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COMPOSITE PHOTOGRAPHY: TYPES OF YOUNG OFFICERS.

TYPES OF YOUNG OFFICERS

CONTENTS.

Copies of the article entitled "Recoil of Small Arms," by Lieut. F. V. Thompson, R.E., which appeared in the January number, may be obtained from the Secretary, R.E. Institute. Price 6d., post free.

TYPES OF YOUNG OFFICERS; AN ESSAY IN COMPOSITE PHOTOGRAPHY.

A COMPOSITE photograph of a number of individuals may be obtained either by photographing each face on the same plate, or by taking separate photographs of each person and then re-photographing the positives on one plate. In each case the final negative is composed of a number of superposed images, in which the eyes are made to coincide. Results from the second method are generally more satisfactory than those from the first. The correct exposure for each individual is of course arrived at by dividing the number of seconds required for an ordinary photograph by the number of individuals who are to form the composite image.

The two photographs reproduced in the Frontispiece of this number each show a type of face which represents a mean of the individual features of sixteen recently-commissioned young officers of the Royal Engineers. It is noticeable that the composite photograph is usually better looking than the faces from which it is composed. It is perhaps permissible to say that this is the case in the two examples here shown, of which one is a photograph of the batch of officers commissioned between the 23rd December, 1903, and the 23rd March, 1904, and the other of the batch commissioned between the 23rd June, 1904, and the 1st October, 1904.

It is, of course, well known that every quality or measurement of a group of men is subject to the laws of the theory of errors, or, in other words, that any measurement of one individual will give a residual from the mean or type; and that the probability of any given divergence can be ascertained for any particular unit in a group, if the group is a large one.

Now the effect of a composite photograph is to smooth out and eliminate the divergences from the type. Therefore, if we find that the type photograph is better looking than the great majority of the individual photographs, it follows that good looks consist in conformity to type, a reflection which is equally consoling to the average and to the exceptional man.

THE RECENT MISSION TO TIBET.

By MAJOR A. T. MOORE, R.E.

FOR several reasons the Tibet Mission must always occupy an honoured place in the record of military exploits. In the first place the operations conducted during the advance along the 370 miles between Siliguri and Lhasa met with natural and climatic difficulties that have never previously been surpassed; except for small tracts in the Chumbi and Gyangtse-Shigatse valleys, in the Sang Po valley near Chaksam and about Lhasa itself, the country was bleak and barren, and for two stretches of nearly 100 miles each was incapable of providing food or fuel; the Sang Po was a formidable river, rapid and dangerous; four mountain ranges were crossed by passes 14,300 to 16,600 feet in height, and actual fighting took place at altitudes of 17,000 to 18,000 feet; gales and snowstorms were frequent during the winter and 50° of frost not unusual. Secondly the physical features of their country had enabled the Tibetans to successfully adopt a policy of absolute exclusiveness from the outside world; few foreigners of any nationality, only ten or twelve Europeans (mostly missionaries) and only one Englishman (Thomas Manning in 1811) had succeeded in penetrating to the legendary capital, Lhasa; and yet a well-organized British-Indian force, in the course of a few weeks, traversed the whole route and thus revealed to civilization one of the few remaining geographical mysteries of the East. The inferior armament and tactics of the Tibetans were largely counterbalanced by their great superiority in numbers, by the natural strength of the positions chosen for defence and by the solidity of the fortifications. For Royal Engineers the Mission has a further and more direct interest in that the command of the Military Escort was entrusted to an Engineer officer, Major and Bt. Col. James R. L. Macdonald, C.B.

Tibet is governed on a sort of feudal system, the monks or Lamas being the overlords and the peasantry the serfs, a bond of union being established by the custom of each family contributing at least one member to the priesthood. The actual rulers are probably the Abbots of the three great monasteries or univerisities, who have a preponderating influence in the National Assembly, which consists of representatives of all the monasteries as well as lay officials. The nominal ruler is (or was) the Dalai or Grand Lama, with a State Council, subject to the more or less shadowy authority of the Chinese Amban or Resident; to prevent the Dalai Lama attaining too much power

it has been customary to appoint a boy, who was deposed surreptitiously before arriving at mature age and replaced by a new incarnation of tender years. It is curious that the last Lama was the thirteenth and that he was the first permitted under the above system to reach full manhood. The exclusiveness of the Tibetans appears to have been due to Chinese influence, and to have dated from 1792; in this year they invoked the assistance of China to repel an invasion by the Nepalese, and from that time they have acknowledged, more or less clearly as it suited them, the suzerainty of the northern Power. In 1886 the Tibetans invaded Sikkim, and it was not until two years later that they were driven out by our Sikkim Expedition, which resulted in the recognition of British control over Sikkim and the definement of the Sikkim-Tibet frontier. As a further consequence, regulations for trade with India were drawn up in 1893 with the intermediation of China; the treaty included the establishment of a mart at Yatung, but the Tibetans built a wall across the narrow valley there and levied high duties on Indian goods, and they subsequently destroyed the boundary pillars and erected guard houses in Sikkim territory. The Chinese Government were requested to use their endeavours to coerce the Tibetans into respecting their obligations, but their inability to do so, even if they possessed the desire, soon became obvious. After years of desultory negotiations the Viceroy of India wrote to the Dalai Lama threatening practical measures for the enforcement of treaty rights, and the letter was returned unopened; about the same time it was definitely ascertained that Russian influence in Tibet had been increasingly exerted through certain Buriat Lamas educated in Russian, and that two (ostensibly religious) Missions had been received by the Czar.

At last arrangements were made for a conference at Khamba Jong, and Major (temporary Colonel) F. E. Younghusband, C.I.E., of the Indian Army, proceeded there in June, 1903, with a small escort; but the Chinese and Tibetan Commissioners appointed to meet him were of purposely inferior rank, the Mission was ostracised, and all intercourse refused. Later on the Tibetans began arming, and boasted of their ability to obtain help from another European Power in case of defeat. In November the Mission was recalled, and it was announced that an expedition would proceed into Tibetan territory to enforce compliance with the British terms.

Colonel Younghusband was retained as British Commissioner in charge of the new Mission; and Colonel Macdonald was entrusted with the command of the Military Escort, which consisted of a Section No. 7 (British) Mountain Battery, two 7-pr. guns (attached to 8th Gurkhas), Machine Gun Detachment of Norfolk Regiment, 3rd (Bengal) and 12th (Madras) Companies, Sappers and Miners, 150 Mounted Infantry, 8th Gurkhas, 23rd and 32nd (Sikh) Pioneers, and portions of No. 21 (British) and No. 71 (Native) Field Hospitals.

The base of the expedition was Siliguri on the Darjeeling railway, whence a fair road existed up the Teesta Valley to Rungpo; from there a track led over the Jelap La into Chumbi, which, it may be noted, is geographically in India though politically in Tibet.

OCCUPATION OF CHUMBI VALLEY.

The first phase of the subsequent operations included the occupation of the Chumbi Valley and the period of preparation for the advance on Gyangtse, or from 15th October, 1903, to 24th March, 1904. In December, 1903, the enemy had collected a considerable body of troops to watch the Mission at Khamba Jong, and every effort was made to encourage them in the idea that our main advance was to be made from there. Thus, when the Mission withdrew into Sikkim simultaneously with the main advance into the Chumbi Valley, a number of the enemy's levies, seeing the former movement and not having time to hear of the latter, disbanded, and could not be again collected in time to resist our advance up the Chumbi Valley. The Mission crossed the Jelap La (14,390) on the 13th December and occupied Chumbi two days later; on 20th December a flying column pushed on to Phari Jong, where the fort was surrendered without fighting, thus completing our hold on the valley. On the 7th January the force crossed the Tang La (15,700) to the wind-swept plateau of Tuna (15,300 feet), where the Mission remained through the winter with an escort of 4 companies 23rd Pioneers, a machine gun section of the Norfolk Regiment, and a detachment of Madras Sappers to protect it against the 2,000 to 3,000 Tibetans who had assembled at Guru. General Macdonald with the rest of the force returned to Chumbi.

Between the Chumbi Valley and Gyangtse stretched a barren tract of about 100 miles, where not even fuel or fodder could be depended on, and before an advance in force could be made some 550 tons of supplies had to be collected at Phari. The forwarding of this mass of stores in mid-winter, over the lofty passes which separate Sikkim from Chumbi, was one of immense difficulty. The Nepalese yaks had succumbed to various diseases, and 700 ekkas were brought up to take their place on the barren uplands of Tibet; these ekkas had to be carried in pieces over the mountains before they could be utilized at Phari. The roads also were execrable, and their improvement when the soil was frost-bound a work of extreme labour. This period of preparation was one of great strain, but the necessary arrangements were completed by the 24th March, 1904.

In the meantime the Tibetans had been collecting at Guru and elsewhere; but Colonel Younghusband at Tuna had succeeded in protecting our right flank by securing the neutrality of Bhutan, whose ruler (the Tongsa Penlop) accompanied the Mission to Lhasa.

ADVANCE TO GYANGTSE.

The second phase included the advance to Gyangtse and the period of preparation for the advance on Lhasa if necessary; this period extended from 25th March to 12th June.

On the 29th March the Gyangtse column was concentrated at Tuna. The Tibetans had now about 7,000 men in the field distributed as follows:—3,000 at Guru guarding the Gyangtse road; 2,000 at Harm, east of the Bam Tso Lake, guarding the Lhasa road, and 2,000 in reserve between Kala Tso and Gyangtse. The first-mentioned body commenced active hostilities on the 31st March, when they occupied a wall across the road near their camp at Hot Springs and some sangars on the hills; being out-manœuvred from the latter they crowded at the wall, up to which the Sikhs and Gurkhas marched without firing a shot; whilst the Tibetans were being disarmed, firing broke out on their side and a hot action ensued at close quarters, which resulted in the enemy retiring, pursued by the mounted infantry.

This defeat led to the hasty retirement of the Harm force on Kala Tso. A company was left at Tuna and the advance to Gyangtse was resumed on the 4th April, the enemy falling back before us after some skirmishing at Samando and Kang Ma.

On the 10th April, having received some reinforcements from Gyangtse, they stood at the Zamdang gorge and were again decisively beaten. The next day our escort pushed on to Gyangtse, where the fort was surrendered without resistance.

The Mission were then located in the village of Chungloo, which was fortified and provisioned; and Lieut.-Col. H. R. Brander, 32nd Pioneers, was placed in command of the escort of 500 Infantry (8th Gurkhas and 32nd Pioneers) and Sappers, 50 mounted infantry, two 7-pounders and two maxims, with sufficient transport for a Movable Column of 400 men and two guns. The remainder of the force, consisting of 300 rifles, 100 mounted infantry, and two guns, with all remaining transport, begun its return march to Chumbi on the 19th April, dropping one company at Kang Ma and another at Kala Tso, where a company had been already left on the way up. Chumbi was reached on 27th April. The weather had been very inclement, with frequent snowstorms.

Meanwhile the Lhasa officials had begged the Chinese Amban to visit the British camp at Gyangtse and effect a settlement so as to prevent a further advance; and he had promised to arrive within three weeks with competent Tibetan representatives. But the enemy having again assembled, Lieut.-Col. Brander took out his Movable Column on the 2nd May and on the 6th, by flank attacks over almost inaccessible heights, he completely defeated a gathering of 3,000 at the Kharo La. Another force of 1,600 men, who had assembled at Dongtse, took the opportunity to attack the Mission Post on the early morning of the

5th, but were beaten off with heavy loss; they, however, occupied and strengthened Gyangtse Jong, which had been abandoned by us, mostly for sanitary reasons.

For the next two months the Mission was practically besieged, and its camp was almost daily bombarded from the Jong. Reinforcements of 200 men, including half a company of Bengal Sappers and two 10-pounder guns were sent to Gyangtse; and Lieut.-Col. Brander was directed not to assault the Jong, but to be sufficiently active to keep the enemy's attention concentrated on Gyangtse and off our communications. By the capture and occupation of a house, afterwards called Gurkha Post, on the 19th, the capture and destruction of Tagu on the 20th, the capture and occupation of Palla on the 26th, when Capt. S. H. Sheppard, R.E., and Lieut. J. A. Garstin, R.E. (killed), particularly distinguished themselves by breaching walls with explosives under fire from close quarters, and by various minor operations, the enemy were kept so busy that their only efforts were an attack on Kang Ma, by a force from Ralung at dawn on the 7th June, and one other threat on our communications, which by that time had been strengthened.

Meanwhile another period of intense strain fell on the Supply and Transport Services, as not only had the advanced troops to be supplied, but larger accumulations had to be laid in at Phari, Tuna, Kala Tso and Kang Ma to facilitate an advance in force to Lhasa. The weather on the upper plateau had improved; but early rains in the Teesta Valley and an outbreak of cholera (fortunately localised) handicapped the lower section of our line. By dint of special efforts, however, the necessary reserves of supplies were collected and distributed by the middle of June.

ADVANCE TO LHASA.

The third phase of the operations was the advance in force to Gyangtse and thence to Lhasa, the period from 13th June to 3rd August. During this phase the enemy's superiority in numbers was more marked; and their fighting men were better armed, more proficient in shooting and in tactical skill, and better led.

