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THE ROYAL ENGINEERS JOURNAL.

Vol. XVIII. No. 4. OCTOBER, 1913.

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Elementary Notes on

Wireless Telegraphy.

PAMPHLET.

31 PAGES. **33 ILLUSTRATIONS.**

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Notes for Officers Proceeding to India.

By Major A. T. MOORE, R.E., 1904.

REVISED

By Major E. C. OGILVIE, R.E., 1912.

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At a short distance from the position selected for the attack, the troops should be closed up and all should extend themselves on the ground. The commanders of the columns and of the groups should creep forward to obtain the position which is considered favourable for explaining the fire action.

The disposition of the troops and the alignment of the trenches is immediately marked out with strips of white linen or with chalk, then the several commanders having left at the post certain indications, return to their troops and bring them to the position. On their arrival the construction of the trenches is at once commenced. While the attacking infantry proceeds to occupy these first posts, the artillery takes up new positions.

The difference between the ideas of the Germans and the Japanese arises in the organization of the attacking infantry, in the strength of the detachments for the occupation of the positions, and in the nature of the fieldworks. In the German regulations it is laid down that the attacking infantry should strive to push forward close enough to the defenders in such a manner that the position selected for opening fire can at the same time be considered as assaulting positions. The Japanese, with their war experience, do not consider such a rapid advance possible. Their regulations state that it is not possible to approach to a position fortified with fieldworks in any other manner than by constructing a series of successive positions of attack. And in their military literature the idea is expressed that *the assailants should accustom themselves to consider their fieldworks as a shield that they carry in front of them, and that in the operations around fortified positions they should not by the use of the spade allow the offensive spirit to be in any way lowered.*

E. T. THACKERAY.

regulations prescribe that the defence should be reinforced with only one line in the most efficacious manner and with every means at its disposal; but in some circumstances a tendency is shown to fortify two successive lines and to construct works in other positions. The idea of long continuous lines of defence is stated to have been completely abandoned, and only the constitution of centres of resistance is admitted.

The instruction in field fortification gives rules for the construction of redoubts for battalions and of trenches for companies, and attributes great importance to the reciprocal flanking of the works. The Japanese field artillery also makes greater use than that of the Germans of concealed and semi-concealed positions, and advocates the construction of deep retrenchments, concealed from the enemy's view, so as to avoid the raising of dust. The profiles used for the trenches, covered defences, and trenches of communication, are of various forms not fixed upon beforehand and depending upon the nature of the soil and the time at disposal. Great importance is also given to the construction of defences with sandbags, or bags filled with earth in cases where the ground is not suited for excavations. In the scarps of the trenches there are numerous ramps to facilitate passages for the counter-attack. The mitrailleuses have also the duty of providing for the flanking defence, and are generally installed in the extreme salients of the lines of fire. Near to these, searchlights are placed in such a manner as to light up, during the night, the objects to be fired upon.

In the Japanese instruction great importance is given to the location and construction of obstacles; the experience of the war shows that the most efficacious obstacle is iron wire netting of a width of about 10 m. placed from 20 to 30 m. in front of the lines of fire. Across the wire netting narrow zigzag passages are left for the patrols which can be closed against the enemy in time of need by means of *chevaux de frise*. Land torpedoes are placed both in front and behind the barbed wire network.

In addition to the requirements of ordinary tactics the Japanese instructions also provide for hygienic conditions. The drainage of water from the trenches is thoroughly attended to; in the interior of the entrenchments the ground is covered with straw, and during the coldest season coal and wood fires are lighted. The latrines are kept with the greatest cleanness.

The Japanese regulations prescribe that the fortification works should be constructed simultaneously along all the lines of defence, and that they should be carried on with vigour and without interruption. The pioneers are employed on special works, such as the construction of covered trenches, obstacles, etc. The rules for the conduct of the attack of a fortified position are treated with the greatest care. The reconnaissances should be made with numerous patrols of officers of infantry and pioneers; they should be made for the most part at night. The infantry patrols should specially reconnoitre the ground for the attack, and those of the pioneers the adversary's positions. For the protection of the exploring patrols, the infantry should advance either in close or open order according to the nature of the ground, in complete silence, and guided by signals from white flags or concealed lanterns.

THE AIRMAN: EXPERIENCES WHILE OBTAINING A BREVET IN FRANCE.

By CAPT. C. MELLOR, R.E.—(John Lane. Price 3s. 6d. net).

CAPT. MELLOR is to be congratulated upon his interesting little book *The Airman*, which gives his experiences while obtaining a brevet in France. Not only will it prove most useful to anybody who wishes to qualify for an aviation certificate, but it is also most interesting to the general reader.

In successive chapters Capt. Mellor gives his reasons for deciding on learning in France, and the advantages or disadvantages of the various schools. He then describes the course of instruction, the tests to be passed and the difficulties to be overcome. In his chapter on "Subsequent Practice" he gives a most interesting description of how he learnt "on his own" the *vol plané*, which would seem to show how well he had mastered the difficulties of flying, even though he had only 7 hours and 2 minutes "actual flying time" before he secured his certificate.

NOTICE OF MAGAZINE.

RIVISTA DI ARTIGLIERIA E GENIO.

May, 1913.

JAPANESE IDEAS ON COMBATS AROUND ENTRENCHED POSITIONS.

Each year, during the great manœuvres in Japan, special exercises are practised for the benefit of the pioneers, in which two or three battalions of these troops take part together with detachments of the other arms. From these they generally proceed to the attack and defence of an entrenched position. The Inspector-General of Instruction, and the Inspector of Pioneers assist at these exercises, and at their termination communicate their observations to the several territorial commands of the army, by whom they are brought to the knowledge of the troops. The exercises take place generally in the months of February, March and April, and are frequently practised on cold and rainy nights which are favourable for such manœuvres, and which accustom the troops to fatigue and hardships similar to those of war.

The recruits—who in Japan are enrolled on the 1st December—do not take part in these exercises. The mixed detachments which participate are formed of two or three battalions of infantry, one or two squadrons, two or three batteries, and two companies of pioneers; the various services are also represented, as the Japanese always maintain that whatever may take place in war should have been previously learnt and practised in peace times.

The general principles of the attack and defence of an entrenched position are identical both in the German and Japanese regulations, but in their application there are certain differences. The Japanese

REVIEWS.

BUILDING SUPERVISION.

By GEORGE W. GREY.—(E. & F. N. Spon, Ltd., 57, Haymarket, W. 2s. 6d. net).

THIS book is written chiefly for the benefit of a Civil Clerk of Works, to assist him in his dealings with not too scrupulous contractors. It may therefore be of some use to a Military Foreman of Works, though much in it is of a very elementary nature. The chapters on cement and concrete are clear and up to date.

C.R.S.

MOLESWORTH'S POCKET BOOK OF ENGINEERING FORMULÆ. (27th Edition).

(E. & F. N. Spon, Ltd., 57, Haymarket, W. 5s. net).

THE "Jubilee" edition of *Molesworth* contains all the data which have made previous editions indispensable to engineers of every branch, together with sixty pages of new matter. The additions include sections on factory chimneys and aeronautics, and a considerable increase in the Electrical Supplement. The size of the book is not noticeably increased, and it will continue to be one of the books every Sapper officer will take with him on service.

C.R.S.

PORTLAND CEMENT: ITS MANUFACTURE, TESTING AND USE.

By D. B. BUTLER.—(3rd Edition. 1913. E. & F. N. Spon, Ltd., London. 16s. net).

THE new edition of this standard work contains details of the modern manufacture of Portland cement in all parts of England. Full descriptions are given of the modern "Semi-wet" method of mixing of the raw materials, and of the modern standard method of calcining the mixture in rotary kilns. The section on testing contains a description of the various tests required by the latest British Standard Specification, together with several alternative tests in some cases preferred by the author. In an Appendix are given in full the British, German, French and American Standard Specifications; and the whole forms a very valuable book of reference.

C.R.S.

The funeral took place with military honours in Richmond Cemetery on Monday, 28th July, and quite remarkable crowds gathered in the streets to show their respect for a brave and distinguished soldier who had fought nobly and well for the British nation. The gun-carriage left Heron Court at 3 p.m. The band of the Royal Military School of Music led the procession to the music of the Dead March in "Saul." The gun-carriage was drawn by a team from the 19th Hussars. Seven mourning coaches followed and then four open carriages full of beautiful wreaths and crosses.

Soldiers from the Royal Engineers bore the coffin into the Richmond Parish Church where it was met by the Vicar of Richmond and five other of the clergy including the veteran missionary Dr. Marks who spent many years in Burma, the country the deceased general won for the British Crown. There was a large congregation in the Church, including many of his intimate friends. After the service in the Parish Church the procession moved slowly to Richmond Cemetery and all the way passed through lines of people. On the way to the cemetery the music of Chopin's funeral march added solemnity to the scene. A large crowd had gathered near the grave. The Committal rites were read by the Vicar, and then from six silvery-toned bugles the soldier's last farewell "The Last Post" rang out. This was the most pathetic moment of all, as the pure clear tones of this requiem floated out across the quiet hillside cemetery, and when the last mournful note died away, there was that stillness which only comes to a crowd in moments of emotion.

HENRY M. VIBART,
Colonel, R.E. (retd.).

Bath, but this was 16 years after he was made a K.C.B. for his highly successful campaign in Burma.

During the South African War he volunteered for service and patriotically offered to waive his rank if they would give him a command. His offer was not accepted.

I have many letters from his friends which are unanimous in extolling his character, but to sum up his eminent qualities I cannot do better than give an extract from the *Madras Mail* of 16th April, 1892, which seems to me to have been written by a man who was well acquainted with him and thoroughly appreciated his grand qualities. It was written when Sir Harry Prendergast was on the point of leaving " the land of regrets " behind him.

"To sum up I may say that Sir Harry Prendergast is a notable specimen of that type of soldier in which we conceive our own nation to be particularly strong. Essentially a man of action, his actions have ever been free from the slightest trace of self-seeking or personal aggrandisement. With a valour, energy and courage of the highest possible kind, he has invariably subordinated self to the best interests of that Empire which is proud to own him as a son. With such great spirits as Outram and Havelock, Stewart, Hugh Rose and Robert Napier for his Captains, he has now by a long, honourable and brilliant record of battles, sieges, fortunes, disastrous chances, moving accidents by flood and field and hairbreadth escapes in the imminent deadly breach become a great Captain himself, and in bidding him farewell I cannot but recall the eloquently simple words Sir Hugh Rose used when he wrote of him in despatches after the Battle of the Betwa when he 'thanked Lieut. Prendergast for his courage and gallantry as devoted, as they were unostentatious.'

The courage and gallantry are as strong, as high now as in the days of yore, and high rank, much fame and many honours have not served to obscure the simple modesty, the unostentatious character of the grand old soldier whose name is a household word not only in Madras but all over India.

Honour, love, obedience, troops of friends—all these Sir Harry Prendergast has, and not the least of his many virtues is that he has richly merited them all—and that he may continue to enjoy them all for many, many years to come is the hearty wish of everyone who knows him."

The writer of this brief memoir knew him well and can emphatically endorse the opinion thus expressed regarding him and is greatly grieved that all must now be taken in the past tense.

In 1864 he married Emilie, daughter of Frederick Simpson, Esq., and niece of General Geo. W. G. Simpson, of Madras Artillery, who was at that time Superintendent of the Gunpowder Factory in Madras. By her Sir Harry had four sons and four daughters but of these only two sons and three daughters survive.

and Brigadier Norman at Bhamo. Sir Harry left Mandalay on the 23rd February, spent a few days in Rangoon, and again reached Tonghoo on 6th March, and went thence to Mingyan and Yemethen with reinforcements, Hlinedat was occupied and by the 10th March no hostile force was near Yemethen. He then returned to Rangoon by the 25th March when he learnt that he was to lose the command he held simply because he had in the meantime been promoted Lieut.-General.

After the end of March, 1886, Sir Harry Prendergast was unemployed in a military capacity although he was a thorough and very successful soldier of very large experience. At that time he was in the prime of life being only 51 years of age.

Sir Harry Prendergast after brief visits to Madras and Secunderabad, at both which places banquets were given in his honour, left for Europe. On arrival in England he was invited to the Mansion House and most of the great City Guilds sent him invitations.

On his return to India he went to Ootacamund and lived there for more than a year out of employment. At last the Governor of Madras offered him the officiating appointment of Resident of Travancore and Cochin. After a few months there he was transferred to Mysore as "Resident." Sir Harry had known the Maharajah as a boy and found him a perfect gentleman. Sir R. Sheshadri Iyer was the Minister and an old friend, Colonel Chas. Bowen, R.E., was the Chief Engineer and Secretary to the Government, P.W.D. He was next transferred to Baroda and found the Guikowar a remarkably intelligent statesman. From Baroda he went to Beluchistan to act for Sir Robert Sandeman—a strong man who knew Beluchistan and its people well. While there Prendergast settled a quarrel between the Mirzais and Achakzais in the Zhob Valley.

From Beluchistan he returned to Baroda and after some time was again sent to Mysore to succeed as Resident on the death of Sir Oliver St. John, K.C.S.I. He held this post till 1892, and while there visited the Coorg territory of which he was Chief Commissioner. He returned to England in 1892 at the age of 57, and from that time up to his death he remained without Government employment.

His rapid promotion was by no means of great benefit to him. He became a Brevet Colonel when 40, he was Major-General 16th September, 1882, and on 22nd February, 1887, became General when only 52. He thus in the very prime of life attained a rank which precluded him from holding any but the very highest military appointments, and as a result a splendid soldier was laid on the shelf owing to his having distinguished himself so frequently. It is a matter for regret that his fine qualities could not be fully utilized and that he never held the highest command, for which he was most admirably qualified in every way.

On the 26th June, 1902, he was promoted to be a Grand Cross of the

with his queens and attendants left the palace. By 6.15 p.m. they were all on board the *Thooreah*, and next morning the vessel left for Rangoon.

On the 1st December the city was ordered to be disarmed. Many arms were given up, the gun factory taken possession of, as well as the powder factory, and guards were placed over them; the elephants belonging to the king were brought in, and tranquility was established in the city.

On the 10th December a great number of congratulatory telegrams were received, and General Prendergast was informed that the distinction of K.C.B. had been conferred on him. The Viceroy also telegraphed "I am commanded by Her Majesty to express to you her warm thanks and her admiration at the skill with which you have conducted the whole Expedition."

On the 6th December a brigade was detailed for Bhamo (250 miles above Mandalay) as it seemed expedient to General Prendergast to garrison that important place without delay.

On the 19th he left Mandalay. Next day having joined the vessels containing General Norman's brigade, they steamed northwards, and on the 27th the flotilla anchored 10 miles below Bhamo.

Next day Bhamo was occupied, and the ambitious projects of China were quashed. This expedition was ordered on the initiative of General Prendergast himself, and on his sole responsibility. In a very few days General Norman was firmly established at Bhamo with his guns—four 25-pr. R.M.L. guns, two howitzers, and six mortars.

All this being secured Sir Harry Prendergast returned to Mandalay on the 12th January, 1886, and a month later the Viceroy, Earl of Dufferin, accompanied by the Countess, and the Commander-in-Chief, Sir Frederick Roberts, entered Mandalay.

Before leaving on the 18th February the Viceroy announced that the kingdom of Ava had been incorporated with Her Majesty's Empire.

In the Queen's Speech on the 21st January, 1886, when Parliament was opened by Her Majesty in person (the speech was read by the Lord Chancellor, Lord Halsbury), it was remarked "Through the gallantry of my European and Indian forces under General Prendergast the country has been rapidly subjugated," but strange to say the British Parliament did not so much as thank the army and its victorious Commander who overthrew the dynasty of Alompra and added a rich province, equalling France in area, to the British Empire. This may perhaps have been due to the defeat of Lord Salisbury's Government very shortly after, by which on the 6th February, 1886, Mr. W. E. Gladstone became Prime Minister till the 3rd August following.

On the 18th February the commands in Burma were reconstructed, Sir Harry Prendergast being placed in command of the whole of Burma from Rangoon to Bhamo, with Brigadier White at Mandalay,

arrangements before advancing. A force of 3,000 British and 6,000 native troops had to invade and hold a country larger than France, which was to be administered by means of a Political Officer (Colonel Sladen) and four or five assistants, but Prendergast was entrusted with full political powers, Colonel Sladen being his Political Assistant. The fine fleet of the Irrawaddy Flotilla Company was engaged to convey the force up the Irrawaddy and took the troops from Rangoon to Thayatmyo (the British frontier port) under the guns of which it was proposed to assemble the flotilla.

On the evening of the 12th November Prendergast left Rangoon by rail for Prome, and embarking the following morning reached Thayatmyo on afternoon of the 13th. The next day the King of Ava's steamer with its attendant barges was captured near Nyoung-ben-Maw and brought away. On the 16th everything being ready the steamers weighed anchor at daybreak and by 9.15 a.m. a landing had been effected at Zoung-gyen-Doung, two miles below the batteries.

