnels of round section to one tunnel of sufficient size to accommodate two roads. The two tunnels

would be connected at intervals. The employment of a separate gallery or passage for drainage would allow of the line being constructed on the level once the necessary depth below the surface was attained, and to do this would not, apparently, involve any very heavy gradients.

He reckons that the tunnel should not take more than 7 years to construct and, on the basis of the present cross-channel traffic, that it would convey not less than 900,000 to 1,200,000 passengers and 1,500,000 tons of goods per annum, though no doubt the new facilities, by placing England in closer touch with the Continent, would lead to a very great increase on these figures.

For all that we have no estimate of what the cost would be.

May, 1906.

STRENGTHENING JOINTS IN DOUBLE-HEADED RAILS.—By M. De la Brosse, Orleans Railway.—With increasing axle loads, running up to as much as 18½ tons, it has become necessary to consider seriously how the joints, which are the weak places of the road, can be stiffened. Improvement has been sought by bringing closer together the sleepers on each side of the joint, so diminishing the bending of the rail and the work of the fish-plates. The sleepers are now placed 41 cm. (16″) apart centre to centre, the minimum amount compatible with good beating up of the ballast. The sleepers are also chamfered off on each side of the chairs, so as to allow of the beater or tamping bar being used. The fishplate at present employed is 45 cm. (18″) long, and thus overlaps the joint chairs, which are of special pattern to admit the rail and its fishplates, of which one of each pair is hollowed to accommodate the key; the bearing area is 38 mm. by 160 mm. and the weight 19·8 kilos. (which seem small dimensions compared with English practice). There are three coach screws.

The introduction of this type of joint on the Orleans line, where the rails are 11 mètres long, has been attended with great success, and has led to the elimination of hollow places and sunk joints.

C. E. VICKERS.

RIVISTA DI ARTIGLIERIA E GENIO.

May, 1906.

MILITARY ENGINEERS.—E.R. deals with the scope and conditions of service of military engineers in the Italian Army. After referring to the glorious records of the Italian military engineers the writer proceeds thus:—Military engineers in the proper and comprehensive meaning of the words are those who design and construct works of fortification for attack and defence. It is well known that since historic times military engineers have existed in all armies.

In the XVIth century their professional personality, if not in a state of

thorough organization, was brought by the Italians into strong relief; they constructed fortresses, were attached to the armies, directed the attack and defence in many memorable sieges, and frequently fell on the field of battle in the exercise of their duties. The names of Girolamo and Camillo Marini, of Antonio Mellone, of Giralomo Pennachi, of Antonio Saresone, of Bartolomeo and Scipione Campi, of Piatti, of Vergano, of Ferramolino, of Maggi, of Martinengo, of Barca—all distinguished military engineers, killed or wounded in battles or sieges—give ample testimony to the eminently military character of the works undertaken by them in the wars of this epoch.

Coming now to the beginning of the XVIIth century, with the consolidation of the monarchy, in the army organization the engineer troops —among whom were comprised the military workmen—commenced to be regularly organized. On these devolved the duty of constructing fortresses and other military works, barracks, and buildings of various kinds. In fact the Italian tradition was continued, under which the duties of an engineer and a soldier were combined in one individual, and it was the duty of those who constructed fortresses also to attack and defend them.

Under these premises we are confronted with the following problem :— After taking away from the military engineer the command of troops, what would be his position in time of peace? and what his position in the field when attached to the great commands or stationed in fortified posts?

It is important to bear in mind that although the military engineer may not take command of the troops his military personality would not in any way cease, and we should not hesitate to declare his duties to be eminently military.

We are convinced that a division of labour may be conceived under which it may be possible to separate the position of the military engineer in time of peace from that which he would hold in time of war. As happened in the XVIth and following centuries there was always employed in the field a nucleus of military engineers, to whom was entrusted the carrying out and surveillance of great operations of a technical character with the aid of the engineer troops, of other troops, and of workmen assisting them. So also in latter times the same has become even more necessary, owing to the great importance in war of technical science, which, if properly used, constitutes one of the principal factors of success.

As has been proved in the late Russo-Japanese war, the battles of the present day become vast and complex operations of attack and defence, protracted for many days, if not for weeks. The very extended field of action in which the manœuvres of the immense armies of to-day are carried on, strewed with obstacles, concealing both the attackers and the defenders, has come to resemble a gigantic fortified position assaulted by the one side and defended by the other. The tactics of to-day exhibit in all the phases of development the necessity of strong reinforced positions and of bases indispensable as places for temporising and for waiting.

