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## Barr and Stroud Rangefinder, FQ Type



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

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.

## DOUBLE TOOL CART



DOUBLE TOOL CART EQUIPPED FOR FIELD TROOP, R.E.
(Lead and centre pairs of horses not shown).

## ENTRENCHING UNDER FIRE



## ROYAL ENGIVEER DUTIES IN THE TUTURE.

By Br. Cor. E. R. Kenyon, R.E.

As all important Barrack Construction work and all Hospital work at home stations have been, or are being, transferred to the new civilian Department, it is sometimes asked what work there will be for R.E. officers at home, especially for the semiors.

It is well known that very many R.E. officers urge that barrack repairs ought to be undertaken by the construction department, on the grounds that it is uneconomical to employ two staffs for building duties, that it is not right or economical to let one department erect buildings to be maintained by another which has had no voice in deciding the materials and methods of construction used, and that the repair duties occupy a great deal of the time of officers and noncommissioned officers while giving them little or no training of practical use as a preparation for war. If this view prevails it is obvious that the question of how the time of R.E. officers is to be usefully employed becomes still more prominent.

It seems to me, however, that the question really arises from the habit, which has been formed during long years of construction and repair duties, of looking upon building work as the primary duty of the Royal Engineer. In reality it has nerer been so. His primary duty in peace is the same as that of any other soldier, namely preparation for war. Building duties have been given to him on finaucial grounds, because it was considered wise in the interests of economy to employ on public works in time of peace the large number of R.E. officers and men who must be maintained for war purposes. This policy is now reversed; and this has led some people to think that consequently there will not be enough work to occupy the time of Chief Engincers, C.R.E.s, and the officers and non-commissioned officers under them. This is in my opinion an entire mistake.

There is one great duty which hitherto we have never had time to perform properly, mamely the thorough study of our own Districts or Divisions from a military point of view. Is there any C.E. or C.R.E. who is fully conversant with every road and railway, every village and town, every hill and valley, in his district; who has had complete road reports prepared and fled in his office; who knows all the possible defensive positions, the routes of adrance against possible invaders, the best lines by which to concentrate, the available railway resources, the possibilities of extending existing railways so
as to facilitate coast defence, the best camping grounds, the means of providing water supply, etc., etc.? On all these matters we can find plenty of occupation for a long time to come, and might be of great service to the Intelligence Department.

Again, in how many Districts has it not been the case that when additional officers are wanted in the summer as umpires, for staff rides, etc., the R.E. officers were "not available?" I think not only that every effort should be made by every C.R.E. to ensure that he himself and his officers are always available for such duties, but also that he should make a point of offering their services to his General, until the habit has been formed of looking on the R.E. as a valuable reserve from which the ordinary training staff can be expanded.

How often we find it difficult to provide the instructors who are being increasingly asked for by cavalry and infantry for their classes of officers and non-commissioned officers. Yet this is a most important duty, and one on which Generals and Commandants of Schools are most ready to welcome all the help we can give. We, in our turn, should gladly seize every opportunity of giving such help.

Much remains to be done in the development of systems of communication suitable for use on the march and in battle. Telegraphs, both wire and wireless, telephones, etc., have to be studied, experimented with, and developed. The training season gives great opportunities for such work.

The entraining and detraining of troops at extemporized stations have to be prepared for; and it is probable that at places where there are railway lines used only, or mainly, by W.D. traffic, practice might be obtained during the training season.

One more point I should like to emphasize is the duty of studying sanitary questions. I am afraid that in times past some of us have rather looked upon the medical officer as a terrible nuisance, who is always "asking for more" in the way of prevention of possibilities of disease; and this has arisen from the fact that the medical requests entail great inroads on our time and on the funds at our disposal. Yet good sanitation is of enormous military importance both in barracks and in the field; and it is essential that every military engineer should be able and willing to co-operate with the medical officer in providing for the sanitary services on the march and in camp, cantomments, and barracks. I include barracks, because, though we shall not build them at home for the present, we may during campaigns abroad have to improvise and occupy them.

The above outline sketch of duties wouk apply to every R.E. officer in greater or less degree according to his rank. But in the Fortress and Coast Commands there are the added duties of fortification, involving minute study of every possible form of attack and defence, of all the means of extending and organizing defensive works, of facilitating the movements of troops, the methods to be adopted
for opposing landings of large or small bodies, etc., etc. Also in all Coast Districts practice should be obtained in arranging for embarking and disembarking troops of all arms.
A rery slight consideration of these duties will convince most people that the posts of Chief Engineer of a Command or a Fortress and of C.R.E. of a District should be no sinecure in the future; and that, far from finding it difficult to give work to their subordinates, their trouble will be to decide the order in which all the duties are to be taken up and to so arrange them that there may be time for their execution, for the due performance of all other military duties, anda very important matter-for systematic and regular study of their profession. It is utterly wrong that-as has hitherto so often been the case-the time of an officer should be so fully occupied that he has no opportunity for study of military history, for working out military probiems, and for making himself acquainted with the organization, duties, and working of the other arms and branches of the service.

## ORGANISATION OF ROYAL ENGINEER UNITS FOR EMPLOYMENT WITH CAVALRY.

By Capt, C. de W. Crookshank. R.E.

The whole question is a comparatively new one, and had its inception in the "Mounted Detachment" which, during the late South African War, developed into 4 Field Troops of which 3 still exist. The title Field Troop is redundant and was presumably adopted in the first instance for want of a better; at that time the Corps possessed other troops (namely Pontoon and Telegraph), but these are now designated companies so that the term "Troop" would now be ample, its Field nature being implied.
The requirements of the Army are for 4 Cavalry Brigades and for a considerable mounted force in South Africa, equivalent to 2 Brigades. At the same time everyone will agree that on the score of expense a large number of R.E. Troops cannot be maintained, particularly as with their present establishment it is tantamount to keeping a number of Sappers doing little eise than grooming horses and routine military duties, with practically no opportunity for getting on the works and keeping up their trades.

This Trade question is a particularly important one, and I submit that for the Cavalry arm it is necessary to have a few Sappers with high qualifications; my reason being that, as Cavalry will more than ever have an independent role in warfare, working either in screen or in detached masses, and will consequently operate principally at considerable distances from the main Army, the Engineers with it must perforce be entirely self-supporting and must be capable of carrying out any jobs in Telegraphs, Railways, and General Engineering that may present themselves, until the Special R.E. Units of the main Army can take them over or necessity ceases.*

To assist in this and to realise economical working, Cavalry Pioneers must be made more use of. These require more training and encouragement ; but outside England, where Classes and the Annual Field Troop Camps offer opportunities, little has been done, and the Pioneer exists virtually in name only. Furthermore, they have no technical vehicles for the carriage of tools, pumps, etc., and with the abolition of wallets their last chance of carrying a few explosives (under very dangerous conditions) has disappeared.

[^0]I am consequently led to make the following suggestions for the proper organisation of R.E. Units for the Cavalry arm:-

The present Field Troops should be reconstructed as 3 Squadrons, R.E. (lettered A, B, C), each consisting of a Headquatters and 2 Troops (A and B); one Troop to be the normal R.E. Unit for a Cavairy Brigade. This will give the requisite War Units for 4 Brigades at Home and for the Force in South Africa; and will furnish Peace Units of better proportions than the existing ones (i) for command and training, (2) for employment on "Works." The units would be organised with ranks, etc., corresponding to those of Cavalry, and adapted for the accommodation of its Pioneers in Peace and War.

## Establishment of Proposed Sguadron, R.E.

I will first work through this in detail for officers, personnel, riding horses, and trades, and thence deduce the establishment of vehicles and draught horses required.

The strength under these heads is for "Higher Establishment"; these Units should be kept at such in Sapper personnel, as trained mounted Sappers cannot be satisfactorily produced at short notice (good tradesmen are rarely handy horsemen and vice versá); any peace reductions to produce "Lower Establishment" economies should only appear in draught, personnel, and horseflesh.

Offcers.-- I Major, I Captain, 3 Subalterns (i extra to be added on mobilisation).

Offcers' Horses.-io. Two horses per Subaltern are necessary in these units; there seems no reason why the R.E. Subaltern should be the only combatant officer in a Cavalry Brigade not allowed 2 horses in Peace Establishments.

Headquarters.-*I Squadron Sergeant-Major, ${ }^{*}$ I do. Ouarter-master-Sergeant, ${ }^{*}$ i Farrier Sergeant, I each Pay, *Wheeler and Saddler Corporals, ${ }^{*} 2$ Trumpeters.

Horses for above.--6 (for those marked *).
Each Troop.*-2 Sergeants, 3 Corporals or and Corporals, 3 LanceCorporals, i Shoeing and Carriage-smith (farrier certificate), 24 Sappers.

Horses for above.- $2_{4}$.

* The N.C.O.s detailed include 3 for the draught establishment. In a mounted unit like this, I am confident it is far better to eliminate the differences which at present exist between the mounted and dismounted branches of the Corps, and which are difficult to avoid in Field Companies and similar units having mounted ranks for Transport duties only.
Draught Section N.C.O.s should, where all are mounted, take their place and assume responsibitity according to rank and without prejudice, and the system improves their status and minds and works satisfactorily (c.f. the Telegraph Companies, R.E.). The Senior N.C.O. on any occasion (whether sapper or draught branch), while responsible for the whole party, takes in detail responsibility for "work" or "horses" after distribution.

Trades (each Troop).--j Telegraphists (3 office, a permanent line), 4 Engine Drivers (2 locomotive, i road, a stationary), 2 Fitters, 2 Smiths, 6 Carpenters, I Wheeler, I Saddler, 2 Bricklayers and Plasterers, i Plumber. Total- 24.
As regards Trades, I have selected the most suitable; and of these the most important are the Telegraphists and Locomotive Engine Drivers. With this strength in Telegraphists a cable cart can and should form one of the techmical velicies of each Troop, which can then be in a position to put through damaged lines or keep its Cavalry Brigade in cable connection with the main Army and to work lines (covered by the Cavalry only, in wide movements), under ordinary conditions without being dependent on Telegraph Units (whose hands will be fuil) to detach parties. Personal experience during the past two years with a Cable Section added to the Field Troop under my command, in addition to Telegraph experience in war, convinces me of the importance of this arrangement, which is after all only slightly increasing and employing to full value the establishment of Telegraph Trades laid down for a Field Troop and giving them the mobile vehicle necessary to carry out their work.

Locomotive Engine Drivers do not, I believe, figure in the Trades at present authorised; but their necessity in a Troop requires no comment. The Director of Railways and the Field Troop Commanders during the late war will, I feel sure, agree.
A summary of the detail given so far furnishes therefore a Squadron R.E. of the following strength :-


Total:-Officers 5; Other Ranks 74; Horses:-Officers 10, Riding 54.

This will not be found to be a large increase on the present Sapper Establishment (War) of a Field Troop. It supplies, howerer, 2 Troops for War, Manocuvres, and Training; and, in virtue of an increase in men and a reduction (pro rata) in horses, will enable a Squadron to employ its 2 Troops in peace time on the "works" or in "stables" alternately, complete as such, which is the only satisfactory solution of the troublesome question of horse Sappers.

It may be suggested that the strength of a Troop is now insufficient for a Cavalry Brigade, but I propose making this good by employing the Pioneers of the regiments forming the Brigade to which the Troop is affiliated; and for this purpose 2 N.C.O.s and 6 men from each regiment, making 24 of all ranks, should be attached for Manœuures, Training and War. In the event of a Regiment being temporarily detached for special duties, its Pioneers and a proportion of the Troop Sappers should accompany it with a pack horse and tool waggon. This brings us to the question of the Establishment of Vehicles.

Establishment of Technical and Obligatory Vehicles, Draught and Pack Horses, and Drivers for a SQuadron, R.E.

> FOR EACII TROOP.
> Hozses.

| Description. <br> Tool Waggons | $\begin{gathered} \text { No. } \\ 3^{*} \end{gathered}$ | Draught. $18$ | Pack. | Remarks. <br> * I extra for Pioneer Troop. |
| :---: | :---: | :---: | :---: | :---: |
| Cable do. ................ | I | 6 | - |  |
| Boat do. .................... | I | 6 | - |  |
| G.S. do. for Spare Cable, etc. | I | 4 | - |  |
| " Technical Stores | 1 | 4 | - |  |
| Forage Cart ............. | I | 2 | -) | and Line, horsed, etc., by Army |
| Water do. ............. | I | 2 | - | Service Corps. |
| Pack Animals for Technical Stores. | - | - | 3 |  |
| Totals ........... | 9 | 42 | 3 |  |

For all ordinary peace requirements, however, teams are only required for:- 2 Tool Waggons, y Cable do., I Boat do., and I G.S.do. (for spare Cable, etc.).-Total 28 horses. Making a total for the Squadron of 56 draught horses, 6 pack horses, and 18 vehicles.
To cover all requirements, a strength of $4^{6}$ drivers would be necessary, resulting in a Summarised Establishment for a Squadron, R.E., of :-

Per Squadron. For 3 Squadrons.
Officers ................... 5 I5
Rank and File ............. I20 360
Horses, Officers ........ 10 30

| $"$ | Riding.......... | 54 | 162 |
| :--- | :--- | :--- | :--- |
| $"$ | Draught...... | 56 | 168 |

If compared with a total for 6 Field Troops required under the present organisation, this shows a saving in favour of the present proposals, without considering other advantages.

As, however, there is no immediate necessity for keeping 3 Squadrons on the "Higher Estabhishment," a suitable "Lower Establishment" can easily be produced by a reduction in horses (riding, draught, and pack), and consequently in the Draught Branch ranks, to that required for the Headquarters and I Troop, which gives-
"Lower Establishaent" Souadron, R.E.
Remarks.

| Officers | 4 | (I Major or Captain, 3 Subalterns). |
| :---: | :---: | :---: |
| Rank and File ... | 98 | (less 2 N.C.O.s, 20 Drivers). |
| Horses, Officers... | 8 |  |
| ,, Riding ... | 30 | (Headquarters 6, i Troop 24). |
| Draught... | 28 | ( F Troop). |
| , Pack ...... | 3 | do. |

Such a reduction would not result in any loss of efficiency as the Establishment is complete in every detail for peace training and work, and the Unit is readily made up to a "Higher" state by the addition of an officer and of draught ranks and horses.

One Squadron on the "Higher Establishment" for the Aldershot Army Corps and two Squadrons on the "Lower Establishment," one at home and one in South Africa, should thus settle the Cavalry requirements in R.E. Units at a total of:-

and this is, I am sure, the least strength which should be maintained in order to ensure good results.

## APPENDIX

## Tool Wagbon for Fimld Troops.

The accompanying photo shows one of the Tool Waggons which I have improvised for use in the and Field Troop. (Owing to a faulty shutter the lead and centre pairs were fogged on the plate, and have been stippled out so that the Vehicle appears with only wheelers in draught).

The limbers are the ordinary Pom-Pom limbers, with slight alterations to the boxes. The wagron bodies were made up from some vehicles brought out by the Electrical Engineer Volunteers for Search Light work in the late war, but which had to be considerably modified and altered to produce the present article.

The weights are-


The wheels at present used are 3rd Class B. 158, and seem to answer well, though they might possibly be made slightly heavier; but as South Africa is so much harder on wheels than home, this point is not serious.

The vehicle has ample clearance, a defect which, to my mind, makes the ordinary R.E. Double Tool-Cart quite unsuited to cross-country work, Having come out well after full and most exacting trials over all varieties of rough country and at all speeds, the design seems not unlikely to furnish a pattern which should meet all requirements for Cavalry use.

I add Loading Tables, which detail the contents answering local requirements; but as different conditions demand different stores, they are not submitted as "hard and fast" examples for adoption.

# 2ND Fifli Troop, R.E. <br> TOOL WAGGON FQUIPMENT. <br> (Loading Tables). 

| Destription. | So. | Description. | No. |
| :---: | :---: | :---: | :---: |
| Immer (Fromi Box) |  | Primers, i-02, boxes of 5 | to |
| İrushcs, carriage | 1 | ", 2.0\%. ", 5 | 3 |
| I'liers, wire cutting | 3 | Matches, Vesurian .............ioxes | I |
| T" side !, | 3 | Slow match .. ..................piece | ! |
| Tapes, measuring, ico ft. | 1 | Fuse, safety .. ..................... box | ! |
| S", lracing | 2 | Tape, india rublut ... . .......... , | I |
| Spanners, hest pipe ...... | 2 |  |  |
| Pins, "lynch............... | 1 | Limber (rear box). |  |
| Pins, lynch.... | 2 | Ases, hand. | 3 |
| Augers, screw, | 1 | " felling | 5 |
| " | 1 | , handles, spa | 2 |
| " ${ }^{\prime \prime}$ | 1 | Blocks, brake | 2 |
| " " | 1 | Hammers, slodge, 14-1 | I |
|  | t | * mincr's boring, 7 | 1 |
| Handles, atiger ${ }^{\text {2* }}$ | I | " mason's spalding | 1 |
| Bevel steel blades, | 3 | " stone breaking | 3 |
| Buzzers, whecier's... | 1 | Hook's handles | 3 |
| Awls, brad, blades | 3 | Hooks, reaping, large | 3 |
| Handies for do. | 3 | Sose, canvas, $40-\mathrm{ft}$. | I |
| Chisels, fromer, $1 \frac{1}{2 \prime \prime}^{\prime \prime}$ | 1 | Stone, grinding, G.S., $10^{\prime \prime}$. | I |
| " | 1 |  |  |
| " | 1 | (Explosives). |  |
| " | 1 | Fuse, instantaneous .................bos | 1 |
| ", " | , | Guncothon* |  |
| " ${ }^{\prime \prime}$ | 1 | ,, Cavalry | I |
|  | 5 | Ammunition, S.A., 303 | ! |
| Ifandes for do. . | 1 |  |  |
| Gimlets, common | 3 | Lhmber (Outside Equipmext). |  |
| Hammers, $24.0 z^{\prime \prime}$ | 1 | Bars, crow $\}$ or on the Wagon $\{$ | 2 |
| Kammers, $24-0 z$. | d | ", boring $\}$ Trail. | 1 |
| Lantes, dressing, folding | 1 | Ropes, picketing, So-ft. ........ | 1 |
| Mallets, cripenters | 2 | Wwinule drag, large.. | 2 |
| Yincers ....... . . | 1 | Swingle trees, spare | I |
| Pencils, sarpenter's | 3 | Traces, rope, A.S. |  |
| Pins, draw, bore 12 " | 1 | Poles or brars, brcas | I |
| Punches, carpenter's | 1 | Boxes, grease | I |
| Saw, hand, $26^{\prime \prime}$ | I | Whggon (Provt \%ox). |  |
| $\because$ turniag | 1 | Lines, Hambro ....... ..... |  |
| Spokeshave. | 1 | Inshings. |  |
| Square, carpenter's | ! | Fickets, $\mathbf{2}^{\prime} 6^{\prime \prime}$ | 54 |
| Screwdriver, 12 " |  |  |  |
| Stones, oil | 1 | Whggon (rear bon). |  |
| Wedge, boxing | : | Axes, pick, head | 30 |
| Planes, jack | 1 | 1 , helves ... | 45 |
| Chalk, white..................... .....libs. | 1 | Mauls, G S. | 5 |
| Bays, carpenticis | 1 | Shovels | 15 |
| Bucket, leather, male and fenale, for <br> L. \& F. pumps | 2 | Spades. | 15 |
| Washers, leather | 6 | Waggos (Outside Equipameti). |  |
| Drag Washers ............. (Explosives). | 2 | Pumps, lift and force, with 2 lengths delivery and $i$ do. suction hose complete $\qquad$ | I |
| Caps, commercial (10) ...........boxes | 1 | Handles, pump ........................ | 2 |
| Detonators, Ňo. S, cylinders ..... ..... | 2 | Troughs, canvas (2,300 gai.) ........ | 2 |
| ", "13 , | \% | Ropes, trough | 2 |
| Bags, gruncotton | 2 | Puckets, leather (water) | 2 |

- Avzequirer.


## ENTRENCIING UNDER PIRE.

By Br. Lt.Col. G. M. Heath, D.s.o., R.E.