On the 17th it was resolved to attack Gue-Gyoun-Ramyo on the left and Minhla on the right banks simultaneously. Both attacks were successful.

The next day the Expedition halted and arrangements were made for holding the fort where 17 guns were captured.

On the 24th the fleet proceeded to Yandaboo where the treaty of 1826 had been signed.

On the 26th at 8 a.m. the fleet left Yandaboo and at 4 p.m. near Nazoon a Burmese State barge with a flag of truce was observed—this proved to contain two of the king's envoys. These two envoys had an interview with General Prendergast and his Assistant, Colonel Sladen. The envoys left with a reply at 6 p.m., and while the interview was taking place the fleet advanced, so that the envoys had the advantage of seeing the whole of the troops file past. The fleet anchored 7 miles below Ava, and as no answer had been received from the king, orders were issued for the attack of Ava, but at 10.30 when the proposed landing place was in sight, some envoys came on board and brought unconditional acceptance of the terms imposed. The Burmese troops at Ava were disarmed, and on 28th the fleet left Ava at 6.30, reached Mandalay at 10 a.m., and an hour later a letter was sent demanding the surrender of the capital as well as King Theebaw. Troops were landed at 1.30 p.m., marched at 2 p.m. At the five gates the guards were disarmed, and the advance continued to the palace (4 miles off) which was surrendered and its four gates occupied.

Colonel Sladen had a long interview with the king, and about 5 p.m. he informed General Prendergast that the king had unconditionally surrendered himself and his kingdom, and would do so personally to General Prendergast next day.

On the 30th King Theebaw surrendered, and at 3.30 p.m. the king

Sir Neville was stopped in the Khyber Pass. War became imminent with Afghanistan; and it was arranged to send a force to Kandahar under General Primrose, and Prendergast was named Commanding Engineer to the division. He afterwards sent companies of Sappers up to the Khyber and put his own name down on the list of officers, but it was struck out as he had been nominated to Primrose's force.

The staff of Primrose's division was not after all made up as at first intended, and Prendergast in consequence missed the first phase of the war; and when the second began he had just started for England to recruit his strength, and although he returned within three months he was too late to join in it.

In 1880 he was appointed Brigadier-General in command of Malabar and Canara with headquarters at Cannanore, and from thence in 1881 he was transferred to the command of the ceded districts at Bellary.

In the autumn of 1882 (16th September) he was promoted Major-General and had to vacate the brigade command. Sir Frederick Roberts, Commander-in-Chief at Madras, invited him to take up the duty of Q.M.G. at once so he joined him in that capacity at Secunderabad. Early in 1883 he was released from duty as Q.M.G. with the view of having a few months' leave in England before taking command of the Burma Division, which he assumed in April, 1883.

There was an idea that war with Upper Burma was imminent but nothing was known for certain. Prendergast with the Chief Commissioner (Sir Chas. Crosthwaite) visited Thayatmyo, rode along the frontier to Mendoon and also went to Minhla and other places; the result being that when war broke out, he knew more of the country than any of his officers.

From Burma he was summoned to the Camp of Exercise at Bangalore in January, 1884, and commanded the 2nd Division. Sir Frederick Roberts, C.-in-C., was present, also Sir Donald Stewart, C.-in-C., India, as well as Sir Arthur Hardinge, C.-in-C., Bombay, and Sir M. E. Grant-Duff, Governor of Madras, was at the flagstaff during the last march past. Prendergast was very successful in his movements and operations at this camp, and he was offered the command of the Hyderabad Subsidiary Force; but returned to Burma for a few months with the desire of being present in case war should be declared. However when there seemed no chance of a campaign he was very glad to be transferred to Secunderabad. Here he had more camps of exercise. While in this command he received an autograph letter from the Viceroy, Lord Dufferin, telling him that he had been selected to command the Burma Expeditionary Force.

On arrival at Rangoon, 7th November, 1885, he was received by Mr. (after Sir Charles) Bernard, the Chief Commissioner, and had a few days to inspect the troops, steamers, etc., and complete final

that fortress when King Theodore died by his own hand. Prendergast was mentioned in despatches as "having rendered singularly valuable and important services."

He had obtained his Brevet Majority in April, 1863, for his services in the Central Indian Campaign in 1858, and now in August, 1868, he received his Brevet Lieut.-Colonelcy for his services in Abyssinia.

On return from Abyssinia he reverted to his duty as Deputy Consulting Engineer for Railways, but after some months he was appointed to the command of the Madras Sappers (7th January, 1869) and this command he held for nearly 12 years, having during the interval been on furlough to Europe for two years from May, 1874, during which time his brother, Major Hew L. Prendergast, officiated for him.

During his command of the Sappers he was appointed C.B. for his services (29th May, 1875), and in March, 1876, in commemoration of the visit to India of H.R.H. the Prince of Wales, Her Majesty the Queen was graciously pleased to appoint H.R.H. Honorary Colonel of the Madras Sappers, and in addition conferred on the regiment the distinction of being styled "The Queen's Own" and wearing on their colours and appointments the Royal Cypher within the Garter.

In April, 1878, Lord Beaconsfield resolved to despatch a force from India to the Mediterranean; 7,000 men were ordered to embark at once, and Prendergast was entrusted with the command of four companies of Madras and Bombay Sappers. After nearly a month at Malta he was ordered to proceed at once to Cyprus with the Sappers and ordnance stores, to land at Larnaca and select a camping ground for Lord Wolseley's force. They arrived at Larnaca on 16th July. The siege train was landed by the 19th; landing stages were constructed for the expected troops; a pier was commenced with the assistance of the navy under H.R.H. the Duke of Edinburgh, and a camp was selected at Chifflek. There were but eight days to do this and when required the Sappers could show six piers; a road to the camp; water supply troughs at the camp and carriage enough to take the regiments on as they landed. At first Prendergast was the senior engineer officer and would in ordinary course have been C.R.E., but Lieut.-Colonel Maquay was sent out from England and being about six months' senior to Prendergast (although two years younger) became C.R.E., and so he returned to India on 25th August, although the companies of Sappers did not leave Cyprus till 1st November, reaching Bombay on the 20th. Lord Wolseley recorded "his sense of the valuable work they had done."

During the Governorship of the Duke of Buckingham for a short time he acted as Military Secretary to the Government. At this time Sir Neville Chamberlain was Commander-in-Chief, and when he was sent on a special mission to Kabul, General Elmhirst, in command of the Mysore Division, became Provincial Commander-in-Chief.

Dick, of the 3rd Bombay Cavalry, halted at Jhansi with a large convoy and offered to take them to Sir Hugh Rose's camp. And the following day they camped with the Sappers of Rose's force and marched with them to Golowlee, near Calpee, on the 15th May. On that day the rear guard was attacked and every day till 22nd the enemy gave us no rest.

From Calpee Prendergast and Fox were sent to Cawnpore and after halting there a few days went on by dâk gharries to Calcutta, when Prendergast went home on two years' leave. While in England he received his decoration of the Victoria Cross, from the hands of Her Majesty at Windsor.

Hearing of the proposed expedition to China he volunteered to proceed with it but was refused permission to go out to India.

Again when in 1859 Austria fought against Italy and France he travelled to Vienna to endeavour to serve with them but was again disappointed.

On return to India he served for a few months as Assistant Engineer in P.W. Department at Vellore under his brother Hew Prendergast, who at that time was District Engineer of North Arcot. Thence he was transferred to the Raidroog Range of the Bellary District where he was employed in looking after roads and irrigation works. After some time there, he was sent to St. Thomas' Mount (the headquarters of the Madras Artillery) where he had charge of military buildings, besides irrigation works in the neighbourhood under Capt. Frank Moberly, R.E. While at Bellary he had passed the departmental examination in Telugu with credit.

During his stay at the Mount a Camp of Exercise was proposed at Lahore (they were a novelty in those days) and he, ever anxious to gain experience of military affairs, applied for six months' leave to attend it. He was granted the leave but before he could avail himself of it the camp was changed into a campaign against Umbeyla under Sir Neville Chamberlain.

On the 20th November, 1863, Lord Elgin, the Viceroy, died and Sir William Denison, the Governor of Madras, went to Calcutta as Acting Viceroy and he invited Prendergast to accompany him. He visited Agra, Delhi, Lucknow, Benares, Allahabad and Cawnpore, but the campaign against Umbeyla was over before he could reach headquarters. He however met Sir Hugh Rose (then Commander-in-Chief) the day after the affair at Shahgudi and had the opportunity of seeing something of frontier life. Soon after his return to Madras, he was appointed Assistant Consulting Engineer for Railways, which post he retained till 1867, when he sailed from Beypore in command of three companies of Madras Sappers for service in expedition to Abyssinia under Sir Robt. Napier. They reached Annesley Bay in January, 1868. He was Field Engineer during the advance, was present at the action at Arogi before Magdala and at the capture of

Prendergast was sent with half the company to blow up Nurrowlie Fort, 14 miles distant. Before sunset the mines were ready and having been exploded the men marched back to Saugor, thus doing a march of 28 miles and plenty of work besides. The next day they destroyed the fort of Sanoda some 10 miles to the east, and on the 11th batteries were commenced against Garrakotta (25 miles to the east) but during the night it was abandoned by the enemy. The fort was occupied and rendered unserviceable. The Sappers then marched back to Saugor and on towards Jhansi. On the 20th March a strong detachment of the 2nd Brigade advanced by a forced march of some 25 miles, placed picquets on all the chief roads round Jhansi, and next day Prendergast accompanied Sir Hugh Rose and Major Boileau, the Commanding Engineer, with cavalry and horse artillery, to make a reconnaissance. By the 30th arrangements had been made for storming the fort but the general action on 1st April with the so-called army of the Peishwa caused the assault to be deferred. The Battle of the Betwa ended in a complete rout of the enemy who lost over 1,000 men and all their 17 guns. The General and Capt. Prettejohn, 14th Dragoons, charged their right and left flanks and turned their position; the infantry dashed forward and put them to flight, while the cavalry and mounted officers charged through and through them.

"2nd Lieut. Prendergast, A.D.C. to the General, charged with Capt. Need's troop."

"The charge was equal to breaking a square, and the result was most successful, because the charge turned the enemy's position and decided in a great measure the fate of the day." Prendergast was severely wounded on this occasion, having received several sabre cuts on his left arm and the thumb of his left hand was all but severed.

On the 3rd April Jhansi was stormed with success but our loss was very heavy—Lieuts. Dick, Meiklejohn, and Bonus, of Bombay Engineers, led the way. Dick was bayoneted and shot dead; Meiklejohn was cut to pieces and Bonus was hurled down, while Lieut. Fox, of the Madras Sappers, was shot through the neck. The next few days a great deal of street fighting took place and it was not till the 6th April that Jhansi was completely ours. On the night of the 4th the Rani of Jhansi fled. The cavalry were sent in pursuit and cut up some 200 of the rebels. While at Jhansi Prendergast and Fox, of the Sappers, were invalided but the difficulty was to get away.

On the 25th April the 1st Brigade marched for Calpee and the officers of 86th invited the two wounded men to go with them in their "dhoolies," so they started, but at the end of the first day the brigadier observed them and insisted that they should return to Jhansi, as nothing would persuade him that marching east from Jhansi was the shortest way to Europe. A short time after this Lieut.

but on 20th October they left for Dhar, Prendergast acting as Brigade-Major. This force was under Major Keane. They had a successful skirmish near Dhar and next day Dhar was invested. After a siege of a week, Dhar was occupied on 1st November. Major A. Boileau, R.E., was Commanding Engineer, and Prendergast was the next senior. The work was extremely hard. One tour of duty lasted 42 hours! From Dhar the field force marched towards Mundisore, and on 21st November encamped four miles south of that place. During this time Colonel Durand (who had charge of the Central Indian Agency and at that time was Political Officer with the force) had need of assistance with his correspondence and appointed Prendergast to this duty. The object Durand had was to relieve Neemuch, 30 miles north of Mundisore, and as but little was known of the state of the country a reconnaissance was ordered and Prendergast was sent with Capt. Mayne and 300 cavalry. Our picquets were driven in by a determined advance of the enemy, which however was checked by a charge of cavalry till the main body came up and subsequently defeated the enemy. Prendergast while gallantly charging with the cavalry was shot through the chest just to the left of the heart. On this occasion he saved the life of Lieut. G. Dew, of 14th Dragoons, at the risk of his own, by attempting to cut down a "Velaitee" who covered Lieut. Dew with his piece when only a few paces to the rear. It was on this occasion that he was wounded and he would probably have lost his life, had not the rebel been killed by Major Sutherland Orr, of the Hydrabad Cavalry.

The Malwa field force returned to Mhow by way of Mehidpore, Oujein and Indore in time to welcome Sir Hugh Rose at a Christmas banquet. At this time Sir Henry Durand offered Prendergast the post of Garrison Engineer at Mhow, but the offer was declined as he was keenly anxious for active military service. Sir Robert Hamilton now returned to his position in political charge of the Central Agency, Durand returning to Bombay and Calcutta.

Now commenced Sir Hugh Rose's brilliant campaign in Central India.

The 2nd Brigade to which the Sappers were attached marched from Indore on 8th January, 1858, through Schore and Bhopal towards Saugor and reached Ratghur (on the Beema 30 miles from Saugor) on the 25th, and next day that place was invested. The cannonade was continued till morning of the 29th, then there being silence in the fort. Lieut. Chas. Strutt, Bombay Artillery, without orders, went forward followed by his gunners; the enemy's flag was hauled down and a Queen's Colour hoisted. Strutt was put under arrest for leading his men into peril, and so ended the Siege of Ratghur. On the 30th the Sappers occupied the fort and commenced to demolish the buildings. On 3rd February followed the Relief of Saugor after the officers and their families had been shut up in the fort for eight months. On the 8th,

He was born in India on 15th October, 1834, was brought up in England, chiefly under the care of his grandfather, and was first educated in a private school at Cheam.

During 1849–52 he was at Brighton College and passed into the H.E.I. Company's College at Addiscombe in August, 1852.

On 8th June, 1854, he obtained a commission in the Engineers. At Addiscombe he was distinguished by his prowess in athletic sports, being an excellent cricket and football player; swift of foot and strong of arm he was second to none as a man-at-arms. From Addiscombe he went to Chatham and passed through the usual engineering courses, and was noted for his skill in boxing, fencing, etc.

In October, 1856, he landed at Madras, and was posted to the Godavery District but only remained there a few months as the B Company of Madras Sappers was ordered to proceed to Persia on active service and Prendergast was delighted to join them. They embarked at Coconada 19th January, 1857, arriving at Bushire in March. The company proceeded on board the Indian Navy s.s. *Victoria* with the 2nd Division of the Persian F.F. under Sir James Outram—up the Shat-el-Arab River to within three miles of the southern battery of Mohumera. On the 25th they were transferred to the s.s. *Hugh Lindsay*. The Indian naval squadron ran up the river until opposite the forts defending the channel leading up to Mohumera and engaged the batteries. The carronades of the *Hugh Lindsay* were worked by H.M.'s 64th Regiment, assisted by the Sappers. By 11 a.m. the enemy's batteries were silenced and the disembarkation of the troops was effected by 1.30 p.m. The Sappers landed and assisted the troops in their advance through the date groves, which were much intersected with channels. The bridge by which the artillery and cavalry crossed the main irrigation channel consisted of trees felled on both sides of the channel with a large Arab boat as a central support. The Persians retired precipitately, leaving their tents, etc., and stores, with a loss of 200 killed.

The Sappers returned to Bombay where they disembarked on 1st June, 1857. Sir James Outram greatly approved of their services and stated that they "had rendered the most efficient service in the expedition against Mohumera and during its occupation." The Indian Mutiny had broken out three weeks before its return and the Company at once volunteered with alacrity for service against the mutineers.

On the 16th June they marched for Aurungabad and joined the Deccan F.F. at that place under Major-General Woodburn, C.B., on 7th July. On 23rd July this force relieved Asseerghur and Mhow on the 2nd August, the Sappers having had frequent employment by the way in making roads passable, etc. During the monsoon they remained at Mhow, employed in strengthening the defences,

MEMOIR.

GENERAL SIR HARRY NORTH DALRYMPLE PRENDERGAST, V.C., G.C.B., R.E.

THE friends of Sir Harry Prendergast (and they are legion) must have been greatly grieved to hear that such a true friend and gentleman and grand and gallant soldier had passed away so unexpectedly on Thursday, 24th July.

He had attended the rehearsal of the ceremonial in connection with the Order of the Bath in Westminster Abbey on the Monday previous, in apparently excellent health. It now seems that he caught a chill in the Abbey on that day, and was unable to attend the final ceremony on Tuesday, 22nd. He was anxious to go to the Abbey on that day but was forbidden by his medical adviser. So little was thought at the time of his indisposition that at his urgent request several of the family attended the ceremony, and it was not till Wednesday that there was any serious alarm regarding his health. He then rapidly became worse and passed away on Thursday evening. He was loved and respected by all who knew him and never had an enemy, at any rate he never deserved one. He was a gentleman, true as steel and in every capacity of life, as a son, a husband, a father and a friend, was truly admirable. It may well be doubted if he had an unkind thought of anyone, and it is quite certain that if he had, he never expressed it.

