43

FEB 1914

FEB 1914

THE TACTICS OF DIVISIONAL ENGINEERS.

By LIEUT.-COLONEL F. E. G. SKEY, R.E., *Commanding Divisional Engineers, 6th Division.*

MANY hold the opinion that the number of Engineer Field Companies allotted to a division in our army is comparatively small, and it is certain that in field operations they will require economical handling on sound lines if their full tactical value is to be obtained. One often hears it stated that three instead of two companies to a division would be a more suitable establishment, and as an additional reason for this it is held that each infantry brigade should have a field company, if not as integral portion of itself, at any rate at its disposal whenever it is actively employed. This reason is not a sound one. Though an additional company is highly desirable, any normal distribution of field companies to infantry brigades should be guarded against. It overlooks a very large section of the troops of the division which may require help from the engineers, viz. the artillery, and it further assumes that the requirements of the infantry brigades will be equal and symmetrical, which would probably never occur in practice. The engineers must be divisional troops, and remain in the hands of the divisional commander to allot as he thinks best to meet any emergency that may occur.

When the division is advancing, it is customary to allot one or more sections of engineers to the advanced guard, and of these a portion will join the vanguard and will send forward cyclist scouts as far to the front as possible. The action of an advanced guard on encountering the enemy is well known. It will act with vigour, endeavouring to push aside his covering troops and to gain touch with his main body. When it can get no further it will dig itself in, with the intention of forming a covering screen behind which the deployment of the main body may be carried on without molestation.

The engineers with the vanguard will be involved in the initial fighting. Their *raison d'être* is not so much an offensive one, as to facilitate the march of the troops; and in the case of a collision with the enemy they should be utilized in clearing the way, and possibly also in the defence of some strong point, some enclosure or group of buildings which may be found on the spot, and which might form a pivot for the attack in case unexpectedly resolute resistance is met with. This action may have to be repeated two or three times before the advanced guard is really held up by superior forces. The end will probably be that the vanguard engineers will be expended, as far as their tactical value is concerned, in the thick of the advanced guard firing line.

The rest of the advanced guard engineers will arrive on the scene near the head of the main guard, and if they are not required to improve communications for the artillery either at first or as the action develops, they should be kept in hand until the time has come for the advanced guard to dig themselves in, when they should be sent forward to the more important point or points of the line. There should be no attempt to distribute them widely along the front, but the commander should endeavour with their help to build up one or more pivots in his line, on which to base his defence during the overwhelming counter-attacks, which he has reason to expect from an enterprising enemy, before the main body can arrive to his assistance. This we may consider to be the end of these sections for the time being. Pinned to the ground and engaged in a desperate defence, they would be no more available until the success of the main body has extricated them, or until the darkness of night enables them to be withdrawn, though, on the other hand, if the advanced guard position becomes part of the firing line of a many days' battle, the darkness of night may mean only an opportunity for improving their defence works. All things considered it would not be wise to count upon the use of their services again during this particular operation.

Turning now to the action of the main body, we find the rest of the division left with little or no more than a single field company of engineers to carry out all the duties which may be required of these troops during a battle. That these duties are by no means simple or few in number may be gathered from a study of Section III of *Engineer Training*, and when it is further laid down that "no considerable portion of the division ordered to carry out a distinct tactical operation should be without its complement of engineers" it will be recognized that their resources, even if they have not already detached a section with the rear guard, will be strained to the uttermost.

Early in the action serious bridging or ferrying problems may have to be tackled, and in this work it is possible that the bridging equipment of the field companies may be called into requisition. If this can be foreseen the pontoons should be brought up in good time to join their companies at the head of the column, for otherwise they will be with the brigade ammunition columns and it will be difficult to get at them quickly.

In detailing engineers to tasks in distant parts of the field, it will be remembered that most of them are dismounted troops and can move no faster than infantry. It should, however, be noted that they have eight cyclists per section, and that a few men can always be carried rapidly on the tool carts in case of necessity.

The need of observatories and crow's nests will probably become prominent at an early stage, in view of the care with which positions are selected to conceal the effect upon them of artillery fire.

Officers preparing for possible future moves of the artillery may require help in cutting openings through natural obstacles, especially when the necessity of the concealment of such moves becomes an all-important item.

The advance of the infantry to the attack will not under the ordinary circumstances of field warfare require any help from the engineers, nor will this be expected. If the country is very close, or even if there are known to be hastily constructed artificial obstacles in their path, there would be nothing easier than to equip a small portion of the infantry with hand axes or cutting pliers. Engineers would be wasted if distributed upon such duties, especially as there is always a far more important service in which their concentrated skill may be of the utmost value, the preparation against counter-attack of some important key which has been gained during the attack. This important service is laid down in *Field Service Regulations* as the work of the local reserves, to which engineer field companies may be attached for their assistance. Here we get a ruling as to the detailing of engineers with other troops in an attack. A special objective is assigned to the operation, special troops are detailed for the attack, and a local reserve is told off with the special object of following the attack and making good against the enemy the defences of the objective when it has been gained. The engineers are attached to this reserve and are placed under the orders of its commander. The attack may follow up its success, knowing that it can count upon the solid backing which will be found, if it is driven back, in the hasty defence work of the local reserve and of its engineer contingent. There is reason to believe that this procedure is not often practised during peace operations. Engineers alone, in such a case, could show but small results, but engineers with infantry *if well trained in utilizing to the utmost their combined efforts*, might in the shortest space of time do work whose effect upon the result of the operation might be little less than decisive. We may assume that there will always be a counter-attack, there will always be an attempt to regain a lost point of vantage if it is of any value, and if this counter-attack is made by fresh troops, more often than not the crucial struggle will take place round the defences hastily organized by the commander of the local reserve with the help of his sappers in the key of the captured locality.

The paragraphs in *Field Service Regulations*, Part I., devoted to night advances and night assaults, bring out prominently and in considerable detail an important application of this action. Here we see the detail of the assaulting columns and of the reserve; here the equipping of the working parties as a result of engineer reconnaissance of the objective; here the provision of hours of darkness to enable them to prepare and organize their defences against a counter-attack at dawn. There is no doubt that all available sappers must be concentrated to work with this reserve, and if any have been

employed earlier in the night in assisting the stage management of the night advance, but few can be spared for such rudimentary, though honourable duties as wire cutting and such like at the head of the assaulting columns.

In siege warfare the conditions are different. Here the obstacles are more formidable, and the task of driving avenues of approach into the heart of the enemy's works requires highly technical skill and training. In this the engineers will take a prominent part, and the divisional companies will be largely reinforced "by units specially trained in the work of sapping and mining."

In a *retreat* the duties of engineers are multiplied. The rear guard must have its contingent to assist in making demolitions and obstructions in its rear. Incidentally it may be suggested that supplies of explosives for their use may be left with the food and ammunition on the roadside to be picked up *en route*. The head of a retreating column cannot safely be left without an engineer party to remove incidental obstructions in its path. There is also important work for engineers in the preparation of rallying positions. Here it is possible that help may be required by the artillery, both to give access to positions from which the best tactical results can be obtained, and also in view of retirement to save them from becoming entangled in a difficult country.

In *defence* the uses of engineers are well known in the preparation of a defensive position, but it should be borne in mind that it is better to concentrate the sappers in the more important pivots than to scatter small parties in an attempt to give engineer assistance to every pivot. The question arises:—Should the engineers be left indefinitely to share in the defence of the pivots to which they are allotted? It is true that the defence work on a pivot can hardly ever be said to be completed. The very conditions of defence of these strong points require that no efforts should be spared to render them impregnable; and yet one would not wish to see the few engineers who are included in the establishment of the army allowed to be involved in the defence, and thereby lost to the more important work of the counter-attack.

This same question may occur in all defence work in the occupation of *points d'appui*. In the case of an advanced guard it cannot be helped. They dig themselves in in the face of the enemy, it is fighting from the first and all the force will necessarily become inextricably involved. In other cases they should be withdrawn, and the decision as to when they should be withdrawn must depend upon circumstances. They will seldom be able to put the finishing touches to their work, but none the less it is conceivable that they will upon occasions become involved in serious fighting.

Their normal place is with the local reserve of the attack. They are not in sufficient numbers to be everywhere and they are essentially troops belonging to the attack and should not be expended in local defence.

DELHI DURBAR, 1911.

(Continued from January).

REPORT ON THE SURVEY AND DEMARCATION, AND THE FIRE PRECAUTION ARRANGEMENTS.

By LIEUT. P. C. HOBART, R.E.

AT the beginning of February, 1911, I reached Delhi with a section of 1st K.G.O. Sappers and Miners to undertake the correction of the existing map. The map in question was on a 4-in.=1 mile scale, made about 40 years ago. It proved to be so inaccurate—the river Jumna having changed its course as much as two miles, and the alignment of canals, roads and railway having apparently altered—that I found it necessary to re-survey the whole area afresh. An area of about 40 square miles was comprised, and urgency was of the first importance as the whole of the work of allocation of sites, roads, railways, water and light, was greatly hindered until the map could be distributed.

I found it advisable to work from a carefully chained base, in order to avoid the delay necessary for the production of a properly graticuled-board. The sketch was frequently checked by long chainages on a ray, which latter were also useful as the basis for the large 16-in. plans of the various camps which were afterward produced. The abnormal rain of the early part of the year added considerably to the difficulties.

In the second half of February, the work of demarcation of camps commenced concurrently with 16-in. survey by Sappers of the 1st S. & M. The camps laid out were for some 90,000 fighting men in addition to all auxiliary services and about 400 camps of civil authorities, Indian chiefs, etc. Ground was very limited owing to various considerations. Distance from centres, liability to flooding, communications, water supply, compensation for crops, etc., etc. And there was difficulty in fitting the camps to the available ground, without undue dispersion or concentrations and with strict regard to the Divisional Organization for war, their distribution in armies for manœuvres, their routes across the Jumna to Durbar camps after manœuvres, and precedence on parade.

Various changes in plans of sanitation necessitated one entire rearrangement of all the military camps, and the various alterations and amplifications of the original order of battle involved constant adjustments later. But by the end of April the demarcation was practically completed. Corners of camps were marked by permanent brick pillars in lime, and the entrance and exit of every road, by tarred pillars. Each was exactly sited by theodolite. About 350 pillars were built and 600 posts erected. In the military camps, and in most of the civil areas, bounds were fixed to the posts bearing abbreviated designation of the unit, and its division and brigade. Altogether about 30 different plans were produced, including one in the vernacular and two for the State Garden Party programme. About 20,000 maps were distributed. 10,000 copies of the final issues of the 4 in. and 2 in. to a mile general plans were admirably reproduced in five colours by the Supdt. of Government Printing, Calcutta, and were of the greatest use: they were included in the Official Directory, and in the military scheme. Five battalions of pioneers and two of infantry were employed under the military staff on works previous to the Durbar. Their work consisted of levelling and clearing completely about 4 square miles of tent sites, 30 miles of Kutcha roads, culverts, causeways, watering ghats for animals and 1½ miles of canal cut, and the preparation of a parade ground 2 miles in area (involving turfing a large portion) from an area originally consisting largely of hills and saturated with saltpetre. In August, 1912, I was appointed Staff Captain on the Durbar Military Staff. The distribution and supervision of military labour were part of my duties. All the road signposts with map-boards, five nullah bridges and three railways overbridges were put up by 1st K.G.O. Sappers and Miners.

The design and provision of a uniform pattern of name board for all civil and Indian chiefs' camps was found necessary late in the day, and a month before the Durbar the Military Staff were asked to undertake the decoration of Kingsway (¾ mile) and Prince Road (1½ miles). The carrying out of both works was made over to me.

A boxing area to hold 7,000 spectators was built under my superintendence. About Rs.10,000 profit was cleared on the tournament, which was devoted to initiating a Boxing Association in India.

A copy of the report on fire precautionary arrangements submitted to the Durbar Committee, is attached. The look-out towers were built of telegraph poles by 1st K.G.O. Sappers and Miners and were quite satisfactory.

The majority of my work was of an ordinary staff nature, having no special bearing on engineering matters, and is not therefore touched on in these reports.

Fire Precaution Arrangements.

The fire protection measures were of two kinds :—

1. *External.*—Under the direct orders of the officer in charge of the fire precautions. The main object of these measures being to provide well-trained, organized, and equipped squads at convenient points, always in a state of instant readiness to prevent the spread of a fire and to assist local brigades. 50-ft. towers were provided for a sentry at each picket. Signals were arranged for night and day, and a private telephone system connected each picket with the tents of the fire officer and his assistant, where one of the two was constantly on duty night and day. It was the duty of the pickets to proceed at once to any outbreak in their area, as soon as perceived—not to wait to be called.

2. *Internal.*—Circulation of notes, memoranda and instructions on all matters into which any possible risk of fire appeared to enter. The rapidity of tent fires, and the necessity for the provision of a suitable fire brigade in each camp to cut down a burning tent at once, was impressed on camp officers together with the fact that they were responsible for the preventive measures and for actual extinction of any outbreak—the duty of the main fire pickets being to prevent the conflagration spreading. Previous to the Durbar period, the fire officer went round each camp in the central area south of the Mall, with the camp officer, and made suggestions and gave any help in his power. Officers were invited to send their local brigades to attend the practices of the fire pickets, which were carried out daily. Lectures were given at meetings of camp officers of Indian chiefs' camps.

Fire Engines.—In view of the special nature of tent fires and the comparative uselessness of fire-engines, only three were provided :—(1), In the camp of His Imperial Majesty the King-Emperor; (2), centrally in charge of No. 5 Picket, Kingsway; (3), at the amphitheatre. These were always kept under steam and were in direct telephonic communication with the fire officer.

Arrangements were also made in each area that a certain number of private engines belonging to camps should be available for use when required.

Incendiarism.—To guard against incendiarism, etc., at such important buildings as the amphitheatre, ridge pavilion, etc., special police guards were arranged and a large number of patent extinguishers were provided. At the Durbar amphitheatre, also, was stationed a fully-equipped and trained fire brigade, kindly lent by the Jubbulpore municipality.

Details of Outbreaks which Occurred.—Previous to the Durbar period there had been three fires in camps, and two considerable petrol fires, one at the central garage and another at Delhi Railway Station.

Beyond the loss of the petrol and the shed wherein it was stored, no further damage was done in either fire. The special precautions taken for storage of petrol were effective, and no further fires were due to this cause.

Between December 1st—18th there were seven outbreaks. Of these the most important were that in the camp of Lieut.-Governor of the Punjab, and that in His Imperial Majesty's camp. The former broke out in the main block of reception tents, etc., about 4.45 p.m. on Sunday, 3rd December, 1911. The local fire brigades of the camp and those adjoining were promptly at work, and four fire pickets arrived shortly after. It was impossible to save the main block in which tents and shamianas were firmly lashed together and supported in places by steel uprights let into solid masonry. A good deal of valuable property was saved, and by the prompt striking of neighbouring dwelling tents the fire was prevented from spreading. Some confusion was caused by excess of amateur assistance, large crowds of coolies from the King's camp, and police not in uniform rendering organization difficult. Steps were taken after this to enforce more strictly the orders issued to the police. The cause of this fire is uncertain. It seems probably to have been due to tampering with electric fittings when fixing a bell; but it is possible that it may have been caused by a cigarette end.

H.I.M. the King-Emperor's Camp.—The fire in His Imperial Majesty's camp occurred about 11 p.m. on 14th December, 1911, in the fourth tent from Her Imperial Majesty the Queen's apartments. The investiture ceremony was in progress at the time and 3,000 people, chiefly high officials, chiefs and officers of high rank were assembled thereat in the big reception tent. To know that a fire was in progress close at hand, without knowing its exact location, caused considerable anxiety, but all the arrangements worked excellently, and the burning tent and the four adjoining it were on the ground within two minutes of the first alarm. The Flagstaff fire picket was on the scene within 1½ minutes of the outbreak. The fire was completely extinguished within five minutes; no damage being done to any thing except the actual tent where it originated and its contents. The cause of the fire is not thoroughly substantiated. It may have been due to a bicycle with lighted lamp being leant against the tent wall, or to an oil stove which was found to have been burning in the tent.

In addition to the above, other fires that occurred during the period December 1st—18th are shown below. These were attended by one of the fire pickets :—

Date.	*Time.*	*Site.*	*Damage.*
6. 12. 11.	2.10 a.m.	Wazir of Hyderabad.	1 tent.
6. 12. 11.	6.45 p.m.	Site 401.	1 motor car.
12. 12. 11.	1 a.m.	Press camp.	1 tent.

There were also small fires in Camp No. 15 on the 2nd of December, 1911, and in Camp 4.

I have the following suggestions to offer for improvements on a future occasion :—

(1). The executive staff to be increased. With one assistant, only, it was not possible even to inspect properly the camps for which the fire officer was responsible ; and it is quite impossible to ensure that recommendations have been carried out. This staff should be struck off all other duties and provided with motor conveyance. A large amount of ground has to be covered, and in cases of emergency it is essential that the fire officer should arrive as quickly as possible.

(2). The police should be carefully trained in their duties, as originally agreed upon. How imperfectly these were understood was well shown at both the Punjab fire and that in Camp No. 1, when a large crowd of all kinds of people assembled from all sides, greatly retarding the work of the fire pickets and rendering very difficult the detection of looting. The police, instead of forming a cordon and keeping the camp clear of all unauthorized persons, were engaged in misdirected and ineffectual efforts to deal with the fire, for which purpose a satisfactory organization already existed. This omission might have led to considerable loss of property.

The following memorandum on fire precautions was issued and is attached for information.

"1. The Committee will, with effect from the 1st of December, 1911, establish five fire observation stations in the camp area, viz. :—

(*a*). The Flagstaff Tower on the ridge.
(*b*). The band stand.
(*c*). The Kingsway Railway Station.
(*d*). Dahirpur.
(*e*). The rifle butts.

At each of these places a picket consisting of one officer and fifty men will be permanently stationed ; telephonic communication will be established between the various pickets, and the nearest picket will proceed immediately to any place in which an outbreak of fire may be detected. Arrangements will also be made for the immediate despatch of a body of police, assisted if necessary by a detachment from the military camps, in order to form a cordon where this is required and to preserve order in the neighbourhood of the fire.

2. It will be incumbent on camp officers to adopt the necessary precautions to prevent an outbreak of fire in the areas under their

charge. The principal precautions which should be adopted are as follows :—

(*a*). The use of naked lights or any form of oil lamp or candle, except hurricane lamps, should be absolutely forbidden except in those camps in which the Committee have admitted the use of other means of internal illumination than the electric light.

(*b*). Fires for cooking, etc., should be lit only in authorized places, and sand bags and receptacles filled with earth should be kept adjacent to servants' tents and quarters.

