THE ROYAL ENGINEERS JOURNAL.

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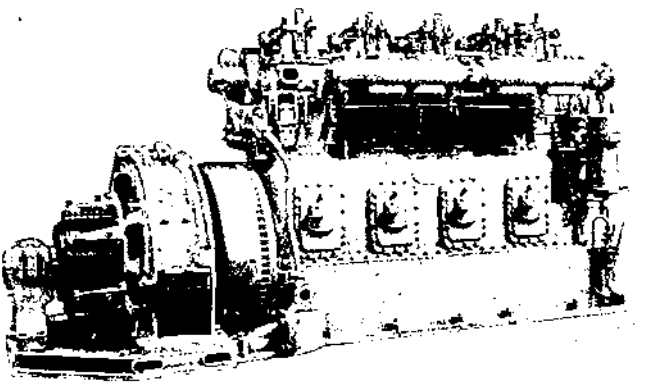

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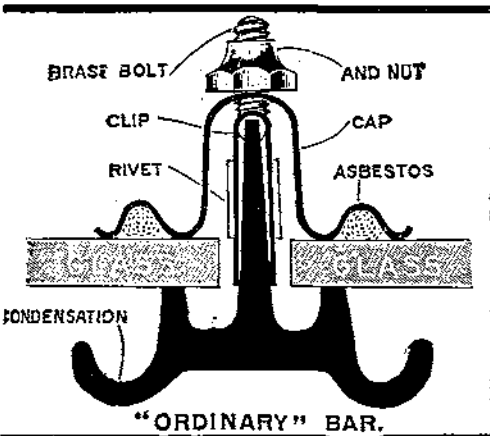

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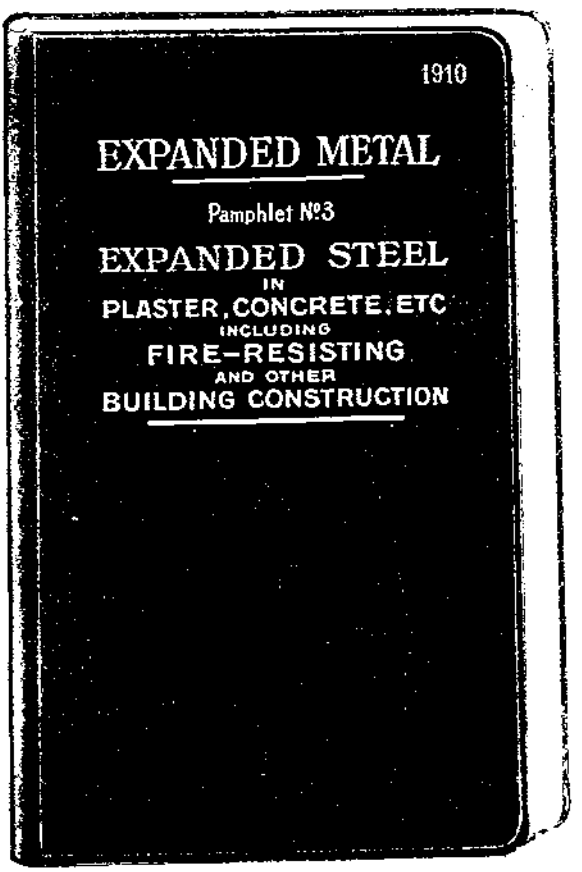

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THE PEAK CABLE TRAMWAY AT HONG KONG

THE PEAK CABLE TRAMWAY AT HONG KONG.

By Lieut. E. St. G. Kirke, R.E.

The Peak at Hong Kong is the highest point of a ridge, between which and the harbour, the town lies. On its slopes are several residences, an hotel, barracks for four companies of British infantry, and an Officers' Mess. To meet the considerable traffic with the town below, the Peak Tramway was built in 1888, running from St. John's Place Garden Road to Victoria Gap a pass over the ridge. From the foot to the summit the line rises 1,207′ in a total length of 4,690′. The maximum grade is 1 in 2, and the minimum 1 in 25. There are three intermediate stations, the top and bottom ones of which are so placed that when the descending car stops at one, the ascending car is opposite the other. The time taken for the trip, including stops, is nine minutes.

The alignment involved a certain amount of rock cutting and embankment. It was found impossible to avoid curves, the radius of the maximum being of 300′, and of the minimum 600′.

2. *Track.*—The track consists primarily of two 30-lb. rails of 5′ gauge held to steel sleepers, 24 lbs. per yard, by clips and $\frac{3}{4}$″ bolts. The rails can be of such light section owing to there being no power applied through them. Midway between termini is a crossing station giving 130′ in the clear, above which the track is formed of three rails. The middle rail is common to both cars and does away with the necessity for points above the crossing. Three lines, however, are unnecessary, as the ascending and descending portions of the cable can be kept from fouling by placing them to their own side of the centre of a single track. In the Stanzerhorn Metre Gauge Railway the cable runs 6·66″ off the centre. Apparently the centre of gravity of the cars is not placed 6·66″ off the centre to correspond, although such an arrangement would neutralize the additional flange friction caused by the eccentricity of the cable. The narrower the gauge the more will such flange friction be aggravated for a given cable eccentricity. In the Stanzerhorn line points are eliminated at the crossing by giving the outer wheels a double flange. The inner wheels have none, but are wider to ensure their keeping to their rail. It may be that the lesser curvature of this line has made the two-rail system possible, as in only one of its three sections is there a greater curve than of 10 chains radius, namely $7\frac{1}{2}$ chains, and on this, the first section the maximum gradient is only 1 in 3·7.

In the Peak line the usual self-acting switch below the station has been replaced by a hand-operating one, as in rainy weather the former was found to get jammed by *débris* coming down the hill-side.

Between the running rails is a brake rail of 66 lbs., also clipped to the sleepers and standing 7″ above them. On this rail grip the differential-screw brakes, either of which is capable of stopping the car on the steepest gradient and in the wettest weather, in a few feet. Near the summit is another rail, between the running rails, of 15 lbs., to carry one pair of wheels of a light trolly which plays an important part in holding down the cables over a concave section of the line. The other pair of these wheels runs on the brake rail.

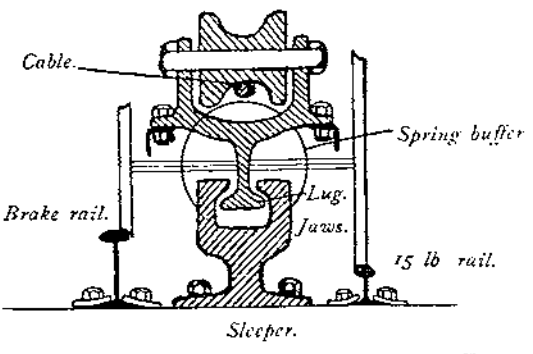


Diagram of Light Trolly.

This trolly consists of a frame carrying the holding-down pulley, attached to the axle of which is a lug to engage jaws on the track at the point where a sudden concave change in the gradient makes it necessary to keep the cable down. A spring buffer in the trolly engages with a corresponding one on the car. Normally the trolly rests in the jaws on the track. After the car ascends to this point, it pushes the trolly ahead of it to the summit, and drops it again on the return journey. The holding-down pulley must be movable or the car could never get beyond it.