The Prendergast family is a very old and distinguished one. Its records show a long list of warriors of note commencing with Sir Maurice de Prendergast, Lord of the Castle of Prendergast in Pembrokeshire (an Anglo-Norman knight who accompanied Strongbow in the invasion of Ireland, A.D. 1169). His grandfather was Sir Jeffrey Prendergast, Knt., of the Indian Army, who served from 1795 to 1835, and was present at the Siege of Seringapatam in 1799. He was afterwards A.D.C. and Military Secretary to Lord Harris, Governor of Madras, and in 1804 married Elizabeth, daughter of Hew Dalrymple, Esq., by whom he had four sons and a daughter. His second son, Thomas, entered the Madras Civil Service in 1825, married in 1827 Caroline, daughter of Marton Dalrymple, Esq., by whom he had two sons. First, Hew Lindsay, who served in the Madras Engineers and attained the rank of Major-General (d. 1892), and second, Harry North Dalrymple, the subject of this memoir.

Gen Sir H D Pendergast VC GCB RE

Three British artillerymen deserted to the enemy during the siege; and one of them who had served at Waterloo in the Royal Artillery was hanged on the N.E. Bastion after the capture of the fortress; the two others were transported.

Engineers (Bengal Presidency) Engaged.

Lieut.-Colonel T. Anburey, C.B., Brigadier.
Capt. R. Smith (wounded).
" J. Taylor (wounded).
" J. Colvin (wounded).
" C. J. C. Davidson.
Lieut. W. N. Forbes (wounded).
" A. Irvine, Brigade-Major (wounded).
" E. Swetenham.
" E. J. Smith (wounded).
" H. de Bude (wounded).
" J. Thomson.
" J. Tindall (killed).
" B. Y. Reilly.
" G. T. Greene.
2nd Lieut. H. Goodwyn.
" A. H. E. Boileau.

(To be continued).

3rd Brigade :—Brigadier J. W. Adams, 4th Extra B.N.I.
33rd, 36th, and 37th Bengal N.I.
6th Brigade :—Brigadier W. T. Edwards, 14th Foot, succeeded by Brigadier C. S. Fagan, 15th B.N.I.
15th, 21st, and 35th Bengal N.I.

In addition the following troops were present :—

Two corps of Irregular Horse, Lieut.-Colonel J. Skinner, viz., the 1st and 8th Local Horse ; detachments from 1st Nusseeree and Sirmoor Battalions ; one wing 1st Bengal European Regt., which arrived on 9th January, 1826, and detachment of the 3rd Extra N.I.

The siege train, 112 pieces, arrived on 14th and 15th December.

Assault on 18th January, 1826.

Right Column :—Lieut.-Colonel J. Delamain, 58th B.N.I.	2 Cos. Ben. Eur. Regt. 58th B.N.I. 100 Gurkhas, 1st Nusseeree Battn.

Main Right Column :—Major-General T. Reynell.

Brigadier R. Paton	4 Cos. H.M. 14th Foot. 5 Cos. 41st B.N.I. 6th B.N.I.
Brigadier J. M'Combe	4 Cos. H.M. 14th Foot. 23rd and 60th B.N.I.
Reserve (Brig. T. Whitehead)..	2 Cos. H.M. 14th Foot. 18th and 32nd B.N.I.

Main Left Column :—Major-General J. Nicolls.

Brigadier W. T. Edwards (killed)	H.M. 59th Foot. 31st, 15th, and 21st B.N.I.
Reserve (Brig. J. W. Adams) ..	36th and 37th B.N.I.

Intermediate Column.

Lieut.-Colonel T. Wilson, 33rd B.N.I.	2 Cos. Bengal European Regt. Grenadier Co., 35th B.N.I. Light Co., 37th B.N.I. 100 Ghurkhas, Sirmoor Battalion.

Casualties at the assault :—

Europeans ..	81 killed.	303 wounded.	2 missing.
Natives ..	42 „	189 „	9 „

Total casualties during the siege :—
180 killed, 780 wounded, 20 missing.

Twelve British and one Native officer, present at this siege, had taken part in Lord Lake's unsuccessful siege in 1805.

The prize money amounted to nearly £500,000 sterling, of which the Commander-in-Chief's share was nearly £60,000, a lieutenant's nearly £250, a sergeant's £8, a private's £4, and a Sepoy's £2 14s.

after his death, and the Commander-in-Chief (Lord Combermere) undertook the siege in December 1825, with an army of 21,000 men, and a battering train of 112 pieces.

Lord Lake's disastrous failure in 1805 against this fortress was due to contempt of the enemy, insufficient preparations, a ridiculously small battering train, and an almost entire lack of engineers and equipment.

These faults were sedulously avoided on this occasion, and the fortress taken by assault after an enormous breach had been made by mining.

Troops employed :—

General Lord Combermere, C.-in-C.

Cavalry Division :—Brigadier J. W. Sleigh, 11th Light Dragoons.
1st Brigade :—Brigadier G. H. Murray, 16th Lancers.
H.M. 16th Lancers.
6th, 8th, and 9th Bengal L. Cavalry.
2nd Brigade :—Brigadier M. Childers, 11th Light Dragoons.
H.M. 11th Light Dragoons.
3rd, 4th, and 10th Bengal L. Cavalry.
Artillery :—Brigadier A. M'Leod.
Bengal Horse Artillery :—Brigadier C. Brown.
1st Brigade :—2nd Troop.
2nd Brigade :—1st, details of 2nd, and 3rd and 4th Troops.
3rd Brigade :—1st, 2nd and 4th Troops.
Bengal Foot Artillery :—Brigadier R. Hetzler.
1st Battalion :—2nd, 3rd, and 4th Companies.
3rd Battalion :—1st, 2nd, and 4th Companies.
4th Battalion :—2nd and 3rd Companies.
Bengal Engineers :—Brigadier T. Anburey.
6 Companies of Sappers and Miners, and 2 Companies of Pioneers.
1st Infantry Division :—Major-General T. Reynell.
1st Brigade :—Brigadier J. M'Combe, 14th Foot.
H.M. 14th Foot.
23rd and 63rd Bengal N.I.
4th Brigade :—Brigadier T. Whitehead, 41st B.N.I.
32nd, 41st, and 58th Bengal N.I.
5th Brigade :—Brigadier R. Paton, 18th B.N.I.
6th, 18th, and 60th Bengal N.I.
2nd Infantry Division :—Major-General J. Nicolls.
2nd Brigade :—Brigadier G. McGregor, 59th Foot, succeeded by Brigadier W. T. Edwards, 14th Foot, who was killed in the assault.
H.M. 59th Foot.
11th and 31st Bengal N.I.

Royal Navy.	Indian Marine.
Alligator	Asseerghur
Arachne	Diana
Boadicea	Emma
Champion	Ernaad
Larne	Exeter
Liffey	Hastings
Slaney	Margaret
Sophie	Matchless
Tamar	Nereide
Tees	Pluto
	Sophia
	Teignmouth
	Trusty

A List of Engineer Officers Engaged.

Bengal Engineers.

Capt. J. Cheape.
Lieut. F. Abbott (wounded).
,, G. B. Thomson (with Brigadier J. W. Morrison's force, Arakan).
,, W. Dickson (wounded).
,, H. de Budé.
,, J. Tindall (Adjutant and Quartermaster).
,, J. Crommelin.

Madras Engineers.

Capt. J. Mackintosh (Chief Engineer, Invalided, 11. 8. 24; died, 22. 10. 24).
,, Alex. Grant (Chief Engineer from 21. 12. 24. Died, 20. 5. 25).
Lieut. G. A. Underwood (Chief Engineer from 21. 5. 25. Wounded).
,, E. Lake (Adjutant).
,, A. T. Cotton.

SIEGE AND STORM OF BHURTPORE, *10th December*, 1825—*1st January*, 1826.

The Siege of Bhurtpore was occasioned by the usurpation of Durjan Sal, on the death of the Rajah.

Sir D. Ochterlony, the Resident at Delhi, began to take the necessary measures, which however were countermanded by the Government of India. The old veteran, distinguished throughout a long career by combined caution and daring in the field and wisdom in council, was so mortified by this rebuff that writing a dignified protest he resigned his post and died a few months later at Meerut. Meanwhile the state of affairs in Bhurtpore went from bad to worse, and the Government were compelled to retrace their steps and justify the measures which Sir D. Ochterlony had commenced, immediately

Bombay Engineers.	Services.
Lieut. J. McLeod	Operations near Poona, Siege and Capture of Singhur, Poorunder and Wassoota.
„ S. Atthill	
„ S. Slight	
Ensign W. M. Ennis	Killed, 13th November, 1817, at the outbreak of hostilities, whilst surveying near Poona.

The detail of the list of services is probably incomplete in a few cases.

THE 1ST BURMESE WAR, 1824–26.

Owing to the fact that special medals for this war were granted by the H.E.I.C. at its close to all the native ranks who served in it, both in Burma and in Arracan, etc., no native was eligible to the medal and clasp "Ava," when the Army of India Medal was granted in 1851.

The King's troops that served in the war were the 1st, 13th, 38th, 41st, 44th, 45th, 47th, 54th, 87th and 89th Foot. The Europeans in the Company's Service entitled to the medal and clasp "Ava" were the European officers, and N.C.O.'s of the Artillery and various corps, also the 1st Madras European Regiment. It was issued also to survivors of the Royal and Indian Navies, who served in the war.

The 1st Foot served at Nagpore and Maheidpoor also; and the combination of either of these clasps with that for "Ava" is met with; as also that of "Nepaul" and "Ava" for the 87th Foot, or "Maheidpoor" and "Ava" for the Madras European Regiment.

Beyond some of the officers, only two or three men of the 13th Foot served in Afghanistan 1839–42, who had previously served in the Burmese War.

The 44th Foot was destroyed at Cabul in 1842.

The combination in a group of the medals with clasps for "Chrystler's Farm" and "Ava" to men of the 89th Foot, is to be met with occasionally, as also of medals with the clasp for "Java" and clasps for "Assye," etc., to the 78th Foot. The combination of the two clasps "Ava" and "Bhurtpoor" is almost unknown.

300 medals with the clasp "Ava" were issued to the Royal Navy, and 46 to the Indian Marine. The vessels employed (many of them very small) were the following. List probably incomplete:—

	Services.
Madras Engineers.	
Lieut. T. Davies	Siege and Capture of Nagpore (wounded), of Rajdeir, and of Trimbuck, April, 1818. Killed at Siege of Malligaum, 18th May, 1818.
,, J. Coventry..	Commanding Engineer at Siege and Capture of Asseerghur.
,, Alex. Anderson	Battle of Maheidpoor. Capture of Talneir (wounded). Siege and Capture of Chanda, May, 1818.
,, Alex. Grant	Siege and Capture of Singhur, February—March, 1818. Capture of Poorunder. Operations south of Kistna, Siege and Capture of Wassoota, Sholapur, May, 1818, and of Copal Droog, May, 1819.
Ensign J. W. Nattes	Siege and Capture of Nagpore (wounded), of Rajdeir and of Trimbuck (on the staff). Killed at the Siege of Malligaum, 29th May, 1818.
,, J. Purton	Battle of Maheidpoor, Capture of Talneir, Siege and Capture of Rajdeir, of Trimbuck, and of Malligaum (wounded), also of Asseerghur.
,, J. Oliphant	Siege and Capture of Nowah, January, 1819, and of Copal Droog, May, 1819.
,, J. J. Underwood ..	Siege and Capture of Rajdeir, Trimbuck and Malligaum (wounded).
,, E. Lake	Siege and Capture of Rajdeir, Trimbuck (wounded), Malligaum, Jilpy Amair, January, 1819, and Asseerghur.
,, J. Jenkins	With Doveton's division. Died at Akola, 4th December, 1817.
Bombay Engineers.	
Capt. J. Nutt	Operations near Poona, Siege and Capture of Singhur, Poorunder and Wassoota, March—April, 1818, as Commanding Engineer.
Lieut. T. Remon	Capture of Koaree (wounded), March, 1818.

Engineer Officers Engaged, 1817–19.

	Services.
Royal Engineers.	
Lieut. T. H. Elliot	A.D.C. to Sir T. Hislop. Battle of Seetabuldee. Battle of Maheidpoor (wounded). Capture of Talneir, 27. 2. 18. N.B.—This officer was on the staff of his father, the Governor of Madras, and was appointed by Sir T. Hislop to be his 2nd A.D.C. His presence at Seetabuldee was due to chance. It is uncertain whether he was present at the subsequent operations round Nagpore.
Bengal Engineers.	
Major T. Anburey*	Principal Field Engineer, 1st Division.
Capt. H. W. C. Smyth* ..	Field Engineer, 1st Division.
,, Rd. Tickell*	Field Engineer, 3rd Division. Capture of Mundla, April, 1818.
Lieut. J. Taylor	Assistant Field Engineer, 1st Division.
,, J. Peckett	Field Engineer, 3rd Division.
,, J. Cheape	Assistant Field Engineer, 3rd Division. Siege and Capture of Asseerghur, March—April, 1819.
,, J. Colvin	Assistant Field Engineer, 3rd Division.
,, A. Irvine*	Assistant Field Engineer, 1st Division. Siege and Capture of Asseerghur.
,, E. Garstin	Assistant Field Engineer, 4th Division. Capture of Nagpore, Capture of Taragarh, June, 1818, and Madoorajpoor, July, 1818.
,, J. F. Paton..	Adjutant, 1st Division.
,, W. J. O. Hall	Field Engineer, Nagpore (5th) Division. *Army of the Dekkan.*
,, G. Hutchinson*	Assistant Field Engineer, 4th Division.
Ensign T. J. Warlow	Assistant Field Engineer, 3rd Division. Siege and Capture of Asseerghur.

* N.B.—These five officers were engaged at the Capture of Fort Hathras, April, 1817.

1st Infantry Brigade :—Lieut.-Colonel R. Scott, Madras European Regiment.
Flank Companies H.M. 1st Foot (7 officers, 161 men).
Madras European Regiment (5 companies, 9 officers, 314 men).
1-14th and 2-14th Madras N.I.
2nd Infantry Brigade :—Lieut.-Colonel A. M'Dowell, 6th Madras N.I.
2-6th Madras N.I.
1st and 2nd Battns. of Russell Brigade (Capt. A. Hare, 7th Bombay N.I.).
Detachment 22nd Bengal N.I. (16 men attached to Russell Brigade).
Madras Pioneers, 4 Companies 1st Battn. (B, E, F, G Companies). Capt. R. M'Craith, 22nd Madras N.I.
Mysore Silladar Horse, Capt. J. Grant, 5th Madras Cavalry.
Sir J. Malcolm's Escort (19 men of 6th Madras Cavalry).
Bhopal Contingent and Nizam's Reformed Horse.

Casualties :—

British Officers ..	4	killed and	34	wounded.
Europeans	19	,,	99	,,
Natives	151	,,	471	,,

N.B.—Over 200 of the wounded died subsequently, on account of the bad medical arrangements. 65 guns and 7 elephants were captured.

(i.). No other battles or sieges of the 2nd Mahratta War are commemorated by the Army of India medal clasps, though much additional fighting took place, some of which was very severe. The most noteworthy of these latter operations were (1) the Siege and Capture of Asseerghur in 1819, by Brigadier J. Doveton's and Sir J. Malcolm's divisions, the total casualties being 313. The regular troops engaged numbered over 15,000 and included H.M. 1st Foot, 14th Foot, 30th Foot, 67th Foot and the Madras European Regiment. When one recalls the fact that a clasp was authorized for the capitulation of this fortress to Colonel James Stevenson in 1803, when two men were killed and six wounded, the omission of this second successful siege is very curious.

(ii.). The Siege and Storm of Malleygaum in May, 1818, when the casualties were 208, including five British officers killed.

(iii.). The Siege and Storm of Nowah in January, 1819, when 200 casualties were sustained. It is to be noted that " Nowah " is borne as an honorary distinction on the colours and appointments of the Native corps engaged which still survive in the Indian Army (none of H.M. Troops were present) but it was passed over in silence in 1851. The Battles of Kirkee and Poona had a political value far outweighing their military character, and probably were commemorated on that account.

1st Infantry Brigade :—Lieut.-Colonel N. McLeod, 1st Foot.
H.M. 1st Foot (6 Companies).
1-12th Madras N.I., 1-22nd Bengal N.I. and Flank Companies 1-2nd Madras N.I.
2nd Infantry Brigade :—Lieut.-Colonel N. McKellar, 1st Foot.
1 Company H.M. 1st Foot.
2-24th Madras N.I.
Detachment Madras H. Artillery (2 guns).
3rd Infantry Brigade :—Lieut.-Colonel H. S. Scott, 1-24th M.N.I.
1 Company H.M. 1st Foot.
A, C, D Companies Madras Foot Artillery, 2nd Battn.
Detachment Madras Sappers and 1st Battn. Pioneers.
1-11th Madras N.I.
Detachment 2-14th Madras N.I. (1 officer and 70 men).