(*c*). It should be impressed upon residents in the camps that the utmost care must be taken in the disposal of cigarette ends, matches, etc., and camp officers should forbid the smoking of hukkas in unauthorized places.

(*d*). As fire may be caused by the fuzing of electric wires, if any fuzing is detected, the current should at once be switched off and if the fire still continues it should be extinguished by hand-grenades or similar means.

(*e*). Stacks of hay should not be placed nearer than 50 ft. to any tent, and it is advisable, where possible, to place them in the proximity of irrigation channels. It is recommended that an arrangement should be made by means of chains or wires so that each layer can be rapidly pulled down to the ground and the extinction of fire thus facilitated.

(*f*). Separate instructions are issued as to the storage of petrol (see paras. 8—11) below.

3. It is advisable that each camp should be provided with some form of patent extinguisher in order to put out at once any small local outbreak of fire inside the tents.

The Minimax Fire Extinguisher has already been brought to the notice of the camp officers. Where camps possess pumps and hose it is advisable that tanks should be provided sufficient to allow the pump to throw a supply of water on the tents which may catch fire. A number of sand bags or other receptacles filled with earth should be kept in readiness and a supply of fire buckets should be kept always filled with water.

4. A small fire brigade should be organized in every camp and provided with billhooks, kukris or knives for quickly cutting down a burning tent. Their duties should be carefully explained to them and rehearsed at intervals. Should a pump be kept in the camp they should be trained in its use and they should also be instructed in the use of any patent extinguisher adopted in the camp and in the method of making a chain for passing buckets.

5. Instructions should be drawn up and published in camp directions or otherwise for the procedure of all inmates of the camp in the case of fire. It is advisable for the native followers to rehearse the action which should be taken by them in the event of an outbreak. Special precautions should be taken against thieving and looting of valuables in tents when a fire takes place.

6. On the outbreak of a fire the action to be taken by the fire party should be, with due regard to the safety of its inmates, to cut down the tent in which the outbreak occurs and such neighbouring tents as appear likely to be in danger. It should be impressed on the fire party that the best and frequently the only way of subduing a fire in camp is to cut down the tents; when tents have been levelled to the ground, pumps, if they exist or buckets, may be brought into play or earth thrown on the fire.

7. As soon as fire is detected, immediate information should be sent either by telephone or mounted messenger to the nearest fire picket, and the police camps should also be advised by telephone or messenger.

Special Rules regarding Petrol.

8. A central depôt for the sale of petrol will be established in the camp area by a well-known firm which will make daily deliveries at the different camps. There is therefore no necessity to store a large quantity in any camp, and a maximum of 4 gallons for each car exclusive of the amount in the tanks of the car has been fixed.

9. The rules issued by the Punjab Government under Section 9 of the Indian Petroleum Act, 1899, Notification No. 90, dated the 15th of February, 1909, require owners or hirers of motors who store petrol to take out a license for this purpose. No fee is charged for the license. Particular attention is invited to the fact that a shed must not contain more than 60 gallons. The drum should, in the opinion of the Committee be sunk in the ground, but the sheds can be of the simplest description.

10. In addition to the condition laid down in the license the Committee consider that (1) no shed should be nearer than 30 ft. to any tent, and (2) that a supply of earth and shovels should invariably be kept handy for filling the pit on emergency.

11. The only petrol to be kept in the camp garage should be that in the tanks of the motors; the remainder must be kept in the petrol pit.

12. Camp officers should intimate to the Committee at their earliest convenience the amount of petrol which they desire to store in their camps calculated on the basis of 4 gallons to each motor. The Committee will then arrange to apply for the necessary licenses."

REPORT ON WORKS CARRIED OUT BY MILITARY WORKS SERVICES.

The first work handed over to the Military Works Services was the construction of roads on military camps. A staff of one officer and one upper subordinate arrived in Meerut on May 11th, where it was found that an estimate providing for 12 miles of metalled road had been provisionally sanctioned. Of these roads about 3 miles were to be metalled 16 ft. wide and the remainder 10 ft. wide, the metalling to consist in both cases of 6 in. of metal without soling.

On proceeding to Delhi, it was found that :—

(*a*). About 10 miles of the proposed roads were on such low-lying ground that no work would be possible during a normal monsoon.

(*b*). The only source of stone for road metal was the ridge.

From this it was clear that the collection of metal was a very urgent matter, firstly because only two months were available to collect some 300,000 cubic ft. and secondly because this metal when collected would have to be carted for distances up to 7 miles, much of which was across country.

After some days had been wasted in calling for tenders and endeavouring to get stone collected and carted by local contractors, who held out for very high rates for both items, it was found necessary to employ outside contractors who would import labour from other districts. By May 25th three outside contractors had commenced work, and as time went on increased their gangs and output of road metal. One local contractor was also at work, but his progress was so unsatisfactory that his orders were cancelled. By 20th July, practically the whole of the metal had been collected and carted to the road alignments, and as the rains were overdue, work was more or less suspended for some time. Later, as the monsoon had partially failed and the concentration of the troops was as a result reduced, orders were received reducing the total length of the road to be constructed from 12 to 9 miles. In September, as the rains seemed to have failed, work of consolidation of the higher-lying parts of the road was commenced. Owing to the heat and dryness of the air consolidation was very difficult, but as roads were likely to be required for early preliminary work other lower-lying roads were taken in hand during the month. Towards the end of the month a very unusually heavy fall of rain entirely stopped work, some parts of the lower road being under 2 to 3 ft. of water. Work was resumed early in October, but even then the sodden state of soil rendered consolidation difficult and in some places impossible for

some time. Finally all roads were satisfactorily consolidated by November the 15th, just before the arrival of the advanced parties of the troops to be concentrated for the Durbar.

In connection with roads construction several points were noted.

(*a*). Pathans and men from Hazara District who were accustomed to stone breaking and quarrying turned out much more work per day than local coolies. In spite of the higher wages paid to Pathans, there is no doubt that the employment of these men facilitated work.

(*b*). It was found necessary to cart chippings from the quarries to the roads to form a "binding." Roads could not be satisfactorily consolidated without this.

(*c*). Trained men were necessary for the satisfactory consolidation of stone roads, especially when, as in this case, the soil is unfavourable. A small number of trained mates is all that is really necessary, though it was found that Pathan coolies being of superior physique were most useful on the hard work of spreading metal.

Minor Works.

Towards the end of July a number of minor works in or near Delhi Fort were proposed, and others continued to be sanctioned until November. None of these works were of any particular interest being merely alterations and additions to existing roads and buildings. The value of the work done eventually amounted to about Rs.22,000, and was carried out by the ordinary M.W.S. Staff of the Delhi Subdivision.

Furniture Supply.

Large quantities of furniture were sent in from various stations for the use of troops and others concentrated at Delhi. For this work an extra staff of three barrack sergeants was sent, and three depôts were established for the issue of furniture. As furniture was drawn and returned to the depôts by the regiments or others concerned, no difficulty was experienced in distribution. Considerable difficulty, however, arose in connection with the cartage of furniture from railway stations to depôt, owing to large consignments arriving simultaneously and transport not being available. This was mainly due to the disorganization of the railway traffic after the floods of September, which upset arrangements and delayed delivery. The furniture supply appears to have been quite satisfactory, and to have added greatly to the comfort of the troops. The only addition which might be suggested is "chopping blocks," the want of which was sometimes inconvenient.

WASHING PLACES FOR BRITISH TROOPS.

Temporary washing places were provided for British troops, both for men and for washing kitchen utensils. The washing places for men consisted of grated tables supported by trestle legs, a drain of match boarding being fixed along the legs to catch the water falling through the grating. The water collected by this drain fell into an open channel cut in the ground which led into an absorption pit. These tables were surrounded by a screen of matting supported on rough wood uprights, and were provided with gratings on which men could stand while washing. The only difficulty experienced in connection with the work was due to the fact that the whole of the tables, etc., had to be erected between the time of arrival of the advance parties and the time of the arrival of the main body. This difficulty was surmounted by cutting up and collecting all the material at a central depôt. The erection was then handed over to Lieut. B. T. Wilson, R.E., who had been especially sent to Delhi to assist in this work, and who succeeded in erecting the whole of the very large number required some two days in advance of time.

The washing places for cooking utensils were of exactly the same design as those for men, with the exception that they were not provided with screens. Both kinds of washing places seem to have been appreciated, and to have added greatly to the comfort of the troops. In some cases the absorption pits did not act satisfactorily owing to the nearness of the subsoil water which rendered absorption very slow. This difficulty was to a certain extent surmounted by increasing the size of the absorption pits, but it was evident that in cases of this sort where the subsoil water is very near the ground level, absorption pits cannot deal satisfactorily with the large amount of water used in lavatories of this sort.

A statement showing the various services connected with the Durbar Works, together with their approximate cost, carried out by the M.W.S. and adjusted by debit to the Military and Civil Departments respectively, is enclosed. Roughly the figures of expenditure stand as follows :—

(i.). Works adjusted through the Central Adjusting Account	Rs.138447/-
(ii.). Works adjusted through the Civil Exchange Account	Rs.18091/-
(iii.). Works done out of the Military Works Funds	Rs.7043/-
Total ..	Rs.1,63,581/-

WORK DONE BY H.M. MINT, CALCUTTA.

His Majesty's Mint, Calcutta, was responsible for the manufacture of the gilt solid silver thrones used by Their Majesties at the Durbar. These thrones are of Georgian design and are facsimiles of two in the possession of the Government of India which were designed and made in 1875 by Messrs. Hamilton & Co. The originals, which are of wood covered with thin sheet silver, were handed over to the makers for renovation and new upholstery.

For this work they had to be taken to pieces, and advantage was taken of this by the Mint to mould each piece separately, casting them with suitable lugs to allow of the various parts being assembled later. But little difficulty was found with most parts in castings solid and well-detailed work but the lions forming the arms of the King's chair, each of which weighed 1 cwt., and a few other pieces which had elaborate detail in several faces required special treatment. They had to be cast in moulds prepared of specially fine sand, and it may be interesting to note that the silt from the bottom of cisterns supplied by the municipal unfiltered water supply was found eminently suitable.

The rough castings were chased and finished by Indian engravers, 11 men working under the general superintendence of Mr. F. K. Wezel, engraver to the Mint, and no difficulty was found in this part of the work. When the gilding, which was done electrically, was first put in hand, it was found difficult to get the gold deposit of one colour on all the different parts. A short series of experiments revealed the secret, and absolute uniformity was obtained.

The various parts of the chairs and footstools were dovetailed together and pinned where necessary.

The upholstery was supplied by Messrs. Hamilton & Co., two identical sets of cushions being made, one for the Mint thrones and one for the renovated chairs.

Owing to the weight of the thrones and the necessity of protecting the delicate work and the gilding, it was deemed advisable that they should be erected at Delhi by one of the Engineers responsible for their manufacture. A slight mistake in fitting such pieces of comparatively soft metal together might have resulted disastrously.

Rs.96,000 of old rupees were melted to produce the silver, and the completed thrones with their footstools weighed 1,911 lbs. The cost of the work excluding the upholstery was Rs.3,000.

Two hundred gold and twenty-seven thousand silver Coronation medals were also made in the Mint. The obverse is an enlarged copy of that of the home Coronation medal. The enlargement from the small die sent out from home was found difficult, but the difficulty

was surmounted by cutting a replica of about three diameters in soft silver so that the cutting tool was not unduly worn. The face of this soft silver replica was then nickelled to make it sufficiently hard to stand the wear of the pointer, and from it was cut the die of the required size for the Indian medal. The medal fittings and the brooches for the ribbon attachments were also manufactured in the Mint.

From the date of receipt of the die from England till the completion of the first order of 200 gold and 25,000 silver medals, only 16 weeks elapsed, a very creditably short time when it is remembered that the Mint was busy not only with the thrones and the tournament medals and official passes for Delhi, but also with the preparations for the new coinage.

The whole work was carried out under the immediate direction of Capt. G. H. Willis, R.E., and in recognition the decoration of M.V.O. (4th class) was conferred on him at the Delhi Durbar in December, 1911.

THE WORK OF THE ENGINEERING STANDARDS COMMITTEE.

By Capt. A. E. Davidson, R.E.

Some of the greatest movements of the engineering world have started from small beginnings, and among these can be included the work of The Engineering Standards Committee. Before this Committee started there had been individual attempts to make standards in various branches of engineering—such as the Whitworth screw thread, but there was no organization to help on such individual efforts and give them publicity. Standardization is no new thing; it has long been recognized as being absolutely necessary in civilized countries in our daily intercourse. Money, weights, measures, distance, time, all these have had their standards fixed in each individual State as a necessary basis for the dealings of a community.

More detailed standards are also agreed upon, such as the width of track of railway lines, the bore of rifles in the different armies, etc. There is no need to argue the necessity for their adoption, it is self-evident. Imagine the confusion and waste of time if each railway company in Great Britain adopted a gauge of its own! Imagine the difficulties of the ammunition supply of an army in which each regiment was allowed to choose the size of bullet that should be used in its rifles!

These are obvious cases, but they demonstrate the value of standardization in detail, and it now remains to show that the same principles can be, and should be, extended to wider ranges than formerly. When the subject comes to be looked into, there are far more standards already in existence than is perhaps realized. In addition to those mentioned above—money, weights, measures, distance, time—there are examples such as sizes for clothes, sizes for paper and books, sizes of photographs, and many more that need no mentioning.

Some of the above are international standards such as time, latitude and longitude, others are only national, such as weights and measures, and vary from country to country. Where they differ they are a source of confusion. Take for instance the ton. In America it is 2,000 lbs., in metric measure the ton=1,000 kilogramme =2,204 lbs., while the British ton=2,240 lbs. This is typical of the small and not really important variations that occur in general engineering work, unless some body which has the confidence of engineers

takes the matter in hand and lays down standards that can be accepted by all and freely referred to without any doubt as to their features.

Now what is the need for standardization? From the purely commercial side of our great manufacturing industries its value cannot well be overestimated. It is the essence of low production costs, and this is in its turn the essence of plentiful supplies of manufactured goods at moderate prices. It is one of the strongest weapons that our manufacturers have of fighting foreign competition. In cases where foreign goods have been sold in large quantities in this country, it has been due to a large measure of standardization having been adopted in their manufacture, and has in many cases been met by an answering measure of standardization among manufacturers at home.

Several British manufacturers have objected to standardization of parts of their productions. This was particularly noticeable in the early days of the motor-car industry, where makers thought that if they could only make the parts of their vehicles non-standard and different to those made by others, purchasers would be bound to come to them for replacements which would be sold at a higher profit than the original vehicle. It was quite overlooked that this cut both ways as no owner of another make of car could come to them for replacements, and those who had purchased vehicles from them not getting value for money soon kicked against being forced to pay a high price for articles which could not be bought in competition.

The French on the other hand perceived the value of specialization and standardization at an early date in this industry, and by getting some firms to specialize in the manufacture of details for a large group of car builders, they were able to produce their vehicles comparatively cheaply.

It was also maintained by some that standardization would mean stagnation and would be a hindrance to young and growing industries or branches of engineering. While it may be true that standardization injudiciously carried out is a drawback, in that it tends to check invention, improvement, and research, it must be admitted on the other hand that certain details can very well be settled on without hampering new design, and, by being fixed, will actually help invention because they free the inventor from having to waste time on unnecessary detail.

In order to meet this objection, the standards fixed by the E.S.C. in this country are periodically reviewed—as will be seen later—with the idea of embodying in them any changes which progress in science or engineering render advisable.

An example of the drawbacks of not standardizing was recently provided when identical engines were being supplied by firms to two

Government departments; to one with British Fine Screw threads; to the other with that department's own special thread. The price to both was naturally higher than it need have been, and the engines and their spare parts were not truly interchangeable. The advantages of standardizing were so obvious in this case that the special departmental screw thread has now been withdrawn.

What is the value of standardization from an R.E. officer's point of view? It will save his time, and ensure that his work can be carried out in a rapid and economical manner. Standardization is a saving of time because it makes the designing of many minor details absolutely unnecessary. For instance, who wants to waste time in designing a screw thread either as regards the form it should take, or the number of threads per inch that should be employed? These details have all been worked out with the greatest care as the result of very wide practical experience and are embodied in tables. All that has to be done in making a design is to choose the standard size or type that best fits in with requirements. Again why waste time in designing, *ab initio*, the scantlings and form of a steel section in a bridge or a floor? This has all been done: it is only a question of choosing the most suitable section from a set of tables. Rapid and economical execution of work is ensured in both the above instances if standard forms are selected. Rapid, because the sizes and types selected will probably be available from stock—or, if not, will be more easily secured. Economical, because the parts can be taken from stock, or can be made from dies or rolls that are in common use, and in neither case does special machinery have to be manufactured before supplies can be made. Sir J. Wolfe Barry has quoted the following example as showing how money is wasted by the use of non-standard sections for a steel structure:—

"For a steel structure some 200 tons of a certain odd section were insisted on by the architect instead of allowing an equivalent standard section. This, of course, entailed the cutting of new rolls, with a consequent cost of £200, and, apart from delay, the architect's clients had to pay £1 per ton more for their non-standard section than they would have done if the contractor had been allowed to use a standard section of equal strength."

The examples cited above may appear to be almost too obvious to mention. It is because they are so obvious that they are of value, for they illustrate the more clearly the value of standardizing. Once this fact is admitted it is easy to extend the subjects in which standards should be fixed.

The Committee whose work is now being dealt with was formed in 1901, as the outcome of a resolution moved by Sir John Wolfe Barry to the effect that the Institution of Civil Engineers should take action to establish a Committee to standardize forms for iron and steel sections. That Committee was formed, and now after

13 years, under the name of the Engineering Standards Committee, it consists of 19 sectional committees divided into a great many more sub-committees. It has the support of the leading Engineering Societies in the country.

When only dealing with its original reference the Committee was supported by

The Institution of Civil Engineers.
The Institution of Mechanical Engineers.
The Institute of Naval Architects.
The Iron and Steel Institute.

Towards the end of the first year's work the original reference was enlarged to embrace the standardization of locomotives, and tests for engineering materials. Subsequently the standardization of electrical plant was undertaken, and the Institution of Electrical Engineers was added to the list of societies supporting the Committee. At the end of 1902 it was decided by resolution of the supporting institutions to confer upon the Committee "power to act with respect to publications . . . to give effect to the findings arrived at from time to time in respect of the questions referred to them."

The work done by the Committee has been enlarged very considerably since that time and embraces a very wide field of subjects. The subdivision of the work is shown in the form of a genealogical tree, which also illustrates the method by which the Committee acts.