Now, how is it possible for the chief commander to organise all this

without the active aid of the above-mentioned nucleus of engineers, consulting and technical inspectors, ready to suggest the most suitable means, and to superintend the execution of the more important works, trusting to workmen of every kind, among whom in the first line are the engineer troops? To the direction of ordinary tactical works is added the direction of communications and information, necessities which inevitably spring up on the same battlefields.

From what has been said above it is clear that the military engineers attached to the great commands constitute an instrument of the first importance and one that is indispensable to the chief commander, who without their assistance would not be able to avail himself of the varied and powerful technical means that he should have at his disposal.

Such being the result of the services of military engineers of to-day in war, there can be no doubt of these being essentially military; nor do we think that their essentially military character should be disputed in any way in time of peace.

The construction of fortresses is one part of the art of war, and the technical military knowledge acquired by such construction includes the more necessary and practical preparation for the attack and defence.

Nor will the construction of fortresses limit the work of military engineers in time of peace. Their duties will also consist in the preparation of their services for war; and the military engineer should therefore study the development of technical engineering as applied to military science.

We have endeavoured to show the character and the nature of the services of military engineers, and we should also study their position with regard to the different branches of the army. The corps of military engineers should be a combatant corps; it should not cease to be such because its officers do not have direct command of troops, nor should its position and prestige be in any way lowered owing to this fact.

It would not seem to be out of place to recall once more that in the XVIth century the military engineers never had the command of troops, but still were soldiers and combatants. The great bodies of French military engineers in the XVIIth century never commanded troops. They were organized by Louvois, Minister of Louis XIV., under Vauban's suggestions, in a regular corps of officers who carried out the works during the continual wars of this period. Their illustrious chief, Vauban, without ever having commanded troops, reached the high rank of marshal of France.

An example of an appropriate military organization for the corps of engineers is shown in the Austro-Hungarian army. In this army the personnel of the military engineers is distinct from the officers of engineers who command troops; it constitutes the staff of the engineers, and is held in the highest military consideration, not inferior to that enjoyed by the general staff with which it shares the same privileges of promotion.

The military engineer may renounce the direct command of troops without losing his military character or having it in any way weakened. He should be the technical adviser and the organ of the commander for the multifarious and essential services of the engineers. In this modest

but important position he will be able to render signal services by his counsel and advice, and to weigh the chances of success which will shed lustre on the chief commander. The Italian military engineer of to-day will be proud to follow the noble tradition of his ancestors, who contributed by their inventions and technical skill to the glory of the commanders of the armies in which they served.

E. T. THACKERAY.

VOËNNYI SBÓRNIK.

April, May, and June, 1906.

SHIELDED GUNS.—An officer of the 6th Battery, 43rd Artillery Brigade, bears testimony in the April number to the efficacy of shields on the guns of his battery at the battle of the Sha-Ho. These shields were improvised, at the instance of the Lieutenant-Colonel Commanding the battery, out of the nearest material at hand, presumably steel, from 2½ to 3 millimètres (say ⅛ inch) thick, which was proof against the Japanese rifle at ranges of over 500 paces. On examining them, on the conclusion of hostilities, they were found to be dented all over, sure evidence of their utility.

They were made of two sheets, a lower one, hung loosely on rings under the seat, and an upper one, hinged so that it could be folded on the seat when not in use. On the march, the lower shield was hooked up under the seat. This protection, in addition to increasing the invulnerability of the guns in prepared positions, also secured the detachment from bullets up to 500 paces, when, owing to the advance of the attackers across the decisive zone, it was imperative in order to obtain better results to expose the guns on the crest line. Moreover, even if the shields were penetrated, their moral effect was good, as cases were observed of soldiers in a heavy fire covering their faces with their arms in order by this means to decrease the danger of being wounded.

Among the conclusions arrived at, from actual experience in the field, this officer states that gun-positions should preferably be chosen on undulating ground, as far as possible from conspicuous points, such as villages, solitary hills, etc., and that trenches should be narrow and deep, and the excavated ground not thrown in front if the position is an open one.

INSTRUCTION AND TRAINING OF FORTRESS TROOPS.—An article in the June number lays down as of first importance the necessity of instilling into all ranks absolute devotion to the Emperor and Country and the idea that a fortress should under no circumstances be surrendered to the enemy. In support of this General Kondratenko's order of 26th September, 1904, to the troops in Port Arthur is quoted, and it is noted that the capture of the ditch and rampart did not necessitate the fall of the keep.