3. *Power.*—The power house is at the summit, and contains two horizontal locomotive-type non-condensing compound engines of 180-B.H.P., placed on each side of the winding gear. The boilers, whose working pressure is 120 lbs., are superimposed. Either engine can be coupled to the winding gear through the flanges at F_1 and F_2. Each engine is used alternately for a month, the idle one being overhauled, and its boiler washed out. Little trouble is experienced with the latter operation as only drinking water is available for use. The high-pressure cylinder is of 13″ diameter, the low 20″, and the stroke 24″. At the end of each crank shaft, remote from the winding gear,

is a heavy fly wheel, which takes the place of the driving wheels of a locomotive so far as balancing the engine is concerned. Power is transmitted to the four-grooved winding drum C, through the gear wheels A and B, (ratio about 1·3). D, with three grooves, is not power driven but merely follows C. The wheels B and C were originally cast together in two semi-circular halves, keyed to their shaft, and bolted to each other. The keys were, however, constantly working loose and the iron of which the drums were cast, was found to be too soft. In the present installation all the three wheels A and B and C are of cast steel. B has been cast

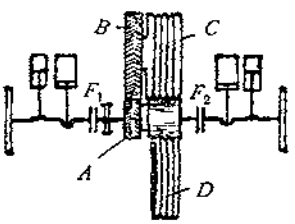


Diagram of Winding Gear.

in one and is pressed hydraulically on to the shaft. C is cast in two parts which are bolted to each other, and to B, by 2″ bolts. In addition, B and C are keyed to the shaft as an extra precaution, each by two keys. The casting upon which the toothed pinion A is carried, is prolonged to form a roller A, which runs between the drums C and D, keeping them apart and so relieving the pressure on the inside faces of their shaft bearings. This it does so effectually, that only once, since the plant was installed, have the driving drum brasses been renewed, and those of the following drum never. Cast with A also is a brake drum G, on which runs a brake band fitted with hard wood blocks. B, C and D are all three of the same diameter, 8′ 4½″ on the pitch circle. The grooves allow the cable to lie quite freely on them. If they gripped it in any way, the outside wires would quickly become crushed and broken, rendering the cable's life a short one. The drum D is canted 2·75″ off the vertical so as to bring all the tangential portions of the cable parallel. This cant prevents the drum D being used as a guide pulley for the outgoing length of cable, and three small auxiliary pulleys are provided to keep the cable off the drum. The cable takes three complete turns round the two drums, both outgoing lengths leaving the rear or driving drum. There is no pressure-equalizing device as in the case with street cable-car installations. The load is steady and not liable to the sudden fluctuations which occur when a car grips or releases the cable at some intermediate point of the line.

4. *Cable.*—The steel haulage cable is of 3½″ circumference, and weighs approximately 2 lbs. per foot. It is formed of 6 strands

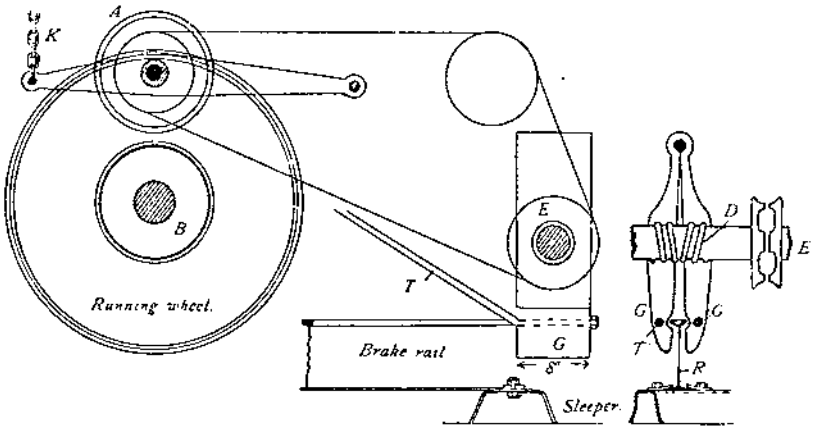
wound round a tarred hempen core. Each of these strands is made up of 16 wires, namely 8 crown, 7 inner, and 1 central. These are given the "Lang" twist, *i.e.* they are twisted in the same direction to make the strands, as the strands themselves are, to form the cable. The surface of the cable, thus formed, in contact with the winding drums and pulleys, is greater than that given in the "Standard" twist, in which the wires are wound in the opposite direction to the strands.

The breaking strain is 45 tons, and the working stress with full load 6—7 tons. Its life varies from 3 to 10 months according to make and quality. The total length is over 5,000′ of which 400′ is round the drums. This life is much shorter than is usual with cable railways. Two years may be reasonably expected, and as much as 10 years' work has been got out of one rope. The friction round curve pulleys shortens a cable's life considerably. A broken crown wire declares itself by giving a click as it passes over the pulleys. No notice is taken of single breaks if they are more than 3′ apart, or occur in different strands. If however as many as six crown wires are broken in one strand, within a distance of 3′, this strand becomes slack, and the rope must be replaced. In England it would be possible to remove 20′—30′ of the defective strand and splice in a new piece. But this cannot be done successfully in Hong Kong. If eight crown wires are broken in different strands, within 3′, it is deemed advisable to replace the cable. Along the track, the cable is supported by cast-iron pulleys (bolted to the sleepers) which are made as soft as possible so that they shall wear sooner than the cable. The latter is lubricated during three trips every day, by dripping special oil on to it as it passes over the winding drums. This takes about one gallon of oil daily. During the first week in use a new cable stretches 10′—12′, and has to be taken up. After six months' running this has generally to be done again. The pulleys are of various shapes and sizes to suit the exigencies of the alignment. Their spindles are of specially hard steel.

5. *Rolling Stock.*—This consists of two cars one of which ascends while the other descends. Each is capable of accommodating 45 passengers on seats placed transversely. The car runs on two bogies (the wheels of which are coupled together to increase the braking power) and lies parallel to the track, *i.e.* the downhill end is not raised in any way to compensate for the gradient. At first sight this might seem a very uncomfortable arrangement, but in practice it rather serves to diminish the sense of the steepness of the hill. The frame of the car is of channel steel, stiffened by two longitudinal angle steel members. These latter were not originally provided, but were subsequently found necessary to prevent the car "hogging" under a heavy load. A transverse steel plate in the centre of the frame carries the bracket to which the cable is

attached, the end being clamped round a thimble. Fully loaded, the car weighs 8 tons. Its superstructure is of teak.

The braking system is simple and efficient, and ensures the brake always being in operation unless *held off* by the brakesman. It consists primarily of two pairs of grippers G, one at each end of the



car, which are held just free of the brake rail R when the car is running. These grippers are actuated by a differential screw D, which is itself turned by the chain C, connected to a phosphor-bronze pinion A. A is held out of engagement with a similar pinion B, in one of the bogie axles, by the brakesman holding down a lever connected with the chain K. This one lever holds off both brakes and, directly the brakesman releases it, the pinion A drops by its own weight and engages B, when the whole weight of the car, directly it begins to descend, is utilized in closing the grippers, and the downward motion is arrested. The pinion A contains a ratchet free-wheel device which prevents its turning the chain C when the car is ascending. This obviates all possibility of the winding gear working against the brake. The grippers are stayed with the tension rods to the frame of the car.

These powerful brakes are only called into operation if the cable breaks, an eventuality which need never be feared if it is properly inspected. The passengers have the satisfaction of knowing, however, that their safety is assured whatever may happen.

6. *Running Arrangements and Miscellaneous.*—The engine driver in the power house has complete control of stopping and starting, in the ordinary course of events. He stands on an elevated platform above the winding drums and has the throttle, reversing, and brake levers under his hand. In addition he has a chart whose moving pointers, gear driven from the engine shaft, show him the exact position of each car on the track. The stations are marked on the chart so that he knows when to stop, should he be required to do so

by either brakesman, who signifies his desire by ringing a bell in the engine room. This bell circuit is completed by pushing out from the side of the car a light frame carrying a vertical copper rod, which makes contact with two bare copper wires, carried parallel to the track on standards spaced 100' apart. The terminal stations are connected by telephone. At intermediate stations either brakesman keeps his bell ringing as long as he wants to stop. His ceasing to ring is the signal to the engine driver that he is ready to start. If he notices anything wrong between stations he rings to stop, and releases his brake lever. If, owing to the cable slipping round the drums, or for any other reason, the pointers on the chart come out of adjustment, they can always be made to indicate correctly by a simple compensating device.

The governor originally fitted to the engine has been dispensed with, and the engine driver judges by ear how fast the drums are turning. A speed indicator would possibly be found useful when training new men. The running speed is from 6 to 9 miles an hour, and a reserve of power is always available by simpling the engine.

The cars run every quarter of an hour from 7 a.m. until 11.15 p.m., with breaks when there is no traffic. As many as 75 double trips have been made in one day. Except in the early morning, the line is used exclusively for passenger traffic, and it frequently happens at busy times of the day that some would-be travellers have to wait for the next train, unless they care to take a special between the regular timings. When nearing the summit the ascending car releases a trigger on the track, which rings a bell in the engine room. This is useful to warn the driver on a dark night or in foggy weather; ordinarily he can see a good distance down the track.

The staff required to work this system is very small. In addition to the Superintendent, there are two engine drivers who receive 150 Mexican dollars per month, with, say, 20 dollars extra for overtime; four brakesmen, whose average wage is 130 dollars (these six must be European by Government order); four stokers, and a few coolies. The daily expenditure including depreciation is $120. Coal consumption varies very much with the kind used, from 1 ton daily of the best Tonkin coal, to 2½ tons of Japanese.