For the further operations reinforcements of 1½ battalions of Infantry (Royal Fusiliers, 23rd Pioneers, 40th Pathans) and 8 guns (of No. 7, British, and No. 30, Native, Mountain Batteries) were sent up; and as soon as these arrived in Chumbi Brig.-Gen. Macdonald's force set out for Gyangtse in two columns. The first comprised 125 mounted infantry, 1,450 infantry, 8 guns, 950 followers and 2,200 animals; the second consisted of 500 fighting men, 1,200 followers and 1,800 animals, and included the supply train. The leading column reached Kang Ma on the 22nd of June and the second arrived next day.

The enemy had by this time collected a force of 16,000 men. They had several small cannon, some 30 jingals and wall pieces, and 800 breech-loaders, while the balance were armed with matchlocks. They were distributed as follows:—(1) At Niru, 15 miles east of Kang Ma and guarding the Kang Ma-Ralung road, 800; (2) at Niani, holding the Kang Ma-Gyangtse road, 800; (3) at Tsechan, guarding the Gyangtse-Shigatse road, 1,200, with a support of 2,500 men at Dongtse; (4) at Gyangtse 8,000; (5) at Gabzi, 18 miles east of Gyangtse and guarding the Lhasa road, 1,200. All these bodies held strongly fortified positions, and a further force of 1,500 was at or *en route* to the Kharo La, which was also fortified. Thus, though the enemy had a great numerical superiority, they were so distributed as to facilitate their being dealt with in detail.

On the 23rd June 500 infantry, with 2 guns and 50 mounted troops, attacked Niru; the defenders hastily withdrew and retired over the Se La instead of to Ralung. The same day the outlet of the Zamdang gorge was occupied with 250 men who entrenched themselves. On the 24th the first-named detachment rejoined; and next day the march on Gyangtse was resumed, the Tibetans being located in a strong position at Niani, where they had been reinforced from Gyangtse. On the 26th the enemy were driven from Niani after a sharp action, in which a portion of Lieut.-Col. Brander's force participated and there was some queer fighting in the dark passages and cells of the monastery. Gyangtse was reached on the same day.

In order to open the fertile Shigatse valley to our foraging parties, the Tsechan position was attacked and carried on the 28th, the success being due to thorough co-operation between the artillery and infantry; this caused the force at Dongtse to retire on Shigatse, while some 2,000 of the enemy also deserted from Gyangtse Jong, to which attention was next directed.

Gyantse lies in a small fertile plain at the intersection of four valleys; and consists of the Jong and the monastery, each on a rocky ridge, and the town, which hugs the base of the former hill and spreads into the hollow between the two. During May and June the Tibetans had laboriously strengthened the already naturally and artificially strong position by numerous sangars and traverses.

With a view to inducing the enemy to believe our main attack on the Jong would come from the north-west, the camp was removed on the 28th to the south bank of the Nyang Chu, and a bridge was commenced west of the town. Meanwhile the enemy sent in flags of truce, and futile negotiations followed until noon of the 5th July, when active operations were resumed. That afternoon a strong demonstration was directed against the north-west face of the enemy's defences, to confirm them in the idea that this was to be the direction of our main attack. Our troops pushed in and occupied some houses within 300 yards of the enemy's line, held their

positions until after dark, and then, having lighted picquet fires, silently withdrew to camp.

At midnight the troops intended for the real attack on the precipitous south-east side of the Jong moved silently off, and were in their allotted positions at 3.30 a.m. on the 6th. The enemy had been misled by our demonstrations of the previous day; and when our three assaulting columns advanced against the town at 4 a.m. under cover of artillery fire, they occupied the houses under the fort with comparative ease, and had so strongly established themselves by the time the enemy could draw men from their north-west defences that they could not be dislodged. Late in the afternoon, the south-west curtain was breached by artillery, and the Jong carried by assault by Gurkhas and Fusiliers, supported by a concentrated fire of every gun and maxim. Though the monastery and greater part of the town were still in their hands, the enemy fled during the night, mostly towards Shigatse, and their force at Gabzi retired hastily on the Kharo La. A flying column, despatched down the Shigatse valley for supplies, found both Dongtse and Penam Jong evacuated, and returned to Gyangtse with large stores of grain and meal.

An advance on Lhasa was now imperative; and on the 14th July a force, consisting of 200 Mounted Infantry, 1,900 Infantry (Royal Fusiliers, 8th Gurkhas, 32nd Pioneers, and 40th Pathans) and Sappers, 8 guns and 6 maxims, with 2,000 followers and coolies and 3,900 animals (mules, yaks and donkeys) carrying 23 days' rations, marched out. A garrison of 8 companies Infantry (23rd Pioneers), 50 Mounted Infantry and 4 guns was left to hold Gyangtse.

On the 16th, after marching in daily rain, the column reached Ralung, and ascertained that the Kharo La (16,600 feet) was strongly fortified by a wall extending to vertical cliffs at the snow line and by sangars on every prominent point.

On the 18th, the pass was forced after slight resistance, the bulk of the enemy having fled during the night. The engagement was chiefly remarkable for the great altitude (18,500 feet) at which our troops had to fight, and the retreat of the enemy over a glacier, up which the Gurkha flanking party had to cut steps with their *kukries*.

On the 19th, Nagartse Jong was occupied without resistance, and here the force halted a day as the weather still continued inclement. Pede Jong was occupied on the 21st, and it appeared that the enemy were fleeing before us and devastating the already barren country. They, however, at last seemed to realize that refusal to treat would not delay the advance on Lhasa.

On the 24th July, we crossed the Khamba La (16,400 feet), and reached the Sang Po (or Brahmaputra), our mounted troops having that morning seized both the ferries. At Tamalung Colonel Younghusband received the first communication from the Tibetan

National Assembly. On the 25th July we reached Chaksam ferry, where a missive was received from the Dalai Lama himself, and passed over the river a company of Mounted Infantry and seven companies of Infantry; as our guns could effectively command the north bank of the river, our position was quite secure. At Chaksam two great ferry-boats, large enough to hold 100 men, and a number of hide boats were found; with this providential aid, four Berthon boats accompanying the troops, and boatmen brought up from Attock in the Panjab, the passage of the whole force was completed in six days, the transport mules being swum over; during the crossing the Mission lost its Chief Supply and Transport Officer (Major G. H. Bretherton), who was drowned by the capsizing of a Berthon raft.

On the 31st July the advance on Lhasa was resumed. The enemy had fortified several positions, but abandoned all of them as we approached; and the force encamped before Lhasa on the 3rd August.

Posts had been established at Ralung, Nagartse, Pede Jong, Chaksam ferry and Tailung bridge, the garrisons of which, together with convoy escorts, absorbed 70 mounted men and 400 Infantry. As about 50 sick had also been left at posts between Gyangtse and Lhasa, our effective strength was reduced to 130 Mounted Infantry, 8 guns, 1,450 Infantry and Sappers and 6 maxims.

OCCUPATION OF LHASA AND WITHDRAWAL FROM TIBET.

The fourth and last phase of the operations included the occupation of Lhasa and the withdrawal of the troops after the conclusion of the Treaty.

The Lhasa valley is extensively cultivated, but does not produce sufficient for the requirements of the city and its monasteries, and the crops were not yet ripe, so that the food question soon became critical. The Chinese Amban and the Tibetan authorities promised supplies; but all the efforts of the Mission to persuade them to act up to their promises proved of no avail, and on the 5th August the troops had only 1½ days' rations in hand. No convoy from Gyangtse could be expected before the 29th, so strong measures were adopted, and on the 8th a force of 900 rifles with 6 guns moved out against the Daibung Monastery, which was said to contain 9,000 monks and have ample granaries. This monastery was selected mainly because it was the largest of the three great institutions which were reported to form the obstructive element in the Tibetan Councils. The monks were very obstinate, and it was not until the guns were in position and infantry had been ordered to advance that they agreed to our demands. Next day a requisition for a smaller amount was made on the Sara Monastery. Both monasteries satisfied our requisitions in full, and were paid at market rates for the supplies furnished. The

demonstration against Daibung also stimulated the Lhasa authorities, and induced them to bring in sufficient supplies daily.

On the 12th August the Mission moved into the Lhalu Palace with a guard of two companies of Infantry, and the military camp was shifted to the driest site available in the marshy environs of the city.

Though the Tibetan authorities had withdrawn their troops from Lhasa itself, they retained them in small bodies in the neighbourhood; so constant reconnaissances were necessary. It was reckoned that, if a proportion of the monks could be induced to take the field, the Tibetans could within 24 hours assemble a force of 8,000 to 10,000 men. On the 13th August a reconnoitring party surprised a camp of the enemy and made 64 prisoners; on the 18th a reconnaissance northwards up the Kyi Chu valley effected the dislodgment of 600 soldiers from the arsenal. The activity of the reconnoitring parties induced the Tibetan troops to withdraw 20 to 30 miles from the capital, and thus reduced the tension.

The Dalai Lama had disappeared prior to our arrival; it was said he had fled to Mongolia, accompanied by the Buriat Dorjieff.

Meanwhile, as our departure might be delayed and low temperatures and snow were reported on the uplands between Lhasa and Gyangtse, arrangements were made for additional warm clothing and blankets for the troops.

It appeared likely that, in spite of durbars and diplomatic correspondence, the Tibetan authorities would protract their negotiations of a treaty so long as to necessitate the Mission remaining at Lhasa through the winter. The common people, however, were evidently thoroughly friendly, bore no malice, and fraternized with the troops, who were allowed daily in the city and bazaar; and one day largess was distributed to 11,000 of the poor. On the 1st September the British Commissioner issued what was practically an ultimatum. This had the required effect, and on the 7th a Treaty was signed in the Dalai Lama's throne room in the Potala Palace, the Guard of Honour escorting the British officials consisting of representative detachments of the Royal Fusiliers and of the Sikhs, Gurkhas and Pathans. The principal clause of the Treaty secured the preponderance of British influence in Tibet.

In anticipation of the withdrawal of the Mission the posts between Lhasa and Gyangtse were stocked with two or three days' supplies for the column; and on the 9th September the Sappers, one company of Infantry, the brigade coolies and 5 days' supplies for the Force were sent ahead to Chaksam, to arrange for the passage of the Sang Po. The upper crossing, Partsi, was found more suitable, and three ferries were extemporised.

On the 23rd the force marched from Lhasa in one column. On the 25th Colonel Younghusband, with the bulk of his staff and a small mounted escort, pushed ahead by double marches. On the 27th

Partsi ferry was reached, and the excellent arrangements made by the Engineers enabled the whole force to be passed over by 2 p.m. on the 29th.

From Partsi to Gyangtse the force marched in two columns, leaving the former place on the 29th and 30th September, and arriving at Gyangtse on the 5th and 6th October. The supply arrangements at the posts were excellent, and the only discomfort was the low temperature (10 to 21 degrees of frost) at night. A survey party with an escort marched independently, and did some useful work between the Sang Po and Gyangtse. From Gyangtse the escort returned to India in smaller columns, picking up the garrisons of posts *en route*.

REMARKS.

In all the escort had 16 engagements and skirmishes in which we suffered loss, and the total war casualties amounted to 202, including 23 British officers, of whom five were killed.

General Macdonald attributes the comparatively small losses sustained in the more important actions to the thorough support afforded to the assaulting infantry by the artillery.

The engineering work of the escort comprised road-making (170 miles), bridging, hutting, defence of posts, siege works, demolitions, and heading storming columns with explosive parties. The General Officer Commanding records that the gallantry of the explosive parties was marked, and that the work of the Engineers, Sappers and Attock boatmen at the crossing of the Sang Po River was excellent.

The important work of the Supply and Transport Department was carried out under extraordinary difficulties in a way that justly merited the admiration of all. In the unhealthy Teesta Valley one form of disease after another seized the transport animals in spite of every precaution. During the winter the transport service had to be maintained over the passes in spite of intense cold and constant gales and snowstorms. On the barren uplands of Tibet there was one long sustained struggle to provide grain, fodder and fuel. A variety of animals were tried—camels, buffaloes, bullocks, yaks, mules, ponies and donkeys—; and also coolies (local men as well as Baltis and Ladakhis from the N.W. Himalayas) and the light two-wheeled ekka carts. Ultimately, the stage from Siliguri to Gantok was worked by bullock carts; ekkas ran over the Phari Jong-Tuna plateau to Kang Ma; the regular transport mules were the mainstay from Gyangtse to Lhasa; whilst yaks supplemented the other means on many stages, and coolies were employed over the most difficult passes.

The peculiar climatic and physical conditions threw an additional strain on the Medical Department.