The writer goes on to bewail the rigidity of the regulations of the Russian Army, which permit of no deviation from the set forms, and thus destroy initiative and the adaptation of the training to local conditions. The training should embrace firing by night and from behind cover, as these are the usual conditions on active service. Troops should be taught the use of hand grenades, and the taking of ranges of the surrounding country from various points in the fortress; they should be practised in digging trenches and making defences under the supervision of sappers, so as to accustom the two branches to work together. Further, the troops should be thoroughly cognisant of all details of the fortress, and not mystified as to the positions of the guns, etc., as appears to be the case at present in Russia owing to the desire to keep everything secret.

C. G. FULLER.

CORRESPONDENCE.

ENGINEER DUTIES IN GARRISON.

Baths and Roads.

Sir,

I should like to add one suggestion to the list of "Improvements to Accommodation" given in Capt. Henniker's admirable paper, in the June number, on "Engineer Duties in Garrison," viz., the addition of showers to the bath-room accommodation for N.C.O.s and men. Sometimes these may be substituted for plunge baths. They are much appreciated, produce saving of water, and enable many more men to take a bath in a given time. Munson's *Military Hygiene* contains some useful and interesting particulars. There is a good type of bath-house, containing plunge, shower, and foot baths, at the new Tidworth Barracks on Salisbury Plain.

Another point deserving of attention in many places is the improvement which may be made in roads by brushing boiling tar on to their surfaces. If the road is fairly well shaped its surface needs only to be slightly loosened. Boiled tar should then be poured on in a thin coat, well brushed in, and dusted over with coarse sand or very fine chippings or gravel. When the tar is hard the road should be rolled. Both mud and dust are greatly reduced by this process.

Yours faithfully.

E. R. Kenyon,
Colonel.

Gibraltar, 19th June, 1906.

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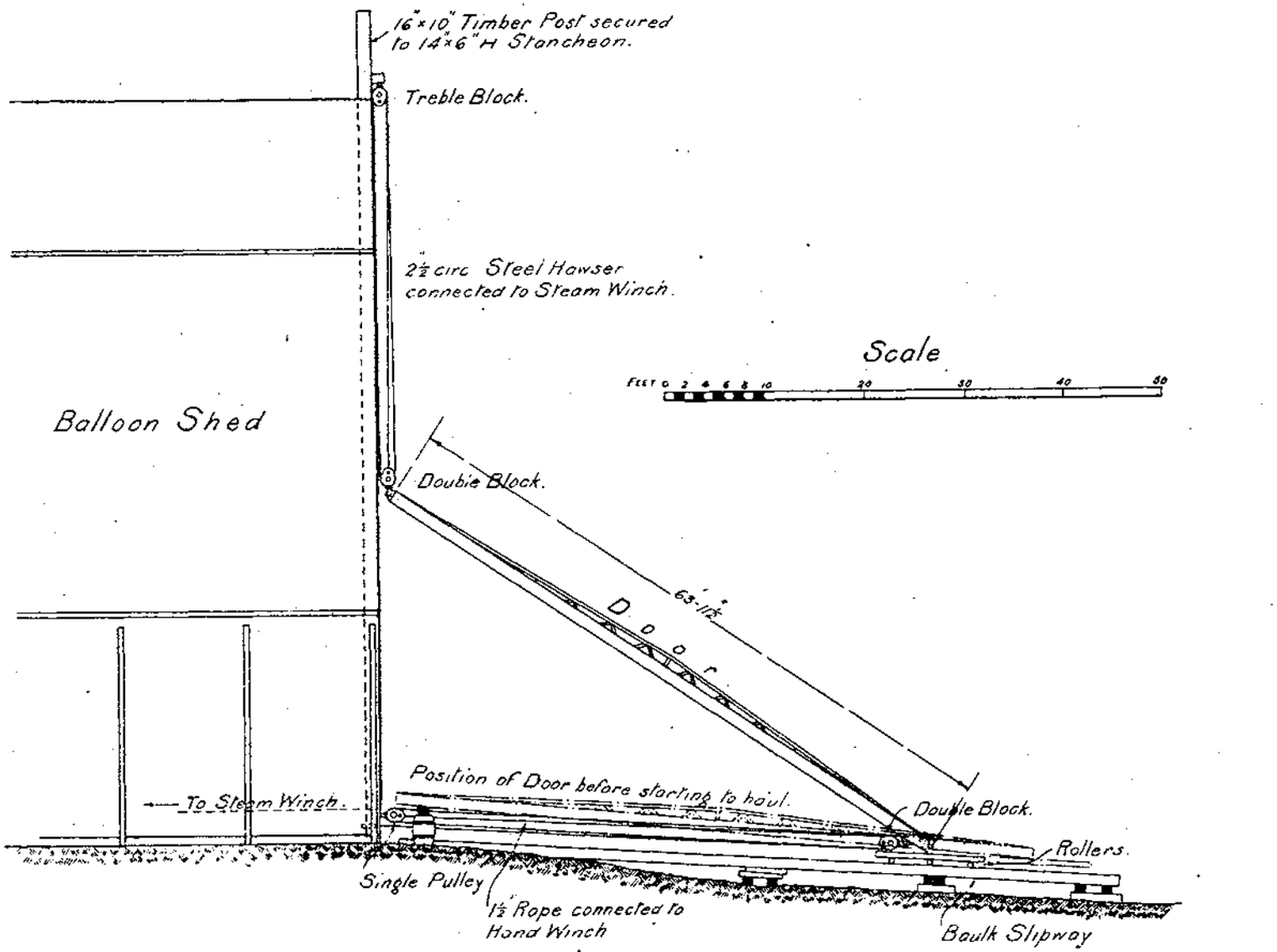
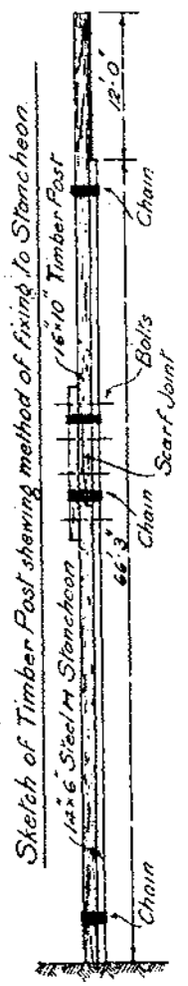
The Science of Dry Fly Fishing, by F. G. Shaw. (9 × 7. 3s. 6d. Bradbury, Agnew).