Recent experience shows that the infantry soldier must carry on his person some sort of entrenching tool. Tools caried on pack animals or in carts may not always be available when most required, that is when attacking infantry are brought to a standstill by the intensity of the enemy's fire.

In selecting a portable tool a choice must be made between three alternatives :-
(I). A combined pick and shovel, weighing 3 to 4 lbs ., designed for all purposes, as carried by us before the South African War.
(2). A light pick carried by one man and a light shovel carried by another, as in the Japanese and some other armies.
(3). A very light implement, weighing $1 \frac{1}{2}$ to 2 lbs., carried by every man, and good enough to enable him to scrape a hole for himself whilst lying down under fire; to be supplemented by full-size tools, carried on pack animals or in carts, for use when circumstances permit, e.g. at night.

The combined pick and shovel has been tried, but was discarded as unsatisfactory after the South African War. A large number of such implements have been devised from time to time; as a rule, they appear to be too small and weak for serious work, while unnecessarily heavy for use under fire. The weight adds considerably to a soldier's burden and experience proves that such a tool is apt to be thrown away.

Useful, and at the same time light, tools can be designed under class (2); but these suffer from the serious objection that the man carrying the pick is likely to get separated from the man carrying the shovel.
Implements of class (3) have been tried from time to time at Chatham, notably a trowel invented by Sir Richard Harrison and improved by Colonel L. C. Jackson, and more recently various adzeshaped tools designed by the Fortification School. It appears that in ordinary soil practically as good results can be obtained, lying down, with the last-named implements as with the heavy varieties;
they are very light and every man can carry one; while for serious work not under fire the heavy tools will be available.

The last system would seem to be the best of the three; but the whole subject requires ventilation.

Experiments with various tools have been carried out recently at Chatham. The three photographs in the frontispiece show the work done in half an hour in ordinary soil ; the uppermost shows the men commencing to dig, the centre the progress about half-time, and the lowest the party covered from view. There was little to choose between the various implements mentioned on the photographs. The parapets at the end of the half-hour were only about If .6 in . thick, and would have kept out a good proportion of builets; but another quarter-hour's work would have been sufficient to provide the protection required.

Under present arrangements, as stated, our Army is primarily responsible for the defence of the coast fortresses, but still both Services must co-operate in carrying out the details of any scheme. As instances of questions which require mutual consideration we may mention-(i.). The regulations for the examination service and the passing in and out of the port of friendly vessels. (ii.). The transmission to the Fortress Commander, as soon as possible, of intelligence from Naval sources as to the whereabouts of the enemy's fleets or ships. (iii.). Arrangements with the Naval officer in charge of the local submarine and torpedo craft, whose sphere of operations would, as a rule, be immediately in front of the fixed defences.

Many other mutual arrangements, which will be necessary, will no doubt suggest themselves to one's mind; and this necessity is provided for in most modern coast fortresses by the formation of a permanent joint Naval and Military Committee, which the Commander of the Fortress, as President, can assemble, from time to time, as he considers necessary, whether for the purpose of preparing for war in times of peace, or for carrying on a successful defence during war.

## Type of Defences.

The type of defence to be adopted in a coast fortress will depend on:-(A) the nature of attack that may be expected; (B) the local conditions of the port; and (c) the strength and nature of the garrison that is likely to be available.

I do not propose to deal with the question of defence against attack from the land side, nor do I propose to take into account the amount of assistance that may be obtained from the defenders' own Naval forces, as this latter may, at any time, cease to exist either permanently or temporarily.

## (A). NATURE OF ATTACK THAT MAY BE EXPECTED.

Any modern scheme of defence for a coast fortress in Great Britain will have to consider the following forms of attack, and each form may be combined with one or more of the others, the one form being often employed as a blind or feint with the object of giving a better chance of success to one or more of the others:-
(a). The attack by torpedo craft at night.
(b). The attack by submarine or submersible vessels by day.
(c). Bombardment by large war vessels.
(d). Blocking operations, by sinking vessels in the fairway, where harbours have narrow mouths or artificial entrances.
(e). The laying of mines to prevent ingress or egress from the port.

## SOME NOTES ON THE MODERN COAST FORTRESS.

By Col. T. Ryder Man, c.b., R.E.

These notes make no pretence to teach the whole duty of the military engineer with reference to the defence of a modern Coast Fortress. They are notes and nothing more.

My only excuse for writing them lies in the fact that, at the present time, much thought is being given to this special type of defence, owing to the lessons of the Russo-Japanese War; and that I, as Chief Engineer of the Portsmouth and Portland defences, have had opportunities of discussing and considering the various changes and modifications that the lessons of that war are forcing upon us.

I propose to omit, as far as possible, the general descriptions to be found in the text-books and elsewhere, and to dwell rather on novel views. These views, as expressed, must be taken as my own, and may not be concurred in by cveryone. Their consideration can do no harm and may do good.

## Responsibility for the Defence.

On the declaration of war the primary duty of a Navy so powerful as ours would be the seeking out of the enemy's fleet, with a view to its destruction. To do this satisfactorily the Navy should have its hands free, and it should not be hampered by having to look after the defence of its "bases"-strong fortified ports, where its ships could be repaired or replenished with coal, ammunition, provisions, and men. On this account it is usual in the British Service to provide " fixed" defences at these ports, and to intrust the land forces with their design in times of peace and their manning in times of war. The relative advantages and disadvantages of this system have been much discussed. On the one side it has been argued that as the Naval bases are solely for the use of the Navy, who are specially acquanted with the methods of attack that are likely to be used by ships, it were better that the Nary should also take charge of the fixed defences; whilst on the other side it is argued that the Nary in time of war will have quite enough to do in "blue water" withont frittering away their time and opportunities in operations on land, and further that the defence of a coast fortress may be from the land as well as the seaside, as was exemplified in the recent attack on Port Arthur.

To explain these attacks more in detail:-
(a). All our harbours, and especially those on the Southem or Eastern Coasts, are liable to attack by torpedo craft by night, which may be expected immediately on, or even prior to, the declaration of hostilities. This fatter fact is fully recognized in our modern defence schemes, and steps are taken to mect such attacks accordingly. It is the most hkely form of attack nowadays, offering as it does a chance of producing far-reaching advantages for the attacker with very hittle commensurate risk.
(b). The landsman cannot assist to any great extent in beating off an attack by submarines or submersibles, and it would not therefore be likely to affect any of his schemes of defence.
(c). As regards bombardment by large warships I cannot do better than quote from Garrison Artillery Training, Vol. I., 1905 :-"The attamment of sea command being the vital issue, an enemy will rarely be prepared, before that issue has been determined, to risk the loss or the crippling of a portion of his battleships or cruisers by exposing them at effective ranges to the fire of shore batteries. The recent development of torpedo craft and submarine boats have, moreover, much enhanced the risk incurred by battleships and cruisers in delivering an attack on a port in which such craft may be stationed."

Still the unlikely may happen, and has happened before now, and the object of coast defences is to prevent such possibilities. Fog has to be specially considered in our English climate in connection with this and many other forms of attack; and there are many positions which war vessels could take up in the vicinity of our modern coast fortresses, in which they could not well be fired upon in thick weather, and from which, nevertheless, they could in a short time produce a very telling effect on a dockyard or on ships crowded together in a harbour.

In these days of wireless telegraphy the movements of all warships will be pretty accurately known to both sides, and the fact that our ships may have been called away for a time to concentrate at a certain point may tempt a few armoured cruisers of the enemy to appear before a port, to which our fleet cannot return for say 24 hours, and, after delivering a rapid and telling bombardment, to get away again before they can themselves be punished.
(d). Some of our harbours are specially open to blocking operations, on account of the narrowness of the natural ships' channel at their entrances, and some on account of the narrow passages through artificial breakwaters. The Japanese in the late war, as is known, made many unsuccessful attempts to block the entrance to Port Arthur; but they would probably have met with more success if they had had at their disposal some of those old battleships and cruisers which we are now throwing away. Such vessels would stand a lot of lmocking about from shore batteries at night (especially as the
heavy guns of those batteries would probably have no auxiliary lights) and would, if sunk in the fairway of the harbour's entrance, possibly prevent ingress or egress of warships for many weeks.
(c). Attack by mine-laying (if attack it can be called) evidently bears but little on the question of "fixed" defences.

## (B). THE LOCAL CONDITIONS OF THF PORT.

The siting and nature of the fixed defences of a port must, of course, be much influenced by its local conditions; and hence a good sea chart and contoured map of the surrounding country is an absolute necessity to the designer of coast defences, who must also have an accurate knowledge of other details such as the rise and fall of tide, the strength and nature of currents, etc.

## (c). THE Garrison that is Likely to be available.

It is not necessary to dilate much upon this self-evident fact that the design of the defences must be much influenced by the numerical strength and value of the troops that can be allotted to them. Where skilled troops are plentiful a type of defence may be entertained which would be quite out of place where many such troops could not be supplied.

## Defersive Measures against the Different Forms of Artack.

Let us now consider how the different forms of attack can be met with the greatest probability of defeating them.

$$
\operatorname{ATRACK}(a) .
$$

Attack (a) by torpedo craft will be delivered at might; and therefore it is imperative for the defender to have a considerable portion of water area well illuminated to allow of the anti-torpedo-boat guns stopping all hostile vessels that attempt to pass them. Remember that these guns are at all times practically useless unless there are ample lights to assist them.
The usual arrangement, where local conditions so permit, is to have an outpost line and inner defences so arranged that the gun resistance and lighting become stronger as we gradually approach the entrance of the port in which the friendly ships can he behind a strong boom.
To warn the guns many look-outs are employed, and these, on detecting the presence of a hostile boat, can ring alarm gongs at all the Q.F. gun groups, and can commumicate by telephone with the different Fire Commanders. Remember that the control of fire of the O.F. anti-torpedo-boat guns is in the hands of the Gun Group Commander and is not controlled by anyone else.

On defence lights and their details I will only touch lightly in these notes. They are fully described in Major Baker Brown's pamphlet "Electric Lights for Coast Defence."

I think that more attention, than is usual, might be given in the modern fortress to the question of protecting the lights both from raiding parties and from the hostile fire of boats, and that the lights should have more spare projectors and engines than at present. Our present system of lighting is run on such an economical scale that if one light is out of action for even a short period a very awhward unilluminated area is formed at many vital points.

The old question of the control of the electric lights crops up again from time to time. I noted the following remark in the 'Highly Commended' Duncan Essay for 1905 by Major H. B. Wood, R.G.A. :"In home waters the control of the electric lights is at present vested in the hands of the R.E." Now this is scarcely correct. The control of the electric lights is, by offcial instructions, in the hands of the Section Commander and he can delegate that power to whomsoever he likes, provided he bears in mind the general instructions to the effect that artillery fire at night will be assisted by "fixed" beams only, and that although "search" lights may sometimes be employed for the purpose of discovering the movements of an enemy's ships, they will only under exceptional circumstances be used for following or fighting them by artillery fire. Peace manouvres have shewn that nothing aids the passage of hostile boats more than putting the control of gunfire and lights into the same hands. The R.E. with their lights assist the R.G.A. with their guns in the defence of a coast fortress in somewhat the same way as the R.F.A. assist the infantry in the attack of a position, but no one would advocate the control of field guns being put into the hands of the brigadiers of infantry. Major Wood adds in his essay "All appear to agree with the principle that electric lights and guns should be under one head." Quite so, but that head should not, primarily, be the R.E. or the R.G.A., but the Section Commander, who is responsible for the defence of the whole section.

The inner lights should not as a rule be exposed continuously; they should be "damped" until the alarm circuit gives warning of the approach of a hostile vessel; and it would appear that the look-outs on that circuit should have the power of warning the lights as well as the guns, which is not the present arrangement.

Owing to the necessity of constant peace practice with the lights their positions are probably well known to all foreign powers, and it would appear advisable to arrange in peace time for certain extra lights to be erected on mobilization so as to act as false guides to an enemy's vessels, and so possibly run them ashore. Naval men, who have had experience of the difficulties of handling torpedo craft in the glare of electric lights, specially advocate the use of such false Iights.

The effective range of electric lights as regards the laying of guns is generally much overstated in the text-books. In considering defences those distances may well be lessened by 30 to 50 per cent. Attack (a) is not likely to be delivered in England on a night that would allow of the maximum effective range of the lights.

The present anti-torpedo-boat guns are for the most part of the I2-pr. Q.F. type. It is doubtful if these guns are sufficiently heary to stop a modern destroyer, and it is probabie that many of them will have to be replaced before long by others of a heavier type. 6 -prs. give no commensurate return for the manning numbers required to work them.

## ATPACK (c).

Attack (c), or bombardment by war vessels, will probably never take place as long as vessels camot carry it out without the risk of receiving considerable punishment themselves; but this fact points at once to the necessity of having guns of sufficient calibre placed well to the front to prevent hostile vessels from getting into positions from which they could bombard satisfactorily. It is stated that Admiral Togo, after some experience before Port Arthur, issued a general order that none of his vessels were to approach within 12,000 yards of the guns of the defence. He would not have been compelled to exercise this precaution unless the Russians had mounted powerful guns to oppose him.
In modern designs therefore we aim at pushing our heaviest guns $\left(0^{\prime \prime}=2\right)$ to the front to fire on all waters there in which big war vessels can manccurre, and at removing them from interior waters into which, in the present day, such vessels could not penetrate.
There seems to be but little likelihood of a heavier gun than the $9^{\prime \prime} \cdot 2$ being used for coast defences. The reason for this was explained by Major-General D. D. T. O'Callaghan, c.v.o., President of the Ordnance Conmittee, in a recent number of the Royal Artillery fournal. The projectiles of the 9 ":2 gun are about the heaviest that can, on an emergency, be man-handled; and the expense and complications of a $12^{\prime \prime}$ barbette mounting would be so great as to render the employment of so heavy a gun improbable, in the immediate future at any rate.

It has been adrocated by some that the medium guns (6") should be done away with altogether, as boing useless against modern armoured vessels. I do not concur in this riew, because:-(i.) there are many parts of a modern war vessel of the ist class that are unarmoured, and, if we are to believe newspaper reports, Admiral Rozhdestvensky has stated that at the battle of the Sea of Japan his vessols suffered more from the fire of medium guns amongst the personnel, etc., than from that of the heavy guns; (ii.) it is important to have some medium guns in the front line to act as auxiliaries to the $9^{\prime \prime} \cdot 2$ gums by

## the mechanical conveyance of orders.

By Major L. J. Dopping-Hepenstal, R.E.

Of late years, on shore, orders and instructions seem seldom to be conveyed by purely mechanical means, electricity and electrical dials being much used, often unaccompanied by any other alternative means of communication. Mechanical telegraphs still hold their own in the Navy and merchant shipping, and it is worth considering whether, for short distances, in and around forts, etc., we make sufficient use of purely mechanical means. There would appear to be a field of usefulness for mechanical telegraphs in forts. I often thought, also, that we neglect too much the old-fashioned speaking tubes as an auxiliary aid.

The commonest form of telegraph usualy met with consists (roughly speaking) of two dals, so mechanically comected that when the pointer on the Bridge Dial is made to point to a certain instruction set forth thereon, the pointer on the Engine-room Dial takes up a position pointing to the same instruction (e.g. "Full Speed Astern"), a gong being at the same time rung; any motion in either direction rings the gong to call attention. It is supplemented by a reply arrangement, and sometimes also by an automatic compliance indicator, neither of which it is necessary to describe here. The working is done usually by an endess taut chain, the pointer in each dial being rigidly connected to a sprocket wheel (or pimed drum or disc), from which the chain takes its motion. As a matter of cconomy and simplicity, long straight stretches of chain are always replaced, between points of change of direction, by lengths of stout wire, this in no way affecting the theory or working.
In all such dial instruments we get :-
(1). An idea or intention of the Commander (e.g. "Full Speed Ahead"; "Commence Firing").
(2). A translation of this idea in his brain to an action, a particular movement of a hande to correspond with that particular idea or intention.
(3). At the other end, the reception of the idea through visually reading a written instruction conveyed by the pointer.
(4). A translation in the brain of this idea or intention of the Commander into a mechanical action with the hands, the selection of a particular direction and the movement of a particular lever to correspond to this idea.
This all takes time, and moreover the translations are not always correctly made in the brains concerned. Formerly the controlling
drawing off the enemy's fire from them whist they are going through the comparatively slow process of loading which is inherent in them.

The use of high-angle-fire guns has to a great extent gone out of fashion. They complicated the defence and required considerable manning parties; but they would be very useful against attack (c) and I, for one, am not convinced as to the advisability of doing away with guns which can be worked by comparatively unskilled men, and which cannot be themselves silenced.

## ATTACK (d).

Attack ( $d$ ), or the channel-blocking attack, is a difficult one to meet satisfactorily: Such an attack would certainly be made at night and probably in conjunction with attack (a). There is considerable difficalty in sinking an old armoured vessel by gunfire before she can get to her goal, and this is specially difficult at night when, as at present, the heavy guns have no lights to assist them.

The best arrangement probably is, as far as possible, to deny alt passages except one to approaching vessels and to have considerable gun power on that one.

It is probable that extra lights will have to be added to our present establishment in some cases with a view to giving the heavy guns of the fortress this power of stopping blocking vessels at night.
current was either made or broken. In each window was an ordinary electric light, and a five-cored cable connected the cottage with the Commander's post. The instructions to the manipulator of the search light were:-Light in Attic window means "Elevate" (keep elevating as long as the light shines); Light in Kitchen window means "Depress"; Light in Right (or green) window, "Move to Right"; Light in Left (or red) window, "Move to Left."
On one occasion, by turning the cottage seawards, the light on a torpedo vessel, moored near shore, was successfully directed by the Commander at the controlling station. It will be noticed that the relative positions of the lights here brought in a relationship between the act to be performed and the method of conveying the order; and that what I had done was merely to modify the Cardew lightbor (one of Major Cardew's many ingenious inventions) to suit my cardinal theory.
In the case of a telegraph to a gim in a fort, I would have the indicator take the form of a diminutive representation of a gun, pointing horizontally towards the front for "Commence Fire," and thrown up vertically for "Cease Fire." The diminutive gun moved upwards through an angle of (say) $40^{\circ}-45^{\circ}$ might indicate "elevate more," and moved downwards the same amount "Depress," as the case might be, if such were desired.
To further exemplify the idea, I may describe the lingine-room Telegraph known by my name, published in 1894, and which can be seen at work in an occasional ship. It is said to still hold the field as the simplest telegraph in use. The theory of it is the exhibition to the engineer of the action required in miminture, instead of calling upon his brain to read a written instruction and translate it into action.
Mistakes in the engine room have been surprisingly frequent. Years ago I witnessed the strange accident to the fine Allan Liner Sarmatian in the dock basin at Liverpool, where she stove in her bow, and sustained such severe damage that the whole of her passengers and cargo, just embarked, had to be transhipped to another vessel ; this was caused by the engines being put "Ahead" instead of "Astern," through brain-mistranslation. The Lansdowne, from the same cause, did over $£ 200$ worth of damage in a few minutes. The Serapis is said to have done an immense amount of mischief through the same mistake. History is full of similar records, in almost all of which the signal appears to have been correctly given from the Bridge and correctly returned by the hand reply (where such was used). All observant Submarine Mining officers will have come across instances, in the twin screw boats, where the engines were discovered to be going the wrong way, breaking and losing hook-ropes, and accompanied by a strained relationship between the cosswain and engine staff, and sometimes an exchange of amiable language.

My transmitter on the Bridge consists only of the usual fore-and-aft
handles on the Bridge usually moved in a horizontal plane (like those of an electric tram car). Instances of this are still to be seen. Mistakes were occasionally made, until it was found of great advantage to give the handles fore-and-aft motion, in vertical planes, so as to bear some obvious relationship to the intentions and orders they were meant to convey. A man on a bridge can make no mistake when, if he wants to go ahead, he pushes his handle to point ahead; if he wants to stop, he pulls it up to vertical; and if he wants to go astern, he pulls it back to point astern. This was found to be so practical an improvement that aimost all the newer transmitters are now so made, in spite of being a little more troublesome to manufacture and fit. It is an extraordinary thing that the controlling handles of electric trams are seldom or never so arranged. Hany a tram accident would be prevented if the handle were pushed forward to go ahead and pulled back to stop or go astern ; the driver would then be likely to stop the car automatically or anconsciously if he lost his head. In the new ship Mimesota, which has attracted much attention, all the electric hoists have the same defect; many an awkward hitch would be saved if the handles moved in a vertical plane, $u p$, to hoist, down, to lower.