So successful has this tramway been in operation, that the Directors are contemplating another larger one to take up 60 passengers and to enable the present one to be used for goods.

The cost of the present installation was about £20,000 and it is interesting to note that the shares were 3½ times their original value within one month of the opening of the line, and have not since depreciated.

A few improvements are embodied in the designs for the proposed new plans, and among them is the use of grooved slip rings on the drums. These ensure that any wear due to slip will take place

between the rings and the drum, instead of between the cable and the drum. Grease is forced in between these rings and the drum by screw lubricators.

Many of these cable railways exist in different parts of the world, notably in Switzerland, where the Stanzerhorn Railway rises 4,594′ in about 2⅘ miles. In South Tyrol the Mendel Railway rises 2,700′ in 2,600 yards.

The special function of cable railways is to surmount big elevations in much less time than can be done by any other known method. This they do by virtue of the steepness of the incline at which they can be laid, and the directness of their alignment. 1 in 8 is the economic maximum at which rack railways can be laid, and about 1 in 40 for adhesion lines. The Marseilles Cliff Railway, worked by water counterpoise, rises at a slope of 1 in 0·58, or nearly 60°, and 1 in 1·6 is the maximum grade on both the Stanzerhorn and Mount Vesuvius Railways. (The central racks in the Marseilles Railway are for controlling the cars; no power is applied through them).

It would seem that the problem of transport to Indian hill stations could be largely solved by the aid of cable railways. One hundred feet a minute may be taken as fair average lift for cable railways, including changes at the junction of sections.

In siting railways of this kind, the alignments should be as straight as possible to avoid pulley friction, and the gradient should become steeper as it ascends, to form a parabolic curve, so that the extra length of cable of the descending car may by its weight assist the ascending one up a correspondingly increasing gradient. This arrangement means an uniform speed with an uniform and minimum expenditure of power. In the Hong Kong line the maximum extra weight of cable is nearly 4 tons. The three sections of the Stanzerhorn Railway all approximately follow a parabolic curve. Its gradients are:—first section, (866′ rise), 1 in 12½ to 1 in 3·7; second, (1,664′), and third, (2,064′), both 1 in 2½ to 1 in 1·6. It must be a matter of considerable experience to determine how great a departure from the theoretically perfect gradient can be made to avoid heavy cutting or embankment, which would make a great difference in the first cost, but in no place should a concave change of gradient be made which greatly exceeds the catenary of the cable, or recourse must be had to holding-down trollies—as at Hong Kong—which are an undesirable complication. By placing the winding gear in the middle of two sections, only one car need be used on each and the cable can be central, but the traffic capacity is reduced by half. Another advantage is that coal, etc., has only to be lifted half the distance. With a single section the power house can be placed at the bottom, but double the length of cable is necessary. The nearer the gradient approaches the theoretically perfect, the less are the wear and tear of plant, and maintenance charges.

Aligning the track down or near a spur will largely eliminate the possibility of damage by the heavy rainfall which occurs in tropical mountainous countries. About £25,000 per mile may be taken as the cost of constructing a cable railway, and since this does not vary proportionately with the steepness of ascent, the steeper the gradient the more economically will any given difference of level be surmounted. Within limits, multiplication of sections makes for increased traffic capacity, in the same way that the number of crossing stations does that of a single railway line.

In conclusion my warm thanks are due to Mr. Buyers, the Superintendent of the Peak Tramway, for placing his great knowledge and experience so unreservedly at my disposal during a recent brief visit to Hong Kong.

THE WORK OF THE R.E. IN THE CHINA OR "BOXER" WAR OF 1900—1901.

A Lecture delivered by COL. F. T. N. SPRATT BOWRING, C.B., LATE R.E., *at the S.M.E.*

MUCH has been written in explanation of the origin and rapid development of the Boxer Movement in 1899 and the early part of 1900, which brought about the China War, in which six European Powers, together with America and Japan, were involved. There is, however, but little doubt that the phenomenal growth and acquisition of strength by this Militant Association was due, in the first place, to the Chinaman's traditional hatred of the "Foreign Devils" who, by active hostility and diplomatic methods of "pacific penetration," were gradually acquiring territory, concessions and rights, which the Chinese believed threatened the very existence of their Empire. The pride of race, the exclusiveness, the self-contained habits of trade, business and commerce, and the antiquity of their forms of administration, laws and methods of thought, can only be understood and appreciated by those who have visited the country and given time to the study of these national characteristics.

The soil was ready to receive the seeds of foreign hate and mistrust which were scattered broadcast by the Boxers, and which took root and shot up as rapidly as that common native millet, known as "Kaoliang," in the springtime.

The first indications of the coming events showed towards the end of 1899, when Mr. Brooks, a missionary, was murdered. During the early part of the following year, further outrages were perpetrated upon the foreigners, but not until the summer did matters become really serious, when anti-foreign disturbances manifested themselves prominently in the provinces of Shan-tung and Pei-chi-Li. Wei-hai-wei, in the former province, was in occupation by the British, having lately been handed over to them by the Japanese. Brigadier-General A. R. F. Dorward, R.E., was in command of the station, and it is here that the Corps of Royal Engineers first comes in contact with the Boxer rising. Major C. Penrose, R.E., was engaged upon the survey of the concession on the mainland, and while thus occupied on the 5th May, 1900, his survey party was unexpectedly attacked by a mob

of Chinamen, and he was severely wounded, together with four of his men. At about the same time the Boxers began to show such decided hostility in and about Pekin, that it was considered advisable to increase the strength of the Foreign Legation Guards by reinforcements from the fleets, and these reached Pekin on the last day of May.

The situation grew rapidly worse, and early in June Admiral Seymour with a small force made an attempt to reach Pekin by the railway, but meeting with determined hostility was checked when about 30 miles from Pekin, and had to fight his way back to Tientsin. Between the 16th and 18th June news reached Wei-hai-wei of the critical position in which Admiral Seymour's force was placed, and General Dorward was ordered to despatch 200 men of the Wei-hai-wei Chinese Regiment, and a detachment of R.E. of the 25th Company to Tientsin. A few days later he was directed to proceed there himself and take command of the British troops.

Hong Kong was preparing to despatch more troops, among them a section of R.E., while India, in hot haste—and in the hottest weather—was getting together the British Expeditionary Force. The Wei-hai-wei and Hong Kong Sapper sections were under the commands of Capt. R. P. Lee and Lieut. F. M. Browne respectively, and arrived on the 21st of June at Tang-ku, the port or landing place for Tientsin on the river Pei-ho and about 30 miles lower down the river by rail. Reinforcements from Japan under General Fukushima and Russian troops under General Vogak reached Tientsin about the 20th June.

The outlook at this critical period was indeed gloomy enough to make the stoutest hearts doubtful of the future. Tientsin City, some 3 miles higher up the Pei-ho than the settlement, was given over to the Boxers, and large bodies of Chinese troops were known to have either entered it, or to be on the outskirts, evidence that the Celestial Court had also joined the rising against the foreigners. The concession itself was being threatened on all sides, and Admiral Seymour's column, which was fighting its way back to Tientsin, was sorely in need of help. Railway communication with Tang-ku had been cut, and the Pekin Legations were besieged by thousands of Chinese thirsting for their blood.

The extreme gravity of the situation drew the foreign elements together in strenuous efforts to save the situation and their own lives. Tang-ku set to work to open communication with Tientsin; Tientsin sent out relief to Admiral Seymour's column—which returned on the 26th—and made every effort to put the concession in a state of defence, hoping to be able to hold out till reinforcements arrived.

Dorward and his two Engineers, Lee and Browne, with their Sapper sections, were untiring in their efforts to make the place as strong as circumstances, materials, men and time would permit. The foreign

area lay along the river on the right bank, and was enclosed to the west by an embankment raised against floods. These were the two main features taken advantage of in the defence, with the railway station, which was unfortunately on the other bank about a mile distant, but could not be omitted from the already unduly extended area to be defended by so small a garrison.

Between the date of their arrival at Tang-ku and the 14th of July, when the Tientsin City was taken after two days' hard fighting, the handful of Sappers, assisted by such local labour as they could procure, were engaged on the defences, the railway, the battery positions, the naval gun mountings, water supply, telegraph and telephone communications, and a variety of other useful work. On the 6th Lieut. Browne was wounded.