In support, 2-13th Madras N.I. from 1st Brigade. Principal Reserve Battery (from 2nd Battn. Madras Artillery, A, C, D Companies).

In rear, Berar Brigade (Artillery, Cavalry, and Infantry).—Major R. Pitman, 6th Bengal N.I.

With the baggage 1-20th and 1-24th Madras N.I.

Total casualties from 16th to 24th December inclusive, 94 killed and 348 wounded.

The above troops also effected the capture of Nagpore later on.

Troops Present at the Battle of Maheidpoor, 21st December, 1817.
(The Defeat of Holkar).

Lieut.-General Sir T. Hislop, C.-in-C., the Army of the Dekkan, in command.

Troops present :—
Horse Artillery Brigade :—Capt. H. T. Rudyard, Madras H.A.
1st and 2nd Troops Madras H.A.
Rocket Troop Madras Artillery.
Gallopers 3rd and 8th Madras Cavalry.
1st Cavalry Brigade :—Lieut.-Colonel J. Russell, 3rd Madras N.C.
1 squadron H.M. 22nd Light Dragoons (100 men).
3rd Madras Cavalry.
2nd Cavalry Brigade :—Major G. L. Lushington, 4th Madras N.C.
4th Madras Cavalry.
8th Madras Cavalry.
Artillery :—Major J. Noble, Madras Artillery.
D and E Companies 2nd Battn. Madras Artillery.
Russell Brigade Artillery.
Light Infantry Brigade :—Major H. Bowen, 16th Madras N.I.
Madras Rifle Corps (4 Companies).
1-3rd and 1-16th M.N.I.

Casualties.					Corps.	Field State 26th November, 1817.					
Natives.			Europeans.			British Officers.	Native Officers.	Other Ranks.	Recruits, Armed.	Recruits, Unarmed.	Recruit Boys.
Missing.	Wounded.	Killed.	Wounded.	Killed.							
—	22	22	2	1	6th Ben. Cav. . .	5	9	286	—	—	—
—	—	—	—	—	Bodyguard . . .	—	1	17	—	—	—
—	9	2	7	3	Artillery . . .	1	2	52	—	—	—
—	46	15	3	1	1-20th M.N.I. . .	12	11	429	80	—	64
—	98	56	4	2	1-24th M.N.I. . .	9	13	510	80	—	60
1	32	10	1	—	Escort . . .	3	3	173	—	—	—
—	13	8	2	—	Nagpore Battn. . .	4	11	13	70	392	—
—	—	—	—	1	Pioneers, Staff & Details	not given.			—	—	—

N.B.—At this period the Madras Bodyguard consisted of details borne on the strengths of the regiments of cavalry from which they were drawn.

The Resident's escort consisted of 2 Companies Bengal N.I. formed of volunteers from regiments quartered at Barrackpore. For its gallantry the 1-24th M.N.I. was restored to its old position and number, viz.: the 1-1st M.N.I. which it had forfeited for its mutiny at Vellore in 1806.

Battle and Capture of Nagpore.

The troops at Seetabuldee were relieved by the arrival of Brigadier J. Doveton's division, and on the 16th December, 1817, the Battle of Nagpore was fought in which 75 guns and 40 elephants were taken. Nagpore was then invested and an unsuccessful assault delivered on 24th December. Negotiations ensued and the fortress capitulated on 30th December.

Troops Present at the Battle of Nagpore, 16th December, 1817.

Brigadier J. Doveton in command.

Cavalry Brigade:—Lieut.-Colonel R. Gahan, 6th Ben. Cavalry.

Detachment Madras Horse Artillery (6 guns).

6th Bengal Cavalry.

6th Madras Cavalry.

Troops Present at the Defence of Corygaum, 1st January, 1818.

Whilst marching with a detachment from Sirur to strengthen the garrison of Poona, Capt. F. F. Staunton, 2-1st Bo. N.I., encountered the Peishwa's Army; seizing the village of Corygaum he held it against all attacks, and though heavy losses were sustained he succeeded in withdrawing his force by night in safety to Sirur.

Troops engaged :—

Auxiliary Horse (250 to 300 men).
Detachment G Company 1st Battn. Madras Artillery (two 6-prs., 25 Europeans and 18 Lascars).
2-1st Bombay N.I. (500 to 550 men).

Casualties :—

Madras Artillery :—13 Europeans and 5 Natives killed, 9 Europeans and 6 Natives wounded.
2-1st Bo. N.I. :—53 killed and 134 wounded.
Auxiliary Horse :—96 casualties.

Of the eight British officers present, three were killed and two wounded.

For their gallantry the 2-1st Bo. N.I. were constituted Grenadiers, and Capt. Staunton was made A.D.C. to the Governor-General, and presented by the H.E.I.C. with a sword of honour and 500 guineas; he was also nominated C.B. in due course. A monument was erected at the site in 1821 to commemorate the action, inscribed with the names of all who lost their lives in it.

II. OPERATIONS NEAR NAGPORE AND MAHEIDPOOR.

The small force at Nagpore, under Lieut.-Colonel H. S. Scott, was attacked suddenly by the Rajah's forces, while taking position on the two hills of Seetabuldee outside the town.

Troops Present at the Battle of Seetabuldee, 26th—27th November, 1817.

Lieut.-Colonel H. S. Scott, 1-24th M.N.I., in command.

Troops present :—

6th Bengal Cavalry (3 troops).
Detachment Madras Bodyguard.
" Madras Artillery (from D Company, 2nd Battn., four 6-prs.).
Detachment Madras Pioneers, 1st Battn.
1-20th and 1-24th Madras N.I.
Residents' Escort (2 Companies N.I.).
Battalion Nagpore Subsidiary Force.

recorded however with regret that the assault on 24th December failed, and that Nagpore capitulated on terms on 30th December.

(vi.). The Battle of Maheidpoor, 21st December, 1817, when Sir T. Hislop (with Sir J. Malcolm as 2nd in command) defeated Holkar's Army on the banks of the Sipra.

I. OPERATIONS NEAR POONA.

Troops Present at the Battle of Kirkee, 5th November, 1817.

Lieut.-Colonel C. B. Burr, 1-7th Bo. N.I., in command.

*Detachment H.M. 65th Foot.
3-2nd Battn. Bombay Artillery (4 guns).
Bombay European Regiment.
*The Resident's Escort (2 Companies N.I.).
2-1st, 2-6th and 1-7th Bo. N.I.
1st Dapuri Battn., with 3 field guns (Poona Auxiliary Force).
*Detachment of Pioneers.
Casualties :—19 killed, 67 wounded.

A wing of 2-6th N.I. with details was left in post at Kirkee. In a few days reinforcements arrived under Brigadier L. Smith, who attacked the Peishwa and captured Poona.

Troops Present at the Battle and Capture of Poona, 11th—16th November, 1817.

Brigadier L. Smith, 65th Foot, in command.

Right Wing :—Brigadier L. Smith.
H.M. 65th Foot.
*1st Troop Bo. Horse Artillery.
A Flank Battalion (formed from the N.I. regiments present).
*1-2nd, 1-3rd, and *2-9th Bo. N. Infantry.

Left Wing :—Lieut.-Colonel C. J. Milnes, 65th Foot.
Bombay European Regiment.
3-2nd Battn. Bo. Artillery.
The Resident's Escort (2 companies N.I.).
*2-1st, 2-6th, 1-7th Bo. N. Infantry.
Light Company 1-4th Bo. N. Infantry.

Also present, detachments of E and F Companies 2nd Battn. Madras and 3rd and 4th Companies Bombay Pioneers, and Corps of Poona Auxiliary (Irregular) Horse, under Capt. W. Spiller.

Casualties among the Regular troops, 15 killed, 79 wounded.

62 guns were taken.

* These corps sustained no casualties.

The Army of the Dekkan (Madras and Bombay Presidencies).

C.-in-C. :—Lieut.-General Sir T. Hislop (C.-in-C., Madras).
1st or Advanced Division :—Lieut.-General Sir T. Hislop.
2nd or Hyderabad Division :—Brig.-General J. Doveton.
3rd Division :—Brig.-General Sir J. Malcolm, K.C.B., K.L.S.
4th or Poona Division :—Brig.-General L. Smith, C.B.
5th or Nagpore Division :—Lieut.-Colonel J. W. Adams, C.B.
Reserve Division :—Brig.-General T. Munro (Brig.-General T. Pritzler, 2nd in command).

The Goozerat Division (Bombay Presidency).

Major-General Sir W. T. Keir, K.M.T.

The fighting that occurred between November, 1817, and May, 1819, was of a most extensive and arduous character. The opening of the campaign was signalized by sudden attacks on the small British garrisons at Kirkee and Nagpore by the Regular troops of the Peishwa and the Bhonsla; while the Army of Holkar met its fate on the banks of the Sipra at the hands of Sir T. Hislop and Sir J. Malcolm in December, 1817. Numberless fortresses were besieged and taken, the Pindarris were exterminated, and the final crushing of the Mahratta confederacy effected at the cost of hard fighting and heavy losses.

The following notes will be confined chiefly to those events, which were commemorated in 1851 by clasps to the Army of India Medal, as follows :—

(i.). The Battle of Kirkee, 5th November, 1817, caused by the Peishwa's attack on the garrison of Kirkee.

(ii.). The Battle and Capture of Poona, 11th—16th November, 1817, when the Kirkee troops reinforced by Brig.-General L. Smith, defeated the Peishwa again and took his capital.

(iii.). The Defence of Corygaum, 1st January, 1818, when a detachment of all arms, 900 strong, held the village of Corygaum against the flower of the Peishwa's army, defeated with heavy loss every attack, and withdrew in good order and safety to Sirur.

(iv.). The Battle of Seetabuldee, 26th—27th November, 1817, where the small garrison of Nagpore, seizing the hills of Seetabuldee, withstood the sudden onslaught of the overwhelming forces of the Rajah and beat them off after a fight lasting 18 hours.

(v.). The Battle and Capture of Nagpore, 16th December and 24th—30th December, 1817. These events were the sequel to the Battle of Seetabuldee, in the same way as the Battle and Capture of Poona was the sequel to the Battle of Kirkee. It has to be

EARLY INDIAN CAMPAIGNS AND THE DECORATIONS AWARDED FOR THEM.

(*Continued*).

By MAJOR H. BIDDULPH, R.E.

THE SECOND MAHRATTA WAR, 1817–19.

This war was occasioned by the intrigues among the Mahratta rajahs, the lawless and anarchical condition of Central India, and the appalling depredations of the hordes of freebooters known as Pindarris.

The Governor-General, Lord Hastings, determined to suppress these marauders who had become a serious menace. Numbering nearly 20,000, and composed almost exclusively of mounted men, they moved with astonishing rapidity, committing the most unspeakable atrocities as they swept along, and at last they even dared to invade British territory. They were undoubtedly countenanced by some of the Mahratta rajahs, who received a portion of their plunder, and to meet the serious evils that had arisen, the Governor-General mobilized a force of over 100,000 troops, consisting of 13,000 European and 74,000 Native Regulars, 20,000 Irregular Cavalry officered by British officers, and 10,000 Native Irregulars. The artillery numbered 282 guns with the Regulars, and 13 with the Native Irregulars.

The combined military force of the Pindarris and those Mahratta rajahs who could not be trusted, totalled over 200,000 men with 589 guns; the mounted portion being no less than 130,000 of this total. As the event proved the British troops had to fight the principal Mahratta princes, as well as exterminate the Pindarris.

The British Army, drawn from every presidency, was brigaded on paper as follows:—

The Grand Army (*Bengal Presidency*).

C.-in-C.:—The Governor-General, Lord Hastings.
1st or Centre Division:—Major-General Thos. Brown.
2nd or Right Division:—Major-General R. S. Donkin.
3rd or Left Division:—Major-General D. Marshall.
Reserve Division:—Major-General Sir D. Ochterlony, G.C.B.

APPENDIX.—R.E. RAILWAY UNITS IN WAR.

TRAINS REQUIRED FOR THE CONCENTRATION OF THE FORCE.

1 Cavalry division	.. ..	= 73 trains.	
6 Infantry divisions	.. ..	= 510 ,,	
2 Brigades M.I.	.. ..	= 36 ,,	(approximate).
Army troops	.. .. ..	= 25 ,,	,,
L. of C.	.. .. ..	= 25 ,,	,,
Total	..	= 669 trains.	

APPROXIMATE TOTAL QUANTITY OF ROLLING STOCK REQUIRED TO RUN 40 TRAINS DAILY FROM EACH PORT OF DISEMBARKATION.

Passenger coaches	.. 380	Vehicle trucks	 1020
Horse boxes	 40	Brake vans	 150
Cattle wagons	 1200		

DISTANCES.

Bristol—Hitchin .. 150 miles. Birmingham—Sandy .. 90 miles.

NOTE.—For purposes of illustration, Birmingham is supposed to be a seaport.

DAILY REQUIREMENTS (NORMAL) AFTER CONCENTRATION.

Food supplies for one infantry division ..	= 67·6 tons.
,, ,, ,, cavalry ,, ..	= 69·2 ,,
,, ,, two mounted brigades	= 31·0 ,,
Petrol supply for mechanical transport of one division	= 350—400 gallons.

NOTE.—Daily supplies include corn but not hay. Gross weight of daily ration for men = 4·2 lbs.

AMMUNITION.

100 Rounds per gun for one infantry division ..	= 111 tons.
,, ,, rifle ,, ,, ,, ..	= 43 ,,

EACH INFANTRY AND CAVALRY DIVISION REQUIRES ONE TRAIN DAILY, CONSISTING OF:—

15 Trucks, supplies.
1 Truck, petrol.
1 ,, ordnance stores, etc.
1 ,, remounts.
1 Coach for details from base, and sick returning.
1 Brake van.

20 Vehicles.

But I may mention one or two points which struck me at the recent Army manœuvres :—Getting vehicles on and off the trains was generally the longest job, and shipping or unshipping the wagon poles was one of the most fruitful sources of delay. Either the pin would not go in when detraining, or it stuck and would not come out in entraining. It is always worth while ascertaining at the entraining station, if possible, which side the horses will come out and at which end or how the vehicles will come off, 4-wheeled vehicles are very awkward things to push off backwards over a long row of trucks, and should be loaded so that they can be pulled and not pushed off. If you have to off-load backwards use drag ropes and allow only one strong man to steer the pole. Similarly, load horses so that they will come out head first. I know the books tell one to load them heads away from the other line of rail. But in my experience this does not matter, and in any case trains often have to be reversed during a journey and they may be heads inwards part of the way and heads outwards the rest. Also load heavy guns so that on arrival they are first to come off.

Of course these considerations cut both ways. Doing as I suggest may mean longer time in loading, but you can generally rely on having reasonable time to load, whereas you never know how long you may have to unload. Delays occur, trains get behind time and you may have to bundle out as quick as ever you can.

Lastly, I would suggest that a certain number of strong men in each battalion should be picked and practised beforehand in handling the loaded vehicles of the battalion, so that they become as handy with their vehicles as gunners are with their guns. And if a series of trains are to be dealt with it is of great advantage to have a permanent loading or unloading party to deal with all the trains of a brigade. They soon get quick at the work and know exactly what to do. A fresh party from each unit has to learn its work and the unfortunate R.T.O. has to repeat the process of instruction afresh for each train.

in the Army Reserve railway men of the necessary qualifications from the principal railway companies of the country. These men did no colour service, but for purely railway work they were invaluable. Unfortunately, for reasons which I cannot go into, this reserve was allowed to dwindle till it has almost disappeared. There are, however, good reasons for hoping it will be revived very shortly and that we shall have a nucleus of about 300 skilled railway men, drivers, firemen, guards, signalmen, shunters, and other grades necessary to run the traffic of a line. Three hundred men certainly will not go very far, but they will enable us to make a start. At a rough estimate they might, assisted by the regular R.E. companies, enable us to run 10 or 12 trains a day over a line 150 miles long, and even that only for a limited time.

We can only hope that the army will not be called upon to work more than this at the first start, and we should have to supplement the 300 as far as possible with specially recruited civilian railway men.

POINTS TO BE CONSIDERED IN ARRANGING TROOP MOVES BY RAIL.

I have already mentioned the importance from a railway point of view of settling on the order of trains beforehand, and of not altering the order or composition of trains at the last minute. In dealing with civil traffic one passenger train is very like another ; troop trains are not. Therefore if ever it falls to you to arrange a large troop movement be quite sure of the numbers you want to go in each train, and do not try and alter their order or composition at the last minute, unless you have made sure that they are stabled so that you can do so without delaying matters.