In a 890 this principle (which one might paraphrase as "the object all sublime of making the punishment suit the crime") was carried out in a device of mine that was used at Halifax, Nova Scotia, for some years to control the movements of an electric search light.

The Commander's end consisted of a small arm moving round in a vertical plane, with a small knob (or horizontal handle) at its outer end for convenience. When the knob was moved to the right, the order "More to the Right" was conveyed; when it was moved to the top (arm being rertical), "Elevate"; when to the bottom, "Depress." When the handle was nowhere in particular-i.e. the arm not pointing obviously in either of the four directions (up, down, right, left), but inclined at somewhere about $45^{\circ}$ to the vertical or horizontal-the order "Stop" was conveyed. This latter position is analogous to the negative predicament certain troops of the brave old Duke of York are said to have been in, when they were neither up nor down the hill-when they were up, they were $u p$, and when they were down, they were doan, etc. The man who could not convey what he wanted with this handle could be safely chassed as a man without any ideas to convey.

At the Receiving end (the search light end) I had a little model 3 -storied cottage of wood, about 4 feet high, 2 feet wide, and 6 inches deep (back to front), with an attic window, a ground floor or kitchen window, and two first floor windows; of the latter, the right (or starboard) window had a green (fairly transparent) blind, while the left window had a red blind. In the cottage was a single-stroke, low resistance, double-dome bell, which gave a whack every time the
handle, moving through about $95^{\circ}$ forward, and the same amount abaft the vertical. There is no dial, dials, to my mind, being of no practical value. Nor is there any hand reply, as in my device the handle itself can be used as a hand reply. The order "Stand By" is not indicated, as in other systems, by any definite position of the handle-which is very anomalous-; but is given by ringing the bell, by working the handle to and fro, and bringing the handle back to its correct position-i.e. to "Full Speed Ahead," if the engines are intended at the moment to be going full speed ahead. The order "All Clear" or "Alongside" is usually given by ringing 3 times as above, with a grod pause between each ring.

In the Engine Room the gong is retained; but there is no dial, as the movements of a dial wouk bear no obvious relation to the actions of the engineer and would entail brain action to read and translate. My indicator consists of a mimature lever or wheel (according as a lever or wheel is used in engine), boited in some convenient place before the eyes of the engineer, and so situated and fixed that its movements are relatively similar to those of the actual handle or wheel by which the engine is controlled; e.g. if the gong rings and the little handle moves up, the engineer moves the big handle up, etc. There is therefore much less chance of the ship being wrecked by a worn-out, stupid, alcoholically-saturated, or wool-gathering engineer whose thoughts are far away. The engineer responsible for the accident to the Sarmatian was said to be a man of very long service, much trusted and valued by his employers, and who had never had a hitcl before; he would probably not have had that hitch if my model indicator had been used, however far away his thoughts were.

In cases where the engines are controlled by a wheel, the indicator consists of a miniature wheel, rotating through $180^{\circ}$, with a conspicuous red, white, or polished spoke to indicate the central or "Stop" position (normally vertical). 'Thus, if the wheel is seen to rotate through $90^{\circ}$, as shown by the bright spoke turning to horizontal, the large wheel is to be turned in the same direction as many turns, or as far as will make "Full Speed"; $45^{\circ}$ would indicate "Half Speed." This is very similar to my steering telegraph from the bridge to the emergency wheel astern, the transmitter on bridge, as well as the dial astern, being replaced by diminutive model steering wheels.

MI $y$ automatic engine-reply consists of a small spur wheel, revolving on the bridge at a maximum speed of 30 revolutions a minute (with engines at full speed), and capable of being both seen and felt. It is unnecessary to further describe it here; I do not think it is much used.

The theory of the above described devices can be applied to the conveyance visually of certain military orders and information: e.g., at the attack of a seaport, instead of a flag indicating "Commence

Firing," a represcntation of a gun like a semaphore may be used. This is unlikely to be misunderstood; seeing the muzzle thrown vertically up or down obviously implies "Cease Firing"; whereas a flag displayed in manœurres often means "Commence Iiring," whilst on a range it means "Cease Firing."
Some years ago realistic mancuvres took place at Halifax, Nova Scotia, which included a naval attack on the port. It was necessary to distinguish friendly ships from foes, and for this purpose the examining steamers used Verry's Pistols. It was agreed that 2 discharged rockets meant a Fricnd and 3 an Enemy. A hostile ship passed in, and the examination steamer tried to signal her; but the pistol jambed after the second shot, thus clearly indicating her to be a Fricnd, and she passed in ummolested. I would suggest that a wavy line, representing a serpent, should be displayed to indicate Enemy (a flag or a board by day, and wavy line of lights at night).

For "Commence Firing" I would suggest a row of lights hung horizontally on a board, shaped to represent a gun, and pivoted on a flagstaff; so as to be capable of being thrown vertical for "Cease Fire." Before the above-mentioned attack on Halifax, it had been agreed that hoisting a Red Lamp meant "Commence Firing." As the night wore on, the enemy's ships were discovered to be entering the harbour, and the lamp was ordered to be hoisted; but an accident happened and the glass broke, the lamp being blown out; and the enemy sailed in past the forts without being fired at. It was impossible, in the time arailable, to improvise any substitute for the missing lamp. There was telephonic communication; but by the time the messages got through, it was too late. Both of these failures were due to the noglect of very ancient axioms, founded on the prudent method of a vendor of eggs, who carries them in several baskets, so that if one basket comes to grief he will not be wholly undone; and of the sagacious archer who carries a second piece of string with him.
Voice Tubes are hardiy mechanical means of conveying orders; still, we will include them. It seems to me that we do not use them often enough. I have never seen a sentry box or post (Barrack or Fortress) connected to its guard room by a voice tube ; but I have seen a great number of places in which one would be very useful, as the sentry could get instructions or report odd things that occurred.
I have seldom seen a Mechanical Bell between a sentry's post and the guard room. I have seen a few instances; but in all of these the bell was rung by a handle, as have been all electric sentries' bells that I have seen. It is as easy to ring them by a treadle as by a handle; and it is possible to conceive occasions on which a sentry would prefer not to sacrifice momentarily the use of one of his hands in order to ring a bell, as such sacrifice might entail the loss of his rifle. Anyhow
make the suggestion that sentries' bells should be rung by foot.

## THE ENGIVEERS OF THE GERMAN ARMY.*

By Col. J. A. Ferrier, d.s.o., R.E.

II. COMMUNICATION TROOPS (VERKEHRSTRUPPEN).
A. I Brigade, consisting of a Traffic Section and 3 Railway Organization. Regiments, each of 2 battalions (Prussian). I Railway Batta\}ion (Bavarian).
B. 3 Telegraph Battalions (Prussian).

I Telegraph Company (Bavarian).
C. I Balloon Battalion of 2 companies (Prussian) at Berlin.
y Balloon Detachment (Bavarian) at Münich.
D. Experimental Detachment of Communication Troops at Berlin.
In Prussia the above are under an Inspector of Communication Troops, ranking as Major-General ; but in Bavaria they are under the Inspector-General of Engineer Corps and Fortresses.

## II. (A). RAILWAY TROOPS. Raillvay Brigade (Prussian).

The Traffic Section is composed of a staff and 3 companies.
Each of the 3 regiments has 2 battalions of 4 companies each, numbered from 1 to 8 .

The 7 th and 8 th Companies in the 2nd Regiment and a small portion of the Traffic Section are furnished by Saxony.

The Bavarian Battalion is composed of a staff and 3 companies.
The peace strength of units is as follows :-


The total peace strength, allowing for regimental staffs, etc., is 177 officers, $1_{5}$ medical officers, i8 officials, 712 non-commissioned officers, and $3,681 \mathrm{men}$.

No information is available as to distribution. Part of the force is employed on the Military Railway between Berlin and the Kummers-dorf-Jüterbog ranges. The Bavarian Battalion is at Münich.

On mobilization the 7 Railway Battalions and the Traffic Section are broken up, and the companies are expanded into
(a). Railway Construction Companies (Eisenbahnbau-Compagnieen).
(b). Railway Traffic Companies (Eisenbahnbetriebs-Compagnieen).
(c). Railway Workman Companies (Eisenbahnarbeits-Compagnieen).

The war strength is as follows:-

| Units. | Officers. | Medical Officers and Officials. |  | Horses. | Vehicles. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Construction Co. ...... | 9 | 2 | 222 | 29 | $\left\{\begin{array}{l}3 \\ 4 \\ 2\end{array}\right.$-horse carriagres. |
| Traffic Co. $\ldots . . . . .$. | 6 | - | 206 | 2 |  |
| Workman Co. ........ | 2 | - | 202 | - |  |

The Construction Companies absorb the greater part of the men of the peace establishment of railway troops.

The Traffic Companies are mostly formed of Reserve officers and men, with a few officers, N.C.O.'s, and men of the peace establishment.
The Workman Companies are formed principally of Reserve men.
The Armament is the same as that of the Pioneers.
Personal Equipment.-No details available.
Transport.-Two 4 -horse wagons for tools and appliances; one 4 -horse wagon with ladder sides for stores; one 2 -horse baggage wagon ; and one 2 -horse carriage for telegraph purposes.

## Training.

The military training is the same as for Pioneers, i.e., drill, gymmastics, rifle exercises, and musketry.

The techuical training comprises the demolition and repair of railways and bridges of all kinds; the construction of narrow gauge ralways; and the traffic management of ordinary and field railways.

The training takes place near Berlin. But companies are very often detached to construct, re-construct, and repair State and Private Railways, particularly if an accident has occurred and a provisional line is required; while thus employed the rank and file receive working pay, varying from $3_{3}^{3} \mathrm{~d}$. to $8_{4}^{3} \mathrm{~d}$. a day.
Railway management, generally, is learned on the military railway between Berlin and the Kummersdorf-Jüterbog ranges. This line is managed by the military though, like other railways, subordinated to the Ministry of Public Works.

The Technical Troops of the German Army are exercised periodi- Mannetryes. cally in works of large scope, similar to what would fall to their lot in war:-eg., i898, bridges'only' 1899 , a few kilomètres of normal gauge line with a wooden bridge over the Oder; and Igor, a field railway of roo kilomètres. In 1904 a metal bridge was thrown across the Elbe at the end of a field line of 50 kilometres which served to transport the materials for the bridge.

Such exercises involve an expenditure of from $£_{2}, 000$ to 62,400 , and as they therefore cannot be repeated yearly they are worthy of arresting our notice.
The Railway and Siege Mancurres of 1896 have already been mentioned, but to give an idea of the scope of the Railway Troops I cannot do better than copy a few extracts from the account of the exercise of 1904 (Revue Militaire des Armées Etrangères, March, 1905).
" Inypothesis. - Wittenberg and Torgau are supposed to be besieged, and to restore communication by rail between the right bank of the Elbe and Leiprig it is necessary to construct a line counecting the Berlin-Jüterbog line with Eilenburg.
" Peace conditions determined the bridge site between Prettin and Domnitzsch, and the Civil authorities prescribed that navigation was not to be interrupted. The Elbe at this point, measured at flood level, between embankments, is about I km . wide ; but owing to the dryness of the summer the waterway was reduced to 60 m , with a maximum depth of nearly 2 m .
"A clear span of 60 m . being obligatory it was decided to utilize the Lübbecke steel girder bridge material, part of which was stored at Berlin and part on the training grounds of Clausdorf and Sperenberg not far from the Berim-Juterbog line. Of course this could have been brought by rail to Ammaburg. But the supposition was held to be that railway communication beyond Juterbog was closed; and so a line of about 50 km . from Juterbog to Prettin was decided on, and this was to be used to bring the material to bridge site.
"Personncl.-In the Prussian Brigade, including the 2 Saxon Companies, there are roundly 150 officers and $3,500 \mathrm{R}$. and F . The Bavarian Battalion has 3 companies, 17 offcers and 450 R . and F . The Working Section on the military line Berlin-Juterbog has $\mathrm{I}_{5}$ officers, 550 R . and F . Out of these were employed :-7 Prussian companies, $a$ Saxon, and I Bavarian, and the Working Section of the military line; there were also attached for ro days 4 Prussian Reserve Companies. These 14 companies were brought up to war strength, each having 9 officers, 20 N.C.Os., 200 men; total 150 officers (including staff) and $3,500 \mathrm{R}$. and F .
"The railway material of the German Empire has been provided for by a vote of $£_{6} 340,000$, made up in amual contributions of $£_{24,000}$ to 628,000; and no departure from original patterns has been found necessary.
"The Lübbecke system of bridges merits some description. This was adopted in 1902 after $£ 40,000$ had been spent in experments. Eight sections of bridge, each of 60 m . span, are estimated to cost $£ 240,000$; each section costs about $£ 29,000$. Parliament has voted approximately this sum anmally since 1902 .
"The bridge is made in separate pieces, each capable of being handled aithough some parts are actually 8 m . long. The bridge platform is carried on two lattice girders, $\mathrm{I}_{5} 5 \mathrm{~m}$. deep; it is wide enough for a double track, and is supported on the lower boom. As the span increases the extra depth of girder is obtained by piling on extra girders; in this case, for 60 m . clear span, 4 girders, equal to 6 ml . in height, were required; the top girders were cross-braced to one another.
"The country traversed presents no serious engineering difficulties; it is a plateau with wide undulations as far as the Black Elster river, after that an open plain as far as the Elbe.
"Werder-Zinna, a few kilomètres north of Jüterbog was chosen as junction station for the field railway and the military line. The trace was as straight as the ground and certain private properties would permit : it passed by Rohrbeck, Oehna, Mägeln, Schweinitz, Anmaburg, Naundorf to Prettin. The trace was indicated by the Director of the Exercise, the details and minimum radius of curvature being determined by the Tracing Section (Tracierkommando). Behind them came the Railway workmen to make up banks, dig cuttings, etc., for formation level, and bridge obstacles. The obstacles were:-

1. Juterbog-Luckenwald light railway.
2. State line Juterbog-Faikenberg, between Dennewitz and Rohrbeck.
3. Black Elster river at Schweinitz.
4. State line Wittenberg-Fakenberg, near Annaburg.
"The Black Eister was crossed by a pile bridge which took two days to construct ; the railways by wooden viaducts at a gentle inchne.
"Work began on 29th July at Werder-Zinna; on 8th August the rails reached Prettin on the near bank of the Elbe; on roth August the whole section was opened for traffic, and in the evening the first trains with sections of the steel bridge were discharging at bridge site; the railway was completed on 15 th.
"Meanwhile the viaduct of approach to the water span, consisting of 320 metres length of wooden trestles, had been begun on 26 th July, as also the abutments and erecting platforms. These involved the driving of 276 piles with ordinary pile drivers moved about by hand, the water being too shallow to admit of the use of floating pile drivers. The piles were in by woth August. The inth and inth were devoted to completing the platforms; and the erection of the girders,
commenced on 53 th, was fimished on 26 th, on the afternoon of which date a heavy goods train was sent across. The line was not completed up to the main line as the exercise was considered concluded with the completion of the girder bridge.
"Under peace conditions the work took 4 weeks. It is considered that in war, when no regard would have been had to keeping the waterway open for mercantile traffic, the work could have been completed within 3 weeks."

## II. (B). TELEGRAPH TROOPS.

Prussia.-In Prussia there are 3 battalions:-
ist Battalion, stationed at Berlin, belongs to the Guard Corps. The 3rd Company is Saxon, and there is a detachment of Wurttembergers. To this battalion is attached the Cavalry School of Telegraphy.
2nd Battalion, stationed at Frankfort on the Oder, belongs to III. Army Corps.

3rd Battalion, stationed at Coblenz, belongs to VIII. Army Corps.
Bavaria.-In Bavaria is a Telegraph Company,* to which is attached the Cavalry Telegraph School, $\dagger$ at Münich, and a Bailoon Section.
The Inspector of Telegraph Troops is directly under the Inspector Inspector of of Communication Troops. He holds the rank of Regimental Com- $\frac{\text { Telegraph }}{\text { Tropps }}$ mander. His control embraces all questions concerning Military Telegraphy and Pigeon Posts $\ddagger$ He is the immediate C.O. of Telegraph Battaiions and directs their instruction, military and technical.
The total effective strength of the combined Telegraph troops is Strengh. 50 officers, 165 N.C.O.'s and 1,353 R. and F. under the Inspector of Telegraph Troops.
The officers are drawn mostly from Engineer and Pioneer officers, Offiers. some from Infantry and from the Railway troops. The Budget of 1902 provided 9 Commissions (8 Prussian, I Saxon) to go to men trained in Telegraph Units.
There are no horses. Teams are provided by the Train, who hold, Transport. specially set apart for Telegraph troops, 3 groups of teams attached to Nos. 3 and 8 Battalions of the Train of the Guard. One group, also attached to the Guard, is detailed for the Cavalry School of Telegraphy.

[^1]The strengths of the groups are as follows :-

|  |  |  | Telegraph. | Cavalry School of Telegraphy. |
| :---: | :---: | :---: | :---: | :---: |
| Lieutenant ... | ... | $\ldots$ | I | -rior |
| Vice Wachtmeister | ... | $\ldots$ | 1 | - |
| Sergeant ... | ... | ... | I | - |
| N.C.O.'s ( I Farrier) | ... | ... | 3 | - |
| Lance Ranks | $\cdots$ | $\cdots$ | 3 | I |
| Priates ... | ... | $\cdots$ | 3 I | XI |
| Labourers ... | $\cdots$ | ... |  | - |
| Horses $\left\{\begin{array}{l}\text { Saddle } \\ \text { Draught }\end{array}\right.$ | $\cdots$ | $\cdots$ | 9 | 25 |

Strength of Units.

The establishments of the Prussian Telegraph units are as follows:-

|  |  |  | Company. | Datalion of 3 Companics. |
| :---: | :---: | :---: | :---: | :---: |
| C.O. ... | ... | ... | - | , |
| Captains ... | $\cdots$ | $\cdots$ | 1 | 4 (a). |
| Semior Lieutenants |  |  |  | \{ 3 |
| Lieutenants f | , $\cdots$ | $\cdots$ | 4 | $\{7$ (b) |
| Paymaster ... | ... | ... | I |  |
| Doctor ... | ... | ... | - | 2 |
| Armourer |  | $\ldots$ | - | 1 |
| Feldwebel* ... | $\cdots$ | $\cdots$ | 1 | 3 |
| Vice Feldwebel | ... | $\cdots$ | 2 | 3 |
| Fähmich ... | $\ldots$ | ... | - | 3 |
| Sergeants ... | ... | ... | 5 | 13 |
| N.C.O.'s ... | $\ldots$ | ... | 10 | 26 |
| Drum-Major ... | $\cdots$ | $\ldots$ | - | I |
| Probationer Paymast |  | $\ldots$ | - | I |
| Old Soldiers ... | ... | $\cdots$ | 2 | 6 |
| Lance Ranks ... | $\cdots$ | ... | 13 | 33 |
| Privates ... | ... | $\cdots$ | 135 | 357 |
| Hospital Orderlies | $\ldots$ | ... |  | 3 |
| Labourers ... | $\ldots$ | ... | I | 3 |
| 'Totals... | $\cdots$ | $\begin{array}{r} 50 \\ 18 \\ 181 \\ 1520 \end{array}$ | Officers. <br> Employé. <br> N.C.O.'s. <br> Ien. | ${ }_{15}$ Officers. <br> 2 Medical Officers. <br> 2 Employés. <br> 50 N.C.U.'s. <br> o2 Men. |

(a). I belongs to Battalion Staff. (b). I Adjutant.

Armament and cquipmont are the same as for Pioneers.

Taining encl bastruction.

The military training is the same as for Pioneers. Individual instruction in gymnastics and foot drill has to be finished by the end of Junuary.

[^2]The technical training includes :-all details of military telegraphy (electric and optic) and telephony. It begins with handling apparatus, erecting lines, and share of work in antumn manourres. The details are arranged between I.G. Communication Troops and the Commanders of Army Corps.