Each sectional committee formed to deal with a subject, such for instance as electrical work, is free to form sub-committees for various phases of the work in hand. These sub-committees report to the sectional committee, and no publications are issued before the results have been before the main Committee. This prevents the sub-committees from working in watertight compartments and issuing findings or specifications at variance with those issued by other committees. The work of many sub-committees overlaps that of others. For instance, key ways and screw threads are dealt with by both the Screw Threads and Automobile Parts Sectional Committees. Some of the members of one Committee belong to the other, and are therefore enabled to co-ordinate the work that is being done under the two separate heads.

Some of the work shown in the Tree has already been completed, and reports have been issued. It has, however, always been recognized that all the committees are really standing committees, and that they may have to revise their work periodically and bring it up to date to deal with modern conditions as they arise. To meet this the Main Committee has ruled that each sectional committee should be afforded an opportunity of meeting at least once a year to consider whether any revisions in the specifications and reports drafted by it are necessary or desirable. As an instance of how this

ruling would act so as not to fetter designs for new conditions, it may be stated that in the aeronautical industry where saving of weight is of the highest importance, bolts and nuts may have to be asked for in sizes intermediate between those already on the list. If this were considered necessary by the Aeronautical Industry the fact could be pointed out at any time when the report in question came up for revision.

The sectional committees are composed of representatives of Government Departments, Consulting Engineers, Contractors, Users, Manufacturers, and representatives of the Technical Societies. The object is to have as many views as possible represented on the committees, and special efforts have been made to ensure that manufacturers are represented, so that the findings of the committees can be taken up with the assurance that they are thoroughly practical and not merely theoretical.

The funds for carrying on the work of the Committee were at first supplied by the supporting institutions but later the Government departments were asked to support the Committee

(1) By giving grants;
(2) By nominating representatives to the Committee; and
(3) By the adoption of the Committee's standards when issued.

In 1903 the first Government grant was given, and since that time an annual grant has been given by the Home Government, while the Indian Government has given money as well.

The War Office, the Admiralty, and other Government Departments representing the Colonies as well as Great Britain, have representatives on all the sectional committees, and the Government Departments use the reports as far as possible in their specifications.

The Admiralty has largely supported the Committee's work by adopting the British Standard specification for steel in marine boilers, for structural steel in shipbuilding, for steel casting and steel forgings in marine work, and also for Portland cement in harbour work. The Board of Trade, Lloyds, Bureau Veritas, and other similar bodies have freely adopted the Committee's specifications in their rules and regulations.

Many public bodies, such as the L.C.C., in their general building regulations have required that all rolled steel used in the skeleton framework of buildings and all Portland cement shall comply with the British Standard specifications for these materials.

The tramway undertakings have shown that they appreciate the standards laid down by the E.S.C. for tram rails, as 68 per cent. of the tram rails rolled last year in this country were of standard sections, and in previous years this proportion has been even higher. A large amount of the remaining 32 per cent. will probably be found

to be replacements of old sections instituted before the E.S.C. had issued recommendations, and possibly new types of section designed to meet special methods of connection, such as electric welding.

The Indian railway companies have ordered a large number of locomotives built to standard types.

As far as practicable, the whole of the material obtained by the Inspector of Iron Structures at the War Office is ordered from these specifications. The Mechanical Transport Committee also uses, and has used for some time past, some of the recognized specifications wherever definite qualities of material have been called for.

The need for further standards has been very badly felt in many cases. Take ball bearings, on which a sub-committee is working at present; it is now only possible to say that they must comply in size—no matter whose make they are—with the dimensions shown in Messrs. ——'s 1913 Catalogue. This is a very unsatisfactory method, and hardly fair to other makers whose names have not been mentioned. At least they say so, with some force, as soon as they see the wording of the clause; and the framer of the specification has to waste time in efforts at peacemaking instead of being able to refer to an E.S.C. report and have no further argument.

These instances indicate that the community at large appreciate the work of standardization, and show that the Committee's findings are backed up in practice and are received with confidence by engineers at large.

The international character of the work is not a feature that entered into the Committee's work at the outset, but it is now beginning to assume an important aspect.

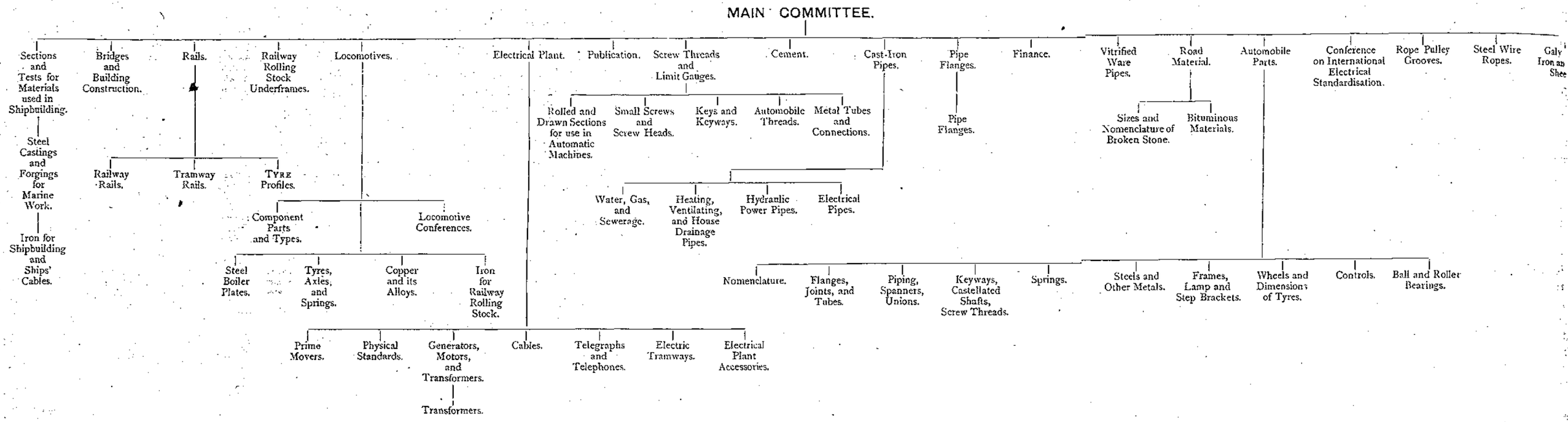
In the electrical industry an International Commission was arranged some years ago, and work has been in progress with standing committees in various countries. One of the E.S.C. sub-committees has taken over this duty as far as Great Britain is concerned. The Commission is doing very valuable work, as it has already arranged international symbols for denoting current, pressure, etc., and has simplified and unified, as far as possible, the words used in the different languages to represent the same thing. And the work in connection with the rating of electrical machinery is in an advanced stage.

The sectional committee on pipe threads has just scored a great triumph for British Engineering in obtaining the international adoption of the British Standard pipe thread (gas thread).

The recently formed sectional committee on automobile parts is working with the American Society of Automobile Engineers, and both these bodies will consult each other in regard to any reports they may publish.

There is little doubt, too but that the work of many of the committees will, in the not very distant future, be of an international

THE ENGINEERING STANDARDS COMMITTEE.



character. It is quite within the bounds of possibility, for instance, that international standards of screw threads in common use may be set up.

The work of the E.S.C. has not merely been confined to laying down standards from the best practice that has been available. Many of the final findings have only been arrived at after lengthy scientific and physical investigations, for which manufacturers have not the facilities. A large number of experiments have been carried out at the National Physical Laboratory. To mention a few of these researches only, to show how wide their field has been :—

Experiments to ascertain the effect of temperature on insulating materials used in electrical work. Other tests on insulating materials.

Experiments to ascertain the relation between temperature in different parts of field coils of electrical machinery.

Experiments to establish useful standards of life and efficiency in carbon filament glow lamps.

Experiments to show the degree of accuracy that could be worked to practically in factories dealing with various classes of engineering work.

Experiments to enable accurate screw thread gauges to be manufactured.

Experiments on the wear of road metals and bituminous materials.

Tests to show what is the best form of key and keyway for fastenings on shafts.

All the above have required original research before any really good and acceptable standards could be laid down, and have in some cases led to the designing and laying down of costly machinery.

A bare recital of the names of the sub-committees, or of the subjects they have standardized will not be of great interest, but a few remarks on some of the more important findings will call attention to the usefulness of the work.

A glance at the Tree facing page 87 will show how much of the material dealt with in ordinary building work or in I.R.E.M.'s work comes within the scope of E.S.C.'s findings.

Screw Threads.—Several types of thread have been standardized. All have the same form of thread, namely, that originally invented by Whitworth. Other countries have used, and are using other threads. The metric thread is used in France, Germany and other countries where the metric system is in vogue. The Sellars thread is used in the U.S.A. Experiments carried out at the National Physical Laboratory and elsewhere have proved the marked superiority of the Whitworth form of thread over all the others for resisting shock, and it is quite likely that the Whitworth will be

adopted as an International Standard. The Germans indeed use Whitworth threads now for the really important parts of many of their engines and machines.

The original number of threads per inch adopted by Whitworth have been found to be unsuitable for much of the modern high-speed machinery, especially in the smaller sizes. Accordingly the E.S.C. has issued a fresh set of threads called British Standard Fine Threads. These only differ from the Whitworth in the number of threads per inch on a bolt of a given size. This is an example of how the Committee works to meet the growing needs of engineering, and encourages rather than retards invention.

For smaller sizes than these there are the British Association threads, which are employed in instruments and other fine work of that nature.

Then there are the British Standard pipe threads for gas pipes. This is practically the old "gas thread" and will, with but small modifications, become an International Standard. More recently further sets of threads have been fixed for several classes of hot-water and heating apparatus fittings. There are also threads for the metal conduits largely used in electric-lighting work.

This shows how the screw threads for practically every class of engineering work have been provided for by the Committee, and in making up any specification or drawing it is only necessary to mark on a bolt or thread say $\frac{1}{2}$-in. B.S.F., and all the other details can be obtained from tables.

Rolled Steel Sections.—These might be used for any bridge, girder, or roof work. If the structure were designed from the catalogue of any one maker and the sections were marked as being British Standard sections, one would be fairly certain of being able to obtain them no matter where the material was eventually procured. If they were not standard sections it might not be possible to obtain the exact sizes selected for the work, with a consequent loss of economy or loss of strength.

Automobile Work.—But little has been actually published in this section as the Committee has only recently been formed, but it will be a great convenience in the future to know that a motor car or motor bicycle has a few of the things mentioned below of standard sizes, so that in the event of replacements being necessary it would be fairly certain that parts to fit could readily be obtained locally or when touring.

Head and side lamps to fit standard brackets.

Tyres to really fit standard rims without damage and without blowing off the rim.

Ball bearings to fit without any difficulty.

Washers, small pins, sparking plugs, bolts, nuts and other small articles which frequently require to be replaced.

Also that the name of a part on one make of engine did not differ from that given to an exactly similar part by another maker.

Road Material.—Work is being carried out on a road-testing machine to ascertain the best method of making up metalling into lasting roads. In this machine a circular road surface is actually made, and wheels with varying loads on them are run over it till it breaks up.

The specification for various sizes of road metalling has just been published, and special gauges have been made to enable its provisions to be properly checked.

Great diversity has been found to exist between the values of different bituminous materials for road making, and the report on this subject when published will be an interesting one, as indicating the unsuitability of some of the materials now used.

Materials for Engineering Work.—Practically all grades of metal commonly used in engineering work are dealt with in one or the other of the reports issued. In the one which deals with railway material for rolling stock there will be found the details of such materials as axle steel, material for many types and kinds of springs, material for ordinary mild steel as used in general structural work; steel forgings, steel castings, in addition to, copper plates, copper rods, and copper and brass tubes.

This report, together with specifications for wrought iron for shipbuilding, structural steel for bridges and general construction; material for use in boilers, steel for shipbuilding; material for boiler tubes, practically covers the whole scope of any work that is likely to be done in iron and steel by R.E. officers.

Electrical Work.—There are a number of specifications which deal with this branch of engineering. The report which deals with standards for electrical machinery covers a very wide field in connection with motors, generators, and transformers. There are other reports which deal with supply meters—articles which householders always suspect of telling untruths against them—measuring instruments, such as ammeters and voltmeters, and standards for carbon filament lamps.

Standard of Workmanship.—This has been in many cases a very difficult matter to specify to the satisfaction of both inspector and contractor. Generally in specifications the wording has had to be left loose, in such form as "workmanship to be of the best," or, "entirely to the satisfaction of the inspecting officer." This question has been dealt with very thoroughly in a long series of tests, and the report on "limit gauges" and "errors in workmanship" now make it possible to specify in clearly defined terms the quality of the workmanship, and the extent of allowable and unavoidable errors.

As it is clear that different degrees of accuracy are required in

different classes of work, different qualities of workmanship are classified under different heads. And it is only necessary to say that certain work has to comply with the provisions for, say, second or third-class work as laid down in Report No. — to make it quite clear that it is possible to allow on the dimensions shown in contract drawings certain tolerances, which are defined as "differences in dimensions proscribed in order to tolerate unavoidable imperfections of workmanship."

The above are only a few notes on the many reports—some 40 to 50 in all—which have been published. These remarks together with a glance at the Tree will show what a great help the standards set up by the E.S.C. may be in practically all classes of engineering work. It is hoped that as these standards become more and more known they will receive greater support than they do at present; and that all who are connected with engineering will do their utmost to help on the good work that is being carried out both at the National Physical Laboratory and by The Engineering Standards Committee.

THE POSSIBILITIES OF WATER SUPPLY IN LATERITE FORMATIONS.

By CAPT. E. W. S. MAHON, R.E.

ALTHOUGH Sierra Leone has the reputation of possessing a very damp climate, yet, in common with other places in the tropics, it has its dry season during which little or no rain falls for months at a time. In consequence of this there is, during the first months of every year, a great diminution in the volume of the streams supplying the town with water. During the last few years this has practically developed into a water famine in the months of April and May.

The rainy season lasts from about the middle of May till November, and the dry season from December to March; the accompanying chart (see *Plate*) shows both the monthly and the total annual rainfalls for every year since 1882, when the first records were taken. It will be noticed that since 1901 the rainfall has diminished almost uninterruptedly until the present year, 1913, which by September showed no sign of improvement.

This diminution in the rainfall has been attributed to the wholesale clearing of forests and woods, both in the Protectorate and in the neighbourhood of Freetown, and the Colonial Government is attempting to remedy it by preserving and planting certain areas.

Whether this action will have the effect of increasing the general rainfall of the colony remains to be seen. It is, I think, open to question whether it is desirable to do so further than may be necessary for the purposes of water supply and cultivation. A greater rainfall will cause a greater humidity, which will render the climate still more enervating and unpleasant to live in. It is, however, necessary to ensure as far as possible, that the catchment areas which provide the sources of the various Military and Civil supplies should be maintained in the most favourable condition for inducing a maximum precipitation of moisture, and retaining it within them.

To effect this, any portion of the slopes of the spurs and valleys, enclosed within the valleys which are not already wooded, should be planted with quick-growing trees. The crowns at least of all hills which are connected with the areas, should be similarly treated, and steps should be taken to protect the woods from fires and from the encroachment of grass.

Woods increase the natural relative humidity of an area and favour a greater precipitation of moisture. They also serve to retain moisture in the soil, prevent the erosion and denudation of

the ground, and assist the percolation of water to lower levels, thereby feeding the springs.

Low bush is not so effective as woods and forests for increasing the humidity of a locality because the shade afforded is much inferior, evaporation and radiation are not retarded to the same extent and the temperature differs very little, if at all, from the open country. Moreover, bush does not promote the retention of moisture in the soil to the same degree as forest-land, and is also more liable to destruction by fire. Grass provides less shade again than bush, and has less effect on the humidity of the atmosphere. It does not assist the retention of moisture in the soil or prevent erosion to any extent, especially on sloping ground; and it is still more liable to destructive fires in the dry season. Grass is liable to encroach on forests when in close proximity to them, unless prevented from doing so by cleared belts which fires cannot cross.

Records were taken of two streams in the Kortright Catchment Area at the end of the dry season in 1913, and it was found that the deliveries from them varied enormously in the early morning and at the end of the day. At the beginning of April, while in the morning they discharged at the rate of 1,200 and 250 gallons an hour respectively, by the evening these amounts had fallen to 700 and 100 gallons. At the end of April, the early morning deliveries were at the rate of 700 and 150 gallons an hour and the evening rates were only 450 and 40 gallons.

This shows, that during the day the waters of the streams are absorbed by the ground and vegetation to replace the evaporation of moisture which is taking place. During the night evaporation ceases, moisture is precipitated from the air and relinquished by the ground and vegetation, and the discharge from the streams is increased accordingly. Until 1913 all the water supply systems, both Military and Civil, have depended solely on the discharge of the streams within their several catchment areas for the fulfilment of their requirements. The provision has proved in every case increasingly inadequate as the rainfall has declined.

Although various suggestions have been put forward from time to time for remedying this most undesirable state of affairs, the possibility of obtaining an efficient supply, by tapping an underground source, does not seem to have been considered. But an examination of the geological conditions obtaining in the hills, and observation of the behaviour of the streams during the dry season, led me to the conclusion that there was a great possibility of finding good underground supplies by boring in certain well-defined localities.

The geological formation of Sierra Leone consists primarily of granitic rock, principally in the shape of syenite, which differs from ordinary granite in the absence or scarcity of quartz in its composition. Syenite is composed essentially of an alkali felspar and a

ferruginous mineral, and is very like a hornblendic granite in structure and appearance. On the slopes, and in the valleys of the hills, the syenite outcrops in well-defined ridges of solid rock, broken, however, by fissures on the surface, and with occasional faults filled with water-worn volcanic conglomerate. Between these ridges of solid rock syenite occurs in boulders, varying both in size and quantity, bedded in, or resting on laterite earth. In some places, the surface of the ground consists of laterite rock alone without any protruding syenite boulders, and the surface of the laterite is covered with a hard ferruginous crust.

Laterite is a clay produced by the decomposition of various rocks in tropical climates, and is especially well developed when the underlying rock is crystalline and felspathic, such as is syenite. The conditions necessary for its formation appear to be a high seasonal temperature and a heavy rainfall, with a well-marked alternation of wet and dry seasons. Laterite occurs in practically every tropical region of the earth, and is very abundant in Ceylon, India, Burma, and Central Africa. In places where the rainfall is more moderate, a calcareous laterite called kunkar is formed; this is much used in India as a hydraulic cement, and I have found it also in the Soudan and up the Yangtse Valley.

The actual decomposition, dissolution, and disintegration of syenite into laterite clay, is most probably due to the chemical action of rain and the acids it absorbs from the air and surface soil soaking into the rock. The formation of the laterite rock, with its hard ferruginous crust, would appear to be due to the reverse action of the water being drawn by capillary attraction to the surface again during the dry season and taking iron in solution with it. The mineral is left behind as an oxide, on and near the surface, as the moisture containing it is evaporated. This hardening only occurs apparently where the laterite can undergo a drying process, and is not found in the beds of valleys which remain moist throughout the year.