During the bombardment of the Foreign Concessions in Tientsin, which lasted upwards of 10 days, the destruction was enormous, many of the large mercantile stores being set on fire and others wholly wrecked. The Chinese artillery was admirably served and their information about the movements of the foreigners was evidently most correct.

During the attack on the city on the 13th and 14th, General Dorward was in command of the British and American troops together with a few Austrian Marines, numbering in all about 1,700 men.

The capture of Tientsin City and the arrival of further reinforcements had an immediate effect upon the situation; it relieved the local strain and extended even to Pekin, where active hostilities against the Legations ceased for a time. Better counsels, known to have been at work, were evidently influencing the Court circle, and belief in the irresistible Boxers was diminishing.

As soon as order was established in and about Tientsin, the thoughts of all turned to considerations for the relief of the Legations, but there were great divergences of opinion as to the strength of the forces needed to accomplish it. The R.E. were mainly occupied in preparing Chinese junks for the transport of stores up the Pei-ho, as the troops simultaneously advanced by the river route to Pekin, and in repairing and assisting to work the railway to Tang-ku.

The contingent from India began to arrive on the 18th July, and Major (local Lieut.-Colonel) G. K. Scott-Moncrieff, the C.R.E., arrived with the Headquarter Staff on the 27th of July.

Due to various causes, the three Sapper companies first told off to the expedition were late in their embarkation from Calcutta, and did not reach China in time to take part in the advance to the relief of the Legations, when their services would have been of great value.

The R.E. on the spot set to work to improvise, mainly from local resources, the engineering requisites for the advance to Pekin *viâ* the river; the railway, rolling stock, and several bridges on the line to

Pekin having been hopelessly destroyed and made unrepairable within any reasonable time.

By the 4th August the preparations of three of the Allies at least, viz., British, American and Japanese, were complete, and the advance commenced on that day. The Russians and French at first declined to co-operate, but when they found that the others were proceeding without them, they joined forces, and advanced by the left bank, the other three keeping to the right.

On the 5th August the Chinese defended the entrenched position between the Pei-ho and Wun-ho Rivers with considerable tenacity, the brunt of the attack being borne by the Japanese with the British in support. These allied troops lost some 325 killed and wounded in the assault. Pursuit was rendered difficult by inundations, in the crossing of which the want of Sappers was severely felt. On account of this obstruction the whole allied force was obliged to retire for some distance and to cross (by means of a bridge of native junks hastily put together by the R.E.) to the right bank, resuming their march next day on that bank. Further Chinese resistance was made at the village of Yangtsun (at which place the railway crosses the Pei-ho) where the embankment approaching the bridge was held by the main Chinese army, who had also constructed gun pits and other earthworks to supplement the railway embankment. The attack on these was carried out successfully mainly by the British, supported by Americans and a few Russians, with a loss of about 130 killed and wounded.

The Allies then recrossed the river to the right bank, along which the rest of their march to Pekin continued. At Ho-shi-wu on the 8th the enemy were preparing a further entrenched position but were surprised by British cavalry, who made a successful charge on their flank. The position was hastily evacuated, the enemy leaving their tools, and a large powder magazine containing from 80 to 100 tons of powder, was captured and destroyed by the R.E. Three (subsequently increased to five) defensible posts were established by the British force on the line of communication between Tientsin and Pekin, the work being done as far as possible by the R.E. as they advanced, and afterwards strengthened by the Madras and other Sapper companies as they followed on. The march lasted 10 days, and the relief of the Legations took place on the 14th of August, the British troops being the first to enter the area defended by the Legations.

The following R.E. officers took part in the march to Pekin:—Lieut.-Colonel G. K. Scott-Moncrieff (C.R.E.), Capt. R. E. Picton (Adjutant), Capts. G. H. Griffith, R. P. Lee, C. H. D. Ryder, and Lieut. S. G. Loch. Lieut. H. Cowie remained at Tientsin with his railway section to assist in repairing the line to Tang-ku.

At Tong-chu, 16 miles from Pekin, the road leaves the river

route, turning west. Along this the Allies advanced to the attack of Pekin, their objective being the city gates on the east and north in the following order. The Russians made for the north gates, the Japanese the east gate of the Tartar City, the Americans the corner where the Chinese City wall joins that of the Tartar City, and the British the east gate of the Chinese City. The French were in reserve.

A small party of Engineers with their tools and explosives were with the British advanced party to blow in the gate if necessary, but as it was found to be unguarded, an entrance was easily obtained by scaling the walls. The British force then pushed on through the streets of the Chinese City, with little opposition, to the main drainage exit of the Tartar City through which they entered. This portion of the city wall was fortunately still held by the troops of the besieged Legations.

During the advance from Tientsin there was neither time nor means for carrying out engineering works of importance, but such as could be done was effectually put through; the presence of a strong company, however, well to the fore, would on several occasions have been of very great assistance to the troops. The Telegraph Section, under Lieut. Loch, R.E., in conjunction with the American section, under Lieut. Stamford, kept the head of the column in touch with the base, to within 30 miles of Pekin, and had the C.R.E. been allowed to take the second junk load of stores, as he earnestly requested leave to do, the same evening as the relief took place, through communication with Europe would have been established.

A useful form of field observatory was devised by means of two bamboo ladders tied at the head, which could be raised to a height of 30′ to enable an observer to overlook the flat country which at that time of year was mostly covered with millet 10′ high, blocking out all near view. Four of these were carried by the Sappers in the advance, and were of great assistance in locating the enemy and in directing the fire of the artillery. A captive balloon attached to the advancing junks would have been invaluable, but the Balloon Section did not arrive in time to be of any practical use throughout the operations.

During this period, in addition to the R.E. already named, the following Sappers rendered excellent service:—Sergt. R. Bowery, Corpls. G. Watkins and R. Wareham, and Sappers J. Tranter and A. Elliott.

When Pekin and the neighbourhood had been cleared of Boxers, the apportioning of the spheres of responsibility between the Powers settled, and a decision arrived at that the whole force should winter in China, then the definite and most arduous work of the Engineer officers began.

The transition from autumn to winter in this northern Chinese province is very sudden. Towards the middle or end of November the Pei-ho becomes frozen over, and the whole coast line of Pei-chi-li Bay becomes icebound for some miles to seaward. Various rumours were afloat as to the severity of the cold and the hardships to be faced. The provision made by the Chinese themselves for keeping their houses warm, with double doors and windows, and their arrangements for heating their sleeping platforms, clearly indicated that special precautions were necessary. The British Indian troops being drawn from all parts of India, it was a matter of considerable anxiety and uncertainty how they would stand the severity of a North China winter.

More troops were on their way from India, increasing the British contingent by one brigade, to make up for the troops unexpectedly diverted at Shanghai, as well as to bring them up to a more proper level with British interests in the East. Colonel W. T. Shone, R.E., was ordered out as Colonel-on-the-Staff, R.E., to be replaced soon after by Colonel F. Spratt Bowring, R.E., on the former being appointed Inspector-General Military Works in India.

The chief centres of winter housing operations taken in hand at once were Pekin, Shang-hai-kuan, Tientsin, Shanghai, and Wei-hai-wei. Before detailing, however briefly, the work that now fell to the Royal Engineers, we must note the order of arrival of the belated companies.

The first to reach the field of operations was the 4th Company of Bengal Sappers, commanded by Capt. H. R. Stockley with Lieuts. C. M. Carpenter, H. D. Pearson and M. R. Elles as company officers. They reached Sinho on the 5th August, after a delay of three days at Wei-hai-wei to land the Native General Field Hospital. This company was embarked at Calcutta without its own transport, and although promised it on arrival in China, it was not then forthcoming. The minimum of transport should invariably be sent with each company to avoid such mishaps.

The next was the 3rd Madras Company, which arrived on the 8th, together with the Printing and Photographic Sections. The company was commanded by Capt. J. A. S. Tulloch with Lieuts. E. G. Henderson, R. E. Goldingham and T. A. Garstin, the company officers.

Three days later No. 2 Bombay Company arrived at Tientsin with the following officers:—Capt. G. H. Boileau commanding, and Lieuts. G. R. Pridham, J. E. Craster and W. B. Chaldecott, company officers. This company experienced very rough weather on the way out and their transport animals suffered somewhat in consequence.

Kotla Sappers arrived last.