The military reseau of Berlin, connecting all barracks and principal military buildings, is maintained and worked by the Corps under the direction of the senior officer, chief of the electro-techmical section of the Engineer Committee.

The regulation and text-books are:-

1. Telegraphen Bau Ordnung. 1877.

Regulations
and Text
Books.
2. Vorschrift für die IIandhabung des Diensles auf Feld-telephon Stationen. II. (C). BALLOON TROOPS.

The Balloon Corps comprise :-
Prussian Battalion of 2 companies at Berlin. Bavarian Section at Münich.

Total, 16 officers, 54 N.C.O.'s, 343 men.
The establishments are :-
Strength.

| 㖪 |  | Prussian Battalion, 2 Companics. |  | Bavarian Section. |
| :---: | :---: | :---: | :---: | :---: |
| Field Officer, C.O. | $\ldots$ | $\cdots$ |  | - |
| Captains | ... | $\cdots$ | 5 (a) | I |
| Senior Lieuts. and L | Lieuts. | ... | 7 (b) | 3 |
| Medical Officers | ... | ... | I | - |
| Paymasters ... | $\ldots$ | $\ldots$ | I | I |
| Foremen ... | ... | $\ldots$ | I | - |
| Armourer | $\ldots$ | $\ldots$ | I | - |
| Feldwebel | $\ldots$ | $\cdots$ | 2 | I |
| Vice Feldwebel | $\ldots$ | $\ldots$ | 2 | I |
| Sergeants ... | $\ldots$ | $\cdots$ | 12 | 5 |
| N.C.O.'s | $\ldots$ | $\cdots$ | 2 I | 7 |
| Probationer Paymas | ster | ... | I | 一 |
| Old Soldiers ... | ... | $\cdots$ | 4 | 2 |
| Lance Ranks ... | $\ldots$ | $\cdots$ | 28 | 10 |
| Privates | ... |  | 227 | 68 |
| Labourers ... | $\ldots$ | $\ldots$ | 3 | - |
| Hospital Orderlies | $\cdots$ | $\cdots$ | 2 | I |
| Totals ... | $\left\{\begin{array}{r} 13 \\ 3 \\ 38 \\ 26 \end{array}\right.$ <br> (a). 3 <br> (b). 1 | Offic <br> Med <br> Emp <br> N.C <br> Men <br> Profes <br> Adjuta | cers. <br> ical Officer. <br> ployés. <br> O.'s. <br> ors. <br> nt. | 4 Officers. <br> I Paymaster. <br> I Employè. <br> iq N.C.O.'s. <br> 8. Men. |

At Berlin 15 officers from other arms are received from ist April for 3 months' instruction in captive and free ballooning. Many other officers are also instructed in captive work. The course at Berlin is independent of the exercises at the Fortresses, which are performed by officers and men of the garrison under the direction of officers of the Balloon Corps or of officers selected from those who have received instruction.

The armancnt and equipment are the same as for the Pioneers.
The matéricl consists of :-
I. A spherical balloon, for free runs.
2. A sausage-shape balloon, called "Drachen (kite) Balloon," for captive work, especially when the velocity of the wind (beyond 10 mètres per second)* makes it difficult for spherical balioons.

Below the sausage balloon is fixed a long inflated rudder formed like a caterpillar. A small balloon inside the large one can be filled with air to make the system more rigid. The car is attached so as to tilt the prow of the balloon and give it a tendency to lift.

The objection to this form of balloon is that it is not suitable for free runs.
It is held in position by a cable of $5-\mathrm{mm}$. still wire, $\mathrm{I}, 000$ mètres long.
The gas is hydrogen, compressed to 150 atmospheres in cylinders. The latter are carried iz to a 6 -horse wagon. Six wagon loads are required to fill one balloon.
The vehicles are:-
First Line.-2 wagons, rigging; i2 wagons, gas ; x wagon, wind-lass-all 6-horse.
Regimental Column.-1 forage wagon, 4 -horse ; I ration wagon, 2 -horse ; i baggage wagon, 2 -horse.
There are 124 horses, of which 22 are for saddle. But in peace time the following detachment is maintained by the Train and attached to the Balloon Corps :--

| Lieutenant | ... | ... | ... | $\ldots$ | I |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Vice Wachtmeister | ... | ... | ... | ... | I |
| Sergeant... | $\ldots$ | $\ldots$ | $\ldots$ | ... | I |
| N.C.O.'s (ı Farrier) | $\ldots$ | $\cdots$ | $\cdots$ | $\cdots$ | 4 |
| Trumpeter | $\cdots$ | $\cdots$ | $\cdots$ | ... | I |
| Lance ranks | $\cdots$ | ... | $\cdots$ | ... | 5 |
| Privates ... | $\ldots$ | $\ldots$ | $\cdots$ | ... | 25 |
| Labourers | $\ldots$ | ... | ... | ... | I |
| Horses $f$ Saddle | $\cdots$ | ... | $\cdots$ | ... | 14 |
| orses $\{$ Draught | $\cdots$ | ... | $\cdots$ | ... | 44 |

Balloonists. -5 officers (including Captain of Section), 12 N.C.O.'s, Personnel. 95 balloonists.

Auwiliaries: Train.-2 Officers, i Medical Officer, i Veterinary Officer, 7 N.C.O.'s, 54 Privates, I Hospital Assistant, I Shoeing Smith ; total-7 Officers, I Medical Officer, i Employé, 170 R. \& F.

Materiel and personnel are divided into 2 divisions, each with 6 gas Company wagons; 5 balloonists can be carried in each wagon.

Empty wagons are filled up with gas by special convoys called "Gas Columns," which exchange cylinders. One of these convoys marches with the ist Ammumition Column, having enough gas for 2 fillings.

It is admitted (Regulation, 7. 10. 1901) that observation beyond Capabilities. 7 kilomètres is difficult. In favourable circumstances the balloon can ascend 1,000 metres, but 600 is normal. In good weather the car holds 2 officers. The Regulation prescribes the employment of balloons in sieges, either for attack or defence, either captive or free.

Special, dated 8. 10. 1903, Exerzier-Reglement für Luftschiffer.
Instruction in drill, etc., is confined at first to what is absolutely and necessary for the single man and to maintain discipline; and the principle is inculcated that "The balloonists only resort to arms to defend themselves, the balloon, or the wagons."

As soon as the recruits have made some progress the technical instruction is begun. But later on they are taught all the drill requisite for men to fight in close or extended order in bodies as large as the company.

The Regulation prescribes 7 groups or squads.

| Balloon Group |  |  | N.C.o.ss |  | Men. |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\ldots$ | ... | $\ldots$ | 2 | 38 |
| Gas , | ... | $\ldots$ | ... | I | 12 |
| Car , | $\ldots$ | $\ldots$ | $\ldots$ | I | 4 |
| Windlass ", | $\cdots$ | ... | $\ldots$ | 1 | 4 |
| Telephone , | . | $\ldots$ | ... | I | 4 |
| Advance Guard | Group | $\cdots$ | $\ldots$ | I | 4 |
| Reserve ... | ... | ... | ... | I | 10 |

The handbook appears to be a very complete and sensible publication, entering into few details. In its 138 pages, about $6^{\prime \prime} \times 4^{\prime \prime}$, it compresses the individual instruction of the soldier, rifle exercise, company drill, close and extended order, balloon drill with both kinds of balloon, general instructions for the field and for sieges, equitation, driving, ceremonial.

## III. (A). GARNISON BAUWESEN.

The Barrack Construction Department is a branch of the Intendantur, an administration that manages the household matters of the army, e.g., supply, barracks, and pay, and with which the Engineer Corps has no connection.

The officers of this branch are recruited from officers of the active army who have served at least 6 years; they go through a course lasting 2 years and 3 months, and pass an examination. The subordinate staff are obtained from N.C.O.'s of the army, who must have served to years and have passed a six months' course of instruction.
Dutics. This Department, however, only prepares estimates. The construction and repair of barracks are carried out entirely by civil labour under civil supervision ; the cost is frequently borne by the town or city concerned, which pays gladly for the privilege of maintaining a large money-spending garrison.

The system has the merit of providing, in peace time, employment for Reserve Officers who become available in war.

The personnel* is as follows:-

## Prussia.

> 33 Intendantur and Bauräte (Control Department and Members of the Board of Works).
> 145 Garmisons Bauinspektoren (Garrison Building Inspectors). 18 Intendantur Bausekretäre (Control Clerks of Works). 106 Gamisons Bauwarte (Garrison Foremen of Works). 106 Gamisons Bauschreiber (Garrison Clerks of Works).

Savony.

4 Intendantur and Bauräte.
I5 Garnisons Bauinspektoren.
2 Intendantur Bausekretäre.
iI Garnisons Bauwarte.
II ", Bauschreiber.

## Würtemberg.

2 Intendantur and Bauräte.
8 Garnisons Bauinspektoren.
I Intendantur Bausekretär.
6 Garnisons Bauwarte.
6 , Bauschreiber.

- From Army Estimates, 1905 , and Bavarian Army List.

Bavaria.
2 Garnison Verwaltung Direktor (Director).

| IO | $"$ | $"$ | Ober Inspektoren (Chief Inspector). |
| ---: | :---: | :---: | :---: |
| 8 | $"$ | $"$ | Kontrolleur (Controller). |
| 21 | $"$ | $"$ | Inspektoren (Inspector). |
| 45 | $"$ | Kasemen Inspektoren (Barrack Inspector). |  |

## III. (C). SURVEY DEPARTMENT.

The Survey Department is under the Chief of the Great General Officers. Staff; and is managed now, though not necessarily always, by one of the 4 Ouartermaster-Generals (a Major-General or LieutenantGeneral) as "Chief of the Survey:"
The Chief of the Survey-at present the 4 th of the Quartermaster-Generals--has an Adjutant, and is assisted by the following officers of the Great General Staff:-

$$
\begin{gathered}
\text { I Major-General. } \\
\\
\\
\text { I Colonel. } \\
\text { 2 Majors. } \\
\\
\\
\text { I3 Captains. } \\
\text { Total } \\
\text { I } 7
\end{gathered}
$$

In addition to these there are 6 officers (Captains and Lieutenants) attached to the Trigonometrical Section, 25 (Lieutenants) to the Topographical Section, and io (Majors, Captains, and Lieutenants) to the Cartographical Section.

The Officer topographers are selected from those officers who officers. show most aptitude for topographical work during their course at the Staff College (Kriegsakademie). In the and year of their course students at the Staff College do 4 hours' topography a week, and in the 3 rd year they have in addition a 3 weeks' "practical" course. Those who distinguish themselves are put into a so-called "T" class, and undergo a 14 days' practical and Iiterary examination. According to the result of this examination officers are selected for attachment to the Great General Staff for a period of I to 3 years.

The higher ranks are selected from those who have been "Topographers," and also from other officers throughout the service according to their capacity and the requirements.

Civiian The civilian personnel consists of the following :-Personnel.

I Map room inspector.
8 Directors of survey.
125 Surveyors and draughtsmen.
$3^{I}$ Assistant do. do.
3 Technical inspectors.
I Superintendent of printing.
I Chief photographer.
32 Engravers, lithographers, and photographers.
I 3 Assistant do. do.
I5 Printers and galvanizers.
I4 Assistant do.
20 Clerks and secretaries.
4 Assistant do.
7 Technical assistants.
${ }^{1} 7$ Messengers, porters, etc.
Total 292
Topographical A proportion of the above "civilian" surveyors and draughtsmen, in the Topographical Section only, are Non-Commissioned Officers of all arms, who have been trained as follows:-

They first undergo a course of one year's duration at the Pyrotechnic School (Oberfeuerwerkschule), during which they are trained in drawing and in the elements of theodolite and plane-table work. Those who show most proficiency are sent to the Topographical Section of the Great General Staff, where they are trained for another 3 years or more as draughtsmen, surveyors, etc.; the remainder are sent back to duty.

The selected men, if satisfactory, then leave the army and are engaged as Civil Officials (Zivilbeante). After 10 years they get paid at the rate of $£ 105$ a year with $£ 27$ a year lodging allowance, rising at 3 years intervals to $£ 130, £ 155, £ 180, £ 205$, and $£ 220$.

The genuine "civilian" printers, draughtsmen, clerks, etc., are engaged and paid as required; there is no Govermment training school of any sort for them.
Cartographical As regards the Cartographical Section :-The men must, as a rule, have passed the examination qualifying them for service as "Oneyear Volunteers," but need not have done their service. Practically all of them are brought in from outside, efficient artisans being enrolled irrespective of where they may have received their training.

The Chief of the Section is very anxious to have a Government School for training them, but at present there is no such institution. As it is, the wing of the Great General Staff allotted to the Survey Department, although large, does not nearly provide the full accommodation required.

The Department is divided into :-
Distribution of
(I). Trigonometrical Section.
(2). Topographical Section.
(3). Cartographical Section, for printing and reproduction, and Map Room.
The Trigonometrical Section has to cover the whole country with Trigonomeni. a network of triangulation, to stations in stonework being erected ${ }^{\text {cal Section. }}$ per German square mile (i German mile $=71$ kilometres $=4.68$ English square miles) in addition to other suitable objects which are fixed. The heights of these points are also determined.

The Topographical Section carries on the topographical survey, and Topographical makes the original plane-table drawings.

The Cartographical Section, in addition to printing and reproducing Cartographical all Ordnance Survey and Military maps, carries out all printing and drawing for the General Staff and undertakes the distribution of maps.
The personnel of the Trigonometrical Section is as follows:- Trigonomeri. $\left.\begin{array}{l}\text { I Chief of a Section } \\ 6 \text { Directors }\end{array}\right\}$ Officers of the General Staff. $\begin{aligned} & \substack{\text { cal Section } \\ \text { Personucl. }}\end{aligned}$
I Director (employé).
8 Attached Officers (Captains and Lieutenants). 26 Surveyors and Assistant Surveyors.
4 Clerks.
I Messenger.
Total 47
This Section is divided into 5 sub-sections with various duties.
The Topographical Section comprises:-

Total ${ }^{117}$
This Section is sub-divided as follows:-
Organisation.
Registry (Office of the Chief of the Section).

Sub-sections $\left\{\begin{array}{l}\text { A. } \\ \text { B. } \\ \text { C. } \\ \text { D. } \\ \text { E. } \\ \text { F. }\end{array}\right\}$ for the Topographical Survey (I director,

Sub-section G. for the custody of instruments and for directing the survey (i director and 3 senior officials).
H. for detailing trigonometrical points. 1 official in charge. The work is carried out by officials during the winter.
" I. for preparing reductions of the district surveys. I official in charge, with one or two officials as assistants. The work is carried out during the winter by officials and by specially engaged young ladies, who are paid $2-3$ marks a day and can be discharged at any time.
Enquiry Sub-section for correcting existing maps. This is immediately under the Chinf of the Section. The work is carried out by several senior officials.

Cartognaphical The Cartographical Section has :Section dersonnel.
$\left.\begin{array}{l}\text { I Chief of a Section } \\ 2 \text { Directors }\end{array}\right\} \begin{aligned} & \text { Officers permanently attached, } \\ & \text { but not actually belonging, to } \\ & \text { the Great General Staff. }\end{aligned}$
2 Directors (employés).
io Attached Officers (Majors, Captains and Lieutenants).
5 Technical Inspectors, including a Superintendent of Printing and i Chief Photographer.
53 Draughtsmen and Assistants (Cartographers).
42 Lithographers and Engravers on copper.
I Photographer.
I Chief Printer.
I Galvano Plastic Modeller.
I Assistant do. do.
I 3 Printers.
I "Glass" printer.
7 Technical Assistants.
io Attached do.
2 Copper printers.
I Coloured work printer.
I Diätar (assistant not permanently attached).
6 Registrars.
2 Secretaries.
I Servant.

This Section is divided into the following sub-sections:-
Organisation.
I. The i: 100,000 Map, "Reichskarte" (plain), under a permanent officer.
2. The $1: 25,000$ Plane-table work.
3. Galvano-plastic (relief) and Photographic
work.
4. Printing. $\int$ officer.
5. War Maps (China, S.V. Africa, etc., and maps for European Wars).
6. The I: 200,000 Map (plain).
7. The $\mathrm{x}: 200,000 \mathrm{Map}$ (coloured).
8. The I: 100,000 Map (coloured).
9. Fortress Plans (this sub-section is attached to, and works under, the Chief of the General Staff).

Geodetic work is performed by the Geodetic Institute under the Gcodetic direction of the Ministry for Spiritual, Educational, and Medical Work. Affairs.

Geological Surveys are carried out by the Royal Geological Land Gcological Institute, under the direction of the Ministry of Commerce, Industry, Survey. and Public Works.

The Survey Department, or rather the Chief of the Great Generai Staff, is in close touch with both the above Institutes, and arranges the yearly task in conjunction with them, but there is sometimes friction.

There are no special " Forest" surveys.
Forest Survey.
The Map Room is under the Cartographical Section, the Map-Room Map Rcom. Inspector being nevertheless responsible for the proper working of his department.

The issue of maps, both to the Army and to the Public, is effected Issue of Maps by the Map Room, except in so far as it is handed over to Messrs. Eisenschmidt (the Edward Stanford of Germany). On the other hand the issue of mancurre maps (except for the Kaiser manœuvres) and of maps of the environs of military stations, required for military purposes, is effected by the Cartographical Section.

For issue of War maps see below.
As stated above, the Survey Department is directly under the Chief Administraof the General Staff. The Chief of the Survey is a member of the tion of Suryey. Central Direction of Surveys of Prussian Territory. According to the decisions passed by this body and the military requirements of the time, he receives from the Chief of the General Staff the general directions to be followed, both as regards technical assistance and the execution of the proposed work.

At the beginning of each working year the Chief of the General Yariy Task. Staff gives out a so-called "Pensum," or task, of about 200 square miles (German), i.e., about 4,380 square miles (English), of German Territory, to be surveyed on a scale of $1: 25,000$.

A survey on this scale, dating prior to $\mathbf{2 8 7 3}$, already exists, but it is of course a good deal out of date. It was not very accurate originally, and the conventional signs are not those now in use; furthermore it was not published at the time it was prepared.

The present "task" consists, therefore, in checking it, briaging it up to date, and drawing, reproducing, and issuing an edition thereof; also of preparing a survey from it on a scale of $1: 100,000$. The old I: 100,000 map, before 1873 , was published, but it was bad; Germans pride themselves on the accuracy of the new map.

Execution of Toporraphical Work.

The work is plane-tabled during the spring, summer, and autumn by the Topographical Section staff, who of course have the trigonometrical points to base their work on, and the old maps to go by to a certain extent. Although the "task" sounds formidable in quantity, it works out to rather less than one English square mile per day per 1 officer and 3 assistants.
Besides this survey, special maps or plans may have to be prepared by the Topographical staff.
Ixecution of
During the winter the work is carefully drawn and coloured by the Section. It is then photographed and coloured, and the result handed to the Cartographical Section. The latter Section, beginning in April, engraves or lithographs the plates, prints the maps (both plain and coloured), and distributes them in bulk when necessary.
The process of reproduction is as follows:-
On receipt of the original drawing and photographed copies from the Topographical Section, the Cartographical Section photographs the i : 25,000 maps on to stone (or, in the case of the I: $100,000 \mathrm{maps}$, transfers them on to copper), and cngraves them on stone (or copper). They would prefer to do the whole on copper, but camot get the necessary workmen in sufficient numbers. Saxony, Baden, and Wurtemberg do the whole of theirs on copper; but Bavaria, like Prussia, does the I : 25,000 on stone.

Three-quarters of the maps are printed under contract by firms outside the office, although over 10,000 stones are in the office. Copper engravers are also employed outside the office.
The scales ordinarily employed are as stated above, $1: 25,000$ and 1: 100,000.
A coloured edition (blue and black only) of the I : 100,000 map is being issued; but as yet only about 50 sheets, of Western Germany, lave been completed. A $1: 25,000$ map is also to be had, coloured by hand in blue only. There is also an edition, coloured (in black, brown, blue, and green) or uncoloured, on the scale of i: 200,000 . A few maps on the scale of $1: 300,000$ (coloured in red, black and blue) have been issued at a cheap rate, 20 pfennig per sheet, for sale to soldiers, etc.; they are excellent, and 37,000 of them were sold in 1904.