When boring through laterite in a valley bed, I generally found a thin layer of Kaolin or China clay just before reaching the hard parent rock. Below the kaolin, the few inches of intervening space contained small particles of decomposing rock, some oxide of iron, and pure sand. The water held in this space was under pressure sufficient to raise it to within a couple of feet of the surface of the ground. In some instances this water was found to contain a thick iron precipitate.

From this it would seem that the formation of kaolin, by the decomposition of the felspar and the liberation of the silica and iron compound, is the first step in the transformation of syenite into laterite; that a thin stratum full of these liberated materials exists between the parent rock and the result of its decomposition, and that this stratum also contains the water which is carrying out the work. As the decomposition proceeds, the silica and iron com-

pounds previously liberated become re-incorporated with the kaolin, and laterite clay is the result.

In the valleys of the hills round Freetown there are found, as stated above, alternate stretches of laterized ground and ridges of hard syenite rock. The flatter the slopes, the more favourable are the conditions for laterization, and the greater is the extent of the laterized areas in consequence. Laterization does not extend to more than 30 or 40 ft. below the surface of the ground.

The streams which flow in the valleys are fed from springs which occur at the junction of the laterized areas with the syenite ridges. Springs also issue from the hard rock itself, brought from some higher level through fissures and channels formed in the faults of the rock. As the dry season advances, the upper springs gradually diminish, and the bed of the stream in the laterized areas is resolved into a series of pools. The lower springs continue to flow as long as the areas above are over-saturated. In some places where extensive faults occur in the syenite, the whole of the stream may be diverted underground, to reappear perhaps in some other valley. I found an instance of this, where a stream delivering about 500 gallons a day only showed for some 30 yards before disappearing entirely, the valley below being perfectly dry for more than a mile.

The formation of the geological strata in the valleys seems to me to resemble a flight of syenite steps, hollowed out like "basins" and filled to the brim with saturated laterite "sponges." As the process of laterization is always proceeding, the "basins" and the "sponges" in them are being continually enlarged. The water which is carrying out the transformation appears to be held freely as a kind of film in the narrow space between the "sponge" and the "basin," and it therefore seems only natural that boring down through the "sponge" to the "basin" should result in tapping this film of water, which should rise in the bore hole to a height dependent on the level of water at the sides of the "basin."

In April, 1913, acting upon my observations, borings were made at the lower end of Kortright Catchment Area, and a fine supply of water was found, at a depth of only 12 ft. below the surface. It was found possible to add to the existing system at least 25,000 gallons a day from two 4-in. bore holes at the driest season of the year. By this discovery, the problem of the water supply of Tower Hill appears to have been permanently solved.

By comparing the geological conditions obtaining in the Kortright and the other catchment areas, everything seems to point to the great probability of similar underground reservoirs existing in equally favourable positions for adding to the other systems of water supply.

If, as reputed, laterization does not go deeper than 30 or 40 ft., this should limit the depth of the necessary boring. Laterite clay is soft and easily penetrated, and practically the only difficulty to

contend with is the presence of syenite boulders below the surface in the process of laterization. These boulders have to be avoided, as they are too hard to bore through with ordinary tools.

It must be remembered that the surface of the main rock will have been disintegrated irregularly and that "pockets" may have been formed, so that the best possible results may not always be obtainable at the first attempt. The yields from two holes in close proximity in the same area may also vary considerably, owing to the inequalities of the underground rock affecting the flow of water upon its surface.

There are three distinct systems supplying the troops in the Sierra Leone Peninsula with water. The catchment areas are, however, all situated in offshoots from the same range of hills. The following suggestions regarding them are based on observations which I made while in the Colony, and with the assumption that my theory as to the formation of laterite is correct.

Kortright Catchment Area supplies Tower Hill and King Tom Cantonments. It contains two valleys; the collecting dam, from which the supply is piped to Tower Hill, is situated at the lower end of a ridge of syenite below their junction. The waters of the western branch are absorbed into the ground early in the dry season, but, as the junction of the valleys occurs in an extensive laterized area, it is probable that this stream contributes to the moisture which it contains. The upper waters of the eastern stream are caught about 150 yards below their source and piped to the lower dam. These top springs never fail entirely, but their delivery fell to about 2,000 gallons a day at the end of the dry season in 1913. Below the upper dam, the springs fail gradually during the dry season nearly down as far as the junction of the valleys.

The area is well wooded on the whole, but there are some bare places on the eastern slopes below Kortright and on Havelock Plateau, which might be replanted with advantage.

I think it would be beneficial if the upper waters of the eastern stream were allowed to flow down the bed of the valley, instead of piping them to the lower dam. They would then be utilized in feeding the area with moisture, and probably cause the lower springs to flow more continuously in the dry season. The actual loss, if any, to the system by closing this diversion, will be more than compensated by the gain of moisture to the area. In any case its loss, if any, is immaterial, in view of the large additional supply now obtainable from underground sources. The bore holes from which this additional supply is obtained are situated in a laterized area below the bottom dam, so that the water extracted from them cannot diminish the flow of the stream above it.

Wilberforce Cantonment Supply.—The Catchment Area for this is situated below, and to the south of, Leicester Peak, at the head of the Babadori Valley. The area is well wooded but the slopes of Leicester Peak itself are not. The reservoir, from which the supply

is piped, is built at the top edge of a big syenite ridge. The streams which feed it run almost entirely through a laterized area. Borings in this area should produce good results. At present the only water caught is that which overflows the "rim of the basin" at the point where the reservoir is built.

Gloucester Catchment Area which supplies Kortright and Mount Aureol gives the worst results of the three systems during the dry season. The delivery fell to about 1,000 gallons a day at one time during April, 1913. Fortunately the requirements are much less than elsewhere, and the supply is capable of improvement. One cause of the poor supply is the fact that the greater portion of the catchment area is bare of all vegetation except grass. This might be remedied by planting trees. But steps would have to be taken early in this direction to prevent the grass encroaching more on the woodland which does exist in the valley, and causing a further diminution in the supply.

In this Area, the impounding reservoir from which the supply is piped to Mount Aureol is built at the bottom of a slope of syenite which is full of faults and fissures; and, though several springs occur in the bed of the stream, the general surface of the ground is so broken that a large proportion of the water discharging from them disappears into other holes and is lost again underground.

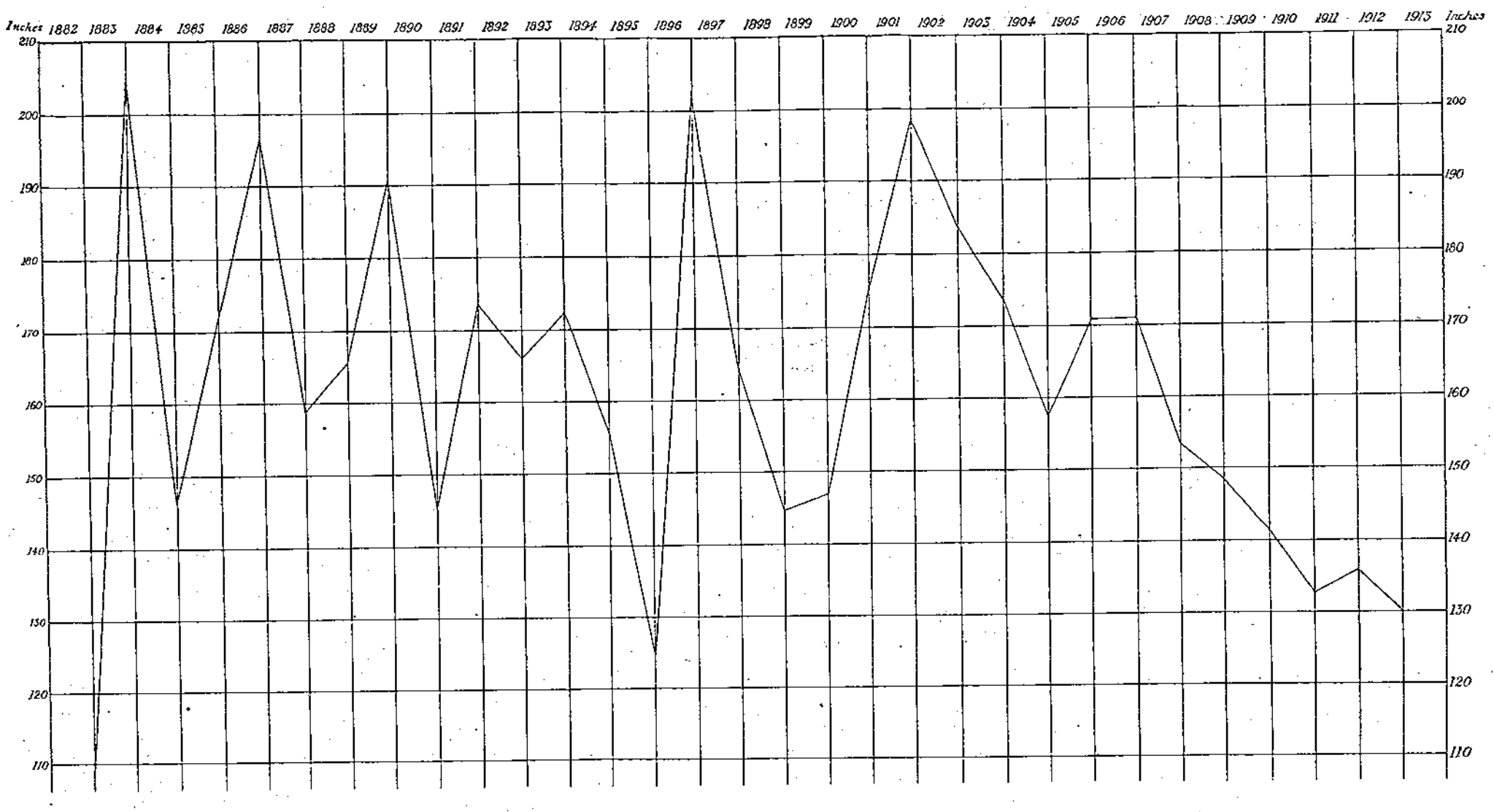
The main stream is caught at the top of this syenite slope and piped down to the reservoir. Above the point where this diversion is made, the valley is flat, and the stream flows through a laterized area from which a supplementary supply could undoubtedly be obtained by boring.

The remedy suggested for the leaks in the ground is to catch each spring at the point where it issues from the rock, and lead it to a main pipe, or channel, delivering into the reservoir. This was tried with beneficial effect last dry season in the case of one spring, but the actual gain was not recorded. This work can only be undertaken in the dry season, and would require careful supervision.

I did not explore the Catchment Areas which provide the Civil water supply. They are all situated in valleys of the same range as the Military Areas. The geological structure of these valleys is similar, and I feel sure that underground reservoirs would be found within them which could be made available for supplementing existing supplies.

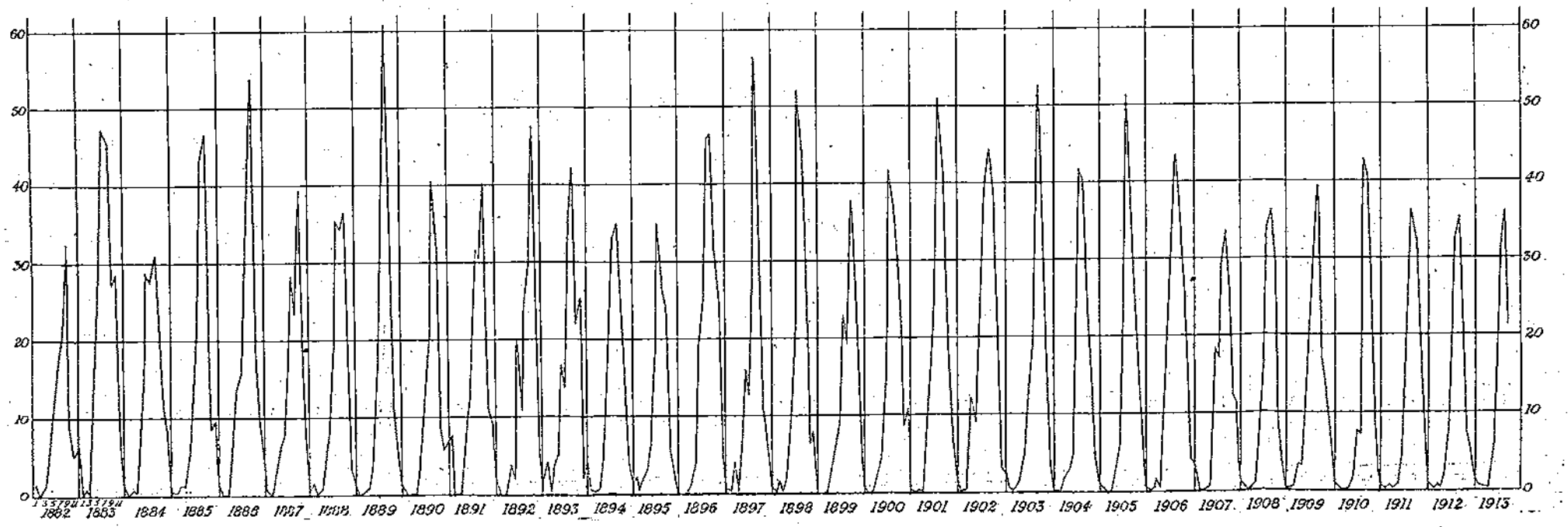
In making use of these underground supplies special precautions are necessary for the prevention of waste. They should never be used as a general rule unless required to supplement a deficiency in the ordinary supply, and no more should in any case be drawn off than is required for the time being.

Although, up to the present, experiments have only been carried out in one of the Catchment Areas in Sierra Leone, it is hoped the successful results achieved in this instance should prove of value, by directing attention to the possibility of finding water in "laterized" areas in other parts of the World.



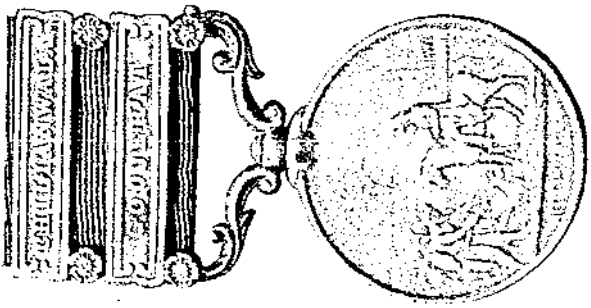
SIERRA LEONE.

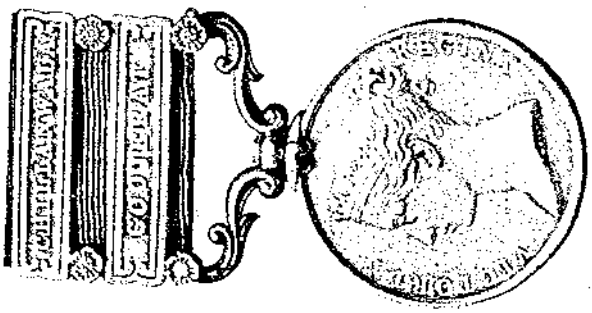
ANNUAL RAINFALLS,
1882—1912.



MONTHLY RAINFALLS,
1882—1913.

EARLY INDIAN CAMPAIGNS AND THE DECORATIONS AWARDED FOR THEM.





THE PUNJAUB CAMPAIGN. 1848-9.

EARLY INDIAN CAMPAIGNS AND THE DECORATIONS AWARDED FOR THEM.

(Continued).

By MAJOR H. BIDDULPH, R.E.

THE PUNJAUB CAMPAIGN, 1848–9.

Exactly two years after the close of the 1st Sikh War hostilities again broke out in April, 1848, on account of the murder at Mooltan of Mr. Vans Agnew and Lieut. Anderson by the Dewan Mulraj.

Lieut. H. B. Edwardes with a force composed almost entirely of irregulars at once took the field, and, defeating Mulraj twice, shut him up in Mooltan.

Lord Gough had deferred operations purposely until towards the end of the hot weather, when a force was despatched to the siege of Mooltan under Major-General Whish. A Sikh army from Lahore co-operated, but it threw in its lot with the rebel Mulraj on September the 1st. This compelled Whish to suspend all active offensive operations until he had been reinforced by troops from Bombay and Scinde. They arrived on December the 21st, the siege was again pressed, and the city taken by assault on January the 2nd. The citadel held out until January the 22nd, when Mulraj surrendered himself. Meanwhile the rebellion had spread over the whole Punjaub, and in November the Army of the Punjaub had taken the field under Lord Gough.

The unfortunate cavalry action at Ramnagar (22nd of November) on the left bank of the Chenab was the opening incident of the campaign, in which the 14th Light Dragoons lost their colonel (W. Havelock, brother of Sir H. Havelock), and the cavalry division their general, Brigadier Cureton, the best cavalry officer in India, whose services included the Peninsula War and nearly half-a-dozen wars in India. Among the killed also was the Subadar-Major of the 8th Bengal Light Cavalry—" an old man of 78 years and nearly 60 years' service."

The whole of the army was across the Chenab by December the 8th, and remained inactive till January the 12th, when it moved to attack Sher Singh, who had 30,000 men and 62 guns, near Rasul on the left bank of the Jhelum.

On January the 13th the armies were in contact, but Gough had not intended to fight that day, until it seemed likely that Sher Singh, who had commenced a heavy artillery fire, might take the initiative.

The ground was covered with scrub and jungle, greatly impeding

vision and co-ordinated movement. The Sikh line, which overlapped the British on both flanks, occupied ground slightly higher than the surrounding terrain. The 2nd Division (Gilbert) was on the right, the 3rd Division (Colin Campbell) on the left, one brigade of which was held in reserve. On the right flank was the 2nd Cavalry Brigade (Pope), and on the left flank was the 1st Cavalry Brigade (White). The 3rd Brigade (Hearsey) was in reserve.

Before the advance began, Colin Campbell told Brigadier Pennycuick that, as the scrub made it impossible for him to effectively superintend the advance of the division, he would leave the leading of the 5th Brigade entirely to him, while he himself would accompany the 7th Brigade (Hoggan) which was dangerously outflanked by the Sikhs.

In the advance Gilbert's division was exposed to the greatest danger; before becoming seriously engaged with the enemy the whole of Pope's cavalry brigade went about, and galloped to the rear, riding over its own horse artillery and causing the greatest confusion.* Pope himself was mortally wounded.

Though taken in flank and in rear Gilbert's division pressed on, repelling all attacks, and carried all before it.