The 4th Bengal Company was first employed on the Tientsin defences, but on the 8th was ordered to escort a convoy of junks

loaded with stores, by the river route, to Pekin, where they arrived on the 19th August, five days after the relief. Between that and the 6th of September they were employed in improving the communications in and about Pekin, after which they left Pekin and established themselves at Feng-tai, the junction of the branch railway to Pao-ting-foo, settling down to the work of reconstructing that part of the demolished railway line to the south in the direction of Tientsin. We must leave them there for the present, returning to the work of railway reconstruction and management later.

No. 3 Madras replaced the Bengal Company at Tientsin and dividing, one half-company was sent to the Junk Yard to continue the work of fitting these out, the other half being set to improve and extend the defences until such time as a second convoy of junks was ready for despatch to Pekin when they were sent north in charge, reaching Tung-chou on the 26th. On the way up they improved and added to the defences of the several military posts. From that date to the 11th September the company was employed in repairing the 16 miles of road between Tung-chou and Pekin, after which Headquarters were transferred to Pekin when the company and its officers, in detached charges, were engaged in the work of housing the troops. Half the company, under Capt. Tulloch, was detached for a time to take part in the Pao-ting-foo operations against the Boxers, during which they carried out a great deal of useful engineering work.

On the return of the column to Pekin early in November, the whole company was ordered to Shanghai to help with the winter housing operations at that station, and arrived there on the 26th November.

No. 2 Bombay Company took up and continued the defence work in and about Tientsin, and on the 19th August went into action with the other troops against a large gathering of Boxers who were threatening the communications to the south, and coming to close quarters with them on one flank, took three standards and a quantity of arms. When not engaged in the various punitive expeditions, such as that to Pao-ting-foo, where half the company was sent under Lieut. Pridham, the officers and men were occupied in preparing the winter arrangements for the troops at Tientsin, and adapting two large warehouses for their own use and accommodation.

In March, 1901, the right half-company was ordered to Ma-chia-poo—the Pekin end of the line—to work on the railway, at which they continued for three months, when they exchanged places with the left half at Tientsin, the latter proceeding to Pekin to work on the Legation defences. Two Engineer Field Parks had been mobilized in India, one at Roorkee and the other at Calcutta, and in due course they arrived at their destination, one being stationed at Tientsin and the other at Shan-hai-kwan, where Lieut. Watt, R.E.,

was in charge under the orders of Major R. D. Petrie, R.E. Between the end of September and the middle of October the further reinforcements for the British contingent in India began to arrive, and with them Colonel W. T. Shone, C.B., D.S.O., his Brigade Major, Major J. G. Day who was, however, invalided shortly afterwards and succeeded by Major A. R. Reynolds, Lieut.-Colonel J. R. L. Macdonald, with the Balloon Section, Majors J. E. Dickie, C. A. R. Browne, Capts. A. H. B. Hume, A. F. Cumberlege, H. J. M. Marshall, P. G. Twining, W. A. Harrison, A. Rolland, Lieuts. H. F. E. Freeland, C. G. W. Hunter, E. C. Tylden-Pattenson, with the Mounted Sappers' Section, E. W. S. Mahon, F. G. Turner, W. A. Stokes with Kotla Sappers, T. G. Martin-Leake, E. D. Carr-Harris, and F. W. Brunner.

In addition to the above were Lieut.-Colonel Asuf Ali, in command of the Maler Kotla Sappers of the Imperial Service troops, Lieut.-Colonel G. W. H. W. O'Sullivan, R.E., on the Headquarters Staff, and Major T. F. B. Renny-Tailyour and Capt. C. H. D. Ryder, survey officers; in all 46 R.E. officers were at that time in North China.

The work of these various officers ranged over a wide area and was very diverse in character. The bulk were at first employed upon the winter housing arrangements, which had to be carried out against time, while others were engaged upon railway reconstruction and management, improving the landing facilities and the storage accommodation at Sin-ho, a pier at Shan-hai-kwan, telegraph and telephone communications, survey, staff and intelligence work and a variety of other branches of engineering, nothing coming amiss to the ubiquitous Sapper. The extent of one section alone of their work will be realized when it is stated that 18,000 troops, 14,000 followers, and 10,000 animals were provided with warm and comfortable shelter before the severe winter weather set in.

The main centres of these activities were Pekin, Tientsin, Shan-hai-kwan, Wei-hai-wei and Shanghai, and the following was the usual procedure in providing accommodation. Where possible, existing storehouses, Chinese houses or forts were made available for the troops, but in most cases the native followers were accommodated in new huts or ruined houses which were repaired, and the animals quartered in sheds erected for the purpose. Contract or direct native labour was as far as possible employed. The British officers in command of the native troops, being accustomed to provide their own regimental quarters in India, were advanced funds to engage local labour and purchase material, the R.E. lending such aid and giving as much supervision as they were able, to the work. One feature of this winter housing was the necessary provision of heating arrangements, and orders for stoves of all sorts and sizes were sent far and wide, and the Chinese method of heating by under-floor flues was also largely resorted to. No less than 2,000 stoves were in use and

7½ miles of flue piping erected, and so severe was the cold that the drinking troughs and sentry boxes had also to be heated to keep the water in one case and the sentry in the other, from being frozen. In addition, the Commissariat was sheltered, and every staff and regimental officer provided with suitable and comfortable winter accommodation.

Accommodation was provided as follows:—

PEKING AND OUTPOSTS.

In New Buildings.

16th Bengal Lancers—Headquarters and 2 Squadrons.
Mounted Detachment, Bengal Sappers and Miners.
Commissariat Bakery and Flour Mill.

In Adapted Buildings.

Headquarters Staff, Intelligence and Survey.
G.O.C. Cavalry Brigade and Staff.
G.O.C. 1st Infantry Brigade and Staff.
New South Wales Naval Contingent.
12th Battery, R.F.A.
R 7 Ammunition Column.
4th Balloon Section, R.E.
Engineer Field Park.
Telegraph Section, "Q.O." Madras Sappers and Miners.
Railway Section.
2 Photographic Sections.
1 Lithographic Section.
1 Printing Section.
16th Bengal Lancers—2 Squadrons (1 in Outposts).
1 Company of Sappers and Miners. } Mules in new stables.
7th Rajputs. }
24th Punjab Infantry. }
1st Sikh Infantry, P.F.F. }
26th Baluchistan Regiment. }
Hospitals—
3 Sections British Field. } In buildings which required extensive alterations.
1¾ Native Field. }
2 Sections Native, General. }
Ordnance Depôt.
Commissariat Depôt and cattle.

Transport, 1,200 mules, of which 620 with followers were in new buildings.

TIENTSIN AND OUTPOSTS.

In Hired Buildings.

G.O.C., Line of Communications and Staff.
G.O.C., 4th Infantry Brigade and Staff.
"B" Battery, R.H.A.
1-Pr. Maxim Section.
R 2 Ammunition Column } With new buildings for 400 horses and followers.
Victorian Naval Contingent.
1 Company Bombay Sappers and Miners.
Telegraph Section, Bengal Sappers and Miners.
Lithographic Section, Bombay Sappers and Miners.
20th Punjab Infantry.
31st Madras Infantry.
Hospitals—
3 Sections Native, General.
1 Section British Field.
4½ Native Field.
Field Medical Store Depôt.
Native Base Military Depôt.
No. 5 Veterinary Field Hospital.
Commissariat Stores and Bakery.
1st Madras Pioneers.
Hong Kong Regiment. } Headquarters and portions of regiments in hired buildings, remainder in posts on Line of Communications.

In Villages Adapted for the Purpose.

3rd Bombay Cavalry.
Alwar Imperial Service Infantry.
Bikanir Imperial Service Infantry.

Partly in Hired and Partly in New Buildings.

Ordnance Field Park.
Ordnance Depôt.

Partly in Adapted and Partly in New Buildings.

Transport and Commissariat cattle.
3,400 horses and mules, and 7,000 cattle and sheep.

In New Buildings.

Provost Prison.

SHAN-HAI-KWAN AND CHING-WANG-TAO.

G.O.C. and Staff, 3rd Infantry Brigade.
Detachment, R.G.A.
Jodhpore Lancers.
Engineer Field Park.
Maler Kotla Sappers.
6th Jats.
4th Punjab Infantry.
34th Pioneers.
Ordnance Depôt.
Hospitals—
1 Section British Field.
2½ Native Field.

Accommodated as far as possible in existing buildings which required extensive repairs and alterations. All stables for cavalry and regimental transport had to be newly built, also quarters for most of the cavalry and some of the sappers and infantry, with the majority of the subsidiary buildings for all arms. Several wells were sunk.