There is a branch-sub-section 5-of the Cartographical Section, Supply of called "Die Verwaltung der Kriegs-Karten" (Administration of War Maps on Maps), part of whose business it is to keep the troops supplied with up-to-date maps for war purposes.

The maps are decentralized and kept at the headquarters, or even quarters, of the unit concerned.

The first attempt at organized Field Survey parties is now being Field Strvey made in S.W. Africa, a "Feldvermessungs" party (consisting of Farties. I captain, 3 officers for trigonometrical and 6 for topographical work, 1 assistant triangulator, 2 photographers, and 2 printers) having been sent there.

It is in the nature of an experiment, and the authorities are looking forward with much interest to the result, as it may lead to permanent parties being organized.

The method of reproduction in the field is photo-lithography, Map reproduced on zinc plates, not stone. Aluminium plates, although Reproduction they would be better and lighter for field work, cannot be used, as there is difficulty in supplying the acids for this work.

During manouvres the Cartographical Section provides, at the Headquarters of the Manœuvres, a small sub-section for drawing and reproducing manouvre maps by "transfers" on stone or aluminium.

The annual cost of the Survey is about $1,250,000$ marks ( $£ 62,500$ ). CostofSurvey. Outside Germany, Kiao Chau is the only Colony where the survey Survey of is done by the military authorities. In alt other Colonies it is carried Colonies. out principally by civilians under the control of the Colonial Section of the Foreign Office.

## Correction.

On page 34 of the previous number, the second sentence of the first para. under the heading I. A. (ii.) should read:-"It is subject to the Inspections of the Corps of Engineers."

## APPENDIX.

## UNIFORM.

## Corps of Enginyers.

Tunic, dark blue with black velvet collars and cuffs, the former slashed with two silver bands, and silver epaulettes; except Saxons, who wear dark green tunics with scarlet collar and cuffs. Silver buttons.

Trousers, dark grey with scarlet piping. I'antaloons (apparently) dark blue without any piping.

Boots, butcher, accordion pleated at the ankle, with heel spurs.
Head-dress, helmet with silver badges and white horsehair plume.
Sivord, straight with steel scabbard.
Great Coat-Grey, with red shoulder straps and I silver slash on collar.

## Corps of Fortress Constructors.

The uniform is similar to that of Engineer and Pioneer officers, with some differences of detail, e.g.-

They wear epaulettes instead of shoulder straps (except the Wallmeister who wear shoulder straps, black for Prussia and Würtemberg, green for Saxony). The letters F.B.O. are worn on the epaulettes and shoulder straps instead of numbers.

The great coat is blue cloth, with red piping and black velvet collar.
Trousers.-Infantry pattern.
Head-dress.-Helmet, as for Engineer officers, but without plume for Saxony.

Cap, as for Engineer officers, with black velvet brow band and red piping.

The Fortress Warders have much the same uniform, but the epaulettes carry a stamped silver wreath with gold coat of arms enclosed.

For further details see Das Festungs Bau Personal by H. Herde, F. Oberleut, to be obtained from K. Grundmann, Glogau, from which publication these notes have been extracted.

## Pioneers.

Tunic, dark blue with black collars and cuffs piped with scarlet, scarlet shoulder straps with battalion number. Saxons wear dark green instead of dark blue. White buttons.

Trousers, dark grey (Bavarians, dark blue) with scarlet piping.
Pantaloons, dark blue without piping.
Head-dress, black leather helmet with white ornaments and spike.
Great coat, dark grey.
Bools, butcher, for mounted men; short Wellington for dismounted.

The Guard Pioneer Battalion is distinguished by :-
Head-dress, black piume instead of spike.
Tunic, two silver slashes on collar and cuffs.
Great coat, one silver slash on collar.
No number or device on the red shoulder strap of tunic or great coat.

## Rallway Troops.

The uniform is almost the same as Pioneers'. On the collar are tabs of black and white horizontal stripes; on the cuffs, depending from the 2 buttons, two straps of black and white; $E$ in yellow on the shoulder straps, with winged wheel for Traffic Section.

Head-dress.-Black leather helmet, with white plate and yellow chain and black dragoons' plume.

The Bavarian tunic is of lighter blue than the Prussian. The Bavarians wear a spike instead of plume.

## Trlegraph Troops.

For ist Battalion the same as the Guard Pioneers; for and and 3rd that of the Line Pioneers. On the red shoulder straps there is a yellow thunderbolt and the battalion number in Roman character. These ornaments for the officers are gilded.

## Balloon Troops.

The uniform is the same as for the Pioneers. But the letter $L$ is carried on the epaulettes and shoulder straps; and a shako is worn instead of a helmet.

## Train.

Tunic, dark blue with tight blue collar, cuffs, and shoulder straps. Saxons, light blue, with black collar and cuffs piped scarlet, and light blue shoulder straps.

Trousers, black; Saxons with thin scarlet stripe.
Pantaloons, dark blue strapped with leather.
Boots, mounted men, butcher with heel spurs; dismounted, half Wellington.

Head-dress, black shako with back and front drooping peaks, falling black plume, yellow ornaments. Saxons, black shako cut straight below, cheese-cutter peak; light blue pom-pom, white side ornament, and yellow plate.

Great coat, dark grey, with light blue collar tabs and shoulder straps (I2th and sth-black collar tabs).

The Guard are distinguished by the slashes on collars and cuffs as for the Guard Pioncers.

## TRANSCRIPTS.

## HUSTED HOSPITALS IN WAR.

As R.E. Officers may at any time find themselves called upon to design and erect huts for hospitals on Lines of Communication, it may be useful to record in these columns the experience gained during the late war in South Africa.

The following notes on constructional details are extracted from the official Report on the Mredical Arrangements in the South African War, by Surgeon-General Sir Wm. D. Wilson, K.c.b., Principal Medical Officer, South African Field Force.

The portions marked as quotations are extracts, included in the above publication, from the Report of a Committee of Medical Officers which was assembled in South Africa.

The notes in brackets after certain paragraphs are presumably comments by the Principal Medical Officer.

The original is fully illustrated with plans; but these are not reproduced here as, with the exception of the "General Scheme for Hospital Camp," the letterpress is sufficiently clear by itself.

## General Remaris.

Where a hospital is likely to be more or less permanent, as in the case of those at the base and at certain fixed points on the Line of Communication, it is an undoubted advantage to replace the tents by huts, and to add more satisfactory accommodation for stores and other necessities than can be provided under canvas. The following pages, therefore, include a description of the type of huts for ward use, and of the various accessories which were found useful in the late war. All the buildings described were in use in one or other of the general hospitals during the campaign, though all may not have existed in one hospital.
It is, of course, not proposed that all these buildings should be invariably provided. As the Committee points out, this is largely dependent on the probable time during which the hospital will be in use, and probably in some cases existing buildings will be available for conversion to hospital purposes. But where suitable buidings do not exist, it certainly adds to the efficiency of the unit and to ease in its working when buildings are provided. The following pages should, therefore, be taken as describing the ideal to which the development of the hospital should tend, and not as a statement of the necessities from the outset.

These semi-permanent structures may be divided into the following classes:-
(I) Those which are necessary from the very first -
(a) Latrines; disinfecting apparatus.
(b) Lavatories; surface drains.
(c) Water supply.
(d) Kitchens; sculleries; milk stores; and the like.
(e) Operating room.
(2) Those zehich should be provided as soon as possible-

Storage accommodation for steward's store; pack, linen, clothing, and quartermaster's stores.
(3) Those which are desirable, but not urgent-

Offices.
Dining or mess-rooms; cantecn; and the like.
(4) Those which depend on local considerations-

Huts for use as wards.
Tents, especially the E.P. tent, do very well under most conditions, and the erection of huts is in most cases not a necessity for wards.

The Committee state-
"We are of opinion that huts should be used in General and Stationary Hospitals at the base for wards and other hospital accommodation; also, when practicable, at the advanced base or other positions where the lines of communication are secure, especially if there is prospect of a prolonged campaign, as we consider them more serviceable than tents, the life of which can only be calculated at six months. They should be constructed of wood and galvanised iron, with wooden lining to walls and roof and wooden floors, the boards being well laid with grooved and tongued junctions, the under surface of which should be tarred or crosoted with free air spaces underneath. The ground beneath should be concreted if possible.
"In all other positions and circumstances than those described above, we consider that tents should form the ordnance equipment of General Hospitals.
"As a similarity in size and simplicity of shape tends to expedite and facilitate erection we recommend that most, or as many as possible, be of same design and construction as per plans attached. In malarious and tropical climates they should be raised off the ground on masonry pillars 3 feet high. The ward huts should be warmed in cold weather by some form of ventilating stove, and lighted by electricity. The E.P.I.P. hospital tents should be lined with a chrome yellow-coloured material. The huts inside might with advantage be washed with this colour also, as it is cleanly in appearance and disliked by mosquitos."
"Portable huts are more desirable for active service than those permanently fixed; they are casier of transport, more rapidly erected and removed for re-erection for further use. Those used in the early months of the late war for hospital wards were too narrow, being only ${ }^{17}$ feet 7 inches wide; the windows, swinging on a central pivot, and the eave ventilation arrangements were primitive and unsatisfactory,
allowing free entrance of dust and causing draughts. The windows would be better made in halves (casement pattern), each half hinged to the side frames, so that cither side could be opened and closed as desired; and the ventilators arranged by sliding panels over perforated zinc openings, one below and above each window. This would keep dust out, and the ingress and egress of air could be casily regulated. There should also be ample ridge ventilation, well protected from entrance of rain."

## Ward Hets.

The Committee have recommended a standard pattern hospital hut for use as a ward on the following plan :-

Outside dimensions-length 84 feet, width 21 feet, height to eaves 8 feet, to ridge $i_{5}$ feet. To have at one end two small rooms, $9^{\prime} \times 6^{\prime}$, leaving the length for ward use 78 feet. Verandah at one end, $21^{\prime} \times 12^{\prime}$.

It should have five windows at each side, each made in two halves (casement principle, and fastened on sill with bar fasteners), measuring $4^{\prime} \times 3^{\prime}$. Thesc should be so placed as to allow room for two bedsteads between each two windows. The doorways should be 3 feet wide.

The huts to be used as follows:-
(1) Ward for 20 patients, giving per patient, superficial area 80 square feet, cubic space 1,030 cubic feet.

One small room at the end for Sisters' linen store and pantry, etc.; with a linen press $S^{\prime}$ high by $4^{\prime}$ wide for spare hospital linen (ward and personnel), etc.; also a fixed perforated zinc safe, $2^{\prime}$ wide by $6^{\prime}$ high, to keep nourishment in, free from dust, flies, and other impurities. A small refrigerator, $2 \frac{1}{2}^{\prime} \times \frac{1}{2}^{\prime}$, should also be supplied for this.

Another small room for ward necessities, cleaning articles, etc., under charge of the ward orderly; with a suitable locker with shelves ( $6^{\prime} \times 3^{\prime} \times 1^{\frac{1}{2}}$ ), for keeping bed-pans, urinals, chambers, spit-cups, other ward utensils and cleaning articles.
(The number of ward huts that would be, therefore, necessary for a 600 bedded hospital would be 30 for warrant, N.C. officers, and men).
(2) Ward for 18 Officers, subdivided by partitions into three smaller wards, holding six beds each. Other arrangements as in (1).
(3) Ward for special cases, or for senior officers, subdivided into ten small rooms, $5^{\prime} \times 9^{\prime} \times 8^{\prime}$, five on each side, separated by a central passage (3 feet). Other arrangements as in (1).
(4) Sick Offiers' dining and sitting room, subdivided by one partition, giving two rooms $39^{\prime} \times 21^{\prime} \times 8^{\prime}$. Small rooms at the end to be used, one as a pantry with sink, cupboards, and shelves, the other for serving meals from.

Two $6^{\prime} \times 4^{\prime} \times{ }^{\frac{1}{2}}$ ' cupboards to be fitted in the dining room.
Furniture for these rooms to be included in the ordnance equipment of the hospital.

Accessory Bulldings.
The Committec say :-
"The accessory buildings necessary for a general hospital at the base should be constructed of wooden frames and galvanised-iron walls and
roof, with matchboarding lining, ample ridge and side-wall ventilation being provided.

A list is appended with a short description of each:

1. Hospital clean finen store ,, foul linen store
$\}$ in one hut.
2. Steward's provision store

Utensil store
Quartermaster's office (for two)
3. Pack store and rifle room.
4. Hospital kitchen
" milk kitchen, sterilising
Meat store
Scullery
Shed for Soyer's stoves (8)
Coal store
5. Patients' bath horse (i2 baths).
6. Lavatories (3).
7. Latrines (7).
8. Operating theatre with, in annexe, X-ray photographic room and sterilising room.
9. Dispensary

Pathological laboratory Nursing Sister's duty room $\}$ in one hut.
to. P.M.O.'s office
Registrar's office
Post office
Orderly Medical Officer's room
11. Medical Officer's kitchen.
12. Nursing Sister's mess hut.
13. Disinfecting sheds, including steriliser and incinerator.
14. Oil and lamp storeroom.
15. Reading room and chapel.
$\left.\begin{array}{l}\text { 16. Clothing store, for supply to patients in hospital } \\ \text { Red Cross store, for patients leaving hospital }\end{array}\right\}$ in one hut.
17. Canteen.
18. Fowl run and hen coop.
19. Ashpits.

1. "The hospital Clean-Linen Store ( $50^{\prime} \times 21^{\prime} \times 10^{\prime}$ ) and the Foul-Linen Store ( 14 ' $\times 21^{\prime} \times 10$ ) are placed in one hut with partition to the roof. The clean linen store should have three 2 -feet wide shelves all round and a double-rack standard shelving down the centre, with a wooden floor; also a serving counter $12^{\prime} \times 2^{\prime} \times 3^{\prime}$, about 6 feet from doorway. The foul-linen store requires no shelving; its foor should be of concrete.
2. "The Steward"s Store $\left(34^{\prime} \times 21^{\prime} \times 10^{\prime}\right)$, the Ulensil Slore $\left(20^{\prime} \times 21^{\prime} \times 10^{\prime}\right)$, and the Quartermaster's Office ( $10^{\prime} \times 21^{\prime} \times 10^{\prime}$ ) are placed in one hut $\left(64^{\prime} \times 2 \mathrm{I}^{\prime} \times 10^{\prime}\right)$, divided by wooden partitions into three compartments.
"The Steward's Store should also be separated into two by a wooden partition, one part for a store, the other for an issuing department, with communicating doorway between. It should have a concrete floor. The issuing department should be fitted with three rows of $1 \frac{1}{2}$-feet shelving round three sides, and a serving counter, $12^{\prime} \times 2^{\prime} \times 3^{\prime}$ high, about 6 feet from doorway; aiso two specially constructed strong cupboards, which should be fistures, for safe custody of wines and spirits.
"The Utensil Store should also have 2 -feet shelving fitted all round, and a concrete floor.
"The Quartermaster's Office, situated at end of hut, should have three short shelves and two cupboards for safe preservation of documents and books. Its floor ought to be of wood.
3. "The Pack Store $\left(5^{\prime} \times 21^{\prime} \times 10^{\prime}\right)$ and Riffe Room $\left\langle\delta^{\prime} \times 21^{\prime} \times 10^{\prime}\right\rangle$ are placed in one hut $\left(64^{\prime} \times 2!^{\prime} \times 10^{\prime}\right)$, divided by a wooden partition. The former should be fitted with three rows of 2 -feet wide shelving ( 2 fect apart) all round, except at windows and doors; and two standard double racks, with four rows of shelving, 2 feet wide, down the centre, with a passage between, 3 feet wide. This will give ample accommodation for 600 kits.
"The Rifle Roon should have stands for a double row of rifles all round, both on walls and floor, and a window at each side. It would be better if each stand was lettered and numbered. Ample light and ventilation should be provided by four windows, $4^{\prime} \times 3^{\prime}$; the floor should be concrete, both in pack and rifle stores, to allow of their being washed out with disinfectants frequently.
4. "The Kitchen, situated between medical and surgical divisions, and equidistant from all, should occupy a central position. It, however, should be sufficiontly remote, say 50 yards from them, to render danger from fire impossible. In this position it is easily accessible for supply carts, etc., and sufficiently distant from hospital wards for a drainage system from scullery to be established. It should consist of one hut $\left(64^{\prime} \times 21^{\prime} \times 10^{\prime}\right)$, divided into general kitchen ( $52^{\prime} \times 21^{\prime} \times 10^{\prime}$ ) and milk (dairy and sterilising) kitchen ( $12^{\prime} \times 21^{\prime} \times 10^{\prime}$ ), the former fitted with four large ranges, situated in the centre of the kitchen (back to back is the best arrangement for them), with a central chimney. We think that four large ranges should prove sufficient; but, if not, two more can be casily added, one at each end, crosswise. Hot water boilers should be attached to each range, and accumulation circulatory cylinders for the supply of hot water to scullery and 12 baths. A hot plate for 500 dicts should be fitted at one end, and cupboard lockers and drawers (the top) of which would form kitchen tables) fixed for storing cooking necessities, etc. The floor should be of concrete. Sliding counters should be attached to two windows for serving dinners through. Four windows, $4^{\prime} \times 6$, three in front wall and one in end wall, should give ample light. The entrance door should be divided horizontally about 3 feet from ground, for entrance of more air and light if necessary:
"The dfilk Kïthon is situated at end of hospital kitchen. It measures $12^{\prime} \times 21^{\prime} \times 10^{\prime}$, has room for six to eight sterilisers if necessary, and should be fited with stona shelves for standing milk on to cool. It is lighted
by a window, size $6 \times 4$ ', situated in gable wall. The entrance door should be divided horizontally to allow of more air and light if necessary; also to act as an issuing counter. The floor ought to be of concrete.

An annexc, constructed as a lean-to hut against the posterior wall of kitchen, inside wall io feet high, outside wall 9 feet, size $64^{\prime} \times 10^{\prime} \times 9^{\prime}$, divided as follows:-A meat store (larder), $122^{\prime} \times 10^{\prime} \times 9^{\prime}$; a scullery, $20^{\prime} \times 10^{\prime} \times 9^{\prime}$; a Soy'er's stuve shed, $20^{\prime} \times 10^{\prime} \times 9^{\prime}$; a coal store, $12^{\prime} \times 10^{\prime} \times 9^{\prime}$.