Also, in notifying train arrangements to the troops you will find it necessary to give each train a number. Do not invent your own numbers but use the railway numbers. The railway people always give each train composition a number, and it makes for confusion if the railway people and the army are referring to the same train under different numbers.

Actual times of departure bear alteration more easily. On a well-organized line the actual times of running can be altered easily enough at any time up to the time the empty trains leave the place where they are stalled, and provided that all civil traffic has to give priority, as will generally be the case in war. But once the empty train has started for its entraining station it will probably be getting in the way of something else if you hang it up anywhere. But all time tables and arrangements, however good, depend for their smooth working largely on the troops themselves.

Rapid entrainment and detrainment is the crux of most large troop moves. Some very good advice on the subject is given in the *Field Service Regulations*, and on p. 151 of the *Field Service Pocket Book* which I do not propose to repeat.

Once concentration is over, it is true that the ten or twelve trains required daily make but a comparatively small demand on a large railway system. But even these we shall have to keep down to the lowest limit possible, and if ever it is proposed to employ the railways for troop moves on any large scale, it will only be done after carefully considering how such movements will affect the supplies of the army or other important traffic.

It is also to be remembered that the ease with which the traffic can be handled will depend much on whether the lines of supply of the army follow the main lines of the country, or run athwart them, *e.g.*, generally speaking the capacity of English railways north and south is far greater than it would be east and west.

Troops for Railway Repairs and Reconstruction.

Assume now that beyond Potton and Royston the lines have been torn up in places, bridges destroyed and water supplies cut off. Here we shall have the regular R.E. railway companies at work mending the damage. We have at present three, but I regret to say that very shortly I believe we shall have only two. Their war strength as given in *War Establishments* is about 250 all ranks, so that we shall only have about 500 in all, and I have no doubt we shall have to supplement them whenever we can by civil labour, and probably R.E. works companies and other R.E. units may be called on to assist.

Repairs are essentially the duty of the R.E. railway companies. They are not intended to work the ordinary trains which supply the army. The trades of the men give a good idea of what they can do. They are roughly as follows :—50 carpenters, 50 fitters and smiths, 54 other artisans of different trades, 30 platelayers, 16 clerks, draughtsmen and surveyors, and 24 engine drivers and firemen.

We have you see a few engine drivers and firemen, but these will mostly be needed to run the trains of construction material required for repairs up to the front beyond the point where the ordinary civilian staff ceases working.

Whether we shall ever see the armoured train again in war I do not know—I am a little doubtful. But if we do, or if we want to run trains right out to the front for reconnaissance or to carry occasional supplies for advanced troops, the R.E. railway companies will probably have to provide the drivers and firemen.

Troops for Working Railway Traffic.

Now let us suppose that beyond Cambridge the railways belong to the enemy. The English staff will not work them, and the "Blue" army has to find its own means of working the trains, as it advances beyond Cambridge. Here I am afraid we are weak. We have at present no troops who can undertake such a job. We used to enlist

probable that lorries will have to be prepared to load up late into the night, or in the early morning before leaving for their rendezvous. So long as the distance to be run by the lorries is short, some delay in off-loading trucks would not matter so much. But where the troops are 30 or 40 miles from railhead, as may often be the case, any delay to the lorries must be avoided by every possible means. Where there is only room at a station supplying two divisions for one train to stand, the other must be kept back at the regulating station, and timed to arrive when the first train has cleared.

All these are matters for the D.A.D.R.T. at the regulation station who must be prepared with the necessary information about all likely stations so that he can advise the I.G.C. as to the selection of stations.

There are certain points to which I would draw your attention in the assumptions made in connection with the concentration and supply.

First you may argue that with all the rolling stock of a large country at its disposal, the amount which I have shown on the attached notes as allotted to "Blue" is very small. But it must be remembered that "Blue's" ally is assumed to be concentrating at the same time and possibly requires a much larger quantity.

Secondly, it must be remembered that though the stock allotted to "Blue" is a very small fraction of the rolling stock of the country, yet the cattle trucks and vehicle trucks represent a considerable proportion of the numbers of that class of truck available. In fact more than three-fourths of the rolling stock of the country is useless to us for horses, guns and vehicles. Therefore I think that even though we are operating in a civilized country with even the largest and best equipped railway system, we shall always be limited in the rolling stock at our disposal and we must study to load it always up to its full capacity and not keep it standing idle for a moment.

You must also remember that the civil necessities of a large population require fulfilling in war almost as much as in peace. Take for instance London. Political considerations would not, I think, allow us to let London go hungry and its industries out of work. At present it is mostly supplied by sea. But suppose sea routes were closed or made too dangerous for merchant shipping. Immediately you will have to bring the food, fuel and industrial necessities of a large population by rail from Liverpool, Bristol and the west, throwing an enormous additional traffic on to the lines of concentration and supply of the army.

The conditions that I have mentioned in this instance will probably be found, in different shape no doubt, in many theatres in which we might be called on to operate, and therefore I do not think that we are ever likely to have unlimited use of railways in war.

officers would advocate loading up the trains on the previous evening so that they can be ready to start from the base early in the morning and reach railhead in the early afternoon. But if the aim is to give the troops fresh meat daily I anticipate that this will seldom be done in practice, unless refrigerator vans are available or unless the weather is cold. It would mean that the bread and meat will have been on rail and road nearly 48 hours from the time of loading at the base to the time of distribution to the troops. It would also add at least 50 per cent. to our requirements of rolling stock for supplies. This additional quantity might be of perhaps small importance if only ordinary open trucks were involved, but it would probably be a more serious consideration where refrigerator vans are required. I therefore think we shall have to endeavour to load supply trains on the morning of the day they are due at railhead.

At the regulating station we have another D.A.D.R.T. with one or two R.T.O.'s whose duty is to separate each division's train and send it on to its own proper railway supply station fixed that day by the I.G.C. in accordance with next day's rendezvous sent him from army headquarters. The trains should be at their supply stations by seven or eight o'clock at latest so that the mechanical transport supply columns can load up over night ready to be off to their rendezvous the first thing in the morning to meet the supply trains. This is the procedure to be aimed at, but it may be anticipated that individual divisions will make urgent demands too late to comply before trains leave the base. Therefore a small reserve, a sort of expense store, may be necessary at the regulating station. But adding or detaching trucks at the regulating station should be avoided by every possible means, it will mean delay—trains should be pushed straight through to the railway supply station. I anticipate that under this supply system the aim will be to get the rendezvous as near the troops as possible, and railway supply stations as near rendezvous as possible.

The distance from the rendezvous and the roads giving access thereto must of course govern the I.G.C.'s selection of railway supply stations. The other desiderata are a goods yard and siding where 13 or 14 lorries can get alongside the 15 supply trucks of the division. Except in station yards of large towns it will not often be possible to find more room than this. Therefore the 27 lorries of a division will have to load in two lots, half at a time, and allowing an hour for each lot to come alongside, load and get clear, that means two hours at least to load the lorries of the division. It follows that unless we can find large station yards where there is room for the railway trains of two divisions (*i.e.*, 30 trucks) to stand and unload simultaneously into two lots of 13 or 14 lorries each, we ought to have a separate supply station for each division. Probably it will not always be possible to find seven suitable stations, and therefore it seems

off once they begin coming out of the sidings to their entraining stations.

Assume now that concentration is completed and that the "Blue" L. of C. is confined to the northern line through Bedford and Northampton with Birmingham as its only base. The D.R.T. is with the headquarters of the I.G.C., probably at Bedford, which is the "regulating station," because I think that what is known as the regulating station will be rather an important centre on the L. of C. His deputy will probably be at the headquarters of the C.-in-C., because it is most necessary that the C.-in-C. should always have advice on railway matters immediately available. If Northampton were the advanced base, just as it was "Blue's" advanced base at manœuvres, we should have another D.A.D.R.T. there. But in the case of a force operating such a short distance from its sea base, I doubt if we should have an advanced base at all. The advanced base is really the main supply depôt where we are supposed to have 15 days' reserve supplies and from whence trains are made up daily with the various rations in their proper proportion for each division. Even if the C.-in-C. considered it safe to have a large reserve so close to the area of operations, there does not appear to be any advantage in moving all our supplies from the base only to dump them a bit farther inland. Therefore in the case in point, and probably for any distance up to 150 miles at least, we shall have nothing between the base, which becomes the main supply depôt, and the regulating station.

At the base is the D.A.D.R.T. whose business is in allotting the necessary rolling stock to the various departments and arranging the despatch daily of supplies, ordnance stores, remounts, reinforcements, and ambulance trains. Under him work, as before, three or four R.T.O.'s whose duties are limited to supervision of loading and entraining. From the figures given in the attached notes (*see* Appendix) you will see that I calculate on one train for each division as a minimum, add one or two ambulance trains for evacuating hospitals on the L. of C., supplies for army troops, occasional trains of forage, remounts, and ammunition, and the daily average will be not much under 12 trains a day, but to save time and engines probably two divisions' trains will be combined as one from the base as far as the regulating station.

So far as normal daily supplies are concerned the order of procedure is this :—Each division's train is loaded up each morning with its proper proportions of meat, fresh bread, groceries, etc. The loading of the supplies in such manner that, while loading economically, everything can be got at quickly and in proper order when unloading at railhead, will require very great care on the part of the A.S.C. officers and the R.T.O.'s. By mid-day the first train should get off followed quickly by the rest so that the last should reach the regulating station by five or six o'clock. I know that some supply

the train and off by the proper time. He will wire off to the R.T.O. at destination the name of unit, etc., and time of departure. The latter has to get them out of the train as quickly as he can and send them on to their bivouac or rendezvous. The empty train is sent back to Swindon as fast as possible, where it may have to be broken up and re-marshalled in accordance with next day's requirements.

I say it may have to be broken up, but to make the best use of the rolling stock available, re-marshalling should be avoided as far as possible. It can be avoided to a great extent by forming the normal compositions so that they can take the maximum number of different units or portions of units. Thus the normal artillery train should be such that it can accommodate convenient subdivisions of horse batteries, field batteries, ammunition columns, etc., and the normal infantry and cavalry trains should be formed with the same object. But to endeavour to cram all units into three or four standard compositions must, I think, result in some waste of train space, and a certain amount of re-marshalling is therefore the lesser of the two evils.

If the proportion of infantry, cavalry and artillery to be despatched each day were the same, we might certainly get along with little or no re-marshalling. But it is inevitable that the proportions will vary on different days; and to put a series of infantry battalions into cavalry trains, no matter how much you mix up the units, will never, I think, be an economical proceeding.

There is one point here to which I would draw your attention as it arises in most troop movements. By the morning of the 12th day there will probably be 15 to 20 trains made up and standing in the sidings at Swindon, and placed with a view to their going in a particular order. That is to say, you may have in one long siding five or six trains of different compositions all standing in a row. They will come out all right in their order, but if the last train is wanted first it may mean an hour or two additional shunting, and blocking half the yard during that time. Therefore it is important from the railway point of view to settle the order of despatch beforehand and not to change it at the last minute. Of course in war where units are all at war strength you can interchange battalions with battalions, batteries with batteries, etc. In peace time at manœuvres, etc., you cannot even do this as a rule. The other day before dispersal after manœuvres when standing room had to be found for a large number of trains, the Great Northern Railway had some 20 trains standing all in a row north of Hitchin on a length of goods line which was temporarily closed for the purpose. It would have been next to impossible to get these out in any order other than that in which they were arranged, and it will be obvious that for the same reason it would be impossible to alter the composition of any train while it is so stabled, and as a rule there is no time to shunt vehicles on or

total numbers to land at each port and will allot its proportion of rolling stock to each line.

Knowing the area chosen by the C.-in-C. for concentration, he will find out which are the most suitable stations for detrainment in this area, and decide which stations are to be used for the detrainment of the various formations and units. For this purpose he will probably be accompanied in the first instance by an officer of the General Staff, because though general staff requirements will be paramount they must of necessity conform somewhat to the railway facilities available.

I may say here that when any troop concentration is contemplated or in progress the D.R.T. should, I think, be directly under the C.-in-C. and in close touch with his staff. Once concentration is over his place is, as shown in *War Establishments*, with the I.G.C.

Having arranged these matters the D.R.T. will leave his assistant to get out time tables and arrange all details with the railway officials, while he himself will get back to the base, and will probably post the rest of his staff as follows :—

One D.A.D.R.T. and say four railway transport officers at each base.

One D.A.D.R.T. and one railway transport officer each at Swindon and Northampton, and two railway transport officers at each detraining station which we may take as Hitchin and Royston for the Bristol line, Potton and Biggleswade for the northern ones. By this time the troops are beginning to arrive at each port.

Let us take the series of events at Bristol and on the southern line. On the evening of the 10th day for instance, the Base Commandant should have full details of all troops due to arrive on the 11th day, and this information he passes to the D.A.D.R.T. This officer makes out a statement of the trains he will require for these troops, which will be due to leave on the 12th day ; this he sends to the D.A.D.R.T., Swindon, and during night of the 11th—12th these trains will be made up at Swindon. This statement will of course be based on the normal train compositions already decided on in London, and will show the order in which the various compositions are wanted.

Possibly owing to want of some particular class of trucks the officer at Swindon cannot make up the trains in just the order wanted, but he will comply as far as he can, and during the night of the 11th—12th he should be able to wire the D.A.D.R.T., Bristol, the times and order of arrival of the empty trains. The D.A.D.R.T., Bristol, who has, of course, the running time tables furnished from London, then makes out on this a time table of departures for the 12th day, and issues these to the R.T.O. at Bristol, and to troops who will have landed on the 11th day and are now in a rest camp.

The R.T.O.'s business, as you know, is to show the troops where and how to load their horses, vehicles and men and to see them into

THE WORK OF R.E. RAILWAY UNITS IN WAR.

A Lecture delivered to No. 3 Senior Officers' Class, S.M.E., by MAJOR G. LUBBOCK, R.E.

I PROPOSE to describe first the concentration of a large force, and a practical application of the system of communications in rear of an army which is given on p. 132 of the *Field Service Pocket Book*.

It is assumed for present purposes that both Bristol and Birmingham are seaports, where a "Blue" force has landed to co-operate with the English Army against a foreign invader "Red," who has established himself in the north and east of Norfolk. It is also assumed that the English authorities have placed at the disposal of "Blue" two lines for concentration, viz., (1) the line from Bristol *viâ* Swindon and London to Biggleswade and Royston, and (2) from Birmingham *viâ* Northampton, Bedford, and Sandy to Cambridge. The area of concentration is the triangle Hitchin, Sandy, Cambridge. I assume also, of course, that our war establishments are the war establishments of "Blue."

To trace the series of events concerning railways from the first day of mobilization :—

Among the first people to appear upon the scene from Blueland are the administrative staff of the Inspector-General of Communications (I.G.C.). With these is the Director of Railway Transport (D.R.T.), his deputy, and his assistant, and 30 officers, and a few others whom you will find duly detailed on pp. 30 and 193 of *War Establishments* under the titles "Administrative Services and Departments," and "Railway Transport Establishment."

The first business of the D.R.T. is to get in touch with the authorities who actually work the lines allotted to "Blue." He himself and the assistant D.R.T. will probably get off to London to see the L.N.W. Railway, G.N. Railway, and G.W. Railway people. There he will find how much rolling stock can be allotted for the use of the "Blue" army, what loads can be hauled and at what speeds, and on this he will get out a table of normal train compositions similar to that shown on p. 153 of the *F.S. Pocket Book*. This table will govern the number of trains he can run per day with the engines and rolling stock allotted. When he has made himself acquainted with these matters, he will give the I.G.C. and, of course, the C.-in-C., information showing exactly how many troops can be got off each day from each base. He should already have information as to the

Night March.—Work found by reconnaissance may either be done before or during the march. If before the march, the R.E. can be concentrated at the objective of the march; if during the march, the R.E. must be at the head of the column ready told off into parties, carrying all the tools and materials required. If no reconnaissance has taken place, R.E. will be in the front.

Night Attack.—The chief duty is to remove obstacles in front of the position, and for this the R.E. must accompany the scouts, and, regardless of loss, remove them and afterwards advance with the leading troops. The men must *carry* with them all tools and materials they require. The R.E. told off to the preparation of the captured position for defence march with the third line ready to start work. All this night work can be practised in peace with not much imagination. The importance of night work cannot be exaggerated, and in order that we may be trained for the confusion and difficulties of it we should be constantly practised with other arms during their company, battalion, and brigade training.

Now I have run through very briefly the organization, training, and employment of the R.E. in peace and war, and from my remarks you will have gathered that a great deal of the successful war training of the R.E. lies in the degree of confidence extended by the commander of the force to his senior R.E. officer and the power of imagination possessed by the latter. Without this, the R.E. officer can do little to instruct his men, for they soon find out whether their work is practical or not, and if not, their interest flags and training dies.

I have frequently dwelt upon the importance of reconnaissance—without this all R.E. work is delayed. Timely information transmitted from the front may save hours of delay, and miles of extra marching.