WEI-HAI-WEI.

(a). Island.

In Converted Existing Buildings.

1 Company R.G.A.
Printing Section, Bombay Sappers and Miners.
Balloon Gas Factory.
British General Hospital, 2 Sections.
Officers' Hospital.
Native Field Hospital, 1 Section.
Nurses' Quarters.
Officers' Quarters.
Ordnance Depôt.
Commissariat Stores.
Native Base Depôt.
Stables.

In New Buildings.

3 Companies 28th Madras Infantry.
Followers.

(b). Mainland.

5 Companies 28th Madras Infantry in Chinese Regiment Barracks.
1st Chinese Regiment in old Barracks.
1 Native General Hospital. } In hired buildings.
Medical Officers. }
Transport. }
500 followers—in new huts.
Infantry mules and Detention Ward—in Flagstaff Camp, converted.

(*c*). *Sun Island.*

Quarantine station for mules.

SHANGHAI.

G.O.C. and Staff, 2nd Infantry Brigade.
1-Pr. Maxim Section.
1 Company "Q.O." Madras Sappers and Miners.
2nd Bengal Infantry.
14th Sikhs.
1st Battalion 4th Gurkhas.
30th Bombay Infantry.
Ordnance Depôt.
Hospitals—
1 Section British Field.
2½ Sections Native Field.
Field Medical Store Depôt.
Commissariat Transport and Stores.
Hospitals and two battalions in hired buildings, remainder in tents with substantial mat shelters.

No better testimony to the thorough manner in which this work was carried out could be found than in the fact that the troops, followers, and animals emerged from their winter quarters at the end of February, or beginning of March, showing a bill of health as good as, if not better than, they would have had had they remained in their own cantonments in India. This reflects the greatest credit on all concerned.

Turning next to the railway operations. The greatest possible havoc had been wrought upon the line from Pekin to Tientsin by the Boxers. Bridges had been destroyed, engines overturned and fired into, the rolling stock burnt, rails uprooted, sleepers either burnt or stolen, and everything small or great that could be lifted, carried off, or hidden away by the Chinese. At Feng-tai the railway stock and sheds were mere charred remains of their former selves, and it seemed all but hopeless to attempt the work of reconstruction.

The railway from Tang-ku to Tientsin passed through many hands and vicissitudes at the start. It was first repaired and controlled by the combined efforts of the British Navy and the R.E., but due to the weak railway section sent from India, the Russian Railway Battalion claimed and obtained control of this section.

After the relief of the Legations the Russians occupied Machiafu, the then Pekin terminus, intending to take into their hands the whole reconstruction. This view of the case did not commend itself to the other allies, and on the 30th August a small force of all arms, under command of Lieut.-Colonel Scott-Moncrieff, R.E., was ordered to Feng-tai, an important junction 5 miles beyond Machiafu, with

orders to clear the country of Boxers, establish a defensive position and commence restoration of the line. In October, the German troops began to arrive from Europe, and with them a railway battalion, when the Field Marshal Commanding, Count von Waldersee, requested the C.R.E. of the British force to meet and confer with the German authorities as to the apportionment of work for the restoration of the railway lines. The arrangement was as follows :—To the British the Pekin end was allotted, working north and south from Feng-tai. The Japanese and Germans shared the interval to Tientsin. The Russians worked from Tang-ku towards Shan-hai-kwan, which had not been badly damaged, later handing it over to the Germans, taking for themselves that part of the railway extending beyond the Great Wall at Shan-hai-kwan, to Niuchwang. At the same time it was decided that the Pekin terminus should no longer be at Machiafu, 2 miles outside the city, but should be brought within the walls to a central station near the Temple of Heaven. Here sidings were made for the several Powers, and a careful system of traffic working inaugurated.

Lieut.-Colonel Macdonald was placed in charge of the British railway operations in October, and by dint of hard work and by making use of every scrap of material that could be procured the first train into Pekin was able to pass over the British section on the 9th December. This was but a beginning and much still remained to be done to put the line in anything like running order.

The Engineer officers at Feng-tai were greatly assisted in their work by Mr. Allardyce, the Chinese interpreter attached to them, whose knowledge of the Chinese and influence with them facilitated the recovery of much of the stolen property and the supply of new material. Capt. Twining on the Tientsin and Tang-ku section, had by great personal exertions brought that portion rapidly into fair working order. The divided system of control had not worked satisfactorily, and it was necessary to reconsider and determine upon some better method of general management of the line throughout from Pekin to Shan-hai-kwan. As this railway had been constructed with British capital and several Britishers were still on its staff, chief among them being Mr. Kinder a civil engineer of local experience, it was finally settled, after protest from certain Powers, to hand over the whole to British control alone, leaving to the Russians that portion beyond the Great Wall.

Lieut.-Colonel Macdonald was called upon to organize the staff from a combination of R.E., British civilians and Chinese.

The history of this work would take a volume to itself to properly describe ; only a man of Macdonald's go and energy could have organized in so short a time a system of railway management with such excellent results. He was appointed Director of Railways with Browne as Deputy Director, Twining as Locomotive Superintendent,

Pekin section, Freeland Traffic Superintendent, Cowie Personal Assistant, Griffith, Rolland, and Pearson on Railway Maintenance, Hunter Wharf Master at Tang-ku, Mahon and Turner on Railway Survey, with the two half-companies of the Sappers on construction. Guards of British troops were established at all the stations and at all the bridges in defensible posts, to prevent any attempts being made to destroy the line or block the traffic. The whole length of line was also patrolled night and day.

A short extract from a report by Colonel Macdonald will give some idea of the work that was accomplished :—

"The railway from Shan-hai-kwan to Pekin is 256 miles long, and of this 120 miles of line and 11,000′ of bridging had been totally destroyed, nothing being left except the earthworks and the masonry or concrete abutments and piers of some of the bridges. Ten stations, including one changing and one terminal station, had been ruined and in the majority of instances razed to the ground, even platform walls being pulled down; rails and sleepers had been taken away, in many cases to considerable distances; the girders of every iron bridge on this length of 120 miles had been thrown down or damaged, and some 14 engines and 500 cars had been broken up or burnt, while several hundred more had been rendered unfit for use. The workshops at Feng-tai had been gutted and demolished. Almost the whole damage had been done at the Pekin end of the line, and the total destruction of the Han-kow and Mingchikee Bridges rendered it impossible to draw power or vehicles from the Shan-hai-kwan end. The additional R.E. officers who had been ordered from India, arrived opportunely, the former civil staff loyally supported and co-operated with the British Military Engineers, the Chinese employés, who had hitherto stood aloof, flocked to resume work, and by the end of March the train service had shown a marked improvement and the railway earnings more than covered the working expenses. The earnings in May reached a higher figure than that of the best month in peace before the outbreak.

"By the end of June, the British Engineers had reconstructed 14 miles of the old line, with 1,500′ of bridging, had nearly completed 29 miles of absolutely new construction, with 1,000′ of bridging, and had strengthened and improved over 100 miles of damaged line and some 9,000′ of bridging, while running sheds, shops, watering and station arrangements, staff quarters, etc., had been brought into efficient condition. Eleven new engines had been erected (9 being at work within 30 days of landing), 6 new tenders had been built, 22 engines received major and 24 minor repairs, 80 new carriages and cars had been built and 940 cars repaired. From March to June over 88,000 troops, 177,000 tons of military stores, 250,000 civil passengers and 880,000 tons of civil goods had been carried, the monthly earnings rising from 160,000 dollars in March to 270,000 in May.

"The *personnel* during this period averaged 28 military officers, 14 civil officers, 95 British N.C.O.'s and men, 17 civil subordinates, 600 Chinese staff, besides some 3,000 coolies."

The task of the British Railway Staff was a difficult one to fulfil. The greatest tact was necessary to avoid friction with one or other of the Powers and satisfy their respective demands for transport of men and material from place to place. Difficulties did at times arise, but strict impartiality and even-handed treatment to all comers was the rule adhered to, and when it was understood that there was no departure from it, things went smoothly enough. The station masters at the important stations were British officers selected for their linguistic qualifications and tact, and it was in a great measure due to their exertions that amity was so well maintained.

Each train was provided with a small native escort travelling in a third-class compartment, and the guards were men who had volunteered for the service, belonging to the Australian naval contingent in their naval kit. As the train drew up at the stations, the station guards of Indian troops fell in under their N.C.O. and remained at attention until it moved on. By these arrangements sufficient authority was displayed to stop irregularities and check disturbances.