The Mcat Slore should have one door, 3 fect wide, opening from outside, and two large perforated zine windows, $4^{\prime} \times 3^{\prime}$, to allow of free admission of cool air but no fies. It should be fitted with a butcher's bench and strong hooks for hanging carcases on. In this store all the meat is cut up before being brought into kitchen for cooking. The floor should be of concrete, and frequently washed out with disinfectants, and the inside of the wafls frequently whitewashed.
"The Scullery" ( $20^{\prime} \times 10^{\prime} \times 9$ ) should have a long porcelain or metal washing trough down the centre or one side, for washing plates, pots, saucepans, etc.; and a double row of shelves along one side and two ends for keeping them on when clean. Its supply of hot water should come from the kitchen accumulator. Its floor should be concreted. There should be a communicating door between kitchen and scullery; also one opening outside.
"The Shed for Soyer's stoves (or, better still, agricultural or cattle food boilers) should have a communicating door to kitchen. Its size has been planned to hold eight of the boilers, which proved far more serviceable after prolonged use than the ordinary Soyer's stoves for boiling vegretables, meat, water, etc. We suggest those fixed on wheels as better for movement. The floors ought to be concreted; there should also be a door opening outside. The chimneys from boilers can pass direct through roof.
"The Coal Store $\left(12^{\prime} \times 10^{\prime}\right)$ ought only to have one door of entrance, and that from outside; and no communication between it and kitchen on account of ingress of coal dust, and no windows. It is capable of holding four tons of coal; this is the main coal supply for the whole hospital. Its floor ought to be of concrete.
5. "The Baths, 12 in number, which is considered sufficient, are situated in a hut adjacent to the kitchen for hot water supply, near centre of hospital for convenience of patients, and in cross roads, being adjacent to drainage scheme. A doubled span hut ( $30^{\prime} \times 21^{\prime} \times 8^{\prime}$ at eaves) with a double row of six baths, arranged in cubicle partitions $S$ feet high, containing a 7 -foot bath and seat in each. The hot water supply should be laid on by pipes from kitchen, fitted with tap to each bath. By this arrangement there is a constant supply of hot water, day and night, which could not be if they were situated elsewhere in the camp, unless a specially designed boiler house was erected in connection with baths. A cold water supply also to be laid on by pipes-one tap to each bath. The branch drain pipes from scullery and bath house should lead direct into the main drain, being properly trapped. The floors of bath rooms and passages should be of concrete, slightly sloping outwards, where a
surface drain should take the surplus water and washings from floor (which should be carried out daily); scrupulous cleanliness should be observed in all other respects.
6. "The Lavatories, three in number, two for patients and one for Detachment R.A.M.C.; each $40^{\prime} \times 15^{\prime} \times 8^{\prime}$. Those for the patients should be situated, one at outer side of both the surgical and medical divisions, about 50 yards distant, and in a line with the latrines; having one door for admission and four windows, two at each side; a washing-stand table with a r-inch edging all round to prevent overflow, constructed of wood and covered with zine, $30^{\circ} \times 5^{\prime}, 3$ feet high, sloping slightly from the sides to the centre, which is hollowed to form a drain, which carries the water to one end, then down a 2 -inch discharge pipe to the branch drain (leading to the main), which should be properly trapped outside the hut. The water supply is arranged by a pipe passing from one end of tabie to the other, about its centre. This is fitted with 30 branch taps, 15 at each side, arranged aiternately. A concrete floor, 4 inches thick, is necessary; also a strong wooden trellis, I yard wide, for standing on, placed round the wash tables. Each wash-house ought to have 30 zinc or enamelled-iron washing basins.
7. "The Laftines, seven in number, as follows:-3 for patients, I for Officers' hospital, i for Detachment R.A.M.C., I for Medical Officers' camp, I for Nursing Sisters' camp.
"The patients' latrines, three in number, two being $45^{\prime} \times 1 S^{\prime}$ in size, consist of a galvanised iron screen down the centre, on one side of which accommodation for a single row of 20 seats is provided, being roofed only over the seats to allow free circulation of air. A protection wall, which is included in measurements, surrounds the whole except for the entrance doorways at both ends.
"The opening in posterior wall is for conservancy men to come and go, a space 6 feet wide being allowed inside this wall for spare buckets and others for emptying bed-pans, urinals, and slops from wards into. In this space is also kept the supply of disinfectants necessary for use, the conservancy being done from the back of the seats, over the openings for which hinged doors should hang to prevent draught and blowing about of latrine paper. The whole floor should be of concrete, 4 inches thick, to allow of daily washing and disinfection. Two seats should be partitioned off and marked 'For venereal patients' use only.' Boxes as fixtures for latrine paper are necessary.
"The third patients' latrine, intended only for convalescent enteric fever patients (placed about 50 yards from the side of that division and containing only sik seats), is designed and constructed like the other latrines; all the excreta and liquid slops brought from wards to this latrine are disinfected.
"The three small latrines ( $12^{\prime} \times 12^{\prime}$ ) for sick Officers, Medical Officers, and Nursing Sisters' use, consist of three seats each, and are of same design, except with partitions between each seat and doorways for privacy. A urine tub stands in the corner of the two former.
"We have allowed an average of 20 seats for each division of 200 beds (to patients per seat), except for the enteric division, for which
latrine accommodation for 60 convalescents, i.e., about one-third of the beds, has been provided.
"The latrine for Detachment R.A.M.C. should be the same in design as that for the patients, only that four seats should be partitioned of for N.C. Officers. Its position should be about 50 yards from inner flank of their camp, behind patients' latrine. Boxes of dry earth and scoops should be placed in each.
"Urinals.-Four soil buckets are placed in each front comer of latrine enclosure. These are partitioned off for privacy. These would, of course, be unnecessary if a system of drainage was laid down, which for prolonged occupation is considered advisable. The dry-earth system is the one advocated. A small shed should be supplied for storing the dry earth in ; removal of the pails to take place morning and evening. The strictest attention to cleanliness is necessary; floors and seats should be washed down with disinfectant solutions; pine-wood sawdust or carbolic powder and dry sand sprinkled over the floor daily, the inside walls being limewashed at frequent intervals."
[Nore.-The drainage system is not very clearly defined. It should certainly be a surface system only. Pipe drains are troublesome and dangerous unless well and carefully laid, and it is not probable that this could be satisfactorily done in a service hospital.]
8. "Operoting Theatre.-This should also be constructed of a wooden frame, with galvanised iron roof and sides and matchboard lining to same; size $25^{\prime} \times 25^{\prime} \times 10^{\prime}$ walls. It should have two roof lights, $6^{\prime} \times 4^{\prime}$, with green-coloured drawn blinds, three sides having two windows, each $6^{\prime} \times 4^{\prime}$; the fourth side has the X-ray photographic and sterilising room attached as annexe.
"The walls should be covered with white enamel paint, two coats, to prevent absorption, and to enable them to be washed with disinfectants when necessary. The white colour also tends to lighten the room. The floor should be covered with thick linoleum all over, to prevent absorption, as also to allow of its being washed with disinfectants. Green roller blinds should be fixed in all the windows, the lower sashes of which ought to have dulled glass. The entrance door, as well as that the X-ray room, should be 4 feet wide, to allow ample room for stretchers with attendants. Four ventilators, sliding panels over perforated zinc, should be placed in the walls. Two powerful hanging kerosene oil lamps, of 100 candle power (if electric light is not procurable), are required for night work; also two small hand lamps with reflectors, for throwing light on the patient. In several of the general hospitals in South Africa portable electric lamps of zo candle power were used for this purpose with very good effect. An ample supply of hot and cold water should be taid on, with taps over $\sin k$ and hand basins. These should discharge into a portable cistern outside, which could be emptied as required.
"The $X$-ray and Photorraphic Room, if not under the same roof, should form, with Sterilising Room, an annexe to the operating theatre, having a door of communication between; their size $20^{\prime} \times 15^{\prime}$, with a partition dividing $5^{\prime} \times 15^{\prime}$ off, to form the dark room for photography. The dark
room requires a red glass window, $1 \frac{1}{2}$ feet square; also a sink and three rows of shelving all round.
"The X-ray room, in which there is ample space, should also be used for administering anasthetics to patients." [Nore.-It is better to have a separate room for this purpose.]
"A room $5^{\prime} \times 15^{\prime} \times 8^{\prime}$, for sterilising dressings, towels, etc., forms portion of the annexe, with communicating door to the operating theatre. It is a convenience that cannot well be done without, and should contain a cupboard $6^{\prime} \times 4^{\prime} \times 1 \frac{1}{2}$ for surgical dressings, towels, etc., under care of the nursing Sister.
9. "The Dispensary $\left(28^{\prime} \times 21^{\prime} \times 8^{\prime}\right)$, the Pathological Laboratory ( $20^{\prime} \times 2 \mathrm{i}^{\prime} \times 8^{\prime}$ ), and the might Sisters' Duty Room $\left(\mathrm{I}^{\prime} \times 21^{\prime} \times 8^{\prime}\right)$ will form another hut $64^{\prime} \times 21^{\prime} \times S^{\prime}$.
"The Dispensary should have a 10 ' $\times 6$ ' room partitioned off in one corner for keeping splints in (this ought to be provided with three rows of shelving, $1 \frac{1}{2}$ fect widc, all round); a poison cupboard, $6^{\prime} \times 3^{\prime}$, at one corner, for safe keeping of poisons, with four shelves; a dispensing counter across room, within 4 feet of entrance door; an enamelled iron or porcelain $\operatorname{sink}$ at one corner, which should discharge through wall into a portable cistern outside; and four rows of shelving all round.
"The Pathological and Bacteriological Laboratory, situated at one end of hut, should have three windows, $6 \times 3^{\prime}$, to afford plenty of light, and locker cupboards, 3 feet high, along the window sides; also a porcelain sink and hand basin fixed in one corner, which should discharge through wall into a portable cistern outside. This room requires ample ventilation, ridge and wall.
"The night Sisters' Duty Room is very necessary for the comfort of these ladies doing night duty, especially during inclement weather. Armchairs, table, hanging lamp, and an oil stove for preparation of nourishment, also cupboards for medicines, stimulants, etc., are all the fittings necessary.
10. "Principal Medical Officer's and Registrar's Offices, Post Office, and Orderly Medical Offcer's room.
"The situation of the hut should be fairly central and convenient to all divisions for purposes of administration.

"They should be all separate, with communicating doors between the first four.
"Telephonic communication should be laid on to the sergeant-major's office from the principal hospital centres, viz.: Quartermaster's and Divisional Officer's offices.
12. "Nursing Sisters' Quaters.-Nursing Sisters, whether living in huts at base or in tents with advanced hospitals, should always have, if
possible, a mess hut, consisting of sitting room, dining room, kitchen, scullery, and pantry.
"The one suggested measures $64^{\prime} \times 21^{\prime} \times 8^{\prime}$, with rooms as follows:sitting room, $20^{\prime} \times 21^{\prime} \times 8^{\prime} ;$ dining room, $24^{\prime} \times 21^{\prime} \times 8^{\prime} ;$ kitchen, $20^{\prime} \times 10_{2}^{\prime} \times 8^{\prime}$; scullery and pantry, each $10^{\prime} \times 10_{2}^{1} \times 8^{\prime}$. A large range should be fixed in the kitchen, also dressers and lockers. A sink in the scullery, which, like those in other huts, can discharge into a portable cistern outside the hut wall. The pantry would require a locker press for stores.
"At the base the ladies ought to be housed in huts. One constructed on same plan as that shown for sick officers, 'single room hut,' would give very suitable rooms; $14^{\prime} \times 9^{\prime} \times 8^{\prime}$ would give accommodation for 6 on each side-12 ladies in one hut. Three such huts would be required, allowing for 34 sisters; this would give one spare room. The two end rooms in one hut should have a partition instead of a 3 -foot passage between them to serve as chief matron's sitting and bedroom; the passage at further end of other huts could be used for bos rooms. A small extra hut would have to be provided for one housckeeper and three servants.
"In base hospitals, the Medical Offeers' mess hut should be similar in design and size to the one for the Nursing Sisters.
"If sleeping huts are necessary, those already described form very comfortable accommodation.
[Note.-Hut accommodation for the staff will only be required under very exceptional circumstances, and need hardly be considered.]
13. "Disinfecting Sheds.-The disinfecting sheds-two in number, one for soiled clothes, the other for infected discharges-should be situated close to one another, and about 50 yards from the outer flank of infectious division, constructed of similar materials as other huts, but without matchboard lining.
"That for infectious clothes, size $55^{\prime} \times 15^{\prime} \times 10^{\prime}$, should consist of three divisions-
(1) $15^{\prime} \times 15^{\prime} \times 10^{\prime}$, where all clothes are steeped in chemical disinfecting solutions and wrung out.
(2) $15^{\prime \prime} \times 15^{\prime} \times 10^{\prime}$, where the frecal soiled clothes and others requiring it are boiled.
(3) $25^{\prime} \times 15^{\prime} \times 10^{\prime}$, for Thresh's steam disinfecting apparatus.
"The floor of this entire shed should be of concrete, 4 inches thick.
"The first should have three wooden tubs, about $3^{\prime} \times 3^{\prime}$ in size, with a wooden tap in each, close to the bottom, for emptying them. They should be raised on 6 -inch concrete platforms, and ought to be placed three on each side of lower half of shed. A small open drain, commencing at first tub each side, made in the concrete, in connection with a portable cistern sunk at back of hut, is also necessary if main system of drainage docs not exist. A low partition, 3 feet high, should separate No. I shed from No. 2, to allow of clothes which have been chemically disinfected and require boiling being passed into No. 2 shed for that purpose.
"No. 2 division requires two large size ( 100 gallon) boilers with cocks. The chimneys should pass through the side walls and extend about 4 feet above the roof.
"No. 3 division should have a large size steam disinfecting apparatus with a door at each end, one for entrance of infected clothing, the other for exit of disinfected. (The Thresh's apparatus supplied to hospitals in South Africa was not large enough for requirements.) A partition should completely divide this shed into two, one for infected, the other for disinfected clothing. The chimney should pass through and extend 4 feet above the roof.
"A small lean-to shed at end of this division as coal cellar is also necessary.
" Excreta and Slops.-The second shed, for disinfection and sterilisation of all infected discharges and slops from infectious division, etc. (size $25^{\prime} \times 15^{\prime} \times 10^{\prime}$ ), should have a sink in one comer, drained into a cistern outside at back of hut, for washing bed-pans and urinals in after chemical disinfection. At one end of hut a large 100 -gallon (or $150-g a l l o n$ ) ordinary boiler, set in brick freplace, should be erected, with chimney buit outside, for sterilising all infected discharges and slops. The walls all round should only extend 6 feet high, leaving a space of I foot below to allow for free circulation of air.
"The clothes boiler, excreta steriliser, and outside cisterns should be emptied by hand buckets into sanitary carts as frequently as necessity demands. All these sheds should be limewashed inside frequently, and floors washed with disinfectants daily.
"An Incinerator, for burning used dressings, infected and worn-out clothing, and all refuse generally found in camps, is a necessity. This can easily be constructed for dry materials. An ordinary covered furnace with good draught is all that is required.
"The combination steriliser and incinerator as used in No. 4 General Hospital (which is reported on as satisfactory in every respect) is practically a steriliser (as far as destruction of liquid excreta is concerned), for the heating of which dry camp refuse, infected and old clothing, etc., was used as fuel. This is an excellent plan, as both processes being performed by the one furnace fucl is saved, and the mixing of dry absorbents to render liquids semi-solid is not required. This is an appliance worthy of imitation and reproduction."
[Nome.-The chief advantage of this method of sterilising excreta by heat is that it disposes at once of the urine and other fluids, and that it can be easily improvised on a smail scale. But incinerators were used at many of the Gencral Hospitail, and when constructed of proper material worked well. The difficulties were chiefly due to subsidence and cracking, the results of faulty construction. These were, of course, most successful where it was found possible to use solid material to mix with the fluids, but in many places there was no dificulty about this. At No. 2 General Hospital and at No. 20 these incinerators worked particularly well. The Committee, however, prefer boiling on account of the difficulty about fluids.]
"If a satisfactory portable appliance, combining in one both steriliser
and incincrator, could be designed of a sufficiently light weight (say, between I and 2 tons) for horse draught, it would be of great advantage to field, stationary, and advanced general hospitals.
"The fire chamber should be of large size, probably lined with specially shaped fireclay blocks, and the boiler capable of holding about 100 gallons, so set in fire chamber that the flames should play all round under surface and sides.
" It would be advisable to have the whole of disinfecting, sterilising, and incinerating appliances surrounded by an 8 feet high corrugated iron fencing. Its size would necessarily depend on the size of enclosed buildings and appliances, and it should be floored with concrete.
14. Oil and Lamp Store Room.-"A small shed, $12^{\prime} \times 12^{\prime} \times 8^{\prime}$, for storage of paraffin oil and trimming all hospital lamps is required. Its position should be central, and near the quartermaster's stores, under whose care it would be.
15. "A hut, to act as Chapel, Library, Reading and Writing Room, would be a convenience both to patients and hospital personnel. A suitable one would be a hospital ward hut, but without partitions or small rooms, size $84^{\prime} \times 21^{\prime} \times 10^{\prime}$.
16. "A hut, the same size and shape as the clean and foul linen store, divided into two, with two rows of shelving all round both rooms, and counters across near the doorways, would form all that is necessary for a Red Cross and Clothing Stores, if still considered necessary for the R.A.M.C. to perform these duties.
17. "Huts in place of tents for Canteen (dry and wet) and filters, also sheds for carpenter, tailor, sailmaker, shoemaker, and barber's shops, if not absolutely necessary, are very desirable.
18. "A fowl-house and tun, size about $24^{\prime} \times 8^{\prime} \times 8^{\prime}$ inclusive, is a necessity when live fowls are supplied, as they were in South Africa.
!9. "Ash-pits.-Two are necessary, each $12^{\prime} \times 12^{\prime} \times 6$ ' (one side being removable), constructed of galvanised iron, and floored with concrete.
"Railway Sidins.-General and Stationary Hospitals should be crected as close as possible to the railway line, for convenience in transferring sick and wounded. If a suitable site cannot be obtained, a railway siding, with platform, should be constructed (as early as possible) to the hospital for its use. Size of platform $150^{\prime} \times 12^{\prime}$, with a ramp 18 feet wide."

## General Scheme of Hospital Camp.

The Committee say:-
"The laying out of a Hospital Camp must necessarily vary according to local conditions (size and formation of ground available) and the military considerations. For administrative purposes the principal accessory buildings, stores, offices, etc., had better occupy a central position. A scheme will be best understood by reference to attached plan, which includes three divisions, Surgical, Medical, and Infectious (enteric), and an Officer's hospital.
"In the central road of the hospital, which is 40 yards wide, are placed
the administrative offices and other buildings, consisting of (enumerating from front of hospital):-
"Day wardmaster and duty room. Dentists" consulting room. Principal Medical Officer's, Registrar's and their clerks' offices; Orderly Medical Officer's room; Post Office. Operating theatre, with X-ray room. Pathological laboratory; dispensary, night Sisters' duty room (for the whole hospital). Red Cross and clothing stores. Kitchen. Filter hut. Lamp and oil store. Barber's shop; electrician's shop. Tailor's, sailmaker's, and shoemaker's workshops. The fowl run and carpenter's workshop lying behind the hospital.
"In the cross avenue, which is also 40 yards wide, are placed:-soiled and clean linen stores; stewards' and utensil stores and quartermaster's office; baths, pack store and rifle room; and chapel.
"The kitchen, including milk kitchen, with sterilisers, larder, scullery, Soyer's boiler room, and coal cellar, occupies the centre of the hospital, about 50 yards distant from each division. Behind the kitchen is the filter hut and lamp room, which must occupy a central position for supply of drinking water and for trimming of all hospital lamps.
"At each side of central avenue in front, are placed the surgical and medical divisions, the infectious being over 50 yards behind the medical. Each is estimated to contain 200 patients, but is capable of expansion if necessary. The Officers' hospital lies behind the surgical division, separated from it about the same distance.
"All the tents (enlarged E.P.I.P.") in the three divisions are calculated to hold 10 patients; those in the Officers' hospital (small E.P.I.P.) four patients each.
"The Surgical Division requires less bed accommodation generally on active service than either of the others, but this must be arranged, by expansion or contraction, as circumstances demand.
"Tents should be reserved for serious cases requiring special nursing, one tent for opthalmic (surgical) patients; the last row of tents ought to be set apart for venereal patients. The Divisional Officer's office and Nursing Sisters' duty rooms are placed on inner flank of division. The latrines and wash-houses are on the outer flank, about 50 yards distant. The prisoners' tent can be pitched when necessary at the back of division, where sentries can be posted without inconvenience. The operating theatre is in close proximity to the division.
"The Medical Division should also have tents set apart for serious cases requiring special nursing and for tuberculosis patients. The Divisional Officer's office and nursing Sisters' duty tents are placed as in the surgical division, also the latrines and wash-houses on outer flank.
"The Infectious Division, which includes a camp for isolation cases, is also equipped for 200 patients, but is designed for expansion or contraction as circumstances demand. The first four rows of tents, with 160 beds, are for the treatment of enteric fever. The last row- 40 beds-for dysentery.
"The Isolation Camp should be behind and well apart from the

[^3]infectious division; the tents, being double circular, are pitched and struck as occasion requires. The Divisional Officer's office and nursing Sisters' duty tents are situated on inner flank as in other divisions.
"All the disinfecting arrangements are situated in an enclosure on outer flank, 50 yards distant, in or near which is also the incinerator.
"'The ashbins are also placed behind the enclosure, out of sight and near to incinerator.
"The mortuary is situated about 100 yards behind the disinfecting enclosure, out of view of the hospital.
"The Offcers' Hospital is practically a distinct unit in itself, having messing and sitting tents, ward tents, Divisional Officer's office, kitchen, lavatories, latrines, wardmaster's and orderly's duty tent; also a Nursing Sisters' pantry, The front row is formed of two tents, one a mess the other a sitting room. The second row has three tents, each containing four beds for medical cases. The third row has three tents, with 10 beds-eight for surgical cases, and two in one as a ward for special cases. The latrines and bath room, also kitchen, are places on one flank. In a General Hospital at the base officers should be accommodated in huts. In advance base hospitals a mess hut should be provided.
"The Medical Officers' Camp is situated to the left front of the hospital; and consists either of a hut, containing mess, sitting room, kitchen, scullery, and pantry, or of two E.P.I.P. tents of large size as mess and sitting room, 22 officers having to be accommodated. The living tents (which should be the Indian Field Officers' tent with bath attachment) are placed in rows adjacent to the mess.
"If a hut is not provided a kitchen with scullery and pantry should be erected.
"The latrine is placed to right of camp about 25 yards distant.
"The Nursing Sisters' Camp, situated to the right front of hospital, should consist of a hut combining mess and siting rooms, kitchens, scullery, and pantry. If hut cannot be provided two E.P.I.P. tents, large size, are necessary, also a kitchen, scullery, and pantry, built as in Officers' camp. The living tents recommended for these ladies' use are the Indian Field Officers' tent, with bath attachment. These would be far more comfortable and convenient for them than the double circular. Each nurse should have a tent to herself. The latrine is situated about 50 yards to the left of camp. In General Hospitals at base we recommend that Nursing Sisters live in huts.
"The Royal Army Medical Corps Camp is placed on the left flank of the hospital. It is also a self-contained unit, having cookhouse and scullery, lavatory, wash-house and latrine. The former is large enough for the double duty of cooking for the detachment's and sergeants' messes. It is situated behind their camp, about 50 yards distant.
"In the front row of tents are the canteen, sergeants' mess, and Warrant Offcers' quarters, the N.C. Officers' tents being on outer flank. The canteen had better be a small hut ( $12^{\prime} \times 12^{\prime}$ ) for safe custody of supplies. The latrines and wash-house lie to the inner side of camp (about 50 yards distant), with their backs to the patients' latrine and wash-house."