Field companies have now 32 bicycles in war, and in peace there are usually a few volunteers riding their own machines at the usual government rates. With these bicycles the capacity for reconnaissance and intercommunication has been so very greatly assisted, that we all hope that in the next campaign the time taken over R.E. work will be sensibly reduced. The position of the R.E. at the front of a column has been arrived at by a process of trial and error, by which it has been found that the closer the R.E. are to their work, the more they can do, and the quicker they do it. We hope that this opinion has come to stay, and that in the future when the R.E. are required it will not be necessary to order them to the front from the tail of the column to take on a piece of work of which the officers have had no previous information.

between the two, it is easy to see how a portion of the retreating force might easily be cut off from the main body by the premature destruction of a bridge, or an easy channel of access from a flank be left open to an enemy.

Having sent the bulk of the R.E. with the advanced guard to do work, there are few left for the rear party, but this will gradually collect the different parties of R.E. as they catch them up, and by proper organization, there should be no difficulty in providing sufficient R.E. with the rear party to ensure the completion of important demolitions, or ensuring the following precautions being taken :—

(1) Narrow roads blocked.
(2) Fords blocked.
(3) Boats burnt.
(4) Villages, heather, etc., burnt to make a smoke screen.
(5) Demolitions.

The bulk of this work must be done on paper during peace, but frequent staff rides and regimental exercises would give very valuable training in this subject.

The question of the defence of a position has already been dealt with, and in the case of a retreat it is easy to see how it might be impossible for a commander himself to choose the position on to which he wished to retire.

Night Work (*E.T.*, Sections 116, 120).—*Reconnaissance.*—As before stated, the R.E. work is to be directed to the assistance of the other arms, and in this case as with others, reconnaissance is one of the most important duties. The R.E. officer can only do this with the complete confidence of the commander, for he must conduct his reconnaissance in such a way as not to betray the commander's intentions.

The object of this reconnaissance is twofold :—

1. *The Start* :—
   (*a*) To facilitate start.
   (*b*) Remove obstacles.
   (*c*) Improve communications.
   (*d*) Cut gaps.
   (*e*) Fill ditches, etc.
2. *The Route* :—
   (*a*) Block roads not to be used.
   (*b*) Erect signposts.
   (*c*) Deaden sound on bridges.
   (*d*) Marking of route, and position of assembly or deployment.
   (*e*) Sites for trenches at position of deployment.
   (*f*) And for a night attack we should include reconnaissance of obstacles, how they are lit up, how defended, and how best to cross them.

the R.E. officer attends, if desired, in order that he may be at hand to give technical advice as to how the R.E. can best be employed in carrying out the wishes of the commander of the force.

It frequently happens that the commander may be unable to inspect a position himself, and may send his senior R.E. officer to do this for him. In this case his instructions to the latter should be perfectly clear as to whether he requires :—

(1) A scheme for the defence of the position, or
(2) A reconnaissance and report on the position on which the commander may be able to frame a scheme for the defence.

If he desires the former, he must give the R.E. officer the detail of the troops which are available for the defence, otherwise the scheme may be far too elaborate or quite inadequate, and time is lost while the scheme is revised. Now it is only by the perfect co-operation on the part of both the commander and the senior R.E. officer that any scheme of defence can be thoroughly efficient. This co-operation can only be arrived at by means of frequent practice, and as I have mentioned before, we regard the periods of brigade and divisional training as the most important for us, as being our best chance of learning how we can best serve the commanders of mixed forces in this respect—by this means only can harmonious working in war be assured. The remaining duties are carried out regularly in peace time during the annual fieldwork course. It is now laid down that the trench work of the field company fieldwork course should, if possible, be done in co-operation with the infantry, and this is the foundation of the co-operation required in taking up a defensive position.

6. *Retreat* (*E.T.*, Section 115).—A strong party of R.E. should be sent either with, or ahead, of the advanced guard to assist in preparing for the defence of such rallying positions as may be selected by the commander of the force.

The whole object of the action being for delay, it depends upon the circumstances of the case whether this can be effected best by demolition or trench work, but as a general rule determined pursuit can best be checked by fighting, and strengthening points in a rallying position will usually obtain priority. The R.E. work in a retreat will therefore include :—

(1) Preparation of bridges for destruction.
(2) Improving line of retreat.
(3) Closing fords.
(4) Obstacles.
(5) Destruction of telegraphs, water supply, and railway lines.

In order that the pursuit may be effectively delayed by the above, the senior engineer officer with the force must have the confidence of the commander of the force. If there is not complete sympathy

For the effective performance of all these duties it is absolutely necessary that the engineer commander should know the plans of the commander of the force. From the above formidable list it is easy to picture a field company fully engaged in making a bridge over a stream for the R.A. or cavalry, when what was really required was the removal of an obstacle to the infantry advance.

In peace time many of these things can be done actually. All of them can be done on paper, but they cannot be done effectively unless disposition of the R.E. is the same as for war, and the C.R.E. is acquainted with the intentions of the commander of the force.

The manual lays down that a certain proportion of R.E. should be as far forward as possible. They will be accompanied with the vehicles as far as circumstances admit, and afterwards they will carry tools and explosives, etc. *They should not be relegated to the reserve except for some definite purpose.* The guiding principle is that "engineer work to be useful must be executed in time, and this is impossible if the engineers are kept too far back" (*E.T.*, Section 110 (5)).

A very useful item in the training of R.E. for work in the attack is the quick recognition by all ranks of the nature of works thrown up by the defence. In these days all works are, or should be, carefully hidden, but the presence of even the best hidden work may be given away by some small detail which it has been found impossible to hide. A short length of a straight line may indicate the crest of a parapet or a traverse, a dark shadow may betray the loophole. The R.E. eye should be trained to know what to look for, and how to recognize it.

5. *Defence* (*E.T.*, Sections 112, 113).—The commander of the force will determine the line which will be held by the force. A R.E. officer will accompany the commander while he inspects the line if desired. The distribution of engineer units to sections is ordered by the commander of the force. The commander of engineers is responsible for collection of tools and materials and their issue to commanders of the sections of defence, and for the distribution and supervision of all military and civilian labour not allotted to section of defence, and for all engineer work not specially detailed to the other commanders.

The duties of the R.E. in the defence of a position will include:—

(1) Work requiring technical skill.
(2) Technical advice (when required).
(3) Overhead cover.
(4) Revetments and drainage.
(5) Mechanical alarms and signals.
(6) Assisting in construction of obstacles, etc.

It is most important that the relative responsibilities as laid down should be thoroughly understood by all. In taking up a position

when the site is selected. All this work can be practised in peace, and very valuable it is.

3. *Quarters* (*E.T.*, Section 107).—Under this heading would be included all work in camps and bivouacs, both for defence and comfort of the troops. All of you, of course, are well acquainted with the work the R.E. do in camp, but probably do not know the difficulties we labour under to get it done.

Water supply is the most familiar and the most important of these duties. Here again, we want time. Men and horses come into camp after a long march parched with thirst, the sight of possible water increases this; both men and animals are very difficult to control under the circumstances, and in the turmoil and fighting for water the R.E. are hampered, their equipment is broken and rendered useless, and everyone suffers.

Given a hint of the probable site for camp, given a chance to have a first look at a possible water supply with the medical officer, so that a scheme for the distribution of the equipment and labour may be made before the troops arrive in camp, the R.E. can obviate much of the discomfort and hardships above-mentioned, but they must be backed by orders issued by the staff and an efficient water police service. The difficulties of the R.E. do not cease when the arrangements are made and the pumps and troughs have been put down. Next morning the force probably moves off early, and as I have already shown the R.E. are well forward in the line of march. They must start at the proper hour, but before marching they must pick up their equipment. Orders must therefore be published stating the hour up to which the water supply equipment will be available. This hour should be settled in consultation with the C.R.E. or senior R.E. officer.

As soon as the army occupies permanent or semi-permanent camps, the training in building to which I have already referred is justified. All of you will recollect how much building was done in the camps in Africa both during and after the war. Without the R.E., little would have been possible, owing to the scarcity of civilian skilled labour, especially up country. In South Africa it was found that units without tradesmen could not take the place of field companies where building operations were involved. Under the term "buildings" I include all accessory works such as a permanent water supply and drainage system, etc.

4. *Attack* (*E.T.*, Sections 109, 110, 111).—Engineer duties in the attack are:—

(1) To assist various arms in the crossing of natural obstacles.
(2) To strengthen a position captured by the infantry.
(3) To remove artificial obstacles.
(4) Communications.
(5) Erection of observatories.
(6) Water supply.
(7) Fighting, if required.

regarding material, extra tools, or natural resources of the neighbourhood. It is easy to see that by this disposition of R.E., any work which may become necessary is more quickly and efficiently dealt with, than if the technical officers and their skilled tradesmen are kept back in rear of the column.

Now the training for this work is not difficult to effect in peace time; the reports and all paper work can be done and valuable practice can be obtained in getting out schemes, if a reasonable amount of imagination is exercised in this branch of our work which we call engineer reconnaissance, but it cannot be done unless the R.E. are properly disposed of in the order of march. It may seem unpractical for a small body of R.E. with their vehicles to be sent with an advanced guard, and the work which they may be actually capable of doing may be very small, but experience shows that we must practice in peace the dispositions which obtain in war, and engineer reconnaissance must be practised continually if the work on the march on service is to be done expeditiously. In addition to this road work, arranging a temporary water supply must be mentioned. The latter is of course frequently carried out.

The *Engineering Training Manual* lays down in Section 96 (1), that the bridging equipment vehicles will accompany the train unless it is likely that they will be required during the march. In my opinion this policy is unsound. Unless a road has been thoroughly reconnoitred beforehand no one can tell from the $\frac{1}{2}$-in. map alone whether bridging will be necessary or not. If the bridging equipment is required at all it is required at the head of the column in order to pass guns and vehicles over a gap without delay. An infantry division is $14\frac{1}{2}$ miles long, *i.e.*, three hours' march at least for the bridging wagons if they were at the head of the train.

The three bridging wagons occupy a space of 60 yards. Apart from the evils connected with disintegrating a unit the advantage of saving 60 yards in a length of a column of 14 miles does not appear to me to be equivalent to a possible delay of three hours.

2. *Passage of Rivers* (*E.T.*, Section 98).—Engineer work in connection with this includes:—

(1) Reconnaissance.
(2) Construction of bridge from equipment.
(3) Construction of bridges from material collected locally.
(4) Improving an existing means of passage.

As regards reconnaissance, it is of course of the utmost importance that the bridges should be constructed to suit the tactical scheme, but it must be remembered that the selection of a site without regard to the nature of its approaches may result in such delay in the construction of the bridge and its approaches as to render it worthless, so that sometimes the actual site must be a compromise. For this reason therefore it is essential that a R.E. officer should be present

5. The number of engineers is limited, and therefore every care must be exercised to see that they are employed only on such work as demands technical knowledge or special tools.
6. Engineers must always be prepared to defend themselves, and may, *in an emergency*, be employed as infantry.

The number of field companies in a division is two, and the engineer commander of a division is the C.R.E.

General Employment in Peace and War (*E.T.*, Ch. VII.).—My object now is to put before you the employment of field companies in peace and war, and I think it will be best to study the duties of the R.E. in war, and then see how we can obtain training for these duties in peace.

The new *Engineer Training Manual* lays down that the work of the engineers is to aid the other arms in carrying out the intentions of the commander of the force.

Engineer officers, to do their work effectively in co-operation with other arms, must have a clear grasp of the intention of the commander of the force, otherwise the men may be tired out by work of temporary importance when the situation really demands that they should be kept fresh for something later in the day. I propose to deal with these duties under the following heads :—

1. March duties.
2. Passage of rivers.
3. Quarters.
4. Attack.
5. Defence.
6. Retreat.
7. Night operations.

1. *March Duties* (*E.T.*, Section 96).—A proportion of the R.E. should be with the advanced guard and the remainder should be near the front of the main body. The reason for this is given in the last two lines of the quotation I made a moment ago.

The rate of progress of an army along a road depends upon its nature, and it is most important that all obstruction should be moved therefrom as quickly as possible, in order to obviate checks. These obstructions may take the form of :—

(1) A length of bad surface.
(2) A broken, or unsafe bridge or culvert.
(3) Sudden narrowing in a cutting.
(4) Sharp corners, or
(5) Trees felled across the road.

Technical knowledge, or special tools and equipment, are required to deal with all of these, and the sooner the R.E. with the troops can get to the obstacle the quicker will it be removed or a proper scheme prepared for the execution of the necessary work.

If the work is greater than can be efficiently dealt with by the numbers at his disposal, the R.E. officer in front can send back an intelligent professional report to his immediate senior who can, from his report, frame a scheme, requisition for the working party from the troops, and hasten up additional vehicles and tradesmen required for the work from the R.E. with the main body. Meanwhile the R.E. officer with the advanced guard would collect all information

signalling, and other duties required to be known by them in war time, by lectures during the winter evenings and as opportunities offer.

Collective Training (*E.T.*, Ch. III.).—Collective training includes drill (which is of course practised all the year round), musketry, and the annual course of fieldworks and the special course of bridging. This is usually completed by the end of June, and then the company is available for collective training with other branches of the Service.

Field companies are attached to brigades during brigade training, and in the divisional training and manœuvre period they are allotted to their own divisions. Thus you see the training of the field companies is as progressive as that of any other portion of the field army. With us, as with the rest, the object of all training, including the period devoted to building, is for efficiency in war. The collective training includes all the preliminary training for field engineering, but it is when we are affiliated to brigades and divisions that we endeavour to acquire our realistic war training.

In the absence of definite regulations on the subject, the correct employment of field companies in the field has not always proved to be a simple matter, chiefly, I think, because the R.E. equipment and training was not familiar to anyone but themselves. In days gone by, the possession of a field company by a commander of a force was regarded as a nuisance, and unless there was a very obvious opportunity for employing it on trench work or bridge building, it was relegated to the rear, and I have known of a commander of a force being surprised to hear that the R.E. carried rifles and could be used as infantry. This of course was several years ago. Now that the *Engineer Training Manual* has been published, there should be no more confusion.

Generally speaking, the duties of the R.E. on service are :—" To apply engineering science to the emergencies of modern warfare, in order to protect and assist troops ; *to ameliorate the conditions under which they are serving ; and to facilitate locomotion.*"

The general principles of employment of the R.E. are shortly, as follows (*E.T.*, Section 85) :—

1. Their work must conform to the tactical situation and the plans of the commander of the force.
2. Engineer work *requires time*, and therefore the engineer commander must be informed of what may be required of him early, or time may be wasted and work incompleted.
3. To assist in the same object, the engineer commander must organize *engineer reconnaissance*, after consultation with the staff.
4. The work required from the engineers may be too much for the numbers available. The engineer commander must inform the commander of the force if this is the case, and obtain from him the order of priority to be given to the various works.

recently every sapper was a tradesman of a specified trade, but the latest approved establishment include a certain percentage of men called pioneers. These men, though they certainly may keep up the numbers of the corps, are not tradesmen, but are what may be called "tradesmen's mates." Under certain conditions they are allowed to learn a trade and become sappers. The possession of the tradesman in the corps is very precious, and if we are to continue to enlist them we must give the men a chance to improve their trade qualifications while they are with us, so that they may not be handicapped on their return to civil life. This is a very important factor to be kept in view during the annual training of a field company. The mounted portion are enlisted quite separately, and are trained in mounted duties only. They are not available for work with the dismounted men except as drivers of vehicles.

Organization.—The company is organized in headquarters and four sections: each section is a self-contained unit, and may be detached from its headquarters for a considerable period at a time. An example of this is the 11th Company, R.E., in South Africa, which had at one period its headquarters at Mafeking, one section near Rustenberg, one section near Belfast, and one section at Komati Port; one of the sections was absent from headquarters 18 months.

The section is the only subdivision of a field company; there is no such thing as half a field company, R.E. If more than one section is detailed in orders, the proper designation is two sections, or three sections.

Equipment.—I think that all I need say of the equipment of a field company is that it consists of sufficient entrenching tools, cutting tools, and tradesmen's tools to meet the requirements of the company. These tools are not available for loan to other units except in very special circumstances; in addition to these tools, explosives and water supply equipment are carried. The former consists of about 560 lbs. guncotton, fuzes, etc. This latter is a figure to be remembered, for it frequently happens that the demands for explosives on even one field day are far in excess of the amount actually carried. The water supply equipment consists of four pumps and four troughs. This is supplemented in peace time.

Training.—The training of a field company follows the same general lines as for the rest of the army. During the individual training season the men are employed at their trades, and every effort is made to reserve a suitable piece of work, included in the Barrack Annual Estimates, for execution by each field company; for instance, a block of officers' quarters, a stable, or a block of shops and stores and other similar buildings. It is found that by this means the officers, N.C. officers and men obtain training in the general engineering and building branches of their profession in its most interesting form. During this period too, opportunity is taken to instruct N.C. officers and men in R.E. reconnaissance, map reading,

THE ORGANIZATION AND DUTIES OF FIELD COMPANIES, R.E., IN PEACE AND WAR.