Meanwhile another disaster had befallen the left flank. Pennycuick's brigade inclined to its right front, losing touch with the 7th Brigade; and the centre regiment, H.M. 24th Foot, pressing forward at headlong pace, left the other regiments of the brigade behind. It arrived quite spent and in disorder at the Sikh batteries, was unable to withstand a heavy counter-attack, and was driven back by the Sikh cavalry to a point in rear of that from which it had started, leaving nearly half its number on the ground.

The 6th Brigade (in reserve) was then pushed into the gap formed.

The 5th Brigade with Colin Campbell had advanced steadily in the meantime, and captured the batteries in front with great slaughter; then wheeling to the right it swept along the Sikh position until it joined hands with the left of Gilbert's division.

The Sikhs were driven from the field, but were not routed, and as it was now very late in the day it was considered prudent to withdraw to a more defensible position at Chilianwala. The British casualties amounted to 2,357. The 24th Foot lost in killed or died of wounds 14 officers and 241 men, and had about 250 more wounded. The Sikh loss was enormous. "Never except at Sobraon have I seen so many of the enemy's slain upon the same space," wrote Lord Gough. If only it had been known how broken the spirit of the Sikhs was, the British would have encamped on the field that night. As it was, Sher Singh recrossed the Jhelum in the night, on hearing of the

* It is said that a chaplain in rear was conspicuous in rallying the fugitives, and that Lord Gough wished to promote him "brevet-bishop" for his services.

British retirement, murdered such of the wounded as had been left behind and recovered most of his guns.

The temper of the British troops did not permit of renewed action on the morrow and Lord Gough awaited the fall of Mooltan, which occurred a few days later, when General Whish with all the Bengal Division, and one strong Bombay brigade, marched to join him. The last of these troops joined Gough on February the 20th. In the meantime Sher Singh, who had received very numerous reinforcements, retired and established himself at Goojerat, with 60,000 men and 59 guns.

On February the 15th, Gough marched from Chilianwala, detaching a force to Wazirabad to prevent any raid across the Chenab on Lahore.

On February the 21st, the attack on the Sikh position at Goojerat began with a heavy cannonade which was maintained until the Sikh artillery was overpowered, and their whole line badly shaken. The infantry now advanced, the 1st and 2nd Divisions on the centre of the position, the 3rd Division on the left of the line, and cavalry on both flanks. By one o'clock, after a desperate resistance, the whole Sikh army was in full flight, leaving 56 guns and numberless dead on the field. The pursuit continued for 15 miles that day, and on the morrow Gilbert resumed it with such persistence and relentless vigour that on March the 14th the Sikh chiefs and the remnant of their armies surrendered to him at Rawal Pindi, giving up 41 guns and 20,000 stand of arms. As some allied Afghan cavalry had fought with the Sikhs, Gilbert continued his pursuit to Peshawar, where the remnants of the Afghan cavalry fled through the Khyber Pass.

The whole of the Punjaub was annexed to British India as the result of the war.

The medal for this campaign was authorized in the first instance by Lord Dalhousie, and was given to all troops serving in the Punjaub; the clasp for Chilianwala was granted later at Lord Gough's personal request.

PUNJAUB CAMPAIGN, 1848–9.

Medal 1·4.-in. diameter, silver.

Obverse.—Crowned head of Queen Victoria. Legend "Victoria Regina."

Reverse.—The Sikh army laying down its arms before Sir W. R. Gilbert and his troops near Rawal Pindi. Inscription "To the Army of the Punjab." In exergue "MDCCCXLIX."

Clasps.—"Mooltan."
"Chilianwala."
"Goojerat."

Mounting.—Silver scroll bar and swivel.

Ribbon.—Dark blue with two thin yellow stripes, 1¼ in. wide.

Nobody earned the medal with three clasps, but Sir H. M. Lawrence received the medal with two clasps, "Mooltan" and "Chilianwala." He was returning to Lahore from leave in England, and travelling *viâ* Karachi and the Indus, spent a few days *en route* at Mooltan, during the last phase of the siege. This combination is, I believe, unique.

The medal with single bar "Mooltan" is not very common to those corps which served at Goojerat as well, *e.g.* the 1-60th Rifles with a strength of nearly 1,000 received less than 100 medals with this one bar, and it is not an uncommon thing to come across a medal to this regiment from which the Goojerat bar has been removed with great care. The irregular levies did not receive any medals.

All the troops quartered in the Punjaub received the medal without the clasp, even if not engaged with the enemy, so that in all some 60,000 medals were issued, with nearly 19,000 clasps for "Mooltan," over 20,000 clasps for "Chilianwala," and about 34,000 clasps for "Goojerat."

The troops who received the medal only were as follows :—

Bengal Horse Artillery :—2-1st, 3-1st, and 3-3rd Brigade.
Bengal Foot Artillery :—1-5th, 1-6th, 3-6th, 4-6th, 2-7th, 4-8th and 6-8th Battalion.
7th Bengal Cavalry; 2nd, 13th, 15th, 16th and 17th Irregular Cavalry.
Bengal Pioneers :—1st Co.
Bengal Native Infantry :—1st, 3rd, 4th, 18th, 22nd, 29th, 37th, 50th, 53rd, 71st and 73rd N.I.
Local Corps :—1st and 2nd Regts. Sikh Local Infantry.
Details of the Indus Flotilla, and of corps in the field.

The troops present at Mooltan, Chilianwala and Goojerat were as follows :—

Troops present at the Siege of Mooltan (18th August, 1848, to 22nd January, 1849. Major-General W. S. Whish, Bengal Artillery, in command).

Bengal Column.

Artillery :—Major H. Garbett.
4-1st Brigade and 4-3rd Brigade Horse Artillery.
2-2nd Battn., 3rd and 4th Cos., 3rd Battn. and 6-7th Battn. Foot Artillery.
Engineers :—Major R. Napier, succeeded by Brigadier J. Cheape.
1st, 2nd and 3rd Cos. Sappers & Miners.
2nd and 3rd Cos. and detail of 5th Co. Pioneers.

Cavalry :—Lieut.-Colonel H. F. Salter, 11th Light Cavalry.
11th Light Cavalry.
7th and 11th Irregular Cavalry.
Detachment 14th Irregular Cavalry.
1st Infantry Brigade :—Lieut.-Colonel A. Hervey, 52nd N.I.
H.M. 10th Foot.
8th and 52nd Native Infantry.
2nd Infantry Brigade :—Lieut.-Colonel F. Markham, 32nd Foot.
H.M. 32nd Foot.
49th, 51st and 72nd Native Infantry.
Detachment of the Guides (Lieut. H. B. Lumsden), Sikh contingent under Lieut. H. B. Edwardes, and Bahawalpur contingent under Lieut. E. J. Lake.

Bombay Column.—Brigadier the Hon. H. Dundas (arrived 21st December, 1848).

Artillery :—Major J. S. Leeson.
3rd Troop Horse Artillery.
2-1st Battn., 4-2nd Battn., 1-4th Battn. and 2-4th Battn. Foot Artillery.
Engineers :—Major W. Scott.
1st and 2nd Cos. Sappers & Miners.
Cavalry :—1st Light Cavalry.
1st and 2nd Scinde Irregular Horse.
Infantry :—1-60th Rifles, 1st Bombay Europeans.
3rd, 4th, 9th and 19th Native Infantry.
Scinde Camel Baggage Corps.
Indus Flotilla :—Capt. F. T. Powell.
Casualties of the Regular Forces :—
9 British officers and 201 other ranks killed.
55 „ „ „ 927 „ „ wounded.

The number of shot and shell fired during the siege was 42,193; but it is uncertain whether this includes the ammunition expended by the Bombay Artillery. At the Siege of Bhurtpore, which lasted 5 weeks, December, 1825, January, 1826, the expenditure was 61,446 shot and shell.

Troops present at the Battle of Chilianwala, 13th January, 1849 (Lord Gough, C.-in-C.).

Cavalry Division :—Major-General Sir J. Thackwell.
1st Brigade :—Brigadier M. White, 3rd Light Dragoons.
H.M. 3rd Light Dragoons.
5th and 8th Bengal L. Cavalry.

2nd Brigade :—Brigadier A. Pope, 6th Bengal L. Cavalry.
H.M. 9th Lancers.
1st and 6th Bengal L. Cavalry.
H.M. 14th Light Dragoons (attached).
3rd Brigade :—Brigadier J. B. Hearsey (in rear with the baggage).
3rd and 9th Irregular Cavalry.
Bengal Artillery :—Brigadier J. Tennant.
2nd Brigade Horse Artillery, 1st, 2nd, 3rd and 4th Troops.
3rd Brigade Horse Artillery, 1st and 2nd Troops.
1st Battn. Artillery, 1st and 3rd Cos.
4th Battn. Artillery, 1st, 2nd and detachment of 4th Cos.
7th Battn. Artillery, 3rd Co.
Bengal Engineers :—Major G. B. Tremenheere.
4th, 5th, 6th and 7th Cos. Pioneers.
2nd Infantry Division :—Major-General Sir W. R. Gilbert.
3rd Brigade :—Brigadier C. Godby, 2nd European Regt.
2nd Bengal European Regt.
31st and 70th Bengal N. Infantry.
4th Brigade :—Brigadier A. S. H. Mountain, 29th Foot.
H.M. 29th Foot.
30th and 56th Bengal N. Infantry.
3rd Infantry Division :—Brigadier C. Campbell,* 98th Foot.
5th Brigade :—Brigadier J. Pennycuick, 24th Foot.
H.M. 24th Foot.
25th and 45th Bengal N. Infantry.
7th Brigade :—Brigadier J. Hoggan, 45th Bengal N. Infantry.
H.M. 61st Foot.
36th and 46th Bengal N. Infantry.
In reserve :—6th Brigade :—Brigadier N. Penny, 69th Bengal N. Infantry.
15th [20th] and 69th Bengal N. Infantry.
With the Baggage Train :—Brigadier J. B. Hearsey.
3rd and 9th Irregular Cavalry.
20th Bengal N. Infantry.
3 guns 1-1st Battn. Artillery.

Casualties :—

22 British officers and 580 other ranks killed.
67 ,, ,, ,, 1,584 ,, ,, wounded.
104 ,, ,, missing.

Casualties of H.M. 24th Foot :—

14 officers and 241 men killed.
10 ,, ,, 253 ,, wounded.

12 guns were captured.

* Afterwards Lord Clyde.

Troops present at the Battle of Goojerat, 21st February, 1849 (Lord Gough, C.-in-C.).

Cavalry Division :—Sir J. Thackwell.
1st Brigade :—Brigadier M. White.
H.M. 3rd Light Dragoons.
H.M. 9th Lancers.
8th Bengal L. Cavalry.
Scinde Irregular Horse.
2nd Brigade :—Brigadier G. H. Lockwood, 3rd Light Dragoons.
H.M. 14th Light Dragoons.
1st Bengal L. Cavalry.
11th and 14th Irregular Cavalry (each 2 rissalas).
3rd Brigade :—Brigadier J. S. Hearsey.
3rd and 9th Irregular Cavalry.
Bengal Artillery :—Brigadier J. Tennant.
Horse Artillery :—1st Brigade, 4th Troop ; 2nd Brigade, 1st, 2nd, 3rd and 4th Troops ; 3rd Brigade, 1st, 2nd and 4th Troops.
Foot Artillery :—1st and 3rd Cos. 1st Battn. ; 2-2nd Battn. ; 3rd and 4th Cos. 3rd Battn. ; 1st, 2nd, and detachment 4th Co. 4th Battn. ; 3rd and 6th Cos. 7th Battn.
Bombay Artillery :—Major J. S. Leeson.
3rd Troop Horse Artillery.
2-1st Battn. (in reserve).
Bengal Engineers :—Brigadier J. Cheape.
2nd and 3rd Cos. Sappers & Miners.
2nd, 3rd, 4th, 5th, 6th and 7th Cos. Pioneers.
Bombay Engineers :—Lieut. W. Kendall.
1st Co. Sappers.
1st Infantry Division :—Major-General W. S. Whish.
1st Brigade :—Brigadier A. Hervey, 52nd N.I.
H.M. 10th Foot.
8th and 52nd Bengal N. Infantry.
2nd Brigade :—Brigadier F. Markham, 32nd Foot.
H.M. 32nd Foot.
51st and 72nd Bengal N. Infantry.
2nd Infantry Division :—Sir W. R. Gilbert.
3rd Brigade :—Brigadier N. Penny.
2nd Bengal European Regt.
31st and 70th Bengal N. Infantry.
4th Brigade :—Brigadier A. S. H. Mountain.
H.M. 29th Foot.
30th and 56th Bengal N. Infantry.
3rd Infantry Division :—Brigadier C. Campbell, 98th Foot.
5th Brigade :—Brigadier A. Carnegy.
H.M. 24th Foot.
25th Bengal N. Infantry (and 45th Bengal N. Infantry in reserve).

6th Brigade :—Brigadier J. Hoggan.
15th and 20th Bengal N. Infantry (in second line).
(69th Bengal N. Infantry in reserve).
7th Brigade :—Brigadier A. McLeod, 61st Foot.
H.M. 61st Foot.
36th and 46th Bengal N. Infantry.
Bombay Division :—Brigadier Hon. H. Dundas.
H.M. 1-60th Rifles.
1st Bombay European Regt.
3rd and 19th Bombay N. Infantry.
Scinde Camel Baggage Corps.
Reserve :—Lieut.-Colonel A. Mercer, 69th Bengal N. Infantry.
5th and 6th Bengal L. Cavalry.
2-1st Battn. Bombay Artillery.
45th and 69th Bengal N. Infantry.
Also present a detachment of the Guides.
Casualties :— 4 British officers and 91 other ranks killed.
25 ,, ,, ,, 681 ,, ,, wounded.
56 guns were captured.

Detached Force near Wazirabad, commanded by Lieut.-Colonel J. Byrne, 53rd Foot.

12th and 13th Irregular Cavalry.
4 guns 6-7th Battn. Bengal Artillery.
H.M. 53rd Foot.
13th Bengal N. Infantry.

On the evening of the 21st February, this detached force had arrived within a few miles of the right rear of the British Army. They received the clasp for Goojerat, with the exception of the 13th Irregular Cavalry, which was probably further to the rear.

Engineer Officers who served in the Punjab Campaign, 1848-9.

Bengal Engineers.

M.G. Major-General J. Cheape, C.B. Chief Engineer.
C.G. Capt. G. B. Tremenheere.
M.G. Bt. Major R. C. Napier. (Wounded. Chief Engineer at Mooltan till December, 1848).
C.G. Capt. J. Glasfurd.
C.G. ,, B. W. Goldie.
C.G. ,, H. M. Durand.
M.G. ,, W. Abercrombie.
M.G. ,, J. R. Western.
M.G. ,, H. Siddons.
C.G. ,, A. Cunningham.
C.G. Lieut. C. B. Young.

C.G. Lieut. R. Baird Smith.
C.G. ,, A. G. Goodwyn.
C. ,, H. Yule.
C.G. ,, T. S. Irwin.
C.G. ,, W. E. Morton.
M.G. ,, J. H. Maxwell.
M.G. ,, E. J. Lake. (Political employ).
M. ,, P. Garforth.
G. ,, W. A. Crommelin.
M. ,, G. W. W. Fulton.
M.G. 2nd Lieut. A. Taylor.
M.G. ,, A. Fraser. (Adjutant).
M. ,, C. S. Paton.
M.G. ,, T. G. Glover.
M. ,, H. Hyde.
M. ,, R. Young.
M.G. ,, B. M. Hutchinson. (Mortally wounded at Battle of Goojerat).
M.G. ,, F. C. Grindall.
M.G. ,, W. W. H. Greathead.
M.G. ,, W. S. Oliphant.
M. ,, H. W. Gulliver.
M.G. ,, C. Pollard. (Wounded).
M.G. ,, C. T. Stewart.
M.G. ,, F. R. Maunsell.
M. ,, A. W. Garnett.
M.G. ,, D. C. Home.

Bombay Engineers.

M. Major W. Scott.
M. Lieut. Jno. Hill.
M.G. ,, Wm. Kendall.
M. ,, H. P. B. Berthon.
M.G. ,, J. T. Walker.
M. ,, J. W. Playfair.
M. ,, J. A. Fuller.

M denotes clasp for the Siege of Mooltan.
C denotes clasp for the Battle of Chilianwala.
G denotes clasp for the Battle of Goojerat.

Medal without Clasp.

Major H. Goodwyn.
Capt. J. R. Oldfield.
Lieut. J. T. Donovan.

(To be continued).

REVIEWS.

GUIDE DE L'OFFICIER CHARGÉ DES COMPAS.

By CAPT. LOUIS MOTTEZ.

THIS is a highly technical publication for the guidance of officers placed in charge of the magnetic compasses on board ship. The first part is mainly theoretical and deals with magnetic fields, Faraday's laws, the magnetic properties of hard and soft iron bars and spheres, their fields, induction, terrestial magnetism, the periodical and diurnal variations of the compass, the magnetic effects of iron ships, formulæ for compensation when the vessel is erect, the effect of heel and its compensation.

The second part is practical, and contains extracts from the regulations laid down for the care and preservation of the compass, records to be kept, descriptions of the various operations to be undertaken in harbour and on the high seas for adjusting the compasses, the calculations to be made, and the application of their results. The treatise is based on 20 years' experience at sea, and appears to be thoroughly practical.

A.R.R.

L'EVOLUTION DE LA MARINE AMERICAINE.

By CAPT. H. DE ROQUEFEUIL.

THIS is a careful study of the recent changes in the American Navy, under which the engineer branch was amalgamated with the executive branch on board ship, and, to a considerable extent, in the arsenals on shore. The change was first introduced in 1899, and was a direct consequence of the war with Spain, due to the dangerous scarcity of naval officers at the outbreak of that war. From that date onwards to the present time the writer traces the progress and results of the amalgamation, and of the altered conditions of training and service which were then instituted, and modified later as experience dictated improvements in the original scheme.

Great Britain has adopted an almost similar scheme, and the tendency of all European nations lately has been towards unity of corps as distinct from a too strict specialization, though in no case have reforms been pushed so far as in the United States and in Great Britain. A separate chapter is devoted to a discussion on the "machinists," or mechanists, whom it was found necessary to engage for the engine room on the suppression of the distinct engineer officer. Another chapter contains a description of the Naval School at Annapolis, and of the course of instruction pursued at that institution.

The study is well compiled and appears to be very complete. Reference is given by footnotes to speeches in the American and British Houses of Parliament, or to articles in magazines and books from which infor-

mation has been drawn. The writer is evidently a partizan of the reform, still the arguments for and against the movement are stated on the whole impartially, and the publication is a useful contribution to the discussion, particularly for the general reader who wishes to keep in touch with current topics and has not the time or opportunity to search through all the multifarious documents bearing on the question.