## SOMIE WORK BY THE ELECTRICAL ENGINEERS, R.E. (Vols.). $\%$

## The Imish Maneevres, 1905.

These manceuvres, to which the Corps was asked to send a detachment with a field search light, took place at Glen Imaal, co. Wichlow, on the 16 th and 17 th August.

The "General Idea" of the operations was that a Fortress (Blue), protected by works on the mountain of Lugnaquilla and the ridges to the north of it, had been invested by an Attacking Force (Red) and gradually: driven back to the last line of advanced works covering the main position. A final attack on these works was commenced on the morning of the 16 th, and was intended to last about three days.

The Red Force consisted of a division of infantry, several artillery brigades, amounting to about eighty guns, and two field companies of engineers.

Elaborate defences, consisting of redoubts, splinter proofs, trenches, and wire entanglements, had been constructed to mark the positions occupied by the Blue or Defending Foree; and as live projectiles were used by the attack, these feldworks were "manned" by dummy targets. The effect of the artillery and infantry fire of the attacking force could thus be duly noted.

Extensive use was made of field telephones, the movements of all the artillery and infantry being controlled by their means from the headquarters of the attack.

A Detachment of Electrical Engineers (Vols.), commanded by Capt. J. J. F. O'Shaughnessy and consisting of C.S.M. W. J. Grey and 16 N.C.O.s and men, left London by the $10.15 \mathrm{p} . \mathrm{m}$. train on Monday, the 1 ath August, and proceeded via Holyhead and Dublin to Dunlavin, co. Wicklow. From there they marched 9 miles to the camp of the 57 th Co., R.E., at Coolmoney, the headquarters of the Red Force, where they arrived on the evening of the 5 th.

The plant, consisting of one of the portable Daimler-Schuckert oil engine sets, field projector, and cable cart, had been sent off in advance by groods train, and was awaiting the arrival of the Detachment at North Wall, Dublin. Corpl. T. Vitty and one sapper were detailed to accompany the search-light train, which was taken by road by a six-horse R.E. team to Coolmoney, a distance of about 40 miles, and arrived at the camp some few hours after the remainder of the Detachment.

The forenoon of the 16 th inst. was spent in overhauling the plant, while the O.C. Detachment accompanied Colonel Scott-Moncrieff, R.E., the Commanding Royal Engineer, in a reconnaissance of the proposed

[^4]position for running the light. This was a redoubt, supposed still to be in the hands of the enemy, but which was expected to be captured and held before nightfall as an outpost of the attack.
At 1.30 in the afternoon the Detachment moved off, escorting the balloon cart and search.light train. Owing to the hilly nature of the ground to be traversed, the latter was provided with an eight-horse team. $\Lambda$ halt was made at Leitrim Castle, the headquarters of the 7th Division, where the search-light train remained until nightfall and opportunity was taken to have a trial run of the engine. During this run the Detachment was inspected at work by General Lord Grenfell, Commander-in-Chief of the Forces in Ireland, and also by Lieut.-General Sir G. de C. Morton, Commanding the 7th Division, who both expressed their satisfaction and thanked the O.C. for the services of the Detachment.

A party of seven sappers were detailed by the O.C. to assist the Corporal, R.E., in charge of the signal balloon, and proved their adaptability by assisting to inflate and handle same.

At 8.30 p.m. the party moved off to take up their position on Mill Hill Redoubt, crossing a ford and negotiating a very steep hill en route. On arrival at the base of the position the engine was run into the shelter of a ruined house and left to the care of Corpl. Vitty and and Corpl. Templeman, who had the engine running at full voltage long before it was required. The projector and cable cart were meanwhile separately man-handled with double ropes by 14 E.E.s up an exceedingly steep hill, covered in many places with large boulders; and the light was running on top of the position 25 minutes after the search-light train arrived at the foot of the hill. This was an exceedingly creditable performance, considering the difficulty of the hill which had to be negotiated and that over 400 yards of cable had to be paid out.

The light was used very effectively to illuminate surprise targets, which were occasionally raised and depressed to represent a counterattack on the hill. The infantry, stationed at the outpost, were instructed to keep up a hot fire on the targets when exposed. The experiments, which were carried out in the presence of the general and his staff, proved that with a $2 f^{-}$-inch projector these targets, which were about 3 feet square, were sufficiently illuminated by a $16^{\circ}$ dispersed beam for effective riffe fire at 600 yards and by a concentrated beam for effective fire at 1,000 yards.

After the firing had ceased the projector and cable cart were lowered down the hill by drag ropes, the search-light train coupled up, and the Detachment marched off to camp, a distance of about 5 miles, where they arrived at $3 \mathrm{a} . \mathrm{m}$. The search-light train was left en route at Leitrim Castie, ready for the next day's operations.

On the following day, the 17 th, the Detachment marched to Leitrim Castle about I p.m., in order to prepare for the night run, which was to have taken place on Cannow Mountain, and which, owing to the difficult nature of the ground to be traversed, would have necessitated the use of a ten-horse team for the search-fight train.
Unfortunately, however, heavy rain having set in, the G.O.C. ordered that the operations were to cease at sunset, and not to continue over next
day; as originally intended. As an alternative to the run on Cannow Mountain, it was suggested by the O.C., E.E., that, if the weather improved before nightfali, the E.E.s should give a demonstration of the light from Leitrim in illuminating men attacking in extended order, but this had reluctantly to be abandoned owing to the severity of the weather.

## The Charing Choss Railmay Station Disaster.

About 4.0 p.m. on the afternoon of 5 th December, 1905, a large portion of the outer end of the arched roof of Charing Cross railway station, London, suddenly collapsed.

At 6.50 p.m. a Detachment of the Electrical Engineers (Vols.) was telephoned for to bring their search lights from their headquarters in Westminster to enable the repair work to go on. Before 8 p.m. 25 men and two field search lights were on the spot, under the command of Capt. J. J. F. Phillips and Lieut. E. G. Sheppard. A fow minutes later the projectors were mounted on top of railway carriages, and the lights concentrated on the places where the repair work was going on, thus enabling very risky work, which would otherwise have been delayed till daylight, to proceed without a break.

This lighting was continued by the corps every night as long as required.

It is very creditable to the corps that at so short notice they were able to carry out the whole of this work entirely unaided, more especially as the men were not in any way picked, but were simply those who happened to be at headquarters for drill.

> REVIEW.

## THE BATTLE OF WAVRE AND GROUCHY'S RETREAT.

> By W. Hyde Kelly, R.E.-(Murray. I905).

Lievt. Keliy has chosen a good subject and has handled it well. The campaign of 1815 is always attractive, and this particular episode of it is comparatively unfamiliar to English readers. It was mid-day on the ${ }^{17}$ th of June when Grouchy took command of his two corps to follow the Prussians; it was mid-day on the 19 th when he begran his well-executed retreat from Wavre, on learning the result of the battle of Waterloo. How he carried out his task during these forty-eight hours has been the subject of infinite discussion, and the problems presented are of great interest. Facts rather than judgments are what the reader wants in order to form an opinion on these problems, and the facts cannot be too fully stated. In this respect the histories of the Napoleonic wars which are now being brought out by the French General Staff are models. Licut. Kelly tells his story clearly and forcibly, but a larger part of his iso pages might with advantage have been devoted to the facts, and less to criticism.

Some introduction was, of course, necessary, but it might have been brief; as it is, we find ourselves half through the volume before Grouchy starts on his mission. On page 78 we read :-
"Whatever may be said in extenuation of Napoleon's delay and inactivity on the morning of the 17 th, the actual circumstances of the case did not warrant his wasting his time on the previous day's battlefield and discussing politics with his generals when all his energies should have been concentrated on the great crisis at hand."

Such a man as Napoleon should not be charged off-hand with wasting his time; he is entitled, like the meanest criminal, to the benefit of the doubt. We know that the battie of Ligny had ended after dark and that the French troops were short of ammunition, that the cavalry had been sent off at daybreak to ascertain by what roads the Prussians were retreating, and that the situation at Quatre Bras was still obscure. Whether Napoleon's inactivity was justified by these or other reasons is fair matter for discussion, but it should be thorough ; and obviously it belongs to the general history of the campaign rather than to the IVavre episode.

In blaming Grouchy for not crossing the Dyle at Mousticr and Ottignies when he heard the guns at Waterioo, Lieut. Kelly is in good
company; but it is going far to say that Grouchy should never have allowed Blucher's flank march to St. Lambert to be carried out. "The cavalry could have reached the bridges (at Moustier and Ottignies) in time to threaten Blucher's flank, and prevent him, if not from assisting Wellington with a part of his forces, at least from throwing his whole weight into the battle against Napoleon." As a matter of fact only about 40,000 Prussians took part in the battle of Waterloo; and looking to the prolonged resistance which Thielemann made on the igth, after Grouchy had passed the Dyle at Limah at nightfall on the 18 th, it seems doubtful whether an earlier passage would have much affected the results.
E. M. Lioyd.

## NOTICES OF MaGAZINES.

## Buletin of the International Ralyay Congress.

November, 1905.
A Cheap Method of Interlocking Switches and Signals.-In the British Isles the concentration of point and signal operation is an accomplished fact on lines open to public traffic; but in other countries the installation of interlocking has not proceeded so rapidly in the case of wayside stations, and consideration of the expense has urged engineers to search for other methods whereby security can be attained at less cost.

Various methods involving bars and padlocks to switches, a central lock (as in the Bouré system), keys in the lever frame, which cannot be removed to unlock an outlying switch unless all conflicting signals are "on," Annett's lock, and various other lock and key arrangements have been tried, but are all a little cumbrous. Again, systems involving wire locking or rod locking have been installed occasionally. They save concentration of levers in a signal box, but involve a good deal of apparatus and are not wholly satisfactory. Besides, particularly at roadside stations, complications of wires are as well avoided.

The system herein described may be called "locking by electrical tappet," and the principle involved is that of mechanical locking by lock and key, controlled by quite simple electrical mechanism, while the key need not be taken from place to place, and no elaborate wire connections are necessary.

For switches the levers may be of very much the ordinary shunting or throw-over type, and for signals any kind of weighted lever would answer.
The electric tappet-or tumbler rather-on the lock consists essentially of a stop which secures the boit of the lock in position when closed. When the lock is shut the tappet holds it normally, and a current must pass to free the apparatus. If the lock is unlocked the circuit is broken. To operate the circuit a push is pressed, and then if there is no break in the circuit the tappet, being lifted by an electro-magnet, releases the lock, the push being held down while the key is turned. Thus a Leclanche battery can be employed.

Hence, conflicting signal and switch levers being connected electrically, the throwing over of any one involves a break in the circuit and prevents any of the others being operated.

It is hardly possible to describe the apparatus in detail without the diagrams. I should mention, however, that in case of breakdown of the electrical arrangements the lock can be released after breaking a lead
seal, and, according to regulations, this may only be done in the presence of the Station Master.

The system is extraordinarily cheap. Average cost per lock £I to $£_{I} 4 \mathrm{~s}$. od. Average cost of equipment of a roadside station ( 13 locks) under $£ 36$.

A specimen station is instanced (Waterloo, on the Brusscls-Charleroi line)-four crossover roads and two sidings-cost of interlocking 883 francs. The furthest switch is 450 mètres from signal levers.
C. E. Vichers.

> Jourxal of the Royal Artillery.:
> December, 1905.

Army Traning for Officers of the R.G.A.-Since the separation of the Garrison Artillery from the Horse and Field the former have become to a great extent specialists, and the officers are now apparently beginning to find themselves out of touch with the rest of the Army as regards work in the Field. Licut.-Colonel F. G. Stone, R.G.A., draws attention to the drawbacks of this development, and what he says applies with equal force to officers engaged in some of the duties of the R.F.
"No officer in any branch of the Service is fit to rise to field rank unless he knows a great deal about the other branches and is capable of applying that knowledge in the field." "The R.G.A. should be fully and fitly represented, both in peace and war, on the Staff of the Army and . . in appointments and commands which should be considered equally open to every branch of the Scrvice-rimembering always that we are Garrison Avtillerymen, but mezer forgetting that we are soldiers."

To counteract the tendency of specialization to put difficultics in the way of acquiring and maintaining general military knowledge, Colonel Stone lays stress on the necessity of R.G.A. officers seizing every opportunity of seeing the work of other troops. But he realizes that opportunities are not afforded as generously as they should be, and rightly argues that "it is desirable in the interests of the Regiment as a whole (and consequently in the interest of the Service) that the R.G.A. should be well represented at manceuvres and staff rides in which every arm of the Service is engaged." "Valuable instruction can be obtained by attaching Artillery officers as assistants to Infantry umpires, and wice versi.." "Let us realize fully the mutual advantage which may be derived from the close association of officers of the R.G.A. with those of other arms of the Service, and the salutary effect of never allowing ourselves or others to regard the R.G.A. as anything but an active fighting branch of the Service."

> A. T. Moore.

[^5]Jourxal of the Usited Service Institution of Inda.
October, 1905.
This quarterly number contains a very great deal of instructive matter, the following articles being especially deserving of study:-

1. A Comparative Study of the Organization, Traning, and Duties of the Staff in the Armifs of France, Germany, and England; with Proposals drduced merefrom for the Organization and Training of the Staff suited to Imperial Neens (Gold Medal Prize Essay, Igos).By Major G. R. Cockerill, Royal Warwickshire Regiment.
2. The Education of Officbrs (Tie for Prize Essay in the Northern Command).-By Major W. Ewbank, R.E.
3. Line of Commencation Iransport.-By Capt. F. W. Hawks, S. \& T. Corps.
4. Mounted Infantry Tactics in Hill and Densely-Wooded Country (Second Essay in the Burma Division).-By Lieut.-Colonel H. D. U. Keary, d.s.o., gist Punjabis.
5. Infantry Scouting.-By Major A. T. Spearman, Royal Warwickshire Regiment.

All these articles are too long for justice to be done in a brief notice. As to the first, however, it is worthy of record that the author's idea of an Army Headquarters to suit this country is


His object is " to divorce strategical policy from administrative execution, lest policy should be bent to evade executive difficulties; and to make finance subservient to administration, lest efficiency should be marred in its strugrle with economy."

Minds, men, materials, and money are the four elements of the matter; and a division of the headquarter administration into four great departments to correspond therewith would appear to be the most economical system. It will be observed that the author combines the three last ms under a Chief of the Administration.
A. 'Г. M0ore.

Nature.
December, 1905.
Camaman Electric Power Stations at Niagara (p. 161 ).-The great power house is situated in Victoria Park on the Canadian side at Niagara. The Canadian Company is allied to the Niasr-ra Falls Power

Company of the New York side of the river, but in its Canadian development it has given men of science the most wonderful installation to study yet known in the field of any water-power development. On the New York side the unit of development is 5,000 horse-power, but on the Canadian side the unit is 10,000 horse-power. In the wheel-pit and tunnel method of developing power at Niagara, a great slot, several hundred feet long, 180 feet deep and 2i feet wide, is excavated in the earth. From the bottom of the wheel-pit a tail race or tunnel is driven through solid rock, a distance of 2,200 feet, to the lower river. This tunnel is in the form of a horseshoe, 20 feet wide and 25 feet high, lined from end to end with vitrified brick and concrete, while the whecl-pit is also carefully lined. From the upper river a short canal diverts water from the main stream to a forebay at one side of the big power house. Near the bottom of the wheel-pit the turbines are installed, connected to the generators in the power station over the wheel-pit by vertical shafts. From the forebay penstocks, io feet in diameter, run to the turbines, and as the gates are raised the water pours from these penstocks into the wheels that give motion and life to the big srenerators, which make 250 revolutions a minute, the speed at which they are steadily worked. The water leaving the turbines falls into the tunnel and then flows through the tail race to the lower river and gorge. All power gencrated in Victoria Park must be, by agreoment, transmitted outside the Park limits for application and use. It will therefore have its voltage raised at a transformer station to 40,000 or 60,000 volts, in order that it may be sent economically to Toronto ( 90 miles away) and other distant places to meet the demand for electric power for trolley cars, lighting, ete.

The Panima Canal (p. 199).-The United States Government referred the technical question, as to whether the canal should be a sea-level one or one constructed with locks, to an International Engineering Advisory Board which recently visited the site. The Board has by a majority of three recommended the construction of a sea-level canal. This project consists of a canal with a bottom width of iso feet, a minimum depth of water of 35 feet, and twin tidal locks at Miranlores (on the Pacific side), having an available length of 1,000 feet and a widh of 100 feet. It is estimated that this canal can be completed in ten years at a cost of $230,500,000$ dollars, the Chargres River being controlled by a dam at Gamboa (midway between the oceans), forming a lake from which the surplus waters would be discharged by a tunnel through the dividing ridge into another river basin. A canal with locks having a summit water level 30 feet above mean sea level would have cost $194,000,000$ dollars; but the Board considered that a sea-level canal free from the restriction of locks, and which could be easily cnlarged and deepened to accommodate an increased traffe and larger vessels, would be well worth the additional cost.

Experiments with Explosines (p. 19.1).-The researches carried out in the laboratory of the Carbonite Explosives Company, Hamburgh, are given to English readers in a valuable little volume published by

Griffin \& Co. The experiments have been made with quantities as nearly as possible approaching those employed in actual practice, so that for some explosives we now have details obtained from experiment on a much larger scale than any hitherto adopted, e.g., for gunpowder 1,500 grams and for the higher explosives 300 grams were exploded. In connection with the safety of explosives for mining, the length of the flame, its duration and temperature, are of the greatest importance. The two former were recorded photographically, a quartz lens being used. A factor deduced from the ratio of the flame duration to the detonators time, termed the "after-flame ratio," is shown to have great influence on the ignition of fire-damp. The general bearing of the book on the question of safety is clearly dealt with, and tables give a mass of information relating to the explosives examined.