At Chumbi (9,700) the mean daily temperature at 9.0 a.m. from

July to October inclusive was approximately 55·75° F.; at Phari (14,300) and Tuna (15,300) about 28° F. of frost occurred almost nightly from the middle of October to the middle of March; at Gyangste (12,900) the mean daily temperature from April to September inclusive was 55·9° F., the minimum being 25° in April and May and the maximum 89° in May, June and July; the lowest recorded was—18·4° F. on the Tang La (15,700) on the 7th January. At Chumbi the average rainfall per mensem from February to October inclusive was about 5·25 inches, the maximum being 7·69 in April; during the march to Lhasa and the stay there heavy rain fell almost daily, and the soil at Lhasa was practically waterlogged. Excluding war casualties, the total numbers of deaths and of men invalided were 411 and 671; of these, 202 and 405 respectively were more or less due to the special climatic conditions. In addition to the above, 160 of our wounded had to be cared for, and a large number of Tibetan wounded also received medical attendance. Most of the sick casualties occurred from dysentery, diarrhœa, pneumonia, frost-bite, snow blindness and mountain sickness, the three first accounting for nearly half the deaths. Five deaths in all occurred from frostbite, and 45 men were invalided; in one day in March 50 cases of frost-bite and 70 of snow blindness occurred in one small convoy; and during the return journey, in two days' marching after a heavy snowstorm, there were 200 cases of snow blindness in a total strength of 2,500 troops and followers. Nineteen men died and 18 were invalided from heart affection due to mountain sickness, and a considerable number died suddenly from syncope whilst weakened by other diseases. There was little enteric fever, but many cases of severe continued fever occurred between Phari and Gyangtse; malarial fever was common in the Teesta valley and Sikkim.

The Survey Department succeeded in mapping a large extent of practically unknown country and the geographical results are likely to be most valuable. In addition to about 300 miles of route sketches (one inch to one mile), some 20,000 square miles were mapped, including large scale surveys of the country round Chumbi, Gyangtse and Lhasa. A proposal that a party should trace the Sang Po down-stream, and definitely prove its identity with the Brahmaputra of Assam, fell through; and the opportunity was also missed of investigating northwards in the direction of the Tengri Nor to connect up with the explorations of Sven Hedin. But Captains C. H. D. Ryder and H. Wood, R.E., with a small escort, were despatched up the Sang Po to examine Western Tibet as far as the sources of the Indus and Sutlej.

The Line of Communications was a long and difficult one, the distance from Siliguri to Gyangtse being 225 miles and from Gyangtse to Lhasa 145. In all some 30 posts had to be maintained, five of which were in the unhealthy Teesta Valley and seven were approxi-

mately 15,000 feet above the sea. Up to the end of the second phase no special officer was sanctioned to command communications; but during the third and fourth phases Colonel H. Read, 4th Rajputs, had charge of the line from Siliguri to Ralung.

The Field Post service had many difficulties to contend with. From Siliguri to Tuna the mails were carried by the Postal Department, and thence to Lhasa by military agency. Up to Gyangtse a daily service was maintained latterly, and from there to Lhasa mails were carried by Mounted Infantry every three days.

In the first phase of the operations the Telegraph accompanied the force and the line was extended from Sikkim to Phari; during the second phase the line was continued to Kala Tso; and in the third phase it accompanied the force to Gyangtse.

The operations threw a very great deal of extra work on the Public Works Department, both in the Teesta Valley and in Sikkim.

The Maharajah of Nepal and the Nepal Durbar offered substantial help in the matter of transport. The Raja of Sikkim placed the resources of his State, both in men and animals, at our disposal; and a locally raised Cooly Corps (organized by Mr. J. C. White, Political Officer, Sikkim) worked over the Nathu La pass from January till the end of the operations.

His Majesty the King-Emperor signified his appreciation of the work of the Mission by granting a special Medal, with a clasp for Gyangtse.

The present writer has borrowed freely from General Macdonald's final Despatch, and is also indebted to Mr. E. Candler's *The Unveiling of Lhasa* and to the *Journal of the Royal Army Medical Corps.*

CONTROL OF TRAIN MOVEMENT.

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

In recent American practice, while much stress is laid on the attainment of greater safety in running than was formerly the case, a principal aim is the provision of as great elasticity as possible in arrangements for the movement of trains, and as absolute a control as possible of the workings.

In this American Railways fundamentally differ in their methods from those in vogue in English practice, and it will be seen that there is little tendency to assimilate their methods of controlling traffic to those which are familiar on this side of the Atlantic.

The system of concentrating the control of movement of trains in the hands of the Train Despatchers has grown up gradually from primitive beginnings, and has now been systematised to a degree of great exactitude.

An examination of actual practice appears to indicate that the system affords a means of effecting great savings in running time, and corresponding economies in working cost.

A consideration of the "Train Despatching" system seems to me to be of peculiar interest from a Military point of view. English methods are mainly adapted to lines where the density of traffic is great, and, safe working being an all-important consideration, involve a number of restrictions which have as yet not much counterpart in America. Under War conditions, and on lines where the normal traffic is sparse, it is likely to be of paramount importance that there should be as intimate a control of movement of trains and distribution of rolling stock as is possible of attainment.

It may be that on a comparatively short line the irregular running of trains can be kept in fairly close check; and that, where the traffic is heavy and the line is laid out for heavy traffic, the relative disturbance of the schedule by, say, one train running out of course is of no great moment; but it might be this one train which it was desired to expedite. In such cases the more direct the means available for the transmission of orders the better. Under War conditions, again, it is seldom possible to look far ahead, or arrange any programme which may not have to be modified at short notice. It is then advantageous to be able to control the movement from Section headquarters,—a measure of centralisation which would very well correspond with the system of Military control. It will be seen,

however, that while Section headquarters of the Railway are kept constantly informed of what is happening, the normal working is not interfered with except when circumstances render it desirable, and a constant reference from Stations to Section Headquarters is not necessary before taking action.

The principle underlying the system herein described is an absolute adherence to Timetable under normal conditions, but modified when necessary by the Train Despatcher's power (he being conversant with the position and running of *all* trains on the Division) of re-arranging the workings and altering the Schedule times or Crossings.

Again the precedence of all trains is definitely determined, and this precedence can only be altered by Orders from the Train Despatcher.

In order that a control such as this may be exercised, it is necessary that a complete system of reporting trains should exist; but, as a matter of fact, this does not involve any complication, provided telegraph facilities are adequate.

It may here be remarked that :—(1) the system does not involve the installation of any costly or elaborate apparatus apart from that appertaining to the Block signals ; (2) it does not supersede or dispense with the protection of trains by Block signals, which are now being installed generally, but it can be and is operated without Block signals on the lines of sparse traffic, *e.g.*, crossing the Western Plains.

Through the courtesy of Mr. W. H. Truesdale, President of the D.L. & W.R.R., and of Mr. W. G. Besler, Vice-President and General Manager of the C.R.R. of N.J., I have been able, during a recent visit to the United States, to examine in detail the working of the "Train Despatching" system on these two up-to-date lines,* and have written a few notes on this method of control, which is, as stated above, particularly well suited to the needs of Military service, but, as will be pointed out, demands a highly skilled and trained staff of Despatchers and Telegraph Operators.

ORGANISATION.

The Superintendent of a Division is, as a rule, in charge of all matters affecting Operation; that is, he controls the movement of trains and all staff concerned therewith (including Loco. men when on the road), the maintenance of Way, telegraphic and Signalling

* The New Jersey Central use absolutely the Standard Rules, their Telegraph Superintendent, who shewed me their methods, being a member of the Standard Rule Book Committee and an ex-Train Despatcher of great experience: the Lackawanna road has a heavy traffic, but many of its principal officials have come from Western lines, such as the Burlington and Rock Island, so that I was there able to obtain information as to points specially arising in single line working.

arrangements, and so on. There is at present a tendency to revert to Departmental organisation as regards Maintenance, but the placing of Loco. men under the Superintendent's orders while employed on Transportation has a good deal to recommend it.

Station Agents are not intermediaries in arranging movement of trains. Their duties end where transportation begins, and they have primarily to do with the commercial side of the business, up to the stage where the traffic is handed over to be moved. They are in charge of Station premises of course. As will be seen later, at a large Station the Agent has to requisition on the Yard Master for any movement of Cars he requires.

The Telegraph Operators are responsible for due and correct passing of Orders as regards movements, under the orders of the Chief Train Despatcher of the Division.

In practice it is essential that every Despatcher should be an operator, and in fact it is from the ranks of the Operators that the Despatchers are recruited (Conductors and other Train men do not necessarily learn telegraphy). But the qualifications of a Despatcher are not easily found; he must have in him the embryo of a Superintendent; he has to be accustomed to carry in his mind the position of all the trains, and to forecast the modifications of the running which may be necessary, based on the running of the trains concerned and the nature of the load, the weather, power of engine, train men, and all the thousand and one considerations which are always present.

Finding men suitable for the office of Despatcher is, in fact, the ruling difficulty which would arise in improvising such a system of train control.

It must not be forgotten that the arrangement of trains on a single line is necessarily more complex than that on a double line.

The arrangement of Meetings is facilitated by the way the "Train Report Sheet" is printed. It shews Down trains running down the column, and Up trains of the same section directly below and up the column (*i.e.*, the names of Stations run the same way—opposite the name of each Telegraph Station is printed its "Code"). Thus the approach of trains to one another is graphically indicated. This arrangement provides a safeguard against arranging Meetings to overlap.

TIME TABLES AND TRAIN REPORTS.

For the original compilation of Timetables large scale time and distance diagrams are employed (*cf.* p. 196, *Instruction in Military Engineering*, Part VI.), the trains being indicated by threads of different colours according to Class. Pins are driven in at intersections, which must occur at Sidings or Stations; these are the Meeting or Passing points.

Once the Timetable is completed, however, it is printed and the

diagram not further used, as the Despatcher, from constant association, knows all the trains without reference to diagram, and finds no difficulty in mentally arranging modifications without the need of using the diagram.

In the printed Timetable Meeting or Passing points are indicated in heavy type (but no specific references are made to the trains to be met or crossed) and trains of different classes are shewn separately—an arrangement for which I did not obtain any reason.

The trains are numbered Odd for Down, or Westbound, and Even for Up or Eastbound, and similar series numbers are allotted to trains of the same category, *e.g.*, Through Expresses, Milk trains, trains for the same destination, and so on. (I may here remark that the system of carrying distinctive Headlights to indicate Class does not seem to be employed, though special lights and signals are carried to notify Duplicates and so forth).

Extra Trains, *i.e.*, Specials, are identified by the number of the Engine. A duplicate is known as a Second Section, and so on, and would be called (for example) 1st 21, 2nd 21, if train 21 is run in sections.

Times of arrival, departure and passing are reported from nearly all Telegraph Stations or Signal Towers (Register Stations). These are immediately entered, as received on the Sounder, on the "Train Report Sheet."

Each Despatcher keeps his own Train Report Sheet, which covers all lines and branches controlled by him—an amount naturally dependent on the density and complexity of the traffic.

There will be several Despatchers to a Division, each of whom comes on duty for eight hours at a time and is continuously at work for that period.

When the Despatcher takes over he signs the Report sheet and initials a book to the effect that he has been informed of all orders in force and so on.

The control of movement of trains on a Division is in fact very intimate and concentrated in the hands of the Despatchers. The Train Master is the Superintendent's subordinate in charge of Train men of all Departments while on the road, as well as of Yards and Switching. The Chief Train Despatcher is entirely in charge of the movement of trains. Under him are several Despatchers, who each have direct charge of a section. These men are in telegraphic communication with all the Telegraph Stations of their sections: all stations of the section are on the same circuit, and the Despatcher actually has the operating key before him and sends and receives all messages himself. Under English practice, now, there is no immediate and direct constant control of the running of trains from headquarters. In fact, the Trains office of a Division (or District) does no more than make arrangements for the running of trains, and

once a Train is "arranged" the further control of its movement rests with the local officials. In many cases arrangements exist for constantly reporting the running times forward, but there is no machinery for modifying the scheduled times at short notice should such a thing be expedient. This may partly be due to the fact that making up time is discountenanced.

It is to be remarked, however, that the recent appearance of an article about the possibility of adapting "Train Despatching" to English working, in the *Great Western Railway Magazine*, shews that there are those who recognise that more central control might be of value.

In America it is usually the practice, in revising a train's schedule by Order to suit the amount it is reported as running late, to assume that a certain amount of time will be made up. If the time is not made up a fresh Order can be issued revising the times.—*E.g.*, a train is delayed by a breakdown; as soon as this news comes in, an Order is issued on the assumption that it will run, say, two hours late; this amount is found to be insufficient, and a fresh Order is made scheduling it three hours late, and so on.

Messages between the Despatcher and the various Operators are not recorded except in the case of Orders. It does not appear to be the practice to record trains in the Signal Boxes. (This refers, of course, to a line where Automatic Block signalling is in operation).

If all trains are running according to schedule, all the Despatcher has to do is to note up the running reports of trains on his Sheet (times of arrival and departure, number of train at head of column, train load, names of Driver and Conductor, and other special information), except as regards arranging meetings, as will be shewn in the case of single line.

Directly a train begins to run out of course, however, his special functions begin to come into play. As the reports come in, he considers what modifications of the fixed times, etc., can be made with a view to improving the running. As soon as the situation is ripe he then issues an Order. This Order is repeated in identical terms to all trains concerned and to such yard masters and others as are likely to be able to take advantage of it by getting off trains which must otherwise wait.

Such an order may modify running times, Crossing or Passing places, notify the running of extra trains or duplicates, annul or alter the precedence of trains, and so on.