A Lecture delivered to No. 3 Senior Officers' Class, S.M.E., by MAJOR R. N. HARVEY, D.S.O., R.E.

THE subject of this lecture is The Organization and Duties of Field Companies in peace and war, and the easiest way I think of realizing the real capacity for work which is implied by the words "1 section of a Field Company, R.E." which so frequently figures in all orders now, and is on manœuvres represented by two sections of fours, or even less, is by studying the tables which show its actual peace and war establishments. It is because the sections are so weak in peace time, that the real advantage of possessing such a unit would seem to be so often overlooked by commanders in the field. It may be difficult to think that six or eight men, R.E., followed by a tool cart, is likely to bring any important bearing on a field operation, but this only requires the exercise of a certain amount of that same imagination without which no peace manœuvres can be successfully conducted. When we see clearly what the section, field company, R.E., really means, perhaps *imagination* may be assisted.

Now considering the officers and dismounted portion only, the peace establishment of a field company is 3 mounted officers, 1 C.S.M., 4 sergeants, and 110 rank and file, but the actual peace strength of the dismounted rank and file of a field company is never as much; a third of the peace establishment being deducted for the purpose of forming a training depôt; and other casualties reduce the actual strength to about 70; therefore for manœuvres the strength of a section cannot be expected to be above about 16 rank and file, and even this small total is rarely realized.

Horses and Vehicles.—The number of draught horses allotted in *peace* time is 18, and with these can be horsed either four double tool carts and a water cart, or the three bridging equipment wagons. Thus you see that, though the peace equipment vehicles consist of four tool carts and four forage carts, one G.S. wagon and three bridging equipment wagons, horses are only provided for a certain proportion of these; and all the vehicles of a field company, R.E., cannot be made simultaneously available unless horses are borrowed from other units, which is very difficult to arrange. The water cart is a mobilization vehicle, but is specially exempted from the restrictions to which the remainder of the mobilization equipment is subject, and it is available for use in camp or on manœuvres.

Personnel.—As you doubtless know, the dismounted portion of a field company is recruited from the tradesman class, and up till

be required in order to make his defences complete. A good rule to follow in this respect is that the enemy should not be able to approach within 300 yards of any work, without being exposed to a heavy flanking fire at an effective range—less than 1,000 yards—from one or more other works.

When his works are complete, he should mark on the plan the points at which the enemy will come under the heaviest fire, that is the points where he will be caught by flanking fire from one, or more, works. The section commander should then go over the ground with the commander of the local reserve, and show him these points. The position of the local reserve can then be allotted, and the line of advance of the counter-attack selected.

be impossible for him to silence the flanking works. It should also be remembered, in this connection, that the flanking fire of one rifle has more moral effect than the frontal fire of ten. Nothing can be more disconcerting to the attacking force than to be caught by a heavy burst of flanking fire just as they are preparing for the assault.

But all these preparations for the counter-attack will be useless, if the commander of the local reserve misses his opportunity. The *Field Service Regulations* lay down that local counter-attacks shall be delivered on the initiative of the section commander. But as the opportunity for a local counter-attack is generally short—a matter of minutes only—it seems probable that it will be missed altogether, unless the section commander is with the local reserve and can give his orders on the spot. If the section commander is not with the local reserve, he should delegate the initiative to the commander of the reserve.

The opportunity for a counter-attack will normally arise when the flank defences have come into action and the defender's fire has reached its maximum. A good rough rule for the commander of the local reserves would be, that he should advance to the counter-attack as soon as the machine guns in the flank defences open fire. If he does this, he will usually allow just sufficient time for the flanking fire to attain its greatest effect before he reaches the enemy with the bayonet. But every case must be judged on its merits. The point to be insisted on is, that the commander of the local counter-attack must study the flank defences very carefully before the action, and see for himself the exact spot in the enemy's advance where the flanking fire will strike him. When the enemy reaches that spot he will know that the decisive moment, the time for the counter-attack, has come.

It may be objected that this is far too rigid and mechanical a method of judging the moment for the counter-attack. No doubt a military genius, relying entirely on his own instinct, might select a more favourable moment. But it is not safe to count on the commander of the local counter-attack being a military genius, and it is far better that he should judge his opportunity by the foregoing method, than that he should trust to a chance inspiration. The danger is that, unless he has made up his mind beforehand to attack at a certain moment, he will never attack at all.

To consider the practical details of the system. In order that the section commander may perfect all his arrangements, he should have a plan of his section prepared at the earliest opportunity. On this plan should be shown all the defence works, and the field of fire of each, both to the front and flanks. By studying this plan he will be able to judge very rapidly—much more rapidly than by inspection on the ground—what additions, and modifications, will

posted on the rear crest of a ridge, or in some similar position, where the field of frontal fire is limited to some 600 yards. This position has the further important advantage of rendering the works difficult to locate, and so protecting them from the attacker's artillery; the communications are easily concealed, and the local reserves, which are to make the counter-attack, can generally find cover close to the works.

But because the rear crest is deliberately chosen for the line of resistance, the forward crest should not be abandoned altogether; though the enemy is to be lured on, this does not imply that in the more distant stages his advance is to be quite unmolested. The forward crest, in fact, must always be held in sufficient strength to prevent the enemy from bringing any formed body of troops within range of it, but the exact amount of resistance that should be offered as the enemy advances to the forward crest can only be determined during the course of the action. It should never be enough to check him altogether.

Some French writers have urged that the forward crest should be held in sufficient strength to compel the enemy to carry it by assault. Then as soon as the assaulting troops appear over the crest line they will be caught by the fire from the main line of works, and thrown back by a vigorous counter-attack. This method, however, demands a very large number of men, for there are virtually two lines of works to be held in strength, and the defenders will need as many men per yard of front as the attacker. Also the fate of the garrisons of the forward line of works does not appear to have received very sympathetic consideration.

Where the topographical features are ill-defined, crest lines disappear, and a defensive position becomes an irregular line of localities, which must be held because, for one reason or another, they are of tactical importance. Here again the defences must be designed in such a way that the enemy's attack is not checked at too great a distance. This may be contrived if the security of each locality is made to depend more upon the flanking fire from the neighbouring localities, than on its own frontal fire. In short, the rule for the fortification of such localities should be—a few small, and well-concealed works to sweep the front, but numerous, and well-armed works for flank defence. Machine guns should always be provided for the flanking works, as they are peculiarly suited to this *rôle*, and their position on the flanks should prevent them from being put out of action by the enemy's fire. Field guns may also be used with advantage.

The use of highly developed flank defences of this nature is the most certain method of ensuring that the defending force shall have a marked superiority of fire at the decisive moment, for though the attacker may smother the frontal defensive works with fire, it should

LOCAL COUNTER-ATTACKS.

By CAPT. J. E. E. CRASTER, R.E.

IN the whole business of war there are few undertakings more difficult than a local counter-attack, and none that are so seldom brought to an entirely successful issue. This is due to two causes:—

1. Because field defences, and defensive tactics, are rarely designed to favour them.

2. Because the opportunities for them are fleeting and are seldom anticipated by the defending force, so that the counter-attack is not launched in time, or else is not launched at all.

If the most is to be made of local counter-attacks, they must be kept in view from the moment that the defensive position is chosen. For instance, if a force takes up a position with an extended field of frontal fire, it is probable that the enemy's advance will be checked by a heavy fire while he is still a long way from the position. In this case opportunities for local counter-attacks will never arise, and the defenders will have the mortification of waiting impotently while the enemy develops some new method of attack.

Repeated instances of this occurred during the South African War, for the country offered many positions with extended fields of frontal fire, and it was these positions that the Boers chose. As a result the British advance was generally checked by long range fire, and the Boers had few, if any, opportunities of making local counter-attacks. Consequently they were never able to strike a vital blow at the British, and the latter withdrew their troops, often without serious loss, and always without serious disorganization.

No decisive result can be expected if the enemy does not come within striking distance. It is only therefore when a defending force is fighting a purely delaying action, that it is justified in holding the enemy at a distance with long-range fire. The normal object of the defender should rather be to lure the enemy on until he is close to the defence works, then to disorganize his troops with a heavy burst of fire at close range, and finally to crush them with a counter-attack.

These tactics demand a great deal of self-restraint on the part of the defending troops, especially if they are posted in works from which they can overlook the whole of the enemy's advance. It therefore seems desirable that the defender's main works should be

length to do at a time. It was also responsible that all the sleepers were spaced correctly under their chalk marks and square. The outside hole in each chair was first bored and the spike half driven; the gauge was then tested and adjusted if necessary, and the remaining two holes were then bored and spiked.

The fastest time made was one rail length (including 12 chairs, 3 spikes per chair) gauged, bored, and fully spiked in ½ hour. The average was, however, usually ¾ hour. Sixteen parties were formed and they generally completed the ½ mile about 2 hours after the linking in had been completed. If another 20 to 30 men had been available the work could thus have been easily speeded up by at least 2 hours.

On this basis with 150 sappers and with correctly fitting chairs, it ought to be possible, with only a 4-hour block, to complete ½ mile of heavy renewals. To make this daily average, in addition to the above, at least 75 coolies would be required for opening out the ballast, and 25 to 50, in addition to the ordinary gangs behind, for lifting and packing, etc.

the spike holes was then found by placing the chair in position and marking the sleeper through the holes, after which the holes were bored and the chairs spiked on. One sapper bored 100 sleepers (300 holes) and 1 sapper spiked 150 chairs (450 spikes) easily in 1 day.

Putting In and Lifting Out Sleepers with Chairs.—Three men per sleeper proved the quickest, though two men can do the work if there is no bank to carry the sleepers up.

Rail Lifting.—After being turned out of their chairs by three men with bars, the rails were lifted and thrown clear by a party of 12 men. These men worked at the double by word of command or by whistle, and one party threw out ½ mile of rails in ½ to ¾ an hour. This rate is far beyond the capacity of coolie labour.

Putting Rails in Chairs.—This operation was found to regulate the speed of the day's work. The chairs supplied were very tight between the jaws and great delay was experienced in getting the rails into 12 chairs at once. The method finally adopted was as follows :—

The chairs spiked to the sleepers were first roughly spaced and aligned by means of a 100-ft. cord. The rail was then laid on the sleepers inside the chairs. Using the rail as a straight edge, all the chairs were aligned on it by pulling in the sleepers until the chairs touched the rail. The rail was then lifted on to the chair and placed on its side, with the lower table partly in the jaws. The rail was next turned over into the chair. Owing to the tightness of the jaws this latter operation always gave trouble. It was found necessary to send every man to the free end of each sleeper to lift it up and shake it about, while 2 men with bars endeavoured to turn the rail over into its seating. As every sleeper had to be manned 12 men were required, plus 2 with bars, making a party of 14 under a N.C.O.

If the chairs had been easier in the jaw, the first alignment with the cord would have been sufficient and the rail could then have been dropped directly into its seating. Twelve men would have been sufficient and the ½ mile would have been completed at least 1½ hours earlier, *i.e.* by 12 noon.

The party putting in the opposite rail consisted of 12 men and no difficulty was experienced as the rail was put into two chairs only, one at each end, and the remaining chairs were afterwards slipped into their places from underneath the rail.

Marking Sleeper Interval on Rail.—The interval centre to centre of sleepers (2 ft. 2 in. at the joints and 2 ft. 6½ in. elsewhere) was marked off on one rail, and the corresponding position then squared off on the opposite rail.

Gauging the Opposite Rail.—For this purpose parties of three were formed. One man held the sleeper close up to the rail and chair with a crow-bar, one man bored holes, and the third drove the spikes and tested the gauge. Each party was given a rail

By 9.30 the dismantling was completed, and as men became spare they were reorganized as follows:—

Hour.	No. of Men.	Nature of Work.	Tools.
9.30	14 Sappers	Laying rails in chairs	2 bars.
a.m.	30 ,,	Reinforce sleeper laying party.	
to	2 ,,	Placing chairs in position.	
3 p.m.	12 ,,	Laying opposite rail on two chairs.	
	2 ,,	Distributing spikes and keys ..	2 baskets.
	12 ,,	Linking up fish-plates	2 spanners each.
	2 ,,	Marking sleeper spaces on rail ..	chalk and square.

By 10 a.m. the sleeper laying party became available, together with various odd men. These, after a short stand easy, were organized as gauging parties, 3 men per party, with 1 keying hammer, 1 gauge, 1 auger, and 1 bar, for tools. Sixteen gauging parties were thus formed. These parties were distributed at rail-length intervals, and as each party completed its rail it moved ahead. By 1 to 1.30 p.m. the rail-laying parties finished their work and a continuous line was once more established. As these men became spare they were put on to lifting, straightening and packing. By 4 p.m. the gauging was usually completed and the line ready for trains. If there had been any necessity the line could have been made fit to pass trains by 2.30 p.m. No attempt was made to keep the same men on the same work each day. In fact this was expressly guarded against to allow every man to get accustomed to the different work.

Coolies are not included in the above details. 50 to 60 were fully employed in packing up the line already completed.

The 4¼ miles were completed in 20 days, of which only 12 days were occupied in linking. The remaining days were devoted to opening out the ballast, collecting material, etc. The company remained an additional five days to give the line a final lifting and packing.

Notes on Rates of Working, etc.

Opening out the Line.—This consisted of opening out all the ballast to the level of the bottom edge of the sleepers. Each sapper did two rail lengths per day. Local coolie labour barely managed one length per man per day. The ballast consisted of round river bed shingle, mixed with sand, which seemed to bind it together and make it difficult to open out.

Marking Sleepers for the First Chair.—The position of the chair was found by means of a template and marked. The position of

(2). Immediately after the passage of the last train the line was dismantled for the length to be done that day.

(3). The material was then placed in position and the line linked up.

(4). Finally the line was straightened and roughly packed.

Organization of Work.—For the first day's linking it was decided to do only ¼ mile. This was completed by 5 p.m. but there were many delays owing to the men being in want of practice, material not always being at hand, staggered joints having to be squared, the work being on a curve, etc., etc. After a week's work, however, this amount was completed easily by 3 p.m. and the remainder of the time was spent in packing and straightening, getting material out for the next day's work, etc.

From the 2nd to the 3rd mile the work was speeded up to 60 rail lengths per day (88 rail lengths to ½ mile), the linking still being finished by about 3 p.m.

For the final mile and a-half the length was 88 rails per day, or ½ mile. After roughly straightening and packing the men were dismissed from work about 4 p.m., except the coolie labour which was kept busy lifting and packing the previous day's work.

Half a mile is considered an excellent day's work for the number of men employed, and could not be much increased without undue fatigue to the men. In an emergency, however, 100 to 120 rail lengths (⅝ to ¾ mile) could have been linked, and train passed, by 5 p.m., *i.e.* in an 8-hour block, in favourable weather.

The following was the organization found most suitable :—

Hour.	No.	Men.	Nature of Work.	Tools.
9–9.30 a.m.	12	Sappers	Removing remaining fish-bolts ..	2 spanners each.
	2	,,	Knocking out keys	2 keying hammers.
	6	,,	Collecting nuts, fish-bolts, keys, etc., and stacking clear of line.	
	3	,,	Turning over rails	3 bars.
	12	,,	Lifting out rails.	
	20	,,	Lifting and throwing out sleepers.	
	12	,,	Cleaning and levelling road bed ..	6 picks, 6 shovels.
	22	,,	Laying new sleepers.	
	6	,,	Aligning and roughly spacing sleepers	100-ft. cord.
	5	,,	Collecting chairs, pins, keys, etc. ..	2 baskets.
Total	100	Sappers.		

however, became evident that the whole section required renewing at once. This was the more necessary as very heavy engines, to haul the trains up the steep gradients to Quetta, are used over this line, and the light 20-lb. chairs were not at all satisfactory. Accordingly orders were issued to renew a length of some 4¼ miles. The new material required, including new deodar sleepers, 40-lb. chairs, spikes, etc., were collected and then distributed along the length. Twelve sleepers were to be laid per rail length, as the 75-lb. rails were somewhat light for the heavy engines in use (between Abigum and Kholpur, where the gradient is as heavy as 1 in 25, 100-lb. rails are used). This gave a spacing of 2 ft. 2 ins. at the joints and 2 ft. 6½ ins. elsewhere, centre to centre of sleepers.

The work was sanctioned towards the end of February, 1913, and as it was desired to complete the job before the end of March, the end of the financial year, it was decided to take 100 men of the 26th (Railway) Company from the Nushki Line to do the work. In addition to the S. & M. about 50 to 60 coolies were also engaged. Accordingly 110 rank and file of the 26th (Railway) Company were entrained and sent into camp on March 2nd.

Method of Working.—Two main systems presented themselves for consideration.

(1). To fasten one chair to each sleeper previous to laying and spiking the other to gauge.

(2). To fasten both chairs to the sleepers previous to laying.