The above is no mean record of services rendered by our officers and those under them to the Allied Powers and the civil community in North China, and is well deserving of a place in the Corps Annals, or even of wider dissemination.

Other R.E. officers in the meanwhile had not been idle; in Pekin the various British officers had been connected up by telephone or telegraph, and the telegraph system between it and Tientsin under British management greatly improved by Brunner. At the Pekin terminus of the railway, near the Temple of Heaven, electric light was installed, the necessary plant being found in the Summer Palace. The Pei-ho River above and below Tientsin was cleared of obstructions, caused by sunken junks, and the landing stage at Sin-ho, the British seaport, was considerably enlarged and the commissariat stores and shed accommodation at that place added to. At Shan-hai-kwan a well-built pile-driven landing pier some 200 yards long was run out into deep water by the Kotla Sappers, giving access to the shore some time after the Pei-ho became frozen. A light railway brought out from India was laid from it to the cantonments 2 miles inland, and a gas generating station for the Balloon Section erected at Wei-hai-wei.

In January a Military Commission, all the Powers being represented, sat at Pekin under the presidency of Colonel Shone to consider and formulate proposals for placing the various Legation areas in a proper condition of defence and mutual support. Each having determined their limits, a combined scheme was drawn up. The British and Japanese elected to close in theirs with high substantial brick walls, loopholed, with flanking projections and gun emplacements at the salients. The others enclosed theirs by a combination of wall, earthen parapet, and ditch. The Tartar City wall 40′ high and 50′ wide

at the top, closed in the whole to the south. A clear zone of from 100 to 150 yards wide was to be left outside each, and the Pekin railway station was to be brought up under, and outside the city wall, to the west of the Chien-Miu Gate, so as to be defended by the Legations. The perimeter of the British Legation having been decided upon, three R.E. officers under Major Dickie's orders were told off to the work of reconstruction and accommodation.

The area had been much extended beyond the old limits, and several large Imperial storehouses enclosed within it, which were adapted for the accommodation of the 250 British European troops to form the garrison. By means of a little ingenuity these buildings were made very suitable, considering the climatic conditions of cold in winter and heat in summer. The usual accessories, such as cook-houses, wash-houses, etc., were built and existing buildings adapted or built for officers' quarters, mess houses, storage accommodation for three months' supplies, a reserve of arms and ammunition, as well as hospital accommodation.

An immense amount of clearing away and rearranging of buildings had to be done within this area, together with draining and levelling for parade and recreation purposes—the garrison being practically confined within its limits, had to be given ample space to move about in.

A strong loopholed wall 12′ high was built on the north and west sides and provided with a musketry parapet all round, flanking projections, and gun emplacements. On the other two sides the British Legation joined up with the Japanese and the Russians, who continued the outer defences in accordance with the general plan agreed upon.

During the siege the Chinese had shown themselves adepts at mining, and it was therefore thought expedient to run countermine galleries well out at selected places, and this was carried out in the British Legation.

These operations were completed in time for the buildings to be handed over for occupation by the British Legation guard in the autumn of 1901 and, this accomplished, the Chinese Expeditionary Force ceased to be any longer in being. With the exception of a few troops to winter at Tientsin and Shan-hai-kwan, the rest were rapidly leaving for India, and the Engineers followed suit when the section of work for which each was responsible was cleared off, the stores disposed of and the accounts settled.

The survey party under Renny-Tailyour was actively engaged throughout the operations taking advantage of the various expeditions sent out from Pekin or Tientsin to map in as much of the country as could be commanded. Altogether 16,000 square miles of country were triangulated and 17,000 square miles of detailed survey on the $\frac{1}{2}$-inch scale completed with the plane table.

Germany was the only other nation attempting any systematic survey of the country.

Although most of the fighting was over before the majority of the R.E. arrived upon the scene, there was an abundance of hard and varied work for them to tackle and get through. Whether our officers rose to the occasion and made the most of it must be left to others to judge. What has, however, been clearly brought out, in this and many other expeditions is, that our companies should not be over specialized in a particular branch of engineering, or they will not so readily be able to turn their hands to whatever work may confront them at the time.

Where *all* did well, and put their backs into their duties, it may seem ungracious to list the names of those who came prominently to notice, but there is this to be said, that as it is at the close of a campaign, after the usual special-action despatches have been submitted, that a better appreciation can be formed of the Engineer officer and his work, we may be permitted to give the names of those brought to the notice of the G.O.C. by the Colonel-on-the-Staff, R.E., at the close of the operations :—

Lieut.-Colonel G. K. Scott-Moncrieff, who from the first to last showed himself to be an excellent Engineer and invaluable officer.

Major and Brevet Lieut.-Colonel J. R. L. Macdonald, C.B., who carried out the onerous duties of Director of Railways under very trying circumstances with great success, but who, unfortunately, had to leave his post on account of ill-health.

Major J. E. Dickie, R.E., an officer of close and assiduous attention to his duties.

Major A. R. Reynolds, Brigade Major, who afforded willing assistance at all times.

Capt. R. P. Lee, upon whose shoulders the engineering work at the start rested, and who rendered valuable service.

Capt. P. G. Twining, an able railway engineer, through whose resourcefulness and energy the rolling stock of the broken-down railway was made able to meet a heavy strain of work.

Capt. R. E. Picton. This officer was Lieut.-Colonel Scott-Moncrieff's Adjutant from start to finish, and his right-hand man.

Lieut. S. G. Loch, of whom too much cannot be said in praise of his management of the British telegraph lines.

Lieut. H. D. Pearson, Orderly Officer, and a most hard-working, intelligent and promising officer.

Lieut. W. A. Stokes, graded as Staff Captain, and through whose energy and tact the Maler Kotla Sappers were admirably handled and worked.

Hon. Lieut. A. Watt, an officer of many excellent qualities who did admirable service.

Also the following officers for good work :—

Lieut.-Colonel C. Penrose.
Major T. J. W. Prendergast.
„ C. A. R. Browne.
„ F. V. Jeffreys.
„ R. D. Petrie.
Capt. H. R. Stockley.
„ G. H. Griffith.
„ G. H. Boileau.
Lieut. H. F. E. Freeland.
„ E. C. Tylden-Pattenson.
„ H. E. C. Cowie.
„ E. W. S. Mahon.
„ M. R. Elles.

The following British warrant and non-commissioned officers and men :—

Conductor W. D. Gray, Adjutant-General's Department. This warrant officer was of the greatest possible assistance as head of the Brigadier-General R.E.'s Office.

Company Sergt.-Major T. J. Keenan, Madras Sappers and Miners, in independent charges did very good work for the telegraph.

Sergt. W. Tinkham, 4th Company, Bengal Sappers and Miners. A non-commissioned officer of much energy and resource.

Sergt. R. J. Sheridan, Military Works Services. This non-commissioned officer did exceptional hard and useful work in connection with the hutting of troops.

Sergt. W. Freshwater, Bengal Sappers and Miners, did excellent work for the telegraph.

Corpl. G. Watkins, 25th Company, R.E. An able, hard-working and efficient non-commissioned officer.

Corpl. A. Pitt, Somerset Light Infantry. A signaller for zeal and resource.

Corpl. G. Heywood, 3rd Battalion Rifle Brigade, for excellent work as a signaller at the Peking Headquarters Office.

22. The following warrant and non-commissioned officers and men for good work :-

Conductor W. Blain, Military Works Services.
Sergt.-Major Foreman of Works C. Shrapnell, R.E.
Company Sergt.-Major R. Snell, 4th Balloon Section.
„ „ J. H. Toy, 4th Company, Bengal S. and M.
„ „ H. Fisher, Mounted Sappers.
Sergt. F. H. Thomas, Military Works Services.
„ H. Edwards, „ „ „
„ M. H. Leonard, Litho. Section, Madras S. and M.
„ R. Bowery, 25th Company, R.E.
„ J. Ross, Litho. Section, Bombay S. and M.