As regards precedence, all trains are classified, and have certain Rights for the purpose of determining which should have right of track and which should be allowed to pass ahead. The inferior train must always keep off the time of the superior train. The train men know what other trains are on the track, for they have to count on all scheduled trains unless they have received any Orders to the contrary,

and the scheduled trains are only modified to such extent as standing Orders (issued by Bulletin) or Orders from the Train Despatcher determine.

As a rule East bound trains have precedence over West bound, and Passenger, Freight, Work trains, etc., have rights in the order named. Sections have the same rights as their first portions; and any special rights given to an extra train are notified in the Order advising its running, otherwise it is inferior to regular trains. Running a train in sections is simpler than arranging an extra, as the precedence is thus immediately determined.

It is the rule that an inferior train must keep five minutes off the time of a superior train, but no train may arrive at a station before it is due, nor leave before due time.

If a train stops or is delayed under circumstances where it might be overtaken by another train, the flagman (who is one of the train men) must go back a sufficient distance to protect it. He can be recalled by a whistle signal. The whistle is used principally for communication with the train men, not for signalling to junctions, etc.

ISSUE OF ORDERS.

The Telegraph Operator at a Station, upon receipt of the Order prefix, puts up his Train Order Signal (this is a semaphore signal of special pattern with pointed end). A copy of the Order is given to the Conductor and Driver, and in certain cases the Order has to be signed before any action may be taken on it, as will be explained further on. The Train Order Signal is displayed until the train for which the Orders are issued arrives. If there are no Orders for a train stopped (being first to arrive), the Operator gives it a "Clearance Card" and it proceeds on its way. Two kinds of forms are used for Orders—a "19" form (green), and a "31" form (yellow). The former is handed by the Operator to the Train men as they pass; but the latter requires signature before it is "complete," and the train must therefore stop. As the train approaches, the Operator being ready and holding up the form to view, the Driver immediately knows from the colour whether he must bring his train to a standstill or not, if it is not a scheduled stop.

The Rules lay down that the Conductor must read the Orders to his brakeman and the Driver to his fireman.

In giving an Order the Despatcher indicates its nature by the prefix 19 or 31. With the prefix is indicated the number of copies required, *e.g.*, "19 copy 5," and the corresponding number of copies is then taken off with carbon paper. If sufficient cannot be struck off at one writing, additional are traced from one of those first made (to avoid any mistake in copying). The paper used is very thin, and waterproof.

The Order is always repeated to the Despatcher immediately it is received, from the copy written for issue, except when the engine of the train for which the order is intended has passed the Train Order Signal. In this case the Order must not be repeated back until the Conductor and Enginemen have been notified that there are orders for them. This is to ensure that a train, which, say, has drawn ahead into a siding, does not go away without receiving the Orders, and that the Despatcher does not assume an Order "complete" which has not duly reached the Train.

The Despatcher then enters it up, at once as repeated, in a book of forms provided for the purpose, and not until he acknowledges it as correct ("complete") can it be acted on.

The signal "X," which precedes an Order, signifies "train must be held until the Order is complete." In certain cases, when "X" has been acknowledged, the repetition of the Order is omitted, if delay to the train can be saved in this way. This would not be done in the case of Meetings. In each case the time at which the Order is made "complete" is shewn on the Form, and noted in the Book.

The names of the Conductor, Driver, Operator and Despatcher also appear on the form.

The portion of the form for the Order itself does not contain any printed words, as the nature of the Orders may vary a good deal, though specimen wordings for all the usual types are provided in the Rule Book.

The "19" form of order is used in ordinary cases of modifying passing times, etc.; the "31" form when the train to which it is addressed has its superiority in any way restricted thereby, also for arranging Meeting places on the single line.

A "Clearance Card," which is a certificate that there are no further orders for the train than those already carried, is given:—(1) to a train leaving the Terminus and running on Schedule according to its rights—thus not requiring any Orders until any modification of his schedule is required, (2) to a train stopped by a Train Order Signal exhibited for another train.

As an example of the functions of the Train Despatcher:—Train No. 1 (First Class) is reported from a Station beyond the Division as running ½ hour late. Normally all other conflicting trains of inferior class must keep off the times of this train, and would consequently have to wait at the scheduled meeting or passing places, or their equivalent supposing any of them are behind time. Therefore an Order as follows may be issued:—

No. 1 will run 25 min. late Joppa to Mainz, and 20 min. late Mainz to Muscat.

This Order is addressed to all trains affected—the Despatcher sees from his Report sheet what and where they are, and enters up in the space provided on the Form when made "Complete" as regards

each—also to Yard masters concerned, *i.e.*, at any collecting stations where trains are made up which this train would pass. Any trains so sent off will be reported directly they start on their journey, and of course cannot start without Orders if "Extra." Should train No. 1 lose more time a further order can be issued, so as to give the trains affected an increased margin of time.

ARRANGING CROSSINGS, SINGLE LINE.

On single lines no train is allowed to run without carrying an Order; but in the case of Passenger trains the only Order carried, except under special circumstances, is the "Clearance Card" which starts the train on its journey. As Orders are not exchanged, and as the passenger train will have precedence over all others of inferior class, there should, supposing it runs according to schedule, be no need for any fresh Orders to be given it at points along its journey. It must not be forgotten that where there are signals these Orders are not primarily for the purpose of securing the safety of trains, but for regulating their running. A train is always given Orders to take it as far as possible on its road.

The type of Order then to be issued for a train moving on single line will be :—

No. 5 *will meet No.* 3 *at Bombay 2nd No.* 10 *at Siam and extra* 95* *at Hong Kong.*

INTERMEDIATE SIDINGS.

Where there are intermediate sidings between Telegraph Stations, it is obvious that no message can reach the trains there unless carried by a meeting or passing train, after the train concerned has left the telegraph station. The Despatcher must therefore watch the running of all trains up to the last telegraph Station carefully, and take care to issue any Orders which may be required to modify schedule times or rearrange meeting points before the trains concerned get beyond telegraphic reach.

No matter what precedence trains have, their running, when in opposing directions, cannot be altered from that scheduled except by Order of the Train Despatcher; and in the same way meetings once arranged by schedule or by Order cannot be altered except by a fresh Order.

If a Train Order is to be delivered to a Train at a point not a Telegraph Station (or where the Telegraph Office is closed), it is addressed to "Conductor and Engineer of ——, c/o the person who carries it."

On the "31" form "complete" is then given on the signature of the person who carries the Order, who is responsible for obtaining

* N.B.—This is the Engine number.

signature of the train men concerned, on a copy given him for the purpose. This copy completed he hands in to the first Operator accessible, who retains it and immediately telegraphs the signature of the Engineer and Conductor to the Despatcher.

If such an Order restricts the superiority of the Train to which it is directed, "complete" must not be given to the inferior train until the Conductor's and Engineer's signatures have been wired back.

It is thus evidently necessary to take full precautions to ensure that an Order limiting the superiority of a train is obeyed.

WRECKS AND OBSTRUCTIONS.

Should the occurrence of a Wreck, or Engineering work in progress, necessitate any modification in the running of trains, the control of movement still remains in the Despatcher's hands, and no attempt is made to localise it at the place where traffic is hung up.

The Train Despatcher in fact, by virtue of the system which reports the running of trains to him, must be better acquainted than anyone else with the general situation and what can be done as regards rearranging trains.

The Superintendent, or Train Master, or whatever official gets to the spot first, therefore puts himself in telegraphic communication with the Despatcher as soon as possible, and keeps him constantly informed how things are progressing until the normal working can be resumed.

Conductors are empowered to call upon trackmen, etc., and men of other trains, so long as it does not interfere with their due protection, for assistance in case of a wreck.

ROLLING STOCK DISTRIBUTION.

The Chief Train Despatcher of a Division is responsible for seeing that the requirements of Stations for Rolling Stock are duly fulfilled.

Stations render to this office a daily return of trucks under load and empty, shewing also how long on hand. Formerly it was the practice to compile from this a general distribution sheet, on which any orders might be based. On those lines whose working I saw, however, this has been abandoned, and it is deemed sufficient to work empties to the nearest distributing centre or large yard, whence any requirements of minor stations can be met. Arrangements for keeping Car record at headquarters, shewing position of each Car from day to day, are not in force, although detailed reports of the composition (not truck numbers) of the more important freight trains are wired forward, so that it may be seen whether it is advisable to quicken the running of any particular train ; and elaborate arrangements are in use for keeping record of the position of each Car in the Terminal yard.

If enquiry is to be made as to the position of any particular Car, its number can be turned up without any great difficulty in the Station reports.

As regards demurrage, (the above reports shew number of days standing under load), Car service Associations have done much during recent years to eliminate delays by Rolling Stock standing idle, but the system still obtains of allowing so many days free for the completion of the journey before hire is charged.

Private owned cars are not very numerous, and appear to be chiefly Refrigerators belonging to the Meat Companies and so forth. This partly explains how so much standardisation has been reached in the pattern of cars.

TRACING OF CARS (HOBOKEN YARD).

The system in force at this Station seems to be local, but is interesting.

On arrival of his train, the Conductor hands in his Vehicle List, which shews particulars of Cars and nature of load, at the Yard Master's office. From this a list is made with, against each car number, the number of the road where it should normally be placed. The cars are chalked accordingly, and the train distributed by the Yard men.

Meanwhile entries are made in a Car Index book (indexed by the terminal figures of the number, and shewing home owned and foreign cars on separate pages; tags facilitate turning up any particular number). The date, time of arrival and train (number of engine) are shewn against the Car, and road where placed.

A copy of the Vehicle List is sent to the Freight Agent, who requisitions on a Form for the placing of the Car where required for unloading, etc. It will be observed that this is in accordance with the principle that the Agent does not control movement, even in the Yard. This list is passed out to the Drill Master (Foreman Shunter), who works with a "Drill" engine and gang of men. There will be several of these crews in a large yard. As each shunt is made, he fills in on a slip where the Car is placed. Subsequent movements of the car are similarly noted and reported, and finally the particulars of the train removing the car are noted up.

Thus each group of entries shews the whole particulars of the disposal of the car, and the position of any car enquired after can be turned up at once.

The number of printed forms used is rather large, and in fact this feature strikes an outsider a good deal. It appears as if it were the the idea to reduce these things to routine as far as possible and eliminate verbal instructions, to get rid of the possibility of dispute and to avoid sending messages. Clerical labour is comparatively cheap.

As a rule Invoices or labels are not attached to the car. A card way-bill is, however, made out for each car as soon as ready to go, and these are given to the conductor to make up his train from, or the Drill crew can equally make up the trains and so save the train engine being brought out before due for departure.

In the office these cards (Way bills) are sorted together in a rack. Different colours shew foreign cars, so that the traffic for any particular destination or train can be picked out at a moment's notice, and the making up of through trains facilitated. A watch can also be kept on cars whose return is urgent. The Yard master can in fact see what he has ready for despatch without leaving his office. This, to my mind, is very characteristic of American Railway practice: the great idea always seems to be to have information tabulated or collected, so that there is no need to stir out of the office or to go and see personally, when it is desired to see how anything is getting on.

The invoices, shewing charges, are sent from Agent to Agent. Movements of trains in the passenger Yard are directed by the Yard master, who gives any necessary instructions to the Signalman in the Signal tower by telephone, and gives similar orders to the Drill master as regards the making up of trains. Engine whistles to ask for roads to be set do not appear to be much used.

In the case of passenger trains of course the making up and shunting to be done is practically the same from day to day. The same trains start as far as possible from the same roads every day.

AUTOMATIC SIGNALLING.

Automatic signalling is being extensively adopted in the Eastern States, and in principle seems to be peculiarly adapted for combination with such a system of train control as has been outlined. The signals *indicate* whether the section in advance is blocked or not, and the Signalman is no longer required as a directing agent, as the directing power is concentrated in the person of the train Despatcher, and the Operator, who is the medium for passing on the Orders, has thus in this matter no *executive* functions.

At Junctions and Shunting Yards (*vide* previous remarks), for such switches as are not turned by hand and main line connections, there are of course signalmen, and probably the Signal Tower also includes a Telegraph Station; but as a rule the working of signals and switches would be independent of "Train Orders," and the train men would, apart from signals, be responsible that they carry such Orders as are required under the system.

Under the "Normal Safety" system the signals do not go to the "on" position until the line is blocked by a train or otherwise, while under the "Normal Danger" system the signal remains "on" until

the train approaches. The Distant Signal has a yellow arm and repeats the Home signal on the post in rear.

The signals vary somewhat in their spacing—I refer to the Electro-pneumatic system, but the same will apply to all automatic arrangements—but do not as a rule exceed 1,200 yards apart, so I was informed. This length is convenient enough where traffic is heavy, but does not allow much distance in which to pull up a fast train.

If the signal is at "Danger," the Driver must bring his train to a stand, but is not compelled to wait till it comes "Off." He must wait one minute, and may then proceed, with his train under control, to the next block signal. This is not, therefore, an absolute Block System; but, seeing there is no human agency to operate the signals, some loophole must be provided to prevent a series of trains being blocked by the vagary of an erratic signal. If anything goes wrong with the apparatus the signal should go to the "On" position. It is stated that the installation of these automatic signals has greatly diminished the number of head and tail collisions.

In some cases an automatically signalled line is used for traffic in both directions. In such case it is signalled both ways. I was unable to ascertain the arrangement of electrical connections, but imagine it must be more complex than where provision has only to be made for traffic in one direction.