The Head Hunters of Borneo.-By Mis. Cator.-The authoress states that "there is nothing revolting in their head hunting, they fight fairly." It is their chance of winning renown and showing what they are made of. A woman's head, owing to her longer hair, is prized more highly than that of a man, but the whole thing to them is a thrilling game, full of excitement ${ }^{\circ}$ and danger. There is nothing unfair in their warfare, both sides are doing the same, and man after man wins his spurs in feats of pluck and daring. When not thus engaged, the authoress deseribes them as being gentle and extraordinarily peaceful in their home life, so much so that she had never heard of a "family jar."

## W. E. Warrand.

Orgay ner Mintärwissenschaftlichen Vereine.

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\text { Vol. 3. } 1905 .
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The Austrian Railway and Telegraph Regment.-This article gives an account of the working of the Hungarian state railways during the strikes in April, 1901. The strikers numbered 37,000 , and the railways affected by the strike had a total length of 13,000 kilometres.

On the 2and April 129 men of the Railway Regiment arrived in Budapest to take over the working of the railways. They were reinforced by reservists from the 7th Pioneer Battalion and 32nd Infantry Regiment, to the number of 151 men.

Many of the smaller parts of the engines had been removed or broken by the strikers, who had also taken away the telegraph instruments. The men of the Railway Regiment were unfamiliar with the type of engine in use on the State railways and with the mechanism of the Westinghouse brake.

In spite of these and many other difficulties three trains were despatched from Budapest on the 22nd April. These reached their

[^6]destinations in safety, though obstacles had been placed across the rails at various places and the points wedged with stones. During the night of the 22nd six more companies of the Railway Regiment, numbering 24 officers and 438 men, arrived in Budapest. The next day eleven trains were despatched, and the day after thirteen.

On the 25 th April the majority of the strikers returned to work, and on the $4^{\text {th }}$ May the Railway Regiment was entirely withdrawn from the State rallways.

The experience gained revealed the necessity for more technical knowledge on the part of the offcers; there was also a dearth of experienced engine drivers among the men.
J. E. E. Craster.

> Revee d'Histoire.
> Nozember, 1905.

Campagn of 1794-Army of the North.-On April 16 th the Emperor Francis reviewed the allied main army, numbering 75,000 men, at Cateau. Next day operations were begun for the investment of Landrecies. The movements of the several columns are fully described.
The Benavente Race.-This is an extract from a forthcoming volume of Commandant Balagny's history of Napoleon's campaign in Spain. The hurried march from Madrid to Astorga in the hope of intercepting Moore was known in the French army as 'the Benavente race.' Of the cavalry action at Benavente, in which the chasseurs of the Guard were routed, the writer says:-
" Why did the French horsemen twice remain at the halt when the enemy charged them? So vicious a practice can only be explained by the contempt for the enemy which a long series of successes had inspired in our soldiers, or by the wish to break his ranks by point-blank fire before assailing him sword in hand; anyhow we meet with many examples of it in the wars of the Empire, and strange to say the method was often successful, especially against Spaniards and Austrians; but it never answered with the English, who always charged home on very.
hard-mouthed horses."

The Wir of 1870-1871.-The Army of Chalons.-On August 26th Macmahon's army crossed the Aisne on its way to Montmedy. The German armies began to move northward and the 12 th German Corps came within 15 miles of the 7 th French Corps. Macmahon offered large rewards for news of Bazaine, and wrote to him that in the absence of such news he could hardly advance further eastward.

December, 1905.
Campaigx of 1794.-Army of the North. - Completion of the investment of Landrecies. This was skilfully executed, but "the tactical advantages so
obtained were soon nullified by the vicious strategy," which gave Pichegru the opportunity of operating against both flanks of the Allies.

The Benayente Race (concluded).-The success of the French cavalry at Mansilla, where it routed 4,000 Spanish infantry, is contrasted with its faiture at Benavente. The reasons that led Napoleon to turn back at Astorga, and leave the pursuit of the English to Soult, are fully discussed. His own statement on the subject at St. Helena is shown to be substantially true, viz., that it was the news of Austrian preparations and of intrigues at Paris.

Uar of :870-1871.-The Anmy of Chalons.-On August 27 th the ist, 5th, and 12th Corps (French) moved south-eastward to support the 7th, which seemed to be threatened, and there was a cavalry encounter at Buzancy. In the evening Macmahon decided to retreat on Mézières. He issued orders accordingly, and informed the Minister of War of his intention. The minister replied in the course of the night: "If you abandon Bazaine there will be revolution in Paris, and you will be attacked yourself by all the forces of the enemy." He urged Macmahon to persist in his advance on Metz, and assured him that he had 36 or 48 hours' start of the enemy. The marshal, thercupon, cancelled the orders he had issued. "Having taken this decision I sent an aide-de-camp to the Emperor to inform him of it. Soon afterwards General Pajol came to tell me on behalf of His Majesty that he regretted this last order. I replied that I had maturely considered the matter, and that it was impossible for me to countermand the orders which I had just given. This was the only time throughout the campaign that the Emperor made any remarks to me about the course of the operations." (Unpublished Reminiscences of Dfarshal Afacmahon).
E. M. Lloyd.

## Revue Militarr: des Armés Étrangeres. <br> October, 1905.

A Germax Conomial Campagn (Operations against the Hereros).-This article is of sufficient interest to justify a lengthy summary of its contents. It gives a detailed account of the methods which Germany adopted in coping with a situation that has often confronted us, but with which she was entirely unfamiliar.

Her lack of success was primarily due to the fact that, with the exception of a composite battalion of marine infantry (numbering 500 men), she had no troops immediately available for service abroad. Much valuable time was therefore spent in raising and training successive contingents of mounted infantry and artillery; and even when these were fit to take the field, they were still distinctly inferior in mobility to the Hereros, though the latter moved with their families and cattle.

The German columns had an unusually large proportion of artilleryroughly two batteries to three companies of mounted infantry; and it is
difficult to believe that so many gruns were necessary, especially as the Hereros had no artiliery at all. Probably the artillery could have been dispensed with altogether, and had this been done the columns would have been rendered more mobile. As the Hereros were entirely dependent on their cattle, it seems that the Germans should have made the cattle their objective from the first.

Since the end of 1903 , Germany has been engaged in suppressing, or attempting to suppress, a rising of the native tribes in South-West Africa. The cost of the military operations, both in men and money, has been so great that many Germans are doubtful whether the country is worth the expenditure.

The area of South-West Africa is one and a-half times that of Germany. There are no good harbours on the coast, and only two inferior roadsteads, one at Swakopmund and the other at Luderitzbucht.

The land rises from the coast in terraces to a region of high plateaus, which stretches eastward for about 500 kilometres as far as the Kalahari Desert. The plateaus are the most healthy and populous part of the country. The northern plateaus are comparatively low, less than 3,300 feet, and are covered with tropical vegetation; they are inhabited by the Ovambos, an independent tribe of Bantu origin, who cultivate the soil and practice various native industries.

South of the 20th parallel the country is more rugged and mountainous, the highest peak is over 7,000 fect and the plateaus vary in height from 4,000 to 5,300 feet. High thick bush occurs in places, and there is plenty of grass. This region is inhabited by the Hereros, a pastoral tribe of Bantu origin, who came from the north and conquered the country at the end of the s Sth century.

South of the 23rd parallel the country becomes gradually drier, bare and rocky hills alternate with sandy plains, and the bush gives way to desert. It is sparsely inhabited by Hottentot tribes, whose miserable cattle form their only means of subsistence.

From the port of Swakopmund to Windhuk ( 382 kilomètres) there is a light railway, but the gauge is only 6 metres (less than 2 feet). There is also another railway under construction from Swakopmund to Otawi. The disembarkation of troops and horses was a very tedious process, owing to the fact that steamers cannot come alongside the pier at Swakopmund.

Before 1896 there had been many native risings in the German Colony; but by employing the Hottentots agrainst the Hereros, and vice verst, they were always successfully repressed. In 1806 the whole country was pacified by the lenient measures introduced by the governor, Colonel Leutwein. From 1896 to 1903 the tribes remained quiet, and the Germans appeared to have been lulled into a false sense of security.

In October, 1903 , the Bondelzwarts, a Hottentot tribe occupying the extreme south of the colony, revolted. At this time there were only four companies of German troops, a mountain battery, and a few native police in the colony. By the berinning of December the rebels had been defeated and dispersed by a company from Keetmanshoop and a detachment of Witbois.

## Sketch Map of German S.W.Africa



The governor, Colonel Leutwein, did not receive news of this success until some time later, and meanwhile despatched two more companies to assist in repressing the rebellion. With the exception of a company at Outjo, the northern and central portions of the colony were therefore quite denuded of troops. This gave the Hereros the opportunity for which they had been waiting; they rose on the 12th January, 1904, attacked isolated farms and massacred the inhabitants, and cut the railway and telegraph on both sides of Okahandja. The Hereros were able to muster a force of about 6,000 men out of a total population of 60,000 to 80,000 ; they were grood shots, and were armed with Mauser and Lee-Enfield rifles, for which they had ample supplies of ammunition.

Luckily, all the Germans capable of bearing arms, to the number of about 500 , had been called out before the rising, and had reinforced the small garrisons in their own districts. A detachment under Lieut. Boysen, sent from Windhuk to relieve Okahandja, was cut to pieces; but Lieut. von Zülow, with about too men from Swakopmund, was able to reach the place and reinforce the garrison.

By the end of January a company, recalled from the south of the colony, had relieved Windhuk, Okahandja, and Omaruru; but the company at Outjo was still cut off, Gobabis was besieged, and the Hereros were gathering again in the Kamas mountains. The first reinforcements to arrive were the reliefs for the colonial troops, numbering 226 officers and men; they reached Swakopmund in February, and were at once despatched to Windhuk.

On the 17th January an order was issued in Germany for the formation of a composite battalion, of four companies of 125 men each, from the two marine infantry battalions at Kiel and Wihelmshaven. There were no other troops available for service abroad, so it was necessary to call for volunteers from all branches of the army to form a special corps for the purpose.

The bulk of the force was equipped as mounted infantry. These werc despatched in haste to South-West Africa under officers who had for the most part no experience of foreign service; it was not, therefore, until after their arrival at the latter port that anything could be done to train or organize this very heterogeneous collection of men and animals. This caused much delay; one detachment, for instance, was not ready to take the fleld until 38 days after disembarkation.

Colonel Leutwein a little later wrote as follows:-_" A number of men belonging to all arms and a number of unbroken horses are not all that is required to form a company of battery fit to take the field. The infantry cannot ride and the cavalry cannot shoot."

To add to the confusion they had pom-poms, mountain guns, field guns, and maxims of various patterns; lastly, the operations were to be conducted by two officers of equal rank, one the commander of the expeditionary force, and the other the governor of the colony.

The first detachment under Major von Glasenapp reached Swakopmund on the gth February. Various small columns were formed and despatched in different directions, but for the most part failed to get in touch with the enemy. However, a column, consisting of 120 mounted men
with 3 field guns and a pom-pom, came up with a force of about 1,000 Hereros, whom they defeated after ten hours fighting, capturing 2,00 head of cattle.

By the roth March the forces in the colony amounted to 2,500 men; the railway communication had been restored, and the various sieges raised ; but the Hereros were still at large. Colonel Leutwein found that the forces at his disposal were not sufficient to enable him to pursue the enemy, and therefore asked for further reinforcements, amounting to 800 men and two batteries.

In spite of Socialist opposition, the Reichstag voted a further sum of six million marks, in addition to $2,821,000$ already sanctioned, and at the beginning of April a force, consisting of 1,100 men, 1,200 horses, and 12 guns, was despatched.
Meanwhile a column, consisting of 11 officers and 55 mounted men under the command of Major von Glasenapp, was ambushed by the Hereros, only one officer and thirteen men escaping unwounded. During the first week of April Colonel Leutwein attempted to attack a force of 3,000 to 4,000 Hereros with two independent columns approaching from opposite sides. The main column, however, was not ready to start on the date fixed. Consequently the Hercros were able to surprise the smaller column, commanded by Major von Glasenapp, while it was entangled in thick bush; it lost heavily and was compelled to abandon its objective. Between the 13 th March and the 3 rd April, Major von Glasenapp's force had lost 63 per cent. of its officers and 39 per cent. of its men, out of a total strength of 14 and 476 respectively. It was unable to take the offensive again.

On the gth April Colonel Leutwein's column came on a force of about 3,000 Hereros occupying a position 5 or 6 kilometres in length. After nine hours fighting the Hereros were defeated, and the Germans captured a few cattle. It was not till four days later that Colonel Leutwein set out with the greater part of his force in pursuit of the enemy's main body. While the column was marching through the bush it was surprised, and only got clear after sin hours fighting; it was compelled to retreat during the night. Colonel Leutwein therefore decided that more reinforcements were necessary.

Though many people in Germany had already pointed out the folly of sending out reinforcements in driblets, yet, for fear of provoking the opposition of the Reichstag, this was the policy adopted. General Trotha was now appointed to the sole command of the troops in South-West Africa, and Colonel Leutwein's authority was restricted to the civil administration. It was further decided to organize a regular expeditionary force with a proper staff. The force consisted of a mixed brigade of ig companies of mounted infantry, 7 four-gun batteries, and two maxim detachments, besides various units for the lines of communication. Yet when General Trotha reached South-West Africa, he decided that even this force was not sufficient, and asked for four more companies and two new batteries.

The difficulty of disembarking the troops at Swakopmund rendered it necessary to send out the transports at long intervals, but by the beginning
of August General Trotha had received all the troops he required. The Hereros had been located on the southern slopes of the Waterburg, and General Trotha decided to surround them there. For this purpose he divided his force into five columns, which were to attack from opposite sides, the passes over the hills being held by a sisth force. On the It th August the Hereros resisted the advance of four of the columns, and handled one so severely that it was compolled to retreat during the night, leaving a gap in the cordon through which the Hereros escaped to the south-east. They were able to take with them the majority of their women, children, and cattle. The Germans lost 12 officers and 69 men.

This was the last engagement of any importance. The Hercros were gradually driven eastward into the desert, where many perished of famine. Some finally crossed the frontier and were disarmed in British territory; others surrendered to the Germans; but many succeeded in getting back to the interior of the colony.

On the 18th October, 1904, the Witbois, a Hottentot tribe who had hitherto helped the Germans, revolted. The operations against them will form the subject of another article in the Revue Militaire.

The reinforcements that Germany has despatched since the beginning of the disturbances amount to 15,734 men and 13,000 horses. The Hottentots are still (October, 1905) unconquered, and it seems probable that an expedition against the Ovambos will be necessary before long.
J. E. E. Craster.

## CORRESPONDENCE.

## THE PREVENTION OF DAMPNESS DUE TO CONDENSATION IN MAGAZINES.

Dear Sir,
The letter from Capt. H. J. Walker, R.E., in the December number of the R.E. fourtal would give one the impression that hollow walls and revolving-cowl ventilators form a perfect cure for dampness in magazines.

These expedients have been for years embodied in the type plans issued by the War Office for the guidance of those who have to design or build batteries; but magrazines built in accordance with these type plans are still damp, often very damp.

The "hollow wal!" so called (which denotes a $4 \frac{1}{2}$ " brick wall separated by from $2^{\prime \prime}$ to $4^{\prime \prime}$ from the concrete that forms the main wall) is undoubtedly beneficial; but it is doubtful whether the revolving-cowl ventilator does not do more harm than good.

If the ventilator draws in hot damp air, this is bound to condense on the walls of the magazine.

From my experience there are only two cures for a damp magazine; i.e. sunlight, or heating by hot-water pipes.

To arrange for sunlight to reach the greater part of the magazine in a modern 12-pr. Q.F., $47^{\prime \prime}$ B.L., 6" B.L., or $9^{\prime \prime} 2^{\prime \prime}$ B.L. coast battery is not so difficult as might be imagined; for store magazines the only remedy is artificial heat up to the temperature of the air outside.

It would be well, perhaps, to give reasons in detail for the above conclusions; and to say that the experience alluded to was gained in carrying out both new work and reconstruction for batteries containing all the types of ordnance enumerated.

All these batteries were constructed in accordance with the latest method for preventing dampness; and by comparing those $6^{\prime \prime}$ B.L. battery magazines which were damp with others that were dry I came to the conclusions given above.

Reconstruction work confirmed these conclusions. For example I may say that at Fort McNab there were, during the first years I was at the station, constant complaints by the Artillery of the dampness of all the underground buildings, not so much because of the damage done to the cordite which was stored in air-tight cases, but because it was impossible to keep from rusting the bright spare parts of the guns in the R.A. Store, During the summer the whole of the underground buildings ran with water, as if a spring of water had broken into them through
a crack in the concrete walls. For years the spare parts of the guns were moved in the summer into a wooden building.

It appeared curious at first that these buildings were quite dry in winter, when the temperature was seldom above the freczing point; but when it was recognized that the dampness was due to condensation, this was easily explained.

Later on, the turn came for revising this battery (which carried B.L. guns, but not of a modern type) ; and during the early summer the rear walls of the magazines were uncovered, and a hole broken through each. Directly the sunlight entered the walls became bone-dry.

As a further confirmation York Redoubt may be mentioned. Here were shell stores and cartridge stores of great variety of constraction, perhaps 20 altogether, some with plain concrete walls, some with a brick lining, and some with "hollow walls." Of these, the brick lining showed an improvement on the solid concrete, the "hollow wall" showed an improvement on the brick Iining, but the only dry shell or cartridge stores were those to which sunlight was admitted.

As said before it is not difficult to arrange for the admission of suniight to a modern coast-battery. The very latest type plan of $6^{\prime \prime}$ B.L. battery shows plenty of window space; but the area should be extended (even if some additional cost be implied) so that light may be thrown on the shell lifts and cartridge lifts (the iron work of which is most difficult to kecp from rusting in the damp and darkness).

I may add that in batteries generally, wherever windows are required to admit light only (and not to give a view of the outside to persons inside), "translucent fabric" is preferable to glass, as therc are no breakages after gun firing. "Translucent fabric" consists of a wire screen embedded in a gelatinous substance. It is proof against stonethrowing and rough handling generally.

## Yours truly,

T. E. Naish,

The Eititor, "R.E. Journal." Major, R.E.

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*Read partly at the Army College, Aldetshot.
August, 1904.
SEVENTEEN passed on the Competitive List and THREE received Nominations,
Atgust, 1903.
TWELVE passed in the Competitive List and FIVE received Nominations,
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ELEVEN passed in the Competitive List and FIVE received Nominations.
PROMOTION.
More than EIGHTY OFFICERS who Read with us PASSED (d) in May last.
WOOLWICH, JULY, 1905.
THE FOLLOWING PASSED DIRECT FROM US:-
SECOND
A. E. H. KILLICK ... ... $: 2,519$

22nd ... ... L. C. OWEN ... ... ... i1,335
29th ... ... G. E. A. GKANET ... ... ... 11,280
Mr, Killick put on 3,320 marks since joining our classes in January last.
Places taken include French, SEC()ND, Eighth; Latin, FIRST; Greek, SECOND;
German, Third, etc.
SANDHURST, JULY, 1905.
THE FOLLOWING NINE PASSED DIRECT FROM US:-
SECOND J. A. CHURCHILL.....10,230| 29 hh H. E. W. BERKELEY.HILL 8,865

FIFTH
10th
3. D. DARLING......... 9,735

13th H. G. L. HALL......... 941
24th
And Four others obtained qualifying marks.
Places taken include Mathematics (i.) FIRST, Mathematics (ii), SECOND; French, SECOND, Foarth and Fifth ; German, SECOND; Latin, SECOND ; Chemistry, FIRST.

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[^0]:    - Examples of this were frequent during the late South African War.

[^1]:    - 2 Captains, I Senior Lieutenant, 3 Lieutemants, I Paymaster.
    + I Captain of Engineers, 2 Senior Lieutenants of Infantry, i Lieutenant Foot Artillery.
    $\ddagger$ Sce also I. A. (i.) under "Engineers," who draw a certain number of pigeons from the Telegraphs for use in Fortresses.

[^2]:    o Feldwebel is about equivalent to Co.-Sergt.-Major or Colour-Sergeant.

[^3]:    * European Privates Indian Pattern.

[^4]:    * Reprinted, by parinision, from The Sapper of December, 1905, and January, 1906.

[^5]:    * Fomerly the Proccetings of the Royal Artillery Institution.

[^6]:    * More so than our Kugby footiball.