A.R.R.

QUESTIONS DE CRITIQUE MILITAIRE ET D'ACTUALITE.

By GENERAL H. BONNAL.

A COLLECTION of some 20 short articles on military subjects, evidently written by one who has at heart the best interests of his country. They are worthy of perusal as illustrations of French military aspirations at the present day. Criticism, where indulged in, is moderately expressed, and should not fail to be of use if read in the spirit in which it is offered. We may be allowed to express a hope that it will be accepted in this spirit, and that it will be productive of the best results, so that if, and when, the struggle in which the French nation is even now engaged is to be put to the test of actual war, its fine army may be found fully prepared to uphold its high reputation.

Amongst others are articles on the following subjects :—

Napoléon chef d'armée.
Napoléon et son Quartier général.
Napoléon foyer d'heroisme.
Deux armées rivales.
Comme à la veille d'Iéna.
Bazaine le 18 Août, 1870.
L'Armée française aux Manœuvres de l'Est en 1911.
Deux méthodes de Commandement.
Paix ou guerre ?
Le général de Ladmirault à Rezonville.
Le général de Charette.
Aeroisme et Faiblesse.
L'Aviation militaire.
Pour la sécurité des Aviateurs.
La guerre aérienne.

A.R.R.

THE RAILWAY ENGINEER'S FIELD BOOK.

By MAJOR G. R. HEARN, R.E., AND A. G. WATSON, C.E.

(Thacker Spink & Co., Calcutta and Simla. Price 20s. Thacker & Co., 3, Creed Lane, London, and Bombay).

PROPERLY understood, no better description of this book can be given, than that of the authors, on the title page, " A Practical Manual for Engineers in the East."

It is practical in that the authors have practised what they preach and know and describe exactly how work is done in the field. Sufficient theory is given to explain the principles on which the practice is based.

The word manual, it should be noted, is used in its true sense, *i.e.*, a book to keep at hand, not in the sense of an elementary primer, as the book is more in the nature of a pocket treatise, containing as well all the tables usually required in the field.

It divides itself naturally into four parts :—

1st. A description of the instruments used, *and their adjustments.*

2nd. How to use them to the best advantage in every class of railway survey.

3rd. Hints on reconnaissance and considerations on location showing how many factors enter into the selection of the best line.

4th. A full description of the actual work of staking out the line in the field, with a chapter on circular curves, another on transition curves, and some notes on solar observation for time and azimuth. Chapter 5 is, in effect, a short treatise on the use of the tacheometer, an instrument that has not been used to any extent in India up to date, but one which appears to be, in the hands of a thoroughly competent man, an ideal instrument for surveys in rough countries.

The appendix contains many tables, such as ordinates, abscissæ of curves, tangents (to every minute), logs of numbers, log functions of angles, and tacheometer tables.

Chapters 3 and 7 are particularly important, as pointing out how numerous and varied are the factors which have to be considered in the choice of the best line (there can only be one best line) and insisting on the value of a careful reconnaissance, before any detailed work is commenced. These chapters will be found to contain much that is new to most of us, and even those engineers well experienced in railway survey will probably find them useful as an aide-memoir, and of great assistance in the issue of orders to subordinates. Not the least useful point brought out in this book, is the fact that a thorough knowledge of the methods of surveying is only the first *qualification* for the railway surveyor, so many and varied are the considerations determining the location of the line.

This book, being written from experience in India (and the only one so written), is particularly useful to R.E. officers proceeding to India, containing as it does a complete description of the organization and work of a survey party, and instructions as to the best way of recording observations in the field, so that they may be easy to find during plotting —a point of no little importance. It is a book to keep at hand both in the field and in the office, and has been described by the Chief Engineer of the Railway Board as one which should be in the library of every engineer.

C. ST. J. LYNCH, *Capt., R.E.*

NOTICES OF MAGAZINES.

REVUE D'ARTILLERIE.

November, 1913.

CONTRIBUTION TO THE HISTORY OF THE ARTILLERY.

The Extraordinary Commission of the Year 'XI.—This commission was convoked by the First Consul with the object of simplifying the heterogeneous patterns of guns in use at the end of the 18th century. The minutes of the first sitting are given. Of historical interest only.

NOTES ON THE EMPLOYMENT OF ARTILLERY IN THE BALKAN WAR.

An extract from notes made by Capt. G. Bellenger of the Artillery, who, with Colonel Mondesir of the Engineers, visited the theatre of war last April. It is published with the reservation that no responsibility is accepted for the opinions expressed.

1. *Siting.*—After Kirk Kilisseh the Bulgarians were generally in action on gentle slopes only, and took up positions well behind the crests, necessitating communication by telephone with the observing station. The Turks usually declined the artillery combat so that the Bulgarians only had to support their own infantry. The slowness of communication often militated against the timeliness of the salvos. The Servians in Macedonia, fighting on steep slopes, drew nearer to the crests, and elected to do so even at Kumanovo and Monastir although there was no great reason for it except that rapid fire could more easily be directed. The Greeks did not choose high screens. Many of the Turkish batteries seemed to be unacquainted with the use of indirect fire.

2. *Occupation of the Position.*—All the belligerents agree that a battery seen on the move is lost. The Bulgarians were so careful that their guns advanced under cover that they frequently opened at 5,000 metres or beyond. At Lule Burgas there were good artillery positions that could have been occupied at 2,000 to 3,000 m. range on condition that the intervening ground was crossed by night, but no attempt was made to do so. The Servians, on the contrary, probably because their artillery was better horsed, took advantage of the cover of night to make advances of 1,500 to 2,000 m., though occasionally they had the misfortune to find that the new position was in full view of the enemy by day. A case is mentioned of a battery thus in sight not being annihilated.

3. *Ranging.*—The officers consider that regularity in the distribution of fire is not necessary, the lines of fire must all be directed upon the important points of the objective. The Turks used one gun for ranging; this is decidedly a mistake as this gun was usually sacrificed at once.

4. *Execution of Fire.*—All agree that shell were generally burst too high. This was probably due to the long ranges, and consequent irregu-

larity in the range, and times of burst. Shrapnel and explosive shell were equally dreaded by the infantry. Searching fire was seldom employed.

5. *Effects of Fire.*—The Servian claim that they frequently destroyed hostile batteries could not be substantiated. In Thrace such an effect seems to have been very rare, but cases of neutralization and immobilization frequent, but then the Turks always entrenched, and three-quarters of them were, as a rule, untrained reservists. Except in a few instances when they attacked bravely, their immobility may have been as much due to faults in their organization as to the enemy's guns. The Bulgarians always entrenched even their reserves as soon as they came under shell fire, but their trenches were often constructed for shelter only, and had no field of fire. The Servians sited their trenches much more skilfully, with a view to a possible offensive return of the enemy. On all sides the great moral effect on the infantry of support by shell fire was insisted upon; in many cases this must have been its only effect.

6. *Objectives, and Nature of Shell.*—In no case was any systematic fire employed against buildings or woods, as they hardly existed. Earthworks were frequent; the Bulgarians dealt with them by time-fuzed shell and night attacks with the bayonet. The Servians carried some by day by dint of well-combined action of both artillery and infantry. As an example of the effect of artillery fire at long ranges, it is reported that at the Battle of Ganitze-Vardar the Turks for a long time prevented the passage of a bridge 6·2 k.m. (3 miles 7 furlongs) away. The Bulgarians and Servians both assert that a battery in the open can always be smashed by a masked battery, but see above, *Section* 2. It is observed that the batteries destroyed were nearly always exposed to oblique or enfilade fire. Fire on masked batteries appears to be of little effect. It would be better to support directly one's own infantry, and enable them either to attack the battery, or to cover some more advantageous artillery position. If these two solutions are impossible the artillery fight is prolonged with no definite result. No use was made of aeroplanes in this campaign.

7. *Distribution of Artillery to the Other Arms.*—The Bulgarian division corresponds to the French *corps d'armée* (24 battalions) but with an addition of one-tenth for losses. With each division are 3 groups each of 3 batteries of 4 guns, or 36 Q.F. guns against 120 in the French Army. Each artillery regiment also mobilizes a second regiment of 6 batteries of six 87-m.m. (3½-in.) Krupps, but these seem to have been all concentrated at the Siege of Adrianople. The Bulgarian divisional artillery, however, does not correspond to the corps artillery, to be kept at the disposal of the commander, but was generally divided amongst the three brigades. Brigadiers, again, generally split it up to such an extent that single guns had often each its separate objective. Except at Adrianople, no concentrated powerful mass of artillery was ever employed in action by the Bulgarians, and there is no battle of theirs in which the artillery can boast of having taken a really decisive part. This is probably due to lack of teams in time of peace and the consequent want of practice in manœuvre. The Servians have the same number of guns in their division of 16 battalions, and their generals did not split them

up but kept them in reserve or employed them at a decisive point. On one occasion guns not required were lent to a neighbouring division.

8. *Expenditure of Ammunition.*—No figures are given, but it is said to have exceeded all estimates, and replenishment was a great difficulty. The halts of the Bulgarians after Lule Burgas, and of the Servians after Kumanovo, seem to have been in a great measure due to insufficiency of gun ammunition.

9. *Heavy Artillery and Howitzers.*—The advantages of curved fire were never utilized by Bulgarians or Servians, who only looked on their heavy artillery as long-range guns with powerful shell. Both had 120-m.m. (5-in.) long guns as well as howitzers. Except at Adrianople and Chatalja the Bulgarians only used their howitzers at Bunar Hissar, and then only because the situation was so critical that every available resource had to be employed. The Servians only used heavy guns at Monastir to support their infantry from behind an extensive inundation. The 120-m.m. long guns were used on one occasion against a mountain position which the field guns could not reach, and caused the Turks much alarm as they thought themselves beyond artillery range. The writer expresses a doubt whether heavy guns and ammunition are worth the trouble of conveyance, and argues his point at some length.

Mechanical Fuzes.

In this third and last part the details of certain parts of the mechanism are described, *e.g.* safety appliances, the trigger, and the striker. As examples of the first the fuzes of Meigs, Nordenfeldt, Klumach and Walsh have been taken, and of the second the fuzes of Maxim, Nordenfeldt, Kelsen and Micciche, and of the third those of Baker, Smith and Wetter.

The final conclusion is that the clockwork fuze realizes an important progress, but is not yet perfect. If a fuze is required that can be regulated to 15 metres, then for a residual velocity of 300 m.s. an accuracy of $\frac{1}{20}$th second is necessary. This accuracy cannot yet be guaranteed with mechanism of such small dimensions, which must also be strong enough to stand rough usage, and the shock of discharge.

German Tendencies at the Present Day in Regard to the Employment of Heavy Artillery.

The German foot artillery has been considerably augmented since 1911. It is clear that the heavy gun is to be a true field weapon, working in conjunction with the other arms. This is evidenced by the recent corrections in the foot artillery regulations (*Provisional Regulations*, 1908, Chapter IV.—The Combat). The author quotes the text of the revised paragraphs, and adds extracts from comments made in regard to them by different German writers. The article is well worth perusal. The conclusions arrived at are :—

1. Under favourable circumstances the heavy artillery will come into action at long ranges before the actual battle commences, to delay the enemy and oblige him to deploy, to deny him defiles which he is bound to try to make use of, to disturb his assemblies, to hinder the arrival of his artillery, etc. To these ends it will be placed further forward than hitherto in the line of march.

2. The principal duty of the heavy artillery is to annihilate early the enemy's artillery, and thus leave the greater part of the field artillery directly free to support the infantry. With this object in view it will be placed as much as possible in the centre of the front, behind the field artillery if necessary. It can disable guns with shields even when they are completely masked—provided the zone in which they are stationed is known—by systematic fire within the limits of that zone. It requires time and ammunition to do so, but these need not be grudged, as the quantity of ammunition with the battery (1,728 rounds) enables the result to be obtained without unduly exhausting the supply.

3. Afterwards the heavy artillery will support the infantry, especially when it encounters a fortified position; in particular it will participate in the final blow which will render the zone selected for the decisive attack ripe for assault. It will then continue to fire up to the extreme limit permissible by considerations of the safety of its own troops.

CUTTING PROPERTIES OF TOOL STEELS.

This article is concluded. The practical application of the curves obtained from the testing machine are explained. It must be remembered that these curves are only applicable in the workshop if the same material (hard or soft metal) is worked as was used in obtaining the curve in the testing machine. Different curves must be made for different metals. From these different curves co-efficients are obtained, for the same quality of tool steel, so that if the best speed to employ for cutting any particular metal (phosphor bronze, for instance) has been obtained by the testing machine, then the best speed for the same steel cutting any other metal (hard steel, or cast iron, say) can be readily calculated.

The output of any particular quality of tool-steel cutting any particular material, remains constant if the three variables, speed, depth, and width of cut, remain constant. This relation is expressed by the formula aSV^3=constant, or a^2lV^3=constant, where a=the depth of cut, S the area of the section, l the width of the cut, and V the speed in metres per minute. From this formula a table is calculated on which can be easily read off the co-efficient by which the speed must be multiplied when the width or depth of cut, or both, is altered, if the maximum output is still required.

It does not necessarily follow that the speed giving the maximum output of a tool is the most economical speed in every case. If a number of articles of exactly the same dimensions is to be prepared, it is better to use the speed that will give the maximum output of the tool, as the frequent removal of the tool for sharpening means alteration in its shape and consequent delay in adjusting it again exactly to the same depth of cut. But if a given quantity of material has to be removed from a large piece of metal it is more economical in point of time, and therefore of money, to use a quicker speed within certain limits, and to sharpen the tool more frequently. This question of the economical speed is fully entered into, and several examples are given.

Chapter II. deals with carbon and special steels in the same manner

as has been adopted in Chapter I. for high speed steels, and similar curves and tables of co-efficients are worked out for these steels.

Chapter III. recapitulates the former chapters and states shortly the general conclusions arrived at.

VARIOUS INFORMATION.

A list is published of the changes in station of the headquarters and various groups of artillery in France from 1st April, 1914.

The spring washers invented by Mr. J. Reiss for bolts subjected to vibration are described and illustrated.

United States.—Field Artillery v. *Aircraft.*—For several years various special cannon have been experimented with, but now it is considered that the introduction of a special weapon would be a mistake, since it is the field artillery which will most often be confronted with this nature of target. The carriage of this gun—model 1902—will therefore be subjected to further modifications to fit it for use against aircraft.

A.R.R.

REVUE MILITAIRE SUISSE.

November, 1913.

THE COMMUNICATIONS OF THE GRAND ARMY IN 1806–07.

Many of the boldest conceptions of Napoleon were based on a change in his line of communications, which he defined as "an operation of genius" and "the cleverest manœuvre taught by the art of war," owing to the way in which it misled the enemy. The plan evolved by the Emperor in September—October, 1806, is one of the most remarkable examples which exist of the use of lines of communications. Ostensibly, at the commencement of the campaign, a main line of communication was organized, while at the same time several others were prepared. The first was merely a lure to attract into Hesse a portion of the enemy's forces, while Napoleon cut off the Prussians from the Elbe by marching direct from Bamberg on Berlin, based on other lines of communication.

Prior to 1806 the French armies lived on the enemy's country; in 1805 (Austerlitz), when larger numbers of troops were employed, great privations had to be endured. In 1807 Napoleon had at one time to yield to necessity and arrange for convoys and supply depôts, but he refused them the next year in Spain. Still the army, although relieved from daily anxiety in regard to its provisions, had yet to be followed by trains of ammunition, reinforcements of men and *matériel*, couriers, etc. To this end the Emperor, directly his plan of campaign was settled, decided on a line of communication which he also called *route de l'armée*, but on principle he never left behind any line of communication troops. Relative security, he considered, should be maintained by moral persuasion, by the responsibility of the communes, by hostages, and by activity of administration. Only large, well-escorted convoys, despatched at irregular intervals, traversed the route, while sick and wounded were cared for in the conquered territory. At every four to six marches a strong position was selected, and organized for defence

by means of fieldworks. The garrisons were composed of conscripts, horseless cavalry, convalescents, and contingents furnished by allies, commanded by a convalescent or sick general, or other superior officer. Although these places could not withstand a siege, they served to shelter magazines, depôts, wounded, etc., and in them convoys could be reorganized and find provisions, ammunition, workshops, hospitals, etc. Thanks to this system Napoleon could abandon his line of communications to itself for days together.

The campaign selected to illustrate this principle and the change in the line is then related, commencing with the European situation at the beginning of September, 1806. It is illustrated by a map, and the events up to the end of September are traced in this number.—(*To be continued*).

MILITARY AVIATION IN SWITZERLAND.

By Lieut.-Colonel Et-Ed. Borel.—An account of what has been accomplished to date, with remarks on the particular qualities required of both aeroplanes and pilots in a mountainous country. The greatest difficulties encountered are changeable winds, mists, the restricted area of most of the landing places, and troubles of communication. The writer was in charge of the aviation services at the recent manœuvres, and describes the results obtained and makes suggestions for ensuring greater efficiency on future occasions.

THE BATTLE OF CRESSIER.

The imaginary attack of this position is continued, step by step. The reasons given for the dispositions adopted for the various troops are sound and instructive.—(*To be continued*).

A.R.R.

RIVISTA DI ARTIGLIERIA E GENIO.

September, 1913.

AUSTRIA-HUNGARY.

New Dirigibles.—According to the *Aérophile* of the 15th July the war minister of Austria-Hungary has given orders for six dirigibles (Zeppelin), which should be supplied in 1915. These airships are destined for Vienna, Prague, Lenberg, Innsbruck, Budapest, and Sarajevo.

Changes in Military Institutions.—We learn that changes in the Austrian-Hungarian military institutions have taken place in recent years. In fact in 1910 the Military Technical Academy was created for officers destined for the troops of communication; and from the end of the current year provision has been made at the said Academy for all the officers for railways and telegraphs.

The *Revue Militaires des Armées Étrangères* of July states also that admission to the school of pioneer cadets at Hainberg is suspended, and that from the beginning of the year 1913–14 the course for pioneers of the Military Technical Academy may be transferred from Mödling to Hainberg. In consequence of the approaching subdivision of engineer

troops into pioneers and sappers, a special course for sappers will be instituted at the Academy of Mödling. At the commencement of 1916 the officers of pioneers and sappers will all come from the Technical Military Academy. The modern tendency in Austria-Hungary is to constitute for all the arms a homogeneous body of officers coming from the Academy, with a grade of general and technical instruction superior to that of the officers coming from the school of cadets.

Military Commands of Lines.—The *Revue Militaire des Armées Étrangères* of July also states that the number of military commands of lines in Austria-Hungary is increased to 26. The commandants of lines are superior officers, and remain in charge for not less than six years.