The semaphore type is now replacing others, *e.g.*, the Banjo pattern, which although working satisfactorily, do not give so visible an indication to the approaching train and are liable in some patterns to be masked by snow. Red and white are the colours used for Home signals (Specs), Green and White for Distant signals. Pot signals or Ground Discs as Switch indicators shew blue for "On" and Green for "Off," as it is considered that these colours are least liable to lead to confusion.

September, 1904.

STEEL CONCRETE BEAMS.

By LIEUT.-COLONEL J. WINN, LATE R.E.

IT may be of interest to those who are undertaking steel concrete construction to know of a very simple formula, which has been deduced in America, as a result of most careful and thorough investigations on large beams.

It was found that the reinforcement failed rather than the concrete as generally used (viz., 1 part of 1 cement and 3 sand to 6 parts broken stone), which was amply strong to resist the compression to which it was subjected; and, consequently, if the reinforcement was sufficient (with due regard to economy of metal), the results agreed with the formula.

$$M_r = (0{\cdot}9 - \tfrac{1}{15}\, p)\, A\, s\, d,$$

where p = % of steel of beam bd,
A = area of steel,
s = stress per unit of steel,
d = distance from top of the beam to centre of the steel.

The results support the conclusions arrived at on page 38 of *Notes on Steel Concrete*, 2nd Edition, where the resistance of the *concrete* is chiefly considered if 2 per cent. of steel is used as recommended, a recommendation which has been endorsed by American practice before and since;

for, taking $\frac{1}{6}\, r_c bd^2$ and equating it with the formula given above for 2 per cent. of steel at $6\frac{1}{2}$ tons,

we get $$\tfrac{1}{6}\, r_c bd^2 = (0{\cdot}9 - \tfrac{1}{15} \times 2)\, \frac{bd}{50} \times 14500 \times d$$

from which $$r_c = 1340 \text{ lbs. per sq. inch};$$

and though this is 3 times the value of r_c usually taken, it has been found by the experiments cited above that the concrete did not fail.

STANDARD SPECIFICATION FOR PORTLAND CEMENT.

APPROVED BY THE ENGINEERING STANDARD COMMITTEE.

(*Condensed Extract from* THE BUILDERS JOURNAL, *January 18th*, 1905).

BEFORE testing, sample to be spread out 3″ deep for 24 hours in temperature 58° to 64° Fahr.

Fineness.— 3% residue on sieve 76 × 76 (5,776 per sq. in.).
22½% „ „ 180 × 180 (32,400 per sq. in.).

Specific Gravity.—3·15 at works, 3·10 after delivery.

Chemical Composition.—Proportion of lime to silica and alumina not greater than ratio 2·75 to 1.

Insoluble residue not to exceed		1·50%.
Magnesia	„	3·00%.
Sulphuric anhydride	„	2·50%.

Water in Gauging Briquettes.—Sufficient to form a smooth, easily worked paste that will leave trowel in a compact mass; no mechanical ramming. Temperature of room 58° to 64° Fahr.

Briquettes to be removed from mould after 24 hours and to remain in water until testing. Temperature as above.

Tensile Test.—

(1). Neat Cement Briquettes 7 days, 400 lbs. per sq. in.
„ „ „ 28 „ 500 lbs. per sq. in.

Increase in 7 to 28 days to be as follows:—

At least 25% when 7-day test falls between 400 and 450 lbs.
„ „ 20% „ „ „ 450 and 500 lbs.
„ „ 15% „ „ „ 500 and 550 lbs.
„ „ 10% „ „ is 550 lbs. per sq. in. or upwards.

(2). Cement and Sand briquettes to be gauged 1 to 3 with dry Standard Sand (Standard Sand from Leighton Buzzard, washed and dried, to pass through a sieve 20 × 20 meshes and be retained by sieve 30 × 30 meshes).

Briquettes to stand 120 lbs. per sq. in. after 7 days.
„ „ 225 lbs. „ „ 28 „

The increase from 7 to 28 days not less than 20%.

Setting.—

Quick-setting cement, 10 to 30 minutes.
Medium „ „ 30 min. to 2 hours.
Slow „ „ 2 hours to 5 hours.
Needle to be $\frac{1}{10}$in. square in section and weight $2\frac{1}{2}$ lbs.

Expansion.—

(1). Fill gauged cement into split metal cylinder 30 millimètres diar. and 30 millimètres high, and place in water (temperature 58° to 64° Fahr.) for 24 hours.
(2). Measure distance between indicator points.
(3). Place mould in cold water, bring to boiling point in 15 to 30 minutes, and boil for 6 hours.
(4). Measure distance between points after boiling.

The difference between the two measurements equals expansion of cement, which must not exceed 12 millimètres after 24 hours aeration or 6 millimètres after 7 days aeration.

We have been requested to state that the word "New" should be substituted for "Experimental" in the heading of the article containing particulars of Horse and Field Artillery Equipments (page 129).

EXPERIMENTAL HORSE AND FIELD ARTILLERY EQUIPMENTS.

PARTICULARS AS TO WEIGHTS, ETC., OF 13-PR. AND 18-PR. Q.F. GUNS.

Particulars.	13-pr.	18-pr.
Muzzle Velocity	1658 f.s.	1610 f.s.
Calibre	3 inches.	3·3 inches.
Weight	6 cwt.	9 cwt.
Breech Mechanism	Swinging Block.	Swinging Block.
Rifling { Grooves, Number ...	18	18
Rifling { Twist	Uniform.	Uniform.
Firing Mechanism	Percussion.	Percussion.
Approximate weight of gun and carriage	Cwt. qr. lb. 18 0 12	Cwt. qr. lb. 23 3 3
Approximate weight of carriage limber	12 0 0	14 3 3
Approximate weight behind traces	30 0 12	38 2 6
No. of rounds in carriage limber	24	24
Approximate weight of wagon (filled)	Cwt. qr. lb. 15 1 21	Cwt. qr. lb. 19 1 14
Approximate weight of wagon limber (filled)	14 1 27	18 1 16
Approximate weight behind traces	29 3 20	37 3 2
No. of rounds in wagon limber	38	38
No. of rounds in wagon ...	38	38
Height to axis of Gun from ground	3 ft. ·86 in.	3 ft. ·86 in.
Wheels { Track	5 ft. 2 in.	5 ft. 2 in.
Wheels { Height	4 ft. 8 in.	4 ft. 8 in.
Weight of projectile (filled and fuzed)	12½ lb.	18½ lb.
Ammunition	Fixed and fitted with percussion primer.	Fixed and fitted with percussion primer.

WAR OFFICE (A. 2),
6th February, 1905.

Printed by permission of the Army Council.

TRANSLATIONS.

DISTANT EFFECTS OF DYNAMITE.

Probably few of us go in fear of the consequences which might result from the explosion of the large quanties of dynamite sometimes stored; but if there are any who desire reassurance they will find it in an article contributed by M. Léon Thomas to *La Nature*.

M. Thomas undertook some experiments in Belgium for the satisfaction of the Belgian Government Explosives Committee, and at the instance of the three Belgian dynamite manufactories. They were made at Bewerloo, not far from Antwerp, and were curious and interesting.

To show the effects of the explosive fifty fixed or movable screens, and two small wooden bungalows with windows, were arranged round the firing point at distances varying from 16 feet to 5 miles. The dynamite exploded was of the regulation kind, and was fired off in four successive charges of 55 pounds, 100 pounds, 200 pounds, and finally of 1 ton.

The distances at which the destructive effects were felt were surprisingly small. The shock of the 25-pound charge was felt only as far as 58 feet, and even the ton of dynamite made its explosion felt at a less distance than $\frac{1}{4}$ mile.

But there was an unexpected subsidiary effect. Beyond the distances at which the direct effects of the explosion were felt was a neutral zone; and beyond that again there was a region of return shock. In the bungalows placed beyond the neutral zone the windows were broken, but the panes had all fallen outwards, as if by suction; this effect was more or less perceptible up to distances of $2\frac{1}{2}$ miles. In this zone of return shock solid constructions were not hurt.

From the experiments carried out it may be deducted that the radius of the effect of a charge of dynamite varies as the square root of the charge.

THE REORGANISATION OF THE EAST SIBERIAN ENGINEERS.

From the RAZVIEDCHIK.

An experience of over 10 months in the present Russo-Japanese War has brought to light certain discrepancies in the organisation of our Sapper Battalions, and especially in that of the Six-Company formation of the East Siberian Battalions.

According to the establishment of the latter, there are 4 Sapper, 1 Pontoon and 1 Telegraph Companies in each, as well as 2 light 70-ft. bridging equipments. Consequently the general organisation of these Battalions appears extraordinarily cumbersome, with an enormous quantity of varied and most complicated equipment; to say nothing of the almost encyclopædic knowledge with regard to engineer, pontoon and telegraphic gear entailed on the part of the Battalion Staff.

Moreover, this variety and wealth of equipment, as well as the number of the *personnel* of the Battalions (over 2,000 rank and file*), necessitate much detailed correspondence on the part of the already over-taxed orderly-room staff in connection with demands for engineer equipment and with the no less intricate returns for clothing, provisions and forage.

The work is still further complicated by the addition to certain East Siberian Sapper Battalions of supernumerary Mounted Sapper Sections and Signalling Stations;† and, although only temporarily detailed from Battalions, they have to be accounted for in its orderly-room returns.

In addition to returns for supplies and equipment the work of the orderly room and of the battalion Quarter Master is further increased by the large number of horses on the strength, which are kept up on a war footing even in peace time. These amount to no fewer than 550; not counting the 2 light bridging parks (42), the mounted sapper section (42), the 4 supernumerary signalling stations (20), division of the field engineer park (65), pontoon company (62), and the extra horses needed when the transport of 2 Sapper companies is changed from wagon to pack transport (52). Altogether the total number of horses in a six-company battalion reaches the respectable figure of 833—almost as much as a whole Cossack regiment!

All this cumbersome and complicated mechanism, created little by little and necessitated from time to time by the exigencies of the war, has now evidently reached the apogee of its development; and strains to the utmost the capabilities of the Battalion Staff. Consequently it sometimes

* This appears to refer to peace strength of combatants in the 6 battalions.
† These "stations" include *matériel* as well as the *personnel*.

occurs that their duties are not carried out with all the exactness and promptitude that one could desire.

It is suggested therefore that under these circumstances the organisation of the East Siberian Engineers should be remodelled somewhat on the following lines :—

1. The telegraph and pontoon companies to be detached from the three Six-Company battalions (1st, 2nd and 3rd), and the remaining 4 companies in each to include equipment for 2 micro-telephone stations with 8 verst cable per company.

2. The telegraph company to be detached from each of the Three-Company battalions (4th, 5th and 6th), and micro-telephone stations added as in (1).

3. Two Three-Company independent Battalions to be formed from the six telegraph companies above ; and

4. One 2nd East Siberian pontoon battalion* from the pontoon companies of the 1st and 2nd East Siberian Battalions ; and finally

5. One East Siberian depôt pontoon battalion* from the pontoon company of the 3rd East Siberian Battalion, with reserve equipment for a pontoon half park.

In this manner it would be possible to form 2 Brigades, viz. :—

1st Brigade.—1st, 2nd and 3rd E. Sib. Sapper Battalions.
1st E. Sib. Pontoon Battalion.
1st „ Telegraph „
E. Sib. Reserve Sapper „

2nd Brigade.—4th, 5th and 6th E. Sib. Sapper Battalions.
2nd E. Sib. Pontoon Battalion.
2nd „ Telegraph „
Depôt Pontoon „

The light bridging equipments, on account of their unsuitability for East Siberia and Manchuria would be done away with. (It is stated that a certain general of high rank on the active list once said that these parks would be an excellent institution if one could only carry about a 70-foot stream as well).

* By a recent Army Order the two battalions were to be formed from the pontoon companies of the present 1st, 2nd and 3rd battalions and one company of the 5th battalion, the last named to be replaced by a new sapper company.

REVIEWS.

DETAILED HISTORY OF THE RAILWAYS IN THE SOUTH AFRICAN WAR, 1899—1902.

(2 vols. fscap. £2 2s. Royal Engineers Institute, Chatham).

After the War was over the various reports from South Africa on the Railway operations were abridged and re-arranged at the War Office to form a connected *History of the Railways during the War in South Africa*, 1899—1902. This compilation was divided into 4 volumes, each accompanied by its own illustrations; the first consisted of an original "General Report" by Lieut.-Col. Sir E. P. C. Girouard, K.C.M.G., R.E., Director of Railways; the remainder comprised abstracts of numerous other reports, concerning the Cape Government, Natal Government and Imperial Military Railways and also sundry special organisations which, though strictly speaking extraneous to Railway working, had been inaugurated and administered by Railway Officers under the control of the Director.

The *History* was completed in November, 1902, submitted for official publication, and accepted; but considerations of the expense involved subsequently caused the Lords Commissioners of the Treasury to sanction the printing of the 1st volume only, and this was issued at the end of 1903 under the title given in the preceding paragraph.