SHED FOR DIRIGIBLE BALLOON AT ALDERSHOT.

PLATE I

SKETCH OF ARRANGEMENTS FOR HAULING DOORS INTO POSITION.





SHED FOR DIRIGIBLE BALLOON AT ALDERSHOT.

PLATE II.

FIG. 1.
DETAILS OF DOORS

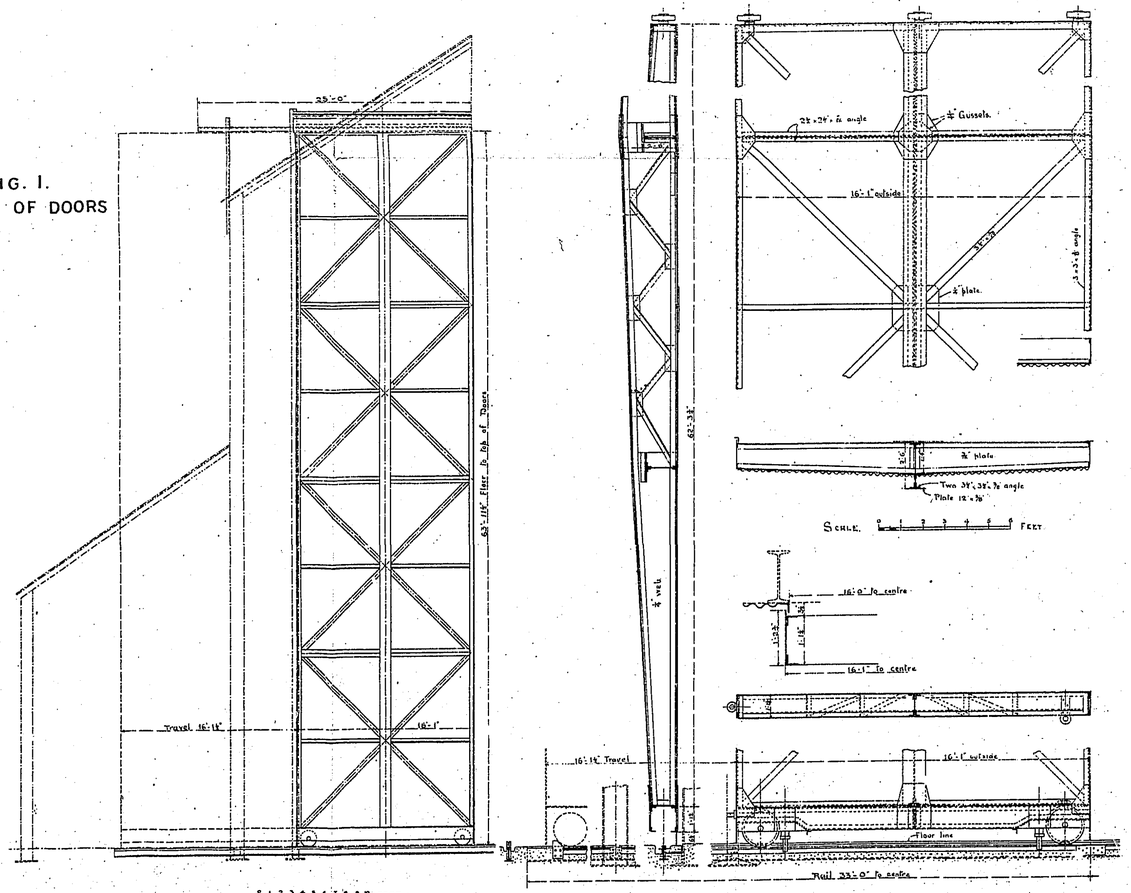
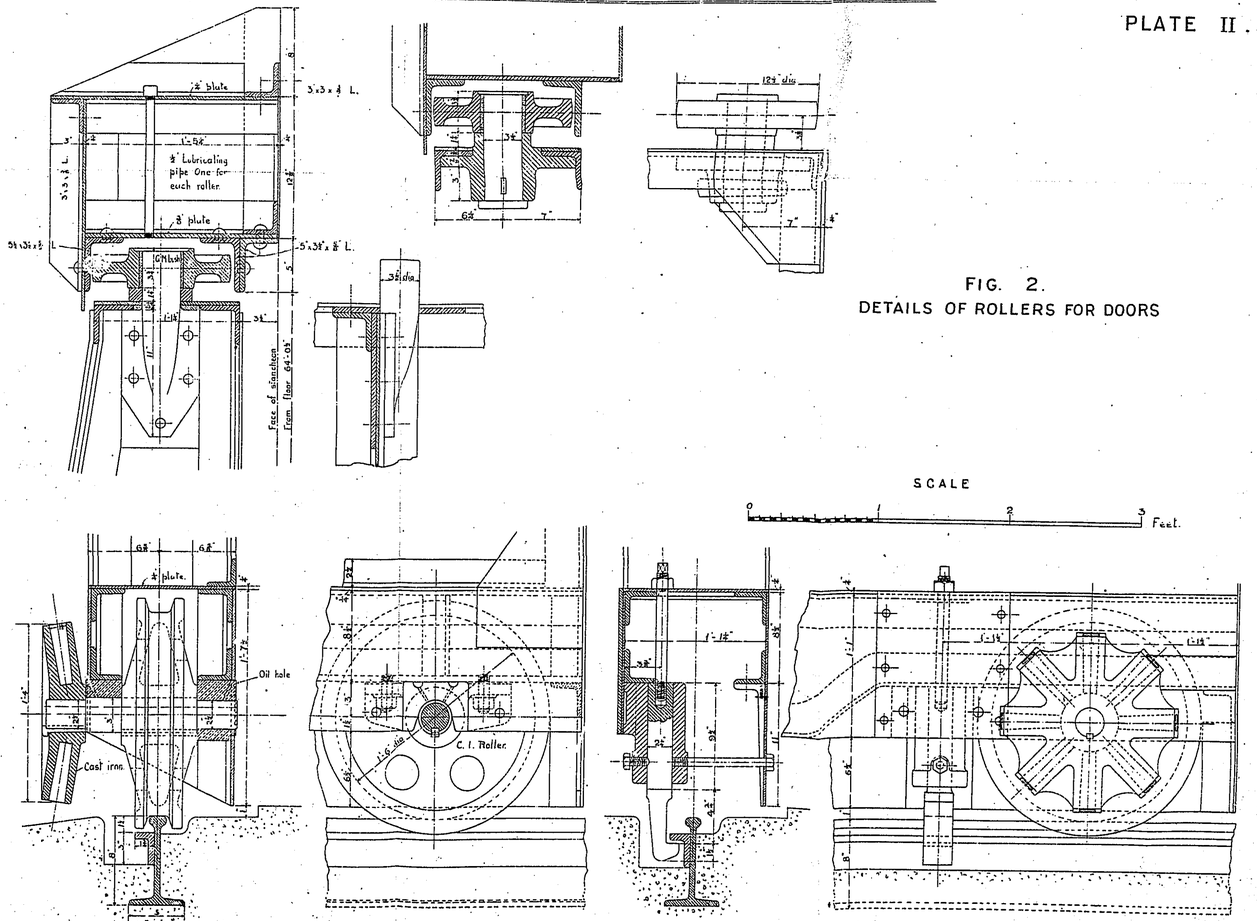


FIG. 2.
DETAILS OF ROLLERS FOR DOORS



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*Read partly at the Army College, Aldershot.

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August, 1903.

TWELVE passed in the Competitive List and FIVE received Nominations.

August, 1902.

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