They have as collaborator a railway functionary (*Militär-Referent*) who takes the place of the commandant of lines during his absence. The commands of lines are at the following stations :—

1, 2, 3, 4, 5	Vienna.	17	Szombathely.
6	Linz.	18	Miskoloz.
7	Innsbruck.	19	Szegedin.
8	Villach.	20	Debrezen.
9	Trieste.	21	Kolozsvar.
10	Pilsen.	22	Arad.
11	Prague.	23	Agram.
12	Cracovia.	24	Temesvar.
13	Lenberg.	25	Szabadka.
14	Stanislao.	26	Sarajevo.
15, 16	Budapest.		

Belgium.

Organization of the Engineers.—*La France Militaire* of 27th—28th July states that owing to the new organization, the corps of Belgian engineers comprises :—

(*a*). An inspector.

(*b*). Three engineer commands of fortresses (Antwerp, Liege, Namur) on whom depend the engineer commands of sectors of those places.

(*c*). A regiment of four battalions and a depôt. The battalions have each four companies, and of these the first is a field company, and the remaining three are fortress companies. These three companies are assigned to Antwerp.

(*d*). One fortress battalion at Liege, and another at Namur, each with two active and two reserve companies.

(*e*). Five special companies, these are, one telegraphist, one miner and artificer, one railway company, one pontooneers, and one workmen and aerostats.

Mitrailleuses drawn by Dogs.—*La France Militaire* of the 28th August mentions that trials on a large scale are being made in Belgium for drawing mitrailleuses by means of dogs. The arm is carried on a small carriage of 0·80 m. in height, drawn by two dogs. In the event of it not being possible to use dogs, two men can carry it ; one carrying the mitrailleuse, and the other the carriage. In the trials

that were made, four men were able to carry the mitrailleuse over a wall 3 m. in height in 40 seconds. The transport by dogs is regular and rapid, and has the advantage of being less visible at a distance. The authorities reckon upon being able to bring the mitrailleuse by this means up to the line of fire.

GERMANY.

Peace Strength of the German Army.—From the *Internationale Revue über die gesamten Armeen und Flotten* of September we learn that, by the law of 3rd July, the complete strength of the German Army on a peace footing is stated to be between 544,211 and 661,478 men. The number of field and horse batteries remains at 633. The batteries of full strength, in number 255, are composed each of 4 officers, 143 N.C.O.'s and gunners, 75 horses, 6 guns, 6 ammunition wagons, and an observatory car with a pair of horses. The 345 batteries on the reduced scale have each 4 officers, 124 N.C.O.'s and gunners, 75 horses, 6 guns, 6 ammunition wagons, and an observatory car with two horses. The 33 horse batteries have each 4 officers, 137 N.C.O.'s and gunners, 144 horses, 4 guns, 4 ammunition wagons, and 1 observatory car.

Dirigible Destroyed.—It is reported in the *Technique aéoranautique* of 15th August that the German dirigible S.L. 1 (Schütte Lanz) (2) has been destroyed in a violent storm that forced it from its anchorage in the place of arms of Schneidemühl. This airship was of the rigid type, and had a capacity of 19,500 cubic metres, a length of 131 metres, two cars, two motors of 270 h.p., and two steel propellers. Its average velocity was 65 k.m. an hour.

The German aerial fleet met with another serious disaster a short time after; the dirigible L.1 belonging to the marine service was completely destroyed in the first days of September, by falling into the sea, and causing the death of some of the crew. The L.1 of the Zeppelin type had a capacity of 22,000 cubic metres, a length of 160 metres, three motors of 510 h.p., and could attain a velocity of 83 k.m. in the hour.

Bomb Throwing from Aeroplanes.—The *Lega navale* of the 31st August reports that trials were made at Kiel of throwing bombs from a height against the old ship *Bayern* which served as a target. The bombs, of cast iron, were not charged and were thrown from aeroplanes during flight at a minimum height of 500 m. From twelve apparatus, only two bombs struck the target. One struck the stern, the other fell on the forecastle; had they been charged they would only have caused slight damage.

Aeronautical Manœuvres.—According to *La France militaire* of the 26th August, three Zeppelin dirigibles, the dirigible M.4, and fifty aeroplanes will take part in the German manœuvres.

RUSSIA.

In the *Aérophile* of the 15th July, the following notice of military aeronautics in Russia is given :—

Dirigibles.—These airships belong to the types non-rigid and semi-rigid. The more important units are :—*Parseval XVIII.* of 10,000

cubic metres, 85 m. in length, 15·50 m. diameter. It has two motors with six cylinders of a total of 300 h.p. and can attain a velocity of 72 k.m. an hour. *Clement Bayard VII.* of 9,600 cubic metres, 86 m. length, with two motors with four cylinders of 260 h.p. *Griff*, of 9,000 cubic metres, has two motors and a velocity of 65 k.m. an hour. *Albatross* of 9,000 cubic metres. Its two motors give a velocity of 65 to 70 k.m. *Astra XIII.* of 10,000 cubic metres and 77·80 m. of length. Has two motors of 300 h.p. and a velocity of about 60 k.m.

The less important units are:—*Lebedy* (type Lebaudy), semi-rigid, of 3,700 cubic metres and 61 m. length, with two motors each of 70 h.p. *Militaire P.L. VII.* (Parseval), non-rigid, of 6,760 cubic metres, 70 m. length, with two motors of 110 h.p. *Outchebny I. and II.*, non-rigid, of 1,500 and 5,500 cubic metres. *Zodiac VII., VIII. and IX.*, non-rigid, 2,200 cubic metres, length 50 m., with two motors of 110 h.p. *Jastrab*, semi-rigid, 2,800 cubic metres, with two motors of 75 h.p. *Kommissiony* (Clement-Bayard I.), semi-rigid, 3,500 cubic metres, length 56 m., with two motors of 100 h.p., at St. Petersburg. *Forzmann I. and II.*, non-rigid, 800 and 600 cubic metres. *Golub* (*Astra*) of 2,270 cubic metres.

It is now stated that the number of dirigibles fit for service is twelve. Russia possesses an office for military aeronautics.

Aeronautic Parks.—Each fortress has a dirigible. These aeronautic parks are stationed at Brest-Litouski, Berditschew, Kiew, Varsavia, Salutschy, Riga, Libau, Petersberg, Sveaborg, Moscow. Attached to each park there are:—one military squadron, some autocars, and sections of kites and spherical balloons.

Aeroplanes.—The biplane is adopted for service in the forts and the monoplane for field service.

All the fortresses are provided with apparatus, pilots, squadrons of aviators, depôts for combustibles, and automobiles. The field squadrons are placed at the disposition of the troops, and each army corps has two; altogether there are 60 squadrilla each with six monoplanes.

In Russia there are ten military aviation centres with aerodromes at Petersberg, Gatschina, Moscow, Kiew, Charkow, Odessa, Saratow, Riga, Varsavia, Sebastopol. Two other centres are being formed at Omsk and Tachkend. There are aeronautic schools at Petersberg, Wolkova-Pole, Gatschina, Kiew, Chackow, Varsovia, Odessa, Riga, Saratov, Sebastopol, the most important being the last owing to favourable climatic conditions.

Hydroplanes.—There are two principal stations for hydro-aviation, one at Sebastopol, and one being formed at an island near Petersberg.

Pilots.—The Russian Army now has 150 brevetted pilots for aeroplanes, in addition to 190 other pilots from the *Aero-club Imperiale.* There are six sections at Petersberg, Moscow, Riga, Odessa, Saratow and Charkoff, each of which place has a school.

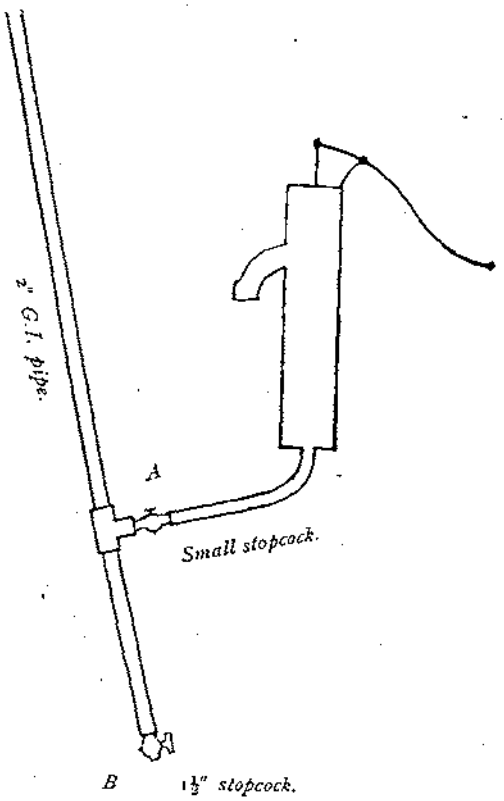
E. T. THACKERAY.

CORRESPONDENCE.

THE SIPHON AS AN AID TO WATER SUPPLY.

DEAR SIR,

With reference to the article on Siphons at Sierra Leone by Capt. Mahon in last month's issue, I find *Plate* I and its instructions a little difficult to follow owing to two of the 2-in. stopcocks having the same number (viz. No. 2).



INSTRUCTIONS.

Open A, close B, and pump.
When pump delivers close A, open B.

I wished recently to siphon out a 6,000-gallon tank, using 120 ft. of ¾-in. garden hose and a small tripod barrel pump. I found the end of

the hose, which was slightly tapered, just fitted into the suction hose of the pump. I daubed the joint with clay, and pumped; as soon as the pump began to deliver I broke the clay joint, and the siphon ran for many hours before it stopped, when a short turn at the pump started it again.

I wonder whether a slight modification of this would not have worked through 530 ft. at Sierra Leone. It seems to me that a pump near the junction with 4-in. main, arranged as in sketch, should suffice, but perhaps an ordinary pump would not work through such a length of 2-in. pipe. If it did there would be a saving of several 2-in. stop-cocks.

H.K.

13th January, 1914.

The Editor, *R.E. Journal.*

RECENT PUBLICATIONS OF MILITARY INTEREST.

REVIEW OF BOOKS.

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BIOGRAPHY AND HISTORY.

NAPOLEON IN THE FIELD. (Napoléon en Campagne). By Colonel Vachée. 215 pp., with 3 maps to illustrate the Jena Campaign. 8vo. Paris, 1913. Berger Levrault.

This is a very interesting book and well worth reading. The object of the author is to present Napoleon to the reader "living, thinking and acting at his Headquarters, with his passions and his habits, his voice and his physiognomy, just as he might appear to a staff officer who has just taken part in a campaign under the Emperor's orders." And most readers of this book will agree that the author's object has been successfully attained.

Chapter I. deals with Napoleon's methods of considering and deciding on his plan of action, and the author quotes numerous authorities to show that in making his plans the Emperor consulted no one, and that every order which emanated from Imperial Headquarters was dictated verbatim by Napoleon himself. Officers of his Staff expressed astonishment at the rapidity with which Napoleon dictated his orders and answered all questions put to him regarding them. To these Napoleon replied: "If I appear always ready to answer any question, it is because, before undertaking any enterprise, I have long pondered over it and have foreseen what may happen. It is not a flash of genius which tells me suddenly what to do or say when something unexpected by others happens; it is by dint of deep thought that I have been able to anticipate the apparently unexpected." Colonel Vachée remarks that this habit of constantly looking ahead and working out his plans a long time in advance was one of the principal causes of Napoleon's astonishing successes. Another very valuable asset possessed by Napoleon was that he could work just as easily by night as by day. "This extraordinary man was so constituted that he could sleep for an hour, wake up and dictate an order, go to sleep again and be roused at intervals during the night, without his health suffering in any way. He only required six hours' sleep in twenty-four and it made no difference to him whether he had these six hours straight on end or at intervals." On the eve of a battle Napoleon made a practice of spending the night in thinking over his plans. He usually lay down after dinner about 8 p.m., but got up as soon as the reconnaissance reports came in, usually about midnight. On a large table in the middle of the room surrounded by 20 or 30 candles, was spread a map of the theatre of war, on which was shown, by means of pins with differently coloured tops, the positions of his own troops and those of the enemy as far as known. Walking round the table with a pair of dividers in his hand, the Emperor decided on his plan of action and afterwards dictated his orders, which were carried out by the troops in the early hours of the day.

The author points out the advantages of this system of night work, but he rightly remarks that it involves a great strain and cannot be carried on indefinitely, and in this connection quotes Napoleon himself as saying in 1805: "I shall be fit to wage war for another six years, after which I must stop."

As Napoleon anticipated, after 1809 his powers began to decline, his ideas began to lack clearness and precision, his character appeared to lose some of its firmness and his marshals remarked that he began to think more of his personal comfort than heretofore.

In Chapter II. it is pointed out that as soon as Napoleon had decided on his plan he at once dictated the orders for giving effect to this plan. He moreover insisted on his marshals adopting similar methods when they received orders from him. Several samples are quoted of marshals being reprimanded for dilatoriness in issuing orders. For instance, on November 26th, 1814, Napoleon writes to Augereau: "My cousin, what! Six hours after receiving the first troops from Spain you had not started. . . . . If you are still the Augereau of Castiglione retain your command, but if your sixty years are weighing heavily on you, hand over to the next senior officer." Commenting on Napoleon's practice of dictating all his orders without consulting his Staff the author says that it resulted in a great saving of time, but he admits that "this method of command should not be taken as a model."

Chapter III. is a particularly interesting one and describes the opening phases of the Jena Campaign, with a detailed account of what passed at Napoleon's Headquarters during the historic night, October 11th—12th, 1806, when the plans were made and orders issued which led to the victories of Jena and Auerstadt. An examination of the orders issued to the various French marshals shows that each was merely told where his corps was to march to, and the position of the rest of the Army, whilst, in the case of the corps in the front line, instructions were added as to obtaining news of the enemy. Not a word was said as to information about the enemy, what the general plan of the Emperor was or what part each corps was to play in it; nor was any mention made as to the zones of march assigned to each corps. No attempt was in fact made to issue a combined order as laid down in our *Field Service Regulations*. The absence of such orders led to great inconvenience and nearly to disaster.

Chapter IV. contains an entertaining account of the *personnel* of the Imperial Headquarters, which consisted of two entirely distinct parts—namely, the Emperor's Military Household and the Staff. The Military Household consisted of Napoleon's immediate entourage, which, we are told, numbered on December 21st, 1806, some 800 persons. The three prominent personages in the household were Berthier, Chief of the Staff, Duroc, the Grand Marshal, and Caulaincourt, the Grand Equerry. The author describes in detail the personal characteristics and duties of these superior officials as well as those of lesser lights such as Bourrienne, Meneval, Fain and Bacler d'Albe. The description of Berthier is hardly flattering. He is said to have been "small, fat, always laughing, very busy in love with Madame Visconti," and again he was "badly built, with a head too large for his body, naturally ugly hands, which were made to look even more repulsive owing to his habit of continually biting his nails till his fingers bled." Colonel Vachée gives also a vivid description of life at Imperial Headquarters, where "the atmosphere was very agitated and everyone remained constantly on the *qui vive*." Often when his hard-worked Staff had lain down for an hour's badly-needed sleep the Emperor would say, "Wake up everybody and order the horses." We are told that Napoleon liked this system because it kept everyone "up to the mark."

When the enemy was at a distance Napoleon always drove in a carriage, but when fighting was imminent he invariably rode, until the year 1809, after which he began to put on flesh and rode less, until finally in 1812 he rarely quitted his carriage. When on horseback he was followed at a short distance by Berthier and the Grand Equerry, the latter carrying a map of the country "attached to a button of his coat." Close behind these two came a page carrying a telescope and further behind again numerous orderly officers, aides-de-camp and the Emperor's personal escort. Apart from Napoleon's Military Household, the remainder of the Imperial Headquarters

consisted, as mentioned above, of the Staff. The latter were practically Berthie staff, and had comparatively little to do with Napoleon. They formed, in fact, one of Napoleon's secretaries once said, "a world apart." Berthier, who end voured in every way possible to imitate his master, divided his staff in very much t same way as Napoleon did, having a small "cabinet" of specially trusted officers as distinct from the remainder of the staff. Colonel Vachée details the duties of the various branches of Berthier's staff at some length, and compares the *rôle* of the latter with that of the German Staff in 1870. The scope of the French Staff in Napoleon's day was so restricted that it really was not a staff at all according to the modern acceptance of the term. As the author remarks, "it is certain that the Staff was a weak point in the armies of the First Empire, and that the want of a proper Staff contributed to the disasters of Napoleon's later campaigns."

A whole chapter is devoted to showing how Napoleon, having given his orders, took steps to see them carried out. In many instances he personally supervised the execution of his orders, and when this was impossible he sent staff officers out to report whether commanders were carrying out their instructions.

Chapters VII. and VIII. describe Napoleon's methods of dealing with his officers and with the rank and file of his armies, and also the means he employed in order to attach them to himself. We are told: "Napoleon considered that there were only two levers which made any impression on men, namely, fear and self-interest. His great general principle, which he applied in small things as well as great, was that no one could be keen unless he was uneasy in his mind. He therefore never gave anyone his entire confidence, he did his best to incite rivalries and he kept everyone constantly on the *qui vive*."

His two "levers" (fear or self-interest) he applied in accordance with the character of the person with whom he was dealing. In some cases he considered that most effect would be produced by a theatrical outburst of anger, and in others he bestowed money and titles with a lavish hand. Colonel Vachée insists that Napoleon's great aim was to attach his Army to himself personally, and that he placed his own interests before those of France. In corroboration of this he quotes the following passage written by Napoleon to Joseph:—"Don't forget that your first duty is towards me, your second towards France, and your third towards Spain." Again in 1815 after his abdication, he is reported to have said of Davout: "I thought Davout loved me, but he only loved France."

Chapters IX. and X. are particularly well worth reading. In them the movements of Napoleon during the 48 hours preceding the Battle of Jena, as well as during the battle itself, are followed in detail; the information received by Napoleon at various times before and during the battle is placed before the reader, and also the action taken by the Emperor on receipt of the different items of news.

The author then criticizes Napoleon's conduct of the battle in view of the tactical principles laid down by Napoleon himself, and he devotes some pages to considering whether Napoleon was right in placing himself where he did during the Battle of Jena. The conclusion he arrives at is one in which most people will agree, namely, that Napoleon's position on the Dornberg was too near the fighting line, and that owing to his being there he became absorbed in the operations which were taking place in his immediate vicinity between the Landgrafenberg and the Capellendorf, and consequently somewhat lost control of the battle as a whole.