The decision not to print the remaining 3 volumes came, in July, 1903, to the knowledge of the Royal Engineers Institute; and its Committee resolved, in October, 1903, to complete the publication themselves, rather than allow such a valuable record of the largest Railway operations ever undertaken by a British Army in the Field to be entirely lost to posterity. These 3 last portions of the original compilation are now issued under the title that heads this notice, and consist of 2 volumes only, viz.:— I. Letterpress, II. Illustrations.

The letterpress volume deals in detail with the separate branches of Railway working on the various lines. Parts I. and II. deal respectively with the railways in the British Colonies of the Cape and Natal. In addition to general descriptions of the railways themselves, and of their normal technical organisation, will be found much valuable matter regarding the measures taken to work them under the stress of invasion and war.

The reader's special attention is directed to Chapter II., Part I., wherein are discussed at some length the questions of the establishment of a Military Controlling Staff and the relations which should exist between it

and the Technical Staff of a railway in friendly country. The absolute necessity for arriving at a clear understanding on the subject of a Military Controlling Staff renders it incumbent on officers of the General Staff to educate themselves in this matter, and to widen their views by a study of the principles enunciated by other European Armies. Such extended studies, supplemented by the experiences of the South African War, will enable them to see clearly to what extent Military Control is necessary and at what point it becomes harmful.

The Appendices to Chapter III., Part I., will repay examination; they show what can be done with limited rolling-stock in the way of large troop movements on making a strategic change of front. The Appendices to Chapter VI., Part II., furnish further examples from the work of the Natal railways during the War.

Part III. deals with the organisation and work of the Railway Pioneer Regiment, a unit which was specially raised in South Africa to assist in dealing with the immense amount of repairs rendered necessary on railway lines through the wholesale destruction carried out by the Boers in their retreat before the British Army in the Orange Free State.

Part IV. contains a full account of the Imperial Military Railways, a title given to the enemy's lines as they were successively captured. It divides itself broadly into the history of the Reconstruction, Management and Working of the Railways in the Orange River and Transvaal Colonies.

In Chapter I. the necessity of a Military Controlling Staff is further emphasised, reference being made also to the modifications found necessary in an enemy's territory. The Appendices to this Chapter all furnish useful information regarding the various railway problems which arose in the conquered territories. Appendices A, B, and N are perhaps the most important, containing as they do the instructions issued for the guidance of the Army generally and of Railway Staff Officers in particular; the relation of these latter to the Director of Railways was much discussed, but after considerable experience it was finally agreed that they should be placed under the orders of the Director. Appendices E, G, and H furnish further examples of large troop movements undertaken for strategic purposes.

Chapter II. contains an account of the Engineering work,—temporary, semi-permanent and permanent,—which fell to the lot of the Works Department, and is of great interest to technical Engineer Officers; the photographs and drawings will repay careful study. The detailed organisation and equipment of Construction Trains is dealt with, and should prove useful to officers in charge of similar trains in future campaigns; the necessity for employing Military officers and men on these trains (when time rather than economy in construction is the prime factor) is very clearly brought out. This Chapter further shows how advantage was taken of the presence of experienced civilian railway engineers when the enemy's lines had fallen into our hands.

The difficulties experienced by the various working departments of the Imperial Military Railways (viz.:—Traffic, Locomotive, Telegraph, Stores and Accounts) are set forth in Chapters III. to VII. These possess an

interest which is primarily technical, but which will also furnish much food for thought to those who are anxious to gain an insight into the practical working of a great system of Railways on which an Army in the Field is dependent for all its supplies.

Chapter VIII. deals with the Railway Police; and Chapters IX. and X. with the Railway Staff Depôt and the Railway Employment Office, special organisations to meet somewhat peculiar circumstances, the former for the administration of troops employed on the Railways and the latter for the enrolment of Europeans for work on the same.

Chapter XI. is a report on Laurenço Marques, Delagoa Bay, and the arrangements made to work harmoniously with the authorities of Portugese East Africa.

Part V. contains a most interesting account of the organisation, equipment and use of Armoured Trains.

Part VI. treats of the Army Labour Depôts, another special organisation, established by the Director of Railways to meet the demands of the Army at large for Native labour.

Volume II. contains reproductions of 61 full-plate photographs and also 93 drawings, many of considerable size, dealing mostly with bridge work and armoured trains. Each volume has for frontispiece a coloured map of the theatre of war, and Volume I. also includes numerous diagrams illustrating the text.

THE DESTRUCTION OF MOSQUITOS.

BEING AN ACCOUNT OF THE DRAINAGE AND OTHER WORKS CARRIED OUT WITH THIS OBJECT DURING 1902 AND 1903 AT ST. LUCIA, WEST INDIES.

By MAJOR W. M. HODDER, R.E.—(Royal Engineers Institute. 2s. 6d.).

The author explains in the preface that these notes were compiled as the result of a suggestion by the War Office that an account of the various works carried out at St. Lucia, during 1902–1903, might prove useful to officers of the corps and others placed in similar circumstances elsewhere. From the first the object aimed at was the destruction of mosquitos, and in carrying out this destruction the drainage of swamps was by no means the only plan adopted. There is a chapter on the outbreaks of yellow and malarial fevers at St. Lucia, followed by one describing how yellow fever was stamped out at Havana. The author, in referring to the habits of mosquitos, says that those who wish to make themselves acquainted with mosquitos and their habits must consult technical books, but for the purpose in hand he gives his own personal observations on the ways and manners of these insects, "looking on them as vermin, so to speak—pestiferous creatures" to be hunted and destroyed by every possible means which can be devised. The Royal Army Medical Corps and Royal Engineers appear to have carried out a large amount of drainage, clearing, and reclamation works since the renewed occupation of the island, but they were insufficient to check malaria to any great extent. The author, referring to these former works, admits there was gained through them an immense advantage by those who were commissioned to continue the work, through knowing why the various works were required. Whereas those who had initiated them had much groping in the dark. All that was known was that the swamps were "bad," but the reason had not then been discovered. Dealing with the precautions to be observed before and during the building of barracks in malarious countries, the author says careful consideration of the site of the proposed barracks is of vital importance, but before all it is the paramount duty of the Government to ponder well whether a malarious country is worth occupying by troops at all. The author explains how it was the Americans were so successful in carrying out the sanitary system which was inaugurated in Cuba. There are two photographs of Cocoanut Swamp, Vigie, one showing the arterial drain in course of construction in May, 1902, and the other the drain completed, April, 1904. The work is a valuable contribution to sanitary science.—(*Broad Arrow*).

In an illustrated pamphlet on "The Destruction of Mosquitos" Major W. M. Hodder, R.E., gives an account of the drainage and other works carried out during 1902 and 1903 at St. Lucia, West Indies, for the prevention of malarial sickness. Reference is made to the experiments made in Havana, and after studying the statistics Major Hodder states that he "cannot imagine any way in which yellow-fever can be communicated other than by mosquitos." It is admitted that the anopheles species of mosquito conveys malaria to human beings, and from the figures given it will be seen that the precautions taken to prevent malaria were in this instance effective. This ably-written treatise should be studied by those who really wish to understand the subject.—(*Morning Post*).

THE CROSSBOW.

ITS CONSTRUCTION, HISTORY AND MANAGEMENT, WITH A TREATISE ON THE BALISTA AND CATAPULT OF THE ANTIENTS.

By SIR RALPH PAYNE-GALLWEY, BT.—(12½" × 9½". £3 3s. Longmans, Green & Co., 1903).

This is one of those monumental works which, owing to the very wealth of its statistics, illustrations and research, is bound to form the standard work for all time on the antient and mediæval weapons it describes so well. As an *Edition de luxe* for the library of the sporting *savant*, the antiquary or the military engineer, no work prepared with such colossal labour has, within our knowledge, been brought before the public in recent years.

This complete masterpiece can be opened at any page, affording restful occupation to the reader, who, perhaps well-nigh nauseated unto death by the wasteful stress and fret of modern existence, is enabled thereby to penetrate into an atmosphere permeated with the grotesque glamour of the middle ages and to live for a little while only in the past—that dim mysterious past of over 2,115 years ago. It is impossible to open its pages without discovering some point of interest, historical, mechanical or biographical. The greatest credit is due to that well-known sportsman, Sir R. Payne-Gallwey, for its production; there is nothing like it in existence; the author could not have a better memorial than this outcome of his taste, discrimination and learning.

The weapons selected for description are the Balista and Catapult of the antients and the Crossbow of mediæval times, with its correlatives the Longbow, the Shortbow and, finally, the Hand-Gun, all of which are most admirably dealt with. Seventy pages of accurately detailed matter are devoted to the great projectile weapons, and 250 pages are taken up with the mediæval and modern, military and sporting history, construction and management of the crossbow and its variations.

The work is illustrated by 220 engravings, many of which are woodcuts from pictures by celebrated masters, illustrative of scenes of the chase, sieges of fortified towns in the French and Italian style, and so forth. Some of these, showing the minutest details of mechanism of the siege engines, are by the famous painter, Leonardo da Vinci, distinguished alike as an Italian painter and as an inventor and writer on mechanics. Accurate diagrams are given of the various weapons and their parts, some of which have been reconstructed by the author for experimental purposes.

To treat adequately of the vast storehouse of information included in these pages is a task far beyond the scope of a review; all that can be

attempted is to indicate the nature of the salient points, which render the facts concerning these siege engines and the crossbow so instructive to the military engineer. These details, when correctly interpreted, shed great light on the social and military life of the antient European nations as they then existed, enabling us to trace out the gradual development of the old-time tactics of the battlefield, when co-ordinated to the weapons which were then in use.

This historic *chef d'œuvre* includes the period dating from B.C. 214—A.D. 1480; from the great times of the Roman power until the period of the Renaissance, marking the termination of the Tudor dynasty at a time when archery was giving way to gunpowder, and the love of money and luxury had so degenerated the taste of the English people for arms that special statutes enacting compulsory training in archery had to be passed.

Commencing with the antient siege engines, the Balista and the Catapult, the author gives his authorities, which include such varied sources as:—Athenæus, B.C. 212; Polybius, B.C. 200; The Bible, Chronicles and Ezekiel; Julius Cæsar, B.C. 48; Tacitus, A.D. 61; Vitruvius, B.C. 180; Plutarch, A.D. 66; Vegetius, A.D. 380; Froissart, A.D. 1400; Grose, A.D. 1780; Viollet-le-Duc, A.D. 1861; Napoleon III., A.D. 1859.

The Balista and Catapult were nearly always used at the antient sieges up to the 14th century, the Balista discharging great arrows, whilst the Catapult cast forth heavy pieces of rock and balls of stone. The Catapult in Roman times was christened the Onager, or Wild Ass, and in mediæval times has also been called a Mangonel. These antient siege engines not infrequently had their huge frameworks put together on the spot by cutting down available trees, their movable parts and fittings being transportable with the field army in carts drawn by oxen.

Light Balista, or field artillery Balista, referred to as Carro-Balista, which were mounted on wheels, were also used. These discharged their missiles over the head of the well-trained mule, who occupied the shafts of the wheelcart. Eleven soldiers formed the gun detachment. Several of these field weapons appear on the Trajan column erected in Rome, A.D. 105—113, to commemorate the victories of Trajan over the Dacians.

In the organization of the Roman army every cohort had one Catapult, every century one Carro-Balista; thus every legion of 6,100 men was provided with ten Catapults and sixty light Balista, or in modern parlance ten machine guns per battalion and six 5-inch howitzers per brigade.

The motive power for discharging the projectiles was obtained by twisting skeins of cord, acting as a spring which actuated a throwing lever.

Catapults taken from the enemy were esteemed in high honour as prizes, as is recorded at the siege of Carthage, B.C. 146, at Paris, A.D. 885, and at Acre, A.D. 1191. These antient siege engines were likewise wont to be treated with great respect by the soldiery, in direct proportion to the power and accuracy displayed by the weapon. A proper pride was taken in the individual engine, those which were popular, or the reverse, being christened the Bull Slinger, Queen, Lady, Wild Cat, Onager, just as in later times we have Brown Bess, Long Tom, Woolwich Infant and,

in the times of our latest civil wars, the Sow and the Boar, as employed at the siege of Gloucester, A.D. 1643.

Edward I. of England, a great believer in siege engines, constructed such a weapon for the attack of Stirling Castle, A.D. 1303, delaying the proffered surrender of the town until an opportunity of experimenting on its defences with his pet engine, the War-Wolf, had presented itself.

The origin of the Balista and Catapult engines is said to rest with Archimedes, who, when besieged in Syracuse 214—212 B.C., in the intervals of his more abstruse studies in geometry and mathematics, had carried out trials in the projection of heavy weights by means of levers. Plutarch, writing in A.D. 65, alludes to Archimedes as the informing soul of the siege, all the others, citizens and military men, being mere puppets, the missiles from his engines, arrows for short range and huge rocks for long range, plying the attacking and retreating Romans from all quarters.

From experiments made with reconstructed siege engines by Sir R. Payne-Gallwey, we gather that a range of between 300 and 400 yards with a 2 to 3-cwt. stone ball is obtainable, agreeing with the range laid down by Josephus, A.D. 80, as that of the Balista at the siege of Jerusalem.