The latter method is probably the quicker, but from experience gained at Delhi it is difficult to get a uniform gauge in this way, unless good templates are made, and as these were not available it was decided to employ the first method.

Owing to the scarcity of men it was impossible to carry out all the operations of boring and spiking chairs, opening out the line, linking, lifting and packing, etc., etc., on the same day. So the system was adopted of opening out enough line, *i.e.* removing the ballast, and spiking on sufficient chairs, to last for two or three days' linking. As there was a speed restriction of 15 miles per hour over the whole section, there was no danger in opening ½ to 1 mile of line at a time.

It had been arranged to run most of the traffic at night, so that we were able to get a clear block of eight hours if required, from 9 a.m. to 5 p.m.

On linking days the method of procedure was as follows :—

(1). Before the arrival of the last train in the morning two fish-bolts were removed from each joint, and the remaining two bolts were first eased and then tightened again to pass the train.

HEAVY RENEWALS BY THE 26th (RAILWAY) COMPANY, SAPPERS & MINERS.

By LIEUT. G. D. RHODES, R.E., *O.C. 26th (Railway) Co., S. & M.*

As so many officers seem to be unaware not only of the work done by the Railway Companies in India, but even of their very existence, the following short account of some heavy renewals recently carried out by the 26th (Railway) Company, S. & M., may prove of interest.

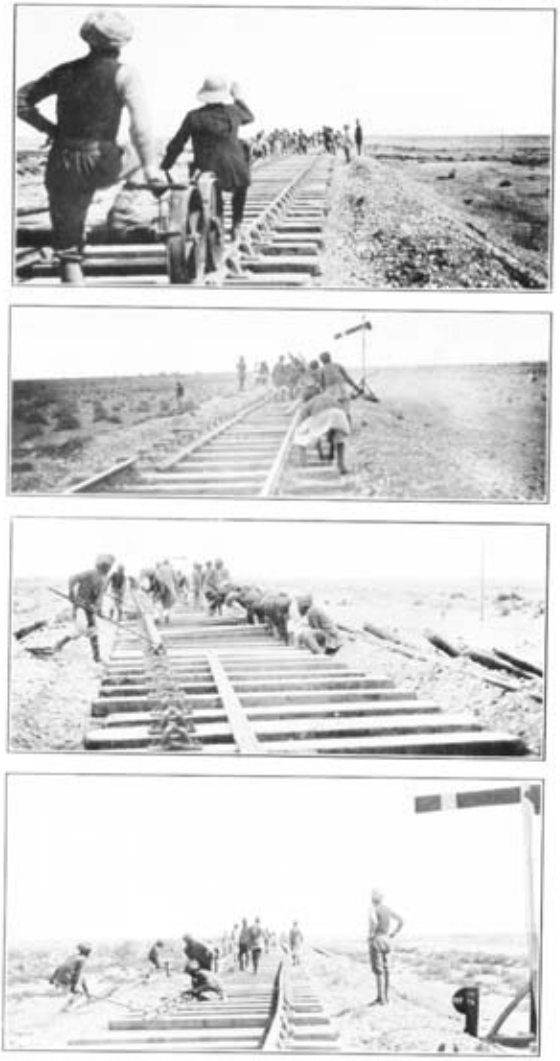
Although raised in 1903 and 1905 the development of the companies has been very slow. The original idea apparently was to form a railway battalion of six or eight companies, but up to date only two—known as the 25th and 26th (Railway) Companies, Sappers & Miners—have been raised, and these are quite independent of each other and of the three Corps of Sappers and Miners. The commanding officers are given the title of "Commandant," but are generally subalterns with only a few years' service. The companies, also, were used as stepping stones to employment on State railways and in consequence they suffered from the continual change of O.C.'s. When the present O.C. of the 26th Company took charge he was the seventh O.C. the company had had in six years. This custom has now been discontinued, no change having taken place for two years.

Originally also the companies were only employed in maintaining branch lines where the traffic was exceedingly light, and this hardly tended to efficiency. Both companies were, however, sent to Delhi to build and maintain the narrow-gauge, and part of the broad-gauge railways required for the Durbar. This was exactly the kind of experience required and at the end of their time there (nearly a year) they showed vast improvement, which without doubt will be hard to maintain except with such practice as is described in the following notes :—

HEAVY RENEWALS, MUSHKAF, N.W.R.

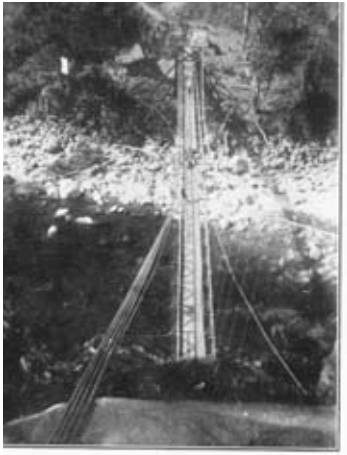
Nature of the Work.—Between Sibi and Mushkaf on the main line to Quetta, the permanent way consisted of 75-lb. rails laid in 20-lb. chairs on wooden sleepers. These sleepers had been laid some ten years and it was found that they were badly eaten by white ants. It was at first attempted to repair the road by removing only the worst of the sleepers and replacing these with new ones. It soon,

HEAVY RENEWALS BY THE 26th (RAILWAY) CO., S. & M.



No. 1. Straightening the New Road. No. 3. Turning the Rail over into the Chairs.
No. 2. Dismantling the Old Road. No. 4.—Gauging Parts.

Heavy Renewals



View from Cliff Anchorage.

A Trestle.

THE DELEI RIVER SUSPENSION BRIDGE, MISHMI COUNTRY.

A Rock Anchorage

Type of Bridge Employed.

THE DELEI RIVER SUSPENSION BRIDGE, MISHMI COUNTRY

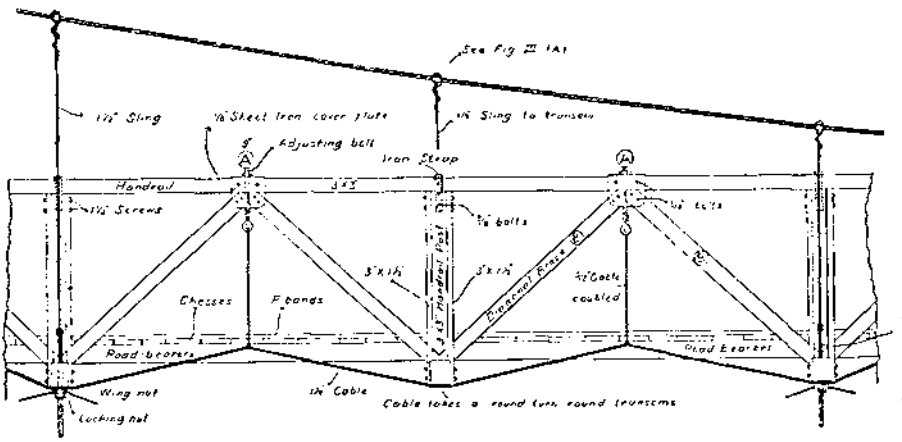


FIG. 3.

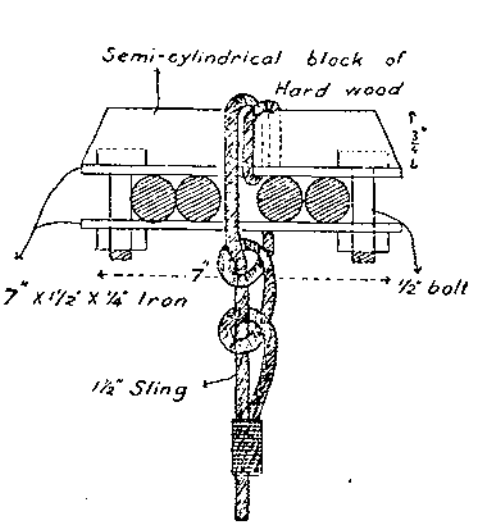


FIG. 3 (A).

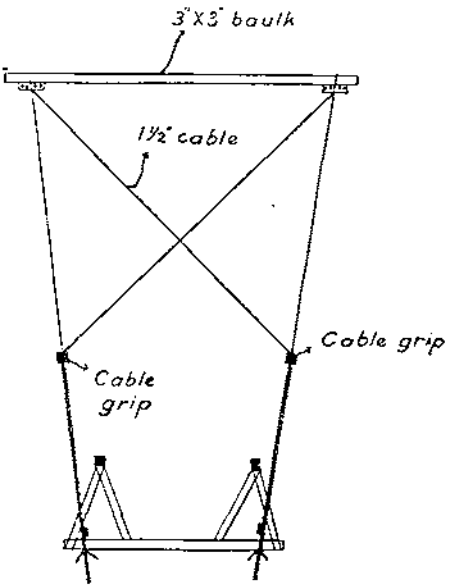


FIG. 4.

The longitudinal stability thus obtained was very satisfactory, but the bridge had a tendency to " roll," which was attributed to the fact that the up and downstream cables were of different lengths. To check this the two were cross-connected as shown in *Fig.* 4. One such cross-connection would probably have been sufficient, but three were made, the great length of the slings making this possible without affecting the headway in the least and the remedy was very effectual.

For lateral stability, two horizontal catenary 1½-in. cables were added. The " dip " of these was about 1 in 9 but a greater dip would have been more effective. Some difficulty was experienced in ensuring that an equal strain was put on to each when tightening up, in order not to pull the bridge out of the straight.

ing bolt must be set to the transom. It can be calculated by assuming that the cables will lie in the same plane as the line of the adjusting bolts and the line joining the points of supports of the cable.

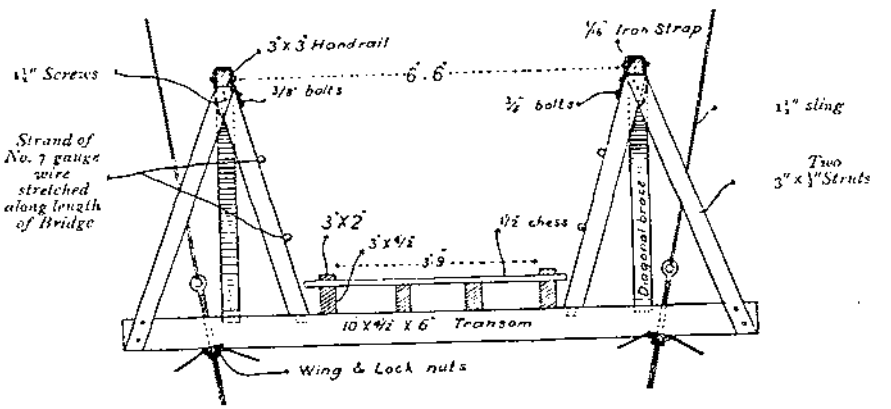


FIG. 2.

Stiffening.—With, however, a span of 273 ft. of cable, a dip of 1 in 9, and a dead load of merely 110 lbs. per ft. run of bridge, it was evident that some sort of girder effect was essential for longitudinal stability. *Fig.* 3 shows the arrangement employed. It was simple and easy to construct and the adjusting bolt (A) makes adjustment at any future date a very simple matter, should any of the girder members work loose. Owing to the outward splay of the handrail, the outside roadbearers could not be used as the lower boom of the girder—and to save the extra weight which would have been caused by the use of two additional longitudinal timbers vertically under the handrail, a 1½-in. steel cable was used for the tension member. At first, the diagonal braces (B) (B) were very lightly connected to each other and to the handrail. It was noticed, however, that when a heavy live load was on one half of the bridge only, the girder towards the further end was subjected to a considerable reversal of stress; so much so, in fact, that after the passage of one or two mule convoys, in both the end bays of the bridge the joints were seriously damaged. This was effectually remedied by the use of heavier iron-work at the joints, the final arrangement being as dimensioned in the diagram. There can be no doubt that for light semi-permanent suspension bridges of any considerable span, a girder handrail should always be provided to stiffen the roadway, and very careful attention should be given to the design and construction of the joints. Nails or screws are quite useless, the stresses due to a moving load causing them to work loose in a very short time. Iron cover plates and bolts are essential.

length, a dip of 1 in 9 was adopted. Thirdly the downstream rock anchorage had to be at a higher level, and consequently further back, than the upstream one, the result being that the spans of the two sets of cables from pier to pier were unequal. Also, since the right bank of the river was 10 ft. 6 in. lower than the height adopted for the roadway, the shore transom on that side had to be placed 10½ ft. up on the frame and a corresponding increase in the height of the frame was necessary.

Dimensions.—As regards the bridge itself, the span from shore transom to shore transom was 218 ft., and the length of the two sets of cable from pier to pier 273 and 286 ft. respectively. The bridge had to carry loaded pack mules or infantry in single file. The dead load of the structure worked out at 110 lbs. per ft. run, and so the total equivalent dead load to be carried was 320 lbs. per ft. run of bridge. The site would have been an ideal one for a pure "single-ender" bridge had there been sufficient cable to carry this load. As, however, only eight 3-in. cables were available, in order to maintain a factor of safety of 3, a frame of height 18½ ft. above transom level was necessary. Thus the total height of the frame was 29 ft.

Anchorage.—As already stated, the left bank provided excellent rock anchorages. The *Photo* shows the type employed. To prevent excessive bending of the cables these were taken round a 10-in. log of hard wood, in which a jumper was embedded to give additional strength. On the right bank, an ordinary log anchorage was unavoidable. As Bt. Major R. L. McClintock, D.S.O., R.E., pointed out in his article "Bridging with the Burmah Sappers and Miners" (*R.E. Journal*, July, 1911), this type is quite unsuitable for a country in which the life of a log buried underground cannot be estimated at more than three or four years. The only precautions that can be taken are to use as large a log as possible, and to have it well tarred, well drained and freely ventilated. In this case the log was not buried at all beneath the surface of the ground. It was placed on a well-drained platform of rubble stone and the necessary resistance obtained by building over and in front of it with carefully packed rocks. The log itself was 18 ft. in length and 3 ft. 9 in. least diameter, and although no data on the subject could be found in *M.M.E.*, Vol. III., it was estimated that, to withstand the calculated pull of 48 tons on it, 15 ft. of stonework in front and 5 ft. above would be sufficient.

Roadway.—The type of transom used is shown in *Fig.* 2 and was intended to ensure that, while giving ample space for loaded mules, the Mishmis would only pass in single file. It will be seen that, having given the cables a good "waist" to aid in lateral stability, the slings came down to the transoms at a considerable angle. This angle differs of course for each sling, and should be calculated in each case in order to find the slope at which the adjust-

THE DELEI RIVER SUSPENSION BRIDGE, MISHMI COUNTRY.

By LIEUT. F. P. NOSWORTHY, R.E.

FROM September, 1912, until May, 1913, a force, consisting of two companies Sappers and Miners and two double companies of Pioneers, was employed on the construction of a 6-ft. graded mule road from Sadiya to the extreme N.E. frontier of British India. The country proved to be an exceedingly difficult one for roadmaking, and bridges, which had to be of a semi-permanent type, were numerous. Of the eight suspension bridges built, the largest and probably the most interesting was that across the river Delei, a rapid and unfordable, snow-fed torrent, which at the bridge site measured about 200 ft. from bank to bank, and which, according to reports, was capable of a rise of 40 ft.—though this was probably an exaggeration—from 20 to 30 ft. being perhaps nearer the mark. The bridge was designed by Bt. Lieut.-Colonel E. C. Tylden-Pattenson, R.E., officer in Technical Charge Work Party, and constructed by No. 6 Company of the 1st (K.G.O.) Sappers and Miners.

Site.—It will be seen from *Fig.* 1 that the site entailed all those departures from the normal type, which are apt to complicate the design and erection of a suspension bridge.

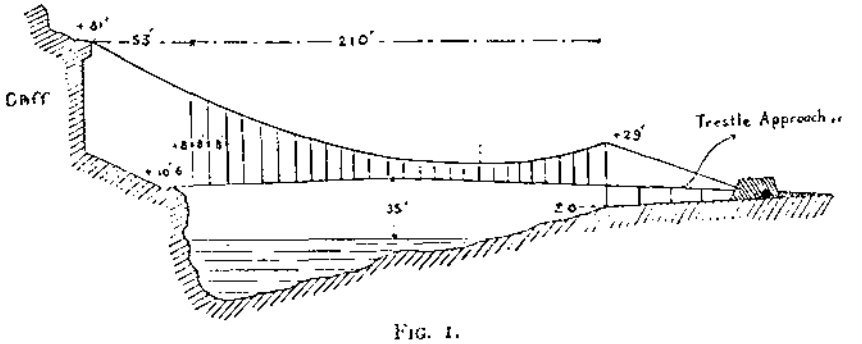


FIG. 1.

In the first place, the cliff on the left bank, whilst affording an excellent anchorage, necessitated a long length of unloaded cable, being much higher than the frame on the other bank. Secondly, in order to reduce the dimensions of this frame as much as possible, and incidentally to shorten the slings which were of exceptional

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