The book concludes with an interesting comparison of Napoleon's method of commanding in the field and that adopted by the Headquarters of the German armies in 1870. The proceedings of Napoleon at Auma on the night of October 11th—12th, 1806, are contrasted with those of the German Headquarters on the night of August 6th—7th, 1870. The point on which the author lays particular stress is that Napoleon on receipt of important information consulted no one before issuing his orders, and consequently a great deal of precious time was saved; whereas with the Germans in similar circumstances five or six people had to be roused and consulted before the necessary orders could be drafted. Colonel Vachée expresses preference for the Napoleonic system of command, but seems rather to lose sight of the fact that such a system requires a Napoleon to carry it out.

THE WAR OF 1870-71. THE 1ST ARMY OF THE LOIRE. VOL. I. TOURY-EPERNON. (La Guerre de 1870-71. La 1ère Armée de la Loire I. Toury-Epernon). 282 pp., and documents annexed, 238 pp., with 18 maps. 8vo. Paris, 1913. Librarie Chapelot. 11s. 3d.

This volume is produced by the Historical Section of the French General Staff, and its accuracy may therefore be considered unimpeachable. It is obvious from the great number of documents (both French and German) referred to, and in many cases reproduced verbatim, that no pains have been spared to obtain a true and impartial story of this period of the Franco-German War.

The reader will, however, be considerably disappointed to find that this volume is, to a great extent, simply a narrative of events and that it is almost devoid of comments. Practically the only thing in the nature of comment appears on pp. 94, 146 and 162—168, where it is pointed out that the want of success attending the operations of the newly-formed XVth Army Corps was to some extent due to the absence of any unity of control over the operations carried on in the neighbourhood of Orleans during the latter part of September, 1870.

The volume is divided into six chapters of narrative and six chapters of appendices. In the latter many of the documents forming the basis of the narrative of operations are quoted at length.

Chapter I. describes the origin of the Army of the Loire, and the manner in which the various units forming the XVth Army Corps were raised. Chapter II. gives the situation of the German forces in the south of Paris on September 20th, 1870. The movements of General Reyau's cavalry from September 13th and the position of the French forces on the Loire on September 20th are described in Chapter III., whilst a detailed account of the operations round Orleans from September 21st to October 1st will be found in Chapter IV. The following chapter is devoted to the story of the fighting which took place round Orleans between October 2nd and 5th, and includes an account of the engagement of Toury, whilst the final chapter deals at length with the doings of the 2nd, 5th and 6th Prussian Cavalry Divisions from September 21st to October 5th, 1870.

THE JAPANESE IN MANCHURIA. (Les Japonais en Mandchourie). Second Part (The March to Battle) and Third Part (The Battle). By Colonel Cordonnier, French Army. 332 pp., 10 maps, 1 sketch bound in text. 8vo. Paris, 1913. H. Charles-Lavauzelle. 5s.

The First Part of this account (translated into English) was reviewed on p. 596 of *The Army Review* for October, 1912. The book is acknowledged to rank amongst the best contributions to the literature of the war, and merits therefore a full review.

The present volume embraces the Second and Third (last) Parts. The Second Part is headed "The March to Battle." Its first chapter deals with the situation of the IInd Japanese Army and of Stakelberg's Corps on the morrow of Wa-fang-kou. Taking as his text the uncertainty regarding each other's dispositions which prevailed amongst both these forces, the author deals with the futility of historical criticisms by military writers who place themselves "astride of the two camps." For fruitful study we must shut out from our minds, says he, what we know of one side. He instances some judgments passed on former commanders to illustrate his point. In connection with the same situation (Oku's and Stakelberg's) he shows the important *rôle* which cavalry may be called upon to play in modern war.

The second chapter, dealing with communications, contrasts Napoleonic conditions in this respect with existing ones. The Emperor employed no line-of-communication troops properly so called. Reinforcements and invalids passing to and fro in rear had to guard the occasional large convoys. Living on the country was the rule. Reliance was placed largely on penalizing inhabitants for attacks on convoys. To-day communication between front and rear must be safe at all times. The author

gives figures to show the dominating importance of ammunition supply upon operations. Communication difficulties rather than excessive prudence were responsible for the extreme slowness of the Japanese, whose Ist Army moved from the Yalu to Tawan at an average daily rate of 1,600 yards. Each army, like a ring on a curtain pole, can slip along its line but move only very little from side to side. "It will be thus until mechanical traction frees armies momentarily from the imperious necessity of touch with the railway. On that day . . . communications will lose some of their fragility."

Following on a detailed enumeration of the opposing forces the author (pp. 48, 49) dwells emphatically upon the necessity of controlling "employment" in combatant units. According to the Russian General Martynov (quoted by him), one Russian infantry regiment (four battalions) had 1,800 employed men to 2,600 in the fighting line.

The final chapter of the first half of the Second Part headed "Accept or refuse battle?" analyzes the situation on the eve of Liao-Yang, and the action of the Russian Commander-in-Chief.

The second portion of Part II.: "Liao-yang, the fighting during the approach (to that battlefield)," begins with a consideration of strategic envelopment. With armies of the size seen in 1870 and 1904, says the author, this envelopment must be prepared long beforehand. To study this question consult the writings (conceptions) of great commanders rather than events where "the action of obstinate and often incapable subordinates has at times been felt." Again: "The Power which disposes of the largest forces will take up the space necessary for their deployment *wherever this space is to be found and can easily be occupied, either in its own territory or in that of a neutral too indifferently armed to ensure respect for his neutrality.*" (Italics are the author's).

Next follows a chapter on the strategy of interior lines with reference to the situation of the contending armies before Liao-yang. It is abundantly illustrated by historical examples, especially from the Rivoli Campaign. The author then discusses the approach of the Japanese armies on Liao-yang: "To remain out of range, each facing his objective, and then to fall upon the enemy all together—such is the theory of movements leading to envelopment." Commendation is lavished on Kuroki's bold tactics on August 25th and following days in engaging on a broad front and with practically no reserves the Russian Eastern Detachment; and his subordinate, the commander of the Guard Division, is similarly praised for his action against the IIIrd Siberian Corps.

On p. 114, after referring to a panic which broke out on August 26th in a Russian battery on the left of the force opposing Kuroki, the author says: "With artillery, panics begin amongst the wagons . . . panic is the most contagious of an army's maladies . . . a firm hand is required to preserve order amongst this mass (of vehicles and teams); now everyone capable of commanding is in the firing line . . . no highly-qualified commanders exist amongst the bunches of wagons." Reading this we may congratulate ourselves on having an officer detailed to the wagon line.

Commenting on the same fighting the author describes the interruption of telephonic communication between the general officer commanding the Xth Russian Army Corps and his subordinates, and draws the conclusion that undue reliance must not be placed upon mechanical means: "In war the true communication is a tactical idea well expressed to well-trained troops." He cites the success of the 46th Japanese Regiment on Kuroki's right on August 26th as an instance of the far-reaching effects which the fight of a small fraction of an army may bring about. In this case it contributed to the retreat of the whole Russian Eastern Detachment behind the Tan-ho.

In Part III. the author first portrays the Japanese situation as follows:—The junction of the armies, the strategic enveloping manœuvre, is effected; but great uncertainty exists as to the enemy. He quotes rather equivocal orders given by Napoleon—when in a similar state of uncertainty—to Soult on November 10th, 1808, to illustrate difficulties of command. Napoleon's object always was, says the

author, to produce *la bataille à fronts renversés* (each belligerent facing his base). Thus alone can decisive results be attained. In Europe it may again become practicable to fight in this posture if the commander of an army has the audacity required. This audacity depends on knowledge of the adversary's fighting value. Napoleon knew this value through constant fighting. To-day it is unfathomable—after a long peace. Early engagements of a war will, however, reveal it. Hence their comparative importance.

Succeeding chapters discuss the Japanese orders for the battle and the linear nature of their attack. The author approves of the tactical dispositions made under the circumstances existing. For an army corps and lesser forces, says he, reserves are essential; but their value decreases proportionately to the increasing size of units larger than the army corps. Time and space limitations will generally result in army reserves being unemployed. Instead, says he, vary the density of front of the several attacking bodies according to the tasks allotted to each. Dealing with the defensive he criticizes Kuropatkin's "intention" paragraph, and his massed army reserves (two and a-half army corps) which should have been more elastically disposed (*articulé*). The inaction of Mishchenko's cavalry comes in for severe censure, "Cossacks are mediocre cavalry soldiers; their mounts are paltry little animals; their military training is practically *nil*." Yet, continues the author, since this war a *néfaste* taste for dismounted action has sprung up. He reproaches the German cavalry especially with having lost the "go" imparted by Ziethen and Seydlitz, and with preferring the rifle to the lance.

Commenting on the paragraph of orders directing each army corps to send two officers to Kuropatkin's Headquarters, he expresses disapproval of the *officiers de liaison* system as practised in France also. "These officers," says he, "bring with them the mentality from below." "*Il faut donc fortement constituer les quartiers généraux, et habituer chacun à se suffire avec les résources qui lui sont attribuées.*" On the other hand he commends the Russian practice of inserting in orders names of officers to succeed the Commander-in-Chief if the latter becomes a casualty. "We French, who have reason to remember what happened at Sedan after MacMahon was wounded," says he, "should never omit this precaution."

A series of chapters headed "The Battle. Combats within the Battle," opens with an interesting study of the size of strategic units. The author comments on the interchangeability of Japanese divisions, each being homogeneous and one-thirteenth of the whole Army. Moltke's army corps corresponded to both these conditions. Napoleon I. formed army corps when a division no longer totalled one-twentieth of the army of which it formed part. Accordingly, says the author, the great military powers of to-day require permanent units of 100,000.

The chapter entitled "*Manœuvrer l'ennemi par le combat*" contains an interesting study of advanced posts, and co-operation between infantry and artillery, as illustrated by the action of Lieut.-Colonel Pokotilo's 3rd Battery of the 6th East Siberian Rifle Division in order to extricate the IIIrd—23rd East Siberian Rifle Regiment. He considers that on the night of August 30th—31st the Russians should have moved a complete army corps (the IVth) on Uluntai to roll up the Japanese left, but adds that such a difficult movement could only be carried out by troops well trained during peace time in movements by night.

The fighting along the front of the Japanese IInd Army on August 30th and 31st supplies him with many examples of illustrating the employment of artillery. He emphasizes the oft-repeated view that the worse the infantry the greater need for guns. He considers that the Japanese artillery did not give its infantry as much support as it might have. He is a firm believer in the necessity of artillery following up an infantry advance. What, he asks, does the infantry soldier understand of the disadvantages of interrupting fire and ranging afresh? He is a "big child" on such occasions. If the artillery remain behind he thinks they are afraid. The author has high praise for both infantries, and thinks especial credit is due to the Russian, weighed down in *moral* by previous defeats. He infers a doubt as to whether western European countries will produce foot-soldiers of equal merit to either. Which will be better, he goes on to say, French or German? All depends upon

infantry. Hesitation caused by doubts as to relative values of this arm is, he adds, the surest guarantee of peace.

The earlier of a series of chapters entitled "*La décision dans la bataille*" is devoted to a eulogy of Kuroki's bold tactics in crossing the Tai-tzu-ho; and to criticisms on the Russian higher leading which ordered a general retreat on the strength of premature and inaccurate cavalry reports as to a Japanese crossing in force over the river.

Then follows perhaps the most remarkable chapter of the book. Under the title "The division of labour," the author considers the *rôle* of all from the chief, whose importance declines from the moment battle is joined, to the private who reigns supreme at the end, and becomes the arbiter of the country's destinies. "The colonel and other officers will one by one be absorbed into the fighting line; . . . no longer commanders, but splendid soldiers to whom fear is unknown. In order to triumph it will only remain (for the officer) to let him (the private) act, or better still to make himself into a private too." How does this compare with the homilies read to British officers in South Africa, who were upbraided for exposing themselves inasmuch as they were too "valuable."

Colonel Cordonnier concludes his masterly study by a *précis* of later events in the war, and a comparison between the Manchurian Campaign and that of 1812 in Russia, in which one army likewise retired continuously before the other. In his final reflections he connects policy, peace preparations, strategy and tactics; and shows how insufficiency of efforts at peace preparation increases proportionately the efforts required during the actual struggle, and *vice versâ*.

The author's vivid style and imposing knowledge of military history combine to render his book a most valuable treatise not only on this particular campaign but on war generally.

There are some obvious misprints:—On page 166, I (d), "XVIII." should read "XVII." Page 250, sixth paragraph, first line, "IVth" should read "Xth" (Corps). In the penultimate line of the penultimate paragraph of p. 280 "IIIrd" should read "IVth" (Army).

MY COMMAND IN THE BALKAN WAR, 1912. (Meine Führung im Balkankriege, 1912). By Mahmud Mukhtar Pasha, commanding the Eastern Army. 190 pp,. with 1 photo and 7 maps. 8vo. Berlin, 1913. Mittler. 4s.

This very interesting book affords a detailed and vivid picture of the operations in Thrace from the outbreak of the war to the Chatalja *impasse*. Included in the text is an extensive series of operation orders, messages, and reports, which show that the Turkish leaders were at any rate inspired by the will to assume the offensive, if they lacked the qualities necessary to carry it out.

Mahmud Mukhtar records in detail the terrible deficiencies in organization and training to which he ascribes the collapse of the Turkish Army. Among other things it appears that the only information which the Turks obtained about the Bulgarian movements was derived from the Austrian newspapers.

As Mahmud Mukhtar admits, the Turkish Army was beaten before ever the Bulgarians attacked.

STRATEGY, TACTICS AND TRAINING.

NOTES ON FORTRESS WARFARE. (Quelques Idées sur la Guerre de Place). By Colonel Rouquerol. 56 pp. 8vo. Paris, 1912. Chapelot. 10d.

The well-known artillery officer, Colonel Rouquerol, has written a small pamphlet on fortress warfare, which is worthy of perusal if only for its lucidity of expression and close reasoning. In a short preface, the author shows that the introduction of explosive shells cannot, as some people have suggested, make fortifications useless. The fundamental principles of fortress warfare remain the same, but modern arma-

ments have rendered anything except permanent fortifications of little use. It is wrong to suppose that field works hastily constructed on the outbreak of war can resist the large calibre howitzers, etc., which modern armies carry in their siege trains. Only permanent works of concrete and steel will avail, and they must be carefully planned and constructed in times of peace. Fortresses of obsolete types should not be defended, for they cannot resist more than twenty-four hours against heavy artillery.

On the other hand, fortresses constructed according to modern ideas will be of the greatest use and will resist for a considerable period. A modern fortress must consist of a line of forts; a line of batteries, which must either be concealed or be made of armour; a secondary line of forts; and, finally, the walls of the town, which, in the author's opinion, still serve a useful purpose. The garrison of such a fortress will, in European warfare, be composed of second line troops, and a small reserve must be kept in hand for the purpose of counter-strokes. There is a short chapter on dirigibles and aeroplanes, which, according to the author, cannot help the artillery but may be of great use in discovering the position of reserves, etc.

THE BRITISH ARMY EXERCISE OF 1913. (Les Grandes Manœuvres Anglaises en 1913). By R. de Thomasson. 33 pp. 8vo. Paris, 1913. Berger-Levrault. 7½d.

M. de Thomasson, who is military correspondent of the *Journal des Débats*, has published in book form his articles in that paper on the recent Army Exercise. His opinion of our Army is, on the whole, most flattering, although he is candid enough to point out some faults and to show where reform is necessary.

In his first chapter he describes for his French readers how the manœuvres of 1912 and 1913 were the final achievement and result of the steady progress made by the British Army since the Transvaal War, and he ventures to hope that the interest aroused by them will lead public opinion to agree to the same military system which all the other Great Powers have had to adopt. He then proceeds to mention the special difficulties with which the military authorities have to contend in arranging manœuvres, and gives a very brief account of the working of the Military Manœuvres Act. This chapter is concluded by a general sketch of our organization (the introduction of the double company system is praised), the programme of the Army Exercise, and the order of battle, in connection with which attention is directed to the high standard reached by our Signal Companies.

Chapter II. opens with the general idea of the Exercise, and describes the marches of the two Brown armies on September 22nd and 23rd. M. de Thomasson, while praising the march discipline of the troops, makes two criticisms: first, that in one of the armies the main body closed up on the advance guard and seemed to be marching without proper precautions, and secondly, that baggage wagons, etc., were placed in between the two divisions. The skill of the cavalry in dismounted action is alluded to, and warm praise is given to the infantry for its thorough training in the principles of the attack. But the general conduct of the fight by the divisional commanders is blamed, mainly because they are apt to rely on a stereotyped distribution, viz., two brigades in first line and one in reserve, and because they invariably divide their artillery among the infantry brigades. M. de Thomasson also makes a remark which is perhaps worthy of consideration. He is inclined to believe that our divisional commanders do not altogether avoid the fault—which he admits is very prevalent in other armies—of "manœuvring too much" and of preferring a complicated flank attack to the simple frontal one. As regards the battle of September 25th, the premature attack of one division and the failure of the enveloping attack are mentioned.

Chapter III. has a most eulogistic description of the British officer, who, it is said, has no superior in Europe. But it must be made clear that the author is referring to the Regular Army, and he concludes this section of the chapter by directing our attention to the necessity of improving the training of the Special Reserve and Territorial officer. One of the points which seem to have struck M. de Thomasson

is the comradeship existing between officers of different rank. He then passes to the private soldier and describes his uniform and equipment. In his opinion the training of the Army is very thorough—except as regards practice in billeting and the question of food. It is interesting to note that the introduction of cooking wagons is thoroughly disapproved of, on the ground that they burden the columns and will prove useless in war.

The question of the supply of horses is next dealt with, and the artillery teams come in for special praise, although, at the same time, the disadvantages of our field guns are mentioned. The chapter ends with a brief description of our present supply system, which is considered as somewhat "fragile" and capable of improvement by making the supply section of the train carry two days' supplies. The author states that one of the weak points of the British Army is the number of transport wagons required for baggage and supplies, which is, according to him, an old failing. In his final chapter M. de Thomasson discusses the military problem with which Great Britain is confronted. He starts by showing how the Regular Army, the Special Reserve and the Territorial Force are below strength and how various are the remedies proposed for the evil. He does not think that Lord Roberts' agitation has been advantageous, since it has failed to convert public opinion to the idea of universal service while it has discouraged the Territorials and may prevent the prompt despatch of the Expeditionary Force. On the whole he prefers the solution offered by the Duke of Bedford, provided that the authorities guarantee the soldier civil employment on leaving the Army. The idea of Germany attempting, on the outbreak of a great war, to invade this country is scouted, but he also inveighs against those writers who seem to think that the Navy is sufficient for England.

The book can be recommended, for it is not only interesting but useful to read what a competent foreign observer has to say about our Army.