Another engine introduced in the 12th century is minutely described by the author, and that is the Trebuchet. This weapon depended for its motive power on the falling of a heavy weight or counterpoise at the further end of a lever arm, on the principle of the seesaw. By this means, at the siege of Cyprus, A.D. 1373, stones weighing as much as 12 cwt. were cast forth. A sling was sometimes attached to the other end of the lever arm, increasing the range of the throw. At the siege of Carolstein, A.D. 1422, dead horses, the bodies of men, with the additional increment of 2,000 cartloads of manure, were ejected into the town by means of the Trebuchet, with a view to creating a pestilence.

On one occasion an emissary with peace proposals was seized and shot back again into the besieged town of Auberoche, from which place he had just sallied forth with mutually favourable terms of agreement.

As an instance of conservatism it is instructive to note that De Foulard, a French expert on tactics, writing as late as A.D. 1727, urges the advantages of the catapult over the mortars and swivel guns of that period; he states that the chief disadvantage of the cannon is the noise it makes. He reiterates the disadvantages of the hand-gun when compared with the crossbow, arguing that, if it were not for the bayonet at the end of the gun, and to the gun being of use in places where there is only a restricted area for attack and defence, the deadliness of aim of the crossbow would more than counterbalance the utility of the gun.

Over sixteen centuries of catapults, and many more than sixteen centuries of bows and arrows, and no man since Archimedes, with his heaven-born genius for mechanics, to originate a new idea capable of overcoming the prejudice of custom until the discovery of gunpowder as a motive power.

Even the Trebuchet, a new engine introduced after the lapse of fourteen centuries, was atavistic in its tendencies, depending simply on gravity, without even the spring of the Roman Balista. The progress of

mechanical military engineering had been strangely slow; and why not, it may be asked, in the presence of powerful sacerdotal bodies, limiting the extent to which it shall be lawful for the human mind to prosecute its natural enquiries. The engines of the Romans embraced, in addition to the rope spring, cogwheels and pawl, sliphook and windlass; those of the 15th century, as depicted by da Vinci, showing a small advance only in mechanism, comprised the endless screw, spring buffers and cutting edge at end of trail to check recoil, cords and pulleys, coupled wheels and connecting rods, rack and pinion, spanner, trigger, releasing catch and screw nut.

Although these antient siege engines gradually disappeared from civilized warfare when cannon came to the front, catapults were still used in barbaric armies, by the Arabs for instance, long after they were discarded in Europe. Their final appearance before a European public was at the siege of Gibraltar, A.D. 1779, being employed for evicting projectiles over precipices, by General Elliott, R.E., afterwards Lord Heathfield.

We can now deal with mediæval small-arm weapons, the decisive arms at many a hard-fought fight in the good old days of yore, the fateful arbitrators by which the destinies of nations, our own in particular, have been fashioned and decreed.

Amongst the antient siege engines described in this book the Roman Balista was included. In using this weapon the Romans were gradually paving the way for the introduction of the crossbow of the 12th century and its improved developments, of which the Balista was the prototype. The evolution of the crossbow, and kindred weapons took place gradually.

Vegetius, a Roman writer on the art of war, whose words are full of wisdom and philosophy, and very far from being mere exercises in archæological curiosity alludes, in the year A.D. 385, to the crossbow as being a manual weapon assigned to light-armed troops, some of whom, doubtless, would be allotted to the grand old garrison army, composed of many men of from 20 to 25 years' service, which occupied the Roman castrums in this country for the first four centuries of the Christian era, each legion of 6,100 men, besides engineers and artillery, having 300 mounted scouts and cavalry attached.

From the 5th to the 10th century there is no record as to whether the crossbow was in common use or not.

In the 10th century we find the crossbow well established, for it is recorded by the monk Richer, in his *Historia*, that at the siege of Verdun the arrows from the crossbow were careering about in the air so thickly that they seemed to be coming down from heaven like falling rain and again coming out of the earth like rising mist.

At the battle of Hastings, A.D. 1066, it has been suggested as one of the reasons for defeat that the irregularly armed jovial English Militia, who fought on foot, armed with shield and javelin, battle-axe and mace, were at a disadvantage when compared with the chivalry of Normandy, mounted on horseback, many of whom were armed with crossbows, prepared for an immediate assault on their foes, *arcubus tensis*, *i.e.*, "stretched bowstrings," being the order of the day. William II. was

accidentally (so 'tis said) killed in 1100, when out deer hunting, by a bolt shot from the crossbow of Sir Walter Tyrrel. William II., Henry I., Stephen and Henry II. all employed foreign mercenaries as crossbowmen in their armies as experts and instructors.

Richard I., again, in A.D. 1189, in spite of a papal decree prohibiting it, re-introduced the crossbow; and so skilful in its use was he that he killed quite a few men by his own hand, eventually falling a victim himself to the very same weapon at the hands of others.

At Lincoln, in A.D. 1217, the relieving force consisted of 400 knights, a number of foot sergeants and 317 crossbowmen. At Taillebourg, A.D. 1242, Henry III. was defeated by Louis IX., who had 700 crossbowmen in his army; but in 1272 the longbow came to the front in England, the crossbow declining as a military weapon. At Agincourt, in 1415, out of 8,000 men only 38 were crossbowmen; whereas at Crécy, in 1346, 15,000 were in the front rank of the French army.

In the 13th and 14th and first half of the 15th century crossbows in the Continental armies were still adhered to for the *corps d'élite*, who were naturally placed in the forefront of the battle line. In Spain, in the 14th century, the crossbow had become such a costly weapon that only those dons who could provide themselves with crossbows at their own expense were granted the rank of a knight. The post of "Master of the Crossbowmen" of France, Italy and Spain was one of high dignity.

Mounted crossbowmen, all knights or of superior denomination, were specially employed on the Continent in the 14th and first half of the 15th century; besides being provided with two horses apiece, and supplied on the line of march with carts in which to carry their crossbows, they had the additional privilege of decorating their horses with variegated bouquets of flowers, fore and aft. front and crupper. For head-dress a large picture hat was worn, surmounted by a canopy of flamboyant plumes, a short arrow, 9½ inches from tip of arrow to tip of the nose, being jauntily set in a side loop. For the protection of their ankle joints when mounted four tiers of ruffled flounces were worn. The *tout ensemble* of these mounted crossbowmen of Spain on their gaily caparisoned steeds was in itself sufficient to terrify the hearts of the most ardent foe.

Crossbowmen were employed in limited numbers on the Continent only till 1515, except in France, where they were popular till 1520; hand-guns and crossbows with steel bows had begun to supersede the ordinary crossbow abroad between the years 1460 and 1470.

The band of adventurous Spaniards, who accompanied Pizarro to explore Peru in 1524, were all well-to-do crossbowmen; but in his conquest of Peru in 1532–33 only twelve crossbowmen were present amongst his followers. Cortes, at the siege of Mexico in 1521, used only one company of crossbowmen.

We find that those Continental nations who, about the year 1522, discarded crossbows for open warfare still used them in sieges.

In 1572 the crossbow was practically extinct in warfare, and the English longbow was also rapidly falling into disuse.

The last occasion crossbows were used against a British army was at Taku Forts in 1860, many of the Chinese being armed with this weapon. But for sporting purposes the crossbow was used for killing deer in France up to the year 1621, and also in England. In that year a keeper of Bramshill Park, Hants, was accidentally slain by Archbishop Abbott, of Canterbury, by the bolt from the crossbow of this prelate, who had unfortunately aimed at a stag.

Early in the 16th century the double-stringed crossbow was introduced, and became very popular with sportsmen, ladies, foresters and keepers as a means of obtaining game-birds, pigeons, hares and rabbits. Towards the end of the 17th century target practice with crossbows was much indulged in as an amusement. In 1760 the stonebow was improved, and by 1810 it was fashionable, being popularly known as the bullet crossbow.

Foreign ships of war still used the crossbow for defence after its decline in 1525 as a weapon on shore. Coleridge's antient mariner in shooting the albatross with a crossbow was not performing an impossible feat-at-arms, for our author has himself shot a bolt with a 15th century crossbow over and across the Menai Straits, a width of more than 400 yards.

Shakespeare alludes to the accuracy of the crossbow in "Twelfth Night," when Sir Toby exclaims: "O! for a stonebow! to hit him in the eye!"

The crossbow is, even at the present day, used for target shooting in Belgium, and competitions at a target with a small bolt-shooting crossbow have been common as a recreation in North Germany and Belgium for some centuries.

Part I. of Sir Ralph Payne-Gallwey's book deals with the history; Parts II. and III., of the construction and management of crossbows, mediæval and modern. In Part I. are comparative notes as to the relationship between the crossbow, the longbow, the shortbow, and the hand-gun.

The shortbow appears to have been the primitive weapon. At Marathon, B.C. 490, we even read of the black archers of Ethiopia fighting in the hybrid and motley gang comprising the Persian army. The early Saxons were wont to use the shortbow, one of which is depicted in the Bayeux Tapestry, illustrative of the Norman Conquest, but no longbows are shown. However, at the time the battle of Hastings was fought the chief weapons of the Saxons were the spear and the battle-axe. The longbow, a most powerful weapon, appeared in England shortly after 1200, and held its own till about 1370, when the improved crossbow, with thick steel bow and windlass, was introduced as an adjunct.

The shortbow was then more often the arm of mounted men owing to its portability, and could be slung on the back of the soldier with cord over the breast like a short rifle. Owing to the fact that the longbow, with string drawn back to the right ear instead of only to the breast, far outranged the shortbow, it became the popular weapon for infantry, and was largely used by Edward I. about 1272—1300; but after the year 1340 the English soldiers carried longbows only, these superseding shortbows and the primitive crossbow.

The successes at Falkirk in 1298, at Crécy 1346, Poitiers 1356, and, finally, at Agincourt 1415, secured the predominance of the longbow for British warfare. The crossbow still lingered on as an easily manipulated weapon for deer slaying, and also at the butts; so much so that, with the exception of nobles and persons of wealth, even the possession of a crossbow had to be forbidden by law in England, owing to the danger that skill in the longbow might be wanting in a national emergency. This was in the year 1508 and again in 1534, during the reigns of Henry VII. and Henry VIII. It was also forbidden to shoot herons with a crossbow, heron-hawking being the favourite sport of royal and noble falconers.

It was about this time that our Continental enemies encouraged the development of the hand-gun, which weapon would place their soldiers, young or old, on an equality with the tall and strong English archers, and which, unlike the longbow, the gradual disappearance of which they hailed with delight, required no great strength to manipulate.

The English kings and troop commanders, however, were loth to believe that any weapon ever invented, or likely to be, could compete with their cherished longbow, by which so many truly glorious victories had been achieved in the past. It was not without a long and persistent struggle with gunpowder, as applied to the hand-gun, that the longbow was finally discarded by the English people about the year 1590, and it died hard, its re-introduction being advocated so late as 1798 in conjunction with the pike. So curiously does English history repeat itself from the days of crossbows and longbows up to more modern times.

Even when it was realized in 1580 that the longbow was being hopelessly beaten by the hand-gun several statutes were passed to save it from extinction as our national and well-tried weapon, its historic reputation being so great that many pamphlets were issued during the 18th century advocating its re-introduction as the greatest of all military weapons. The hand-gun did not, by any means, jump into popularity with rapidity, the first people to use it being the Florentines and Hussites in Bohemia, 1436. After Crécy the French tried the longbow, but after proclaiming that English archery was a very peculiar gift of God, they gave it up, reverting to their favourite weapon, the crossbow.

The first hand-gun was in reality a miniature cannon with a metal tube ½ inch in diameter and a touch hole for priming powder, lit by a burning fuse; a straight piece of wood supported the tube, a handle being fixed to the breech end to hold and direct it. By and by a straight stock was fixed; sighting over the thumb, as in the crossbow, was retained till 1500, when an enlarged butt-end for the shoulder appears. The next variety of the hand-gun was the culverin, with barrels resting on a forked stick with matchlock and flash pan. In 1510 the matchlock arquebus, with trigger and automatic ignition, came in, to be followed by the wheel-lock in 1560, the wheel grinding against a composition of pyrites in the jaws of a hammer kept down by a spring. This in turn gave way to the flintlock produced in Spain about 1625, flint being substituted for the pyrite; the hammer was now cocked and released every time the gun was discharged, the springs of the lock

acting as in a modern gun. Flintlocks were introduced in England in 1690—1700, and with slight modifications were carried by our soldiers till 1840.

It took some 200 years to push the hand-gun, with lock, stock and barrel complete, into the British army, so disinclined was the nation, whose prowess in the longbow had been termed by their enemies "A peculiar gift of God," to take up any innovation in weapons. Although the Chinese had from time immemorial used a double-barreled repeating crossbow, discharging as many as two dozen arrows in 15 seconds by merely working a lever to and fro, the date of its origin being beyond conjecture, we do not hear of its ever having been adopted, even in principle, by European nations till some 2,000 years later, when its detachable magazine became harmonized in principle with the European single-barrel rifle about the year 1880 as an experiment.

Nor does there appear to have been any particular reason for change as long as the European nations were content, in mediæval to later times, to kill each other with out-of-date weapons, always provided that no man should steal a march on his neighbour by adopting a secret arm, the details of which were unknown to others.

All the weapons in early use in Europe appear to have been common property; indeed, Richard I., who was slain by a crossbow near Limoges in 1199, is said to have introduced the weapon into France. Some nations preferred the crossbow, others the longbow, as more suited to the national temperament; but then came a time when, owing to the discovery of gunpowder, some comparatively insignificant people thought it would be advantageous to make up for their deficiencies in other respects by using their brains to outwit their more powerful enemies, experimenting with new arms; and by degrees, in the fulness of time, their more ponderous neighbours followed suit.

(To be continued).

O. E. RUCK

NOTICES OF MAGAZINES.

BULLETIN OF THE INTERNATIONAL RAILWAY CONGRESS.

December, 1904.

This number, which consists of something like 400 pages, contains so much reading matter that it is hardly possible to notice the contents in detail. The principal papers are to be presented at the next meeting of the Congress at Washington next May. The following are perhaps the most interesting from an operation point of view:—

SUBURBAN TRAFFIC.—By H. G. Drury, Supt., G.E.R.—In the great cities, and more especially in London, while the attraction of life in a centre of population continues steadily to draw people from the country to the city, there is a continuous migration of people from the central to the suburban districts. The vast crowds, who throng the city streets during the day, go into the suburbs to sleep; and the position to be met is that practically the whole of the working population has to be brought into town and taken back again daily.

The pressure of traffic is thus concentrated between certain close limits of time; and since also legislation imposes a severe obligation on companies with regard to running workmen's trains, the traffic is not recognised as remunerative. In fact, if it pays working expenses, it can hardly be expected now to return interest on capital.

As to the handling of the traffic, the determining conditions are:—

(1). The frequency with which trains can be run from a given centre.
(2). The greatest number of passengers per trip which a train can carry.

It is fairly obvious that the greatest train capacity which a line can attain is accomplished when all trains on one pair of metals run at the same speed, assuming that terminal facilities are adequate to avoid delay in turning and the block which might be entailed thereby.

It follows that, to attain the maximum capacity, trains which stop at all stations and those which, serving further off districts, stop at certain stations only must have separate roads.

The average overall speed of suburban trains attained on the G.E.R. is 19·5 miles per hour.

The enlarged carriage sets provided can seat 808 passengers in 15 coaches, and by lengthening platforms it is apparently intended to increase trains to 17 coaches.

Mr. Drury considers that, although electricity may be adapted to working short local traffic of a continuous character in well-populated districts—

trains conveying say 400 each—it has not so far been shewn that it would answer for long and heavy-laden trains and so great a volume of traffic as is experienced on suburban lines in this country.

He thinks that the following are main desiderata :—

(1). Engines to start quickly and attain speed rapidly.
(2). Trains to be short buffered and of large capacity.
(3). Trains to be fitted throughout with automatic continuous brake.
(4). Stations to have straight platforms, so that Guard can see along train.
(5). Line through station to be level.
(6). Block sections to be about half a mile long.
(7). Termini to have loops, so as to obviate trains entering and leaving having to cross one another's path.
(It will be recollected that this expedient has been successfully adopted at the new Boston terminal.)

LOCOMOTIVES OF GREAT POWER.—By M. E. Sauvage, of the Chemin de Fer de l'Ouest.—M. Sauvage reviews exhaustively the most recent developments in locomotive design, but comes to the conclusion that it is vain to expect finality. It may be tempting to keep for a long time to standard types, and so simplify maintenance; but progress, which does not stop, hardly allows such types to be reached with satisfaction.

He considers the most important determining factor is the permissible wheel load, remarking that as high a figure as 10 tons has been allowed on some English railways. The danger of these heavy loads is that of fatigue in the rails where the oscillations of load are large.

Wheel diameters seem disinclined to increase beyond 6′ 6″; with very high-speed engines, decrease of size introduces the difficulty of excessive wire-drawing of steam.

He thinks that the use of widened fireboxes will become more extended; but the problem of stoking has not been satisfactorily met up to the present.

M. Sauvage is a decided advocate of the compound system, in the form of a four-cylinder engine with separated valve gears for each group, and cranks placed at 180° so as to facilitate balancing—in fact the De Glehn type.

The only type of very powerful locomotive, with its whole weight adhesive and arranged to run round sharp curves, which is largely used is the Mallet design. Some such are apparently in use on the Siberian Railway (two sets of six-coupled wheels).

The number also contains a report on the cheap working of branch lines, by steam carriages and so forth, bringing out the point, incidentally, that branch lines afford a place where the rolling stock no longer up to main line standard can be used up; also a general comparative review of the working of French, German and American Railways, this latter shews that the average capital cost per mile of railways in England is nearly three times that in Germany.

C. E. VICKERS.

REVUE D'HISTOIRE.

January, 1905.

THE CAMPAIGN OF 1794.—*Army of the North.*—This section is devoted to military ballooning, a subject which was taken up warmly by some of the scientific men who advised the Committee of Public Safety. A factory was established at Meudon; a balloon company was formed; a code of signals was drawn up for use at night; reconnoitring from a captive balloon was practised at Maubenge as part of the operations of defence; and at length, on June 26th, it was employed on the battlefield of Fleurus. The balloon used was spherical, 27 feet in diameter, and rose to a height of 1,200 feet. General Morlot went up in it, and sent reports to the French commander-in-chief, which Morlot believed were very useful to him. Jourdan, however, afterwards said that they had been misleading, and that beyond astonishing the enemy at their first appearance, he had never found balloons of any use.

SIDI-BRAHIM.—Extracts are given from a forthcoming work which deals with this episode of Algerian warfare, the disaster to Lieut.-Colonel Montagnac's column in September, 1845. The account here given of it is very carefully compiled, and differs in some respects from the graphic sketch by the Duc d'Aumale in *Les Zouaves et les Chasseurs à Pied.*

THE WAR OF 1870-1871.—*The 18th of August in Lorraine.*—The description of the battle of Gravelotte, which (including appendices) has extended to nearly 1,200 pages, is at length completed. The battle cost the French 13,218 officers and men, and the Germans 20,160. In the evening Bazaine telegraphed to the Emperor:—"I have just come back from the plateau. The attack has been very brisk. The fire is now (7 o'clock) dying away. Our troops have held their ground. One regiment, the Sixtieth, has suffered heavily while defending the farm of St. Hubert." This misleading report seems to have been mainly due to ignorance of the real situation. His great preoccupation throughout the day had been lest the Germans should work round his left, down the valley of the Moselle, and cut him off from Metz. His intervention in the battle was confined to superintendence of the fire of some guns on Mont Saint-Quentin, and sending off two batteries with a score of ammunition wagons to the Sixth Corps. The orders for the retirement of the French corps to positions under the guns of Metz seem to have been drawn up on the morning of the 18th, and issued at night without modification.

E. M. LLOYD.

RECENT PUBLICATIONS.

The King's Regulations and Orders for the Army. 1904. (Provisional Edition). (1s. 6d. Wyman & Sons).

A Short Guide to the Various Ways of obtaining a Commission in His Majesty's Regular Forces, together with some Information as to Pay, Allowances, Choice of Regiment, Outfit, etc., and Directions as to the Regulations which should be consulted. War Office. (4d. Wyman & Sons).

Regulations for the Equipment of the Army (Auxiliary Forces), Part 2, Sect. XVIII., Volunteers. (6d. Wyman & Sons).

Lhasa and its Mysteries (an Account of the British Mission to Lhasa, 1903–04), by Lieut.-Colonel L. A. Waddell, C.B., C.I.E. ($8\frac{1}{2} \times 5\frac{1}{2}$. 21s. John Murray).

Lhasa, by Perceval Landon. 2 vols. ($9\frac{1}{2} \times 6\frac{1}{2}$. £2 2s. Hurst & Blackett).

Port Arthur (Three Months with the Besiegers; a Diurnal of Occurrents), by Frederic Villiers. (7s. 6d. Longmans).

The Russo-Japanese Conflict: Its Causes and Issues, by K. Asakawa. (7s. 6d. Constable).

Reflections on the Art of War. 3rd edition, with a Chapter on Mountain Warfare, by Major-General Sir R. C. Hart, V.C., K.C.B. (7s. 6d. Clowes & Sons).

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Recollections and Letters of General Robert E. Lee, by Capt. R. E. Lee. (12s. 6d. Constable).

Life and Times of Lieut.-General Sir James Browne, K.C.B., K.C.S.I., R.E. ("Buster Browne"), by Lieut.-General Sir J. J. McLeod Innes, V.C., R.E. (8½ × 5½. 18s. John Murray).

Tools for Engineers and Woodworkers (including Modern Instruments of Measurement), by Joseph Horner. (9s. Crosby, Lockwood & Son).

The Other Side of the Lantern (a Tour round the World), by Sir Frederick Treves. (9½ × 6½. 12s. Cassell).

The Great Pyramid: Its Builder and its Prophecy, by Colonel Garnier. (9 × 6. 3s. 6d. Banks).

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Ambidexterity (Two-handed-ness and Two-brained-ness), by J. Jackson. (9 × 5½. 6s. Kegan Paul).

Uganda and its People, by J. F. Cunningham. (10 × 7½. 24s. Hutchinson).

Cambridge Modern History. Vol. III. The Wars of Religion. (16s. Cambridge University Press).

Dai Nippon (The Britain of the East: A Study in National Evolution), by Dr. Henry Dyer. (8½ × 5½. 12s. 6d. Blackie).

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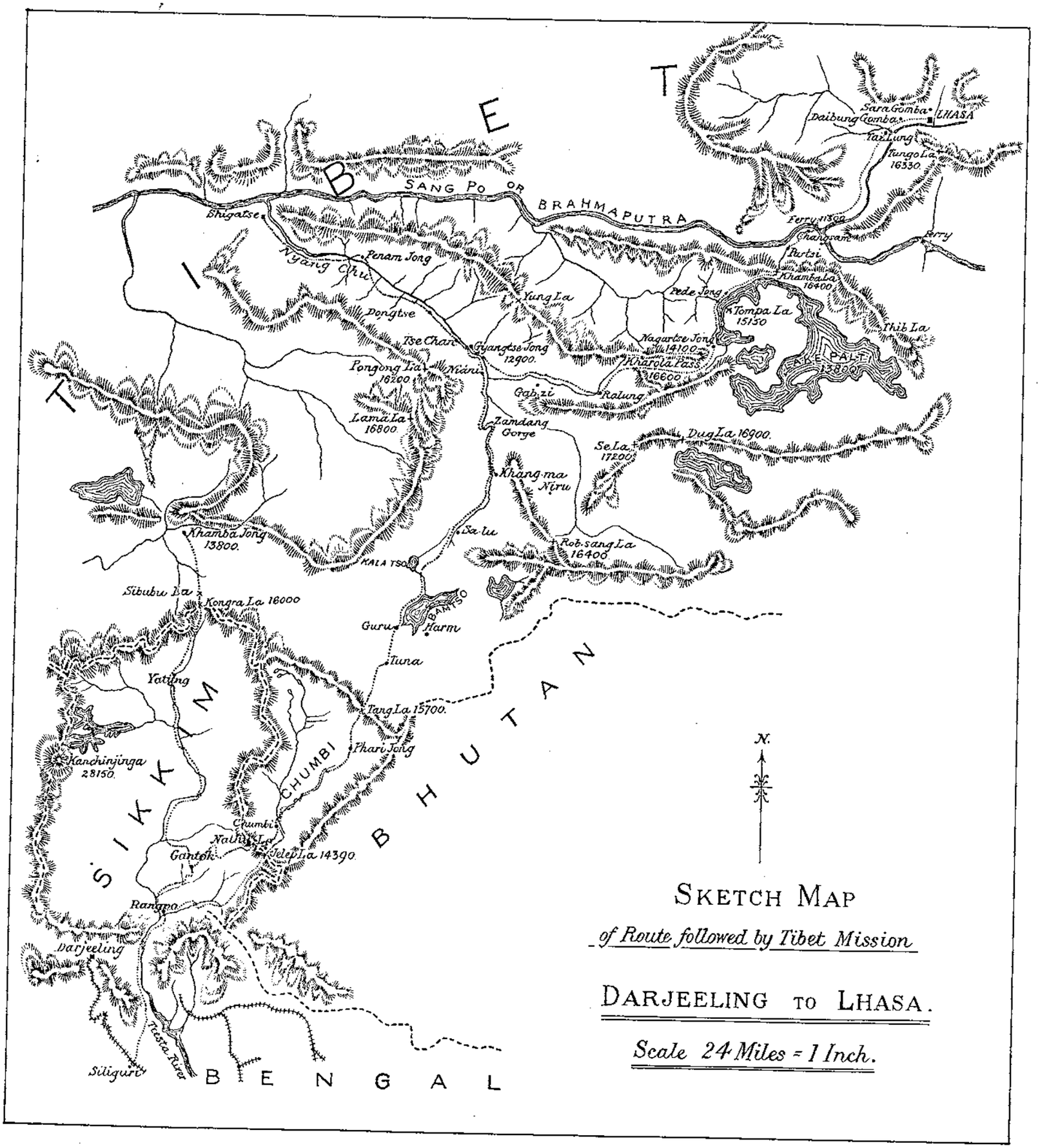

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SKETCH MAP

of Route followed by Tibet Mission

DARJEELING TO LHASA.

Scale 24 Miles = 1 Inch.

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