Sergt. J. Shedwell, Printing Section, Madras S. and M.
„ H. Withers, Telegraph Section, Bengal S. and M.
„ C. W. Rowe, 44th Company, R.E.
Farrier-Serjt. Hobbs, 4th Balloon Section, R.E.
Corpl. R. Wareham, 25th Company, R.E.
„ Welsh, „ „ „
Sergt. J. W. Elles, D.C.L.I.
„ C. Bailey, R.A.
Corpl. W. Scott, 1st Cameronians.
Lance-Corpl. G. D. Wilson, "The Queen's."
„ A. Wade, 1st Battalion Norfolk Regiment.
Private A. E. Webb, 3rd Battalion Rifle Brigade.
„ J. W. Mitchell, 1st D.C.L.I.
„ C. Cowlard, 1st Royal Scots Fusiliers.
„ W. Young, 1st Northampton Regiment.
„ A. Warnes, „ „ „
Sapper J. Tranter, 25th Company, R.E.
„ A. Elliott, „ „ „

23. The following native officers :—

Ansuf Ali Khan, Commandant, Maler Kotla Sappers. By his example and personal exertions he helped to keep up the *morale* of his company.

Subadar Mahomed Buksh Khan, Maler Kotla Sappers. This native officer helped along the work with great goodwill.

Subadar Krishnaji Gaekwar, Bombay Sappers and Miners, was of great service to his commanding officer.

Subadar Devasahayam, 3rd Company, Madras Sappers and Miners, carried out his duties very thoroughly.

Jamadar Krishna Appaji, Bombay Sappers and Miners. A very capable and zealous officer.

Subadar Jag Singh, 4th Company, Bengal Sappers and Miners, for good work.

25. The following native non-commissioned officers and men for good work :—

Havildar-Major Hyder Buksh Khan, Maler Kotla Sappers.
Havildar Gnanapragasem, Madras Sappers and Miners.
„ Mukhtesar Khan, Bengal „ „
„ Chinnasami, Madras „ „
Sapper Lazar, „ „ „

We cannot omit from this record the mention of the hearty co-operation which the United States Engineers, in the persons of Lieut. Stamford and others, gave on all occasions, nor were the Japanese—to mention Colonel Shiba and others—behind them in their readiness to join forces and assist in any way.

Although we had some things to impart to our neighbours, we had others to learn from them. For instance, the Americans and

Japanese were ahead of us in field service telephones and telegraph; the Germans brought with them a very complete system of light railway and rolling stock, and a good pattern of portable hut; the Russians had a most excellent field kitchen; and so on. Those who kept their eyes open—and none were more apprehending than the all-seeing Japanese—could pick up many useful hints from their neighbours.

A digression from strictly engineering matters may perhaps be permitted, the occasion being exceptional, not only on account of the number of first-class Powers co-operating in a *casus belli*, but because the occasion was the first where our native troops, alone practically,—for only one British regiment and two British batteries were with our China expedition—were employed on Imperial service in conjunction with white troops other than our own.

Many were the conjectures as to the consequent effect this experiment would have upon the future bearing of our native troops towards ourselves, but the writer is satisfied that nothing but good came of their association with foreign troops. For one thing they were given a near view of the Russian—the much-talked-of Russki—and they found him to be an ordinary being, of no greater proportions or pretensions than anybody else, and they also could not help noticing that the troops of some Powers were not so well cared for by their officers as they themselves were by theirs.

The writer on one occasion was sketching in the grounds of the Summer Palace when a soldier of one of the Indian frontier regiments came up to him and enquired if he might look on. Taking a seat and entering into conversation he remarked in Hindustani "You know, Sir, we learn and understand more about many things in a week here than we could in a lifetime at home," and further added "Some day you will have to fight one of these European nations which are here, and when you do, don't leave us out, as you did in South Africa!" If such sentiments were to be found among our native troops in China, it was no false policy assuredly to place them in the field with the white troops of other Powers.

Further it must not be forgotten that in 1900—1901 the ill-feeling against us created by the Boer War was still prevalent, and showed occasionally in a manner not creditable to the troops of certain Powers, but although at times provoked, our native troops displayed tact and good temper, and held their own with commendable dignity.

It has been said with some degree of humour and a little sarcasm, that as a medal was not struck to commemorate the fighting combine of eight first-class Powers against China, some token at least should have been issued to inaugurate the fact that they did not fall out among themselves. Be this as it may none succeeded better than did the British Sappers in working in harmony with all with whom they came in contact.

MOTOR CAR IGNITION SYSTEMS.

By LIEUT. G. L. HALL, R.E.

THE question of igniting the combustible mixture in the cylinder of a high speed petrol engine, such as is used at the present time for motor car and launch work, involves other considerations than are suggested for the stationary type of internal combustion engine. The difference between their requirements is mainly due to the fact that the stationary engine is normally a one-speed machine and rarely works with such a volatile fuel as petrol. The motor-car engine, on the other hand, runs at speeds varying over a considerable range, with average piston speeds greatly in excess of those commonly found in the stationary type.

In the early days of internal combustion engines, a form of magneto ignition was used, afterwards generally discarded for the more reliable hot tube. The latter was practically universal when the motor car appeared, with the natural result that it was used, in the form of a tube kept incandescent by a petrol or benzine burner, by practically all the pioneers of the motor industry. Its days were, however, numbered from the outset, as tube ignition in any form is quite unsuited to the work. Apart from the grave risk of fire, which was found to be very real in practice, it was wasteful of fuel and did not lend itself to variable timing ; that is to say the charge was always fired at a fixed point in the stroke of the engine, irrespective of the speed at which it was running. It is obvious, from the nature of the case, that the time of ignition should be varied with the speed, in order to obtain the best results ; the charge being fired early in the working stroke at high speeds, and later at low speeds. In fact, a range of some 30° to 45° is normally provided with the now universal electric ignition.

The firing of the charge electrically may be accomplished in two distinct ways, generally distinguished under the names of "high tension" and "low tension" ignition respectively. The original source of the electric energy required is either a battery—generally a secondary battery or accumulator—or a form of generator known as a magneto, which is simply a small dynamo whose magnetic field is produced by steel permanent magnets, instead of by the electro-magnets of its larger brother. It is usual, and will be convenient for the purpose of this article, to subdivide electric ignition into three main heads :—1. High tension battery. 2. High tension magneto. 3. Low tension magneto and battery. The first two depend on precisely similar

electrical phenomena, their main difference in theory being that the first derives its energy from a battery, and the second from a magneto, or permanent magnet generator. The phenomena responsible for the action of the third type of ignition are very similar to those involved in the first two, but are manifested in a slightly different form.

High tension ignition, whether battery or magneto, depends for its action on electric induction. It is beyond the scope of this article to consider the theory of induction between adjacent conductors in any detail. Those to whom the principle is not familiar are referred to the various textbooks dealing with the subject, or are recommended to take certain facts for granted. Roughly speaking, the action is as follows:—A current is supplied from a battery or generated by a magneto at low pressure and passes round a closed circuit, known as the primary, back to the battery or magneto as the case may be. This primary circuit, part of which consists of a coil wound over an iron core, is periodically "broken," that is the current is suddenly interrupted, these interruptions corresponding with the firing strokes of the piston, and being effected mechanically by the rotation of the engine itself. Over the primary coil, on the iron core, is wound a second coil, electrically insulated from the primary but very close to it. The ends of this coil, known as the secondary, are connected to the sparking plug, the combination of the primary and secondary windings with the iron core forming the induction coil. The principle of its action is shortly this. Any alteration in the value of the primary current induces in the secondary winding an electrical pressure whose magnitude depends on the ratio of complete turns in the secondary to complete turns in the primary, and on the rate at which the necessary alteration in the value of the primary current is effected. The windings are so arranged as to produce a very high pressure in the secondary, which pressure is sufficient to force a small current across the spark gap inside the cylinder and so to fire the explosive mixture. For reasons which need not be investigated here, the maximum pressure is induced in the secondary when the primary circuit is *broken*, and the more rapidly this operation is effected, the higher will be the induced pressure. In practice, the interruption of the primary circuit is accomplished in two distinct ways, either by means of a cam operated by the engine, or electrically, by a device known as a trembler, which is precisely similar in its action to the striker of the ordinary electric trembling bell. The two systems are commonly known as the "trembler," and "non-trembler" or simple make and break.

1. *High Tension—Battery and Coil.*—In *Fig.* 1 (see *Plate*) is shown diagrammatically the simplest form of high tension battery ignition circuit for a single cylinder. For the sake of clearness, the primary and secondary windings are shown separately, though in fact the latter is wound over the former. The iron core has also been omitted.

In all ignition systems, to simplify the wiring, use is made of earth returns, that is the frame and engine are used to convey the current back to the battery and coil. These earth connections are shown by the symbol E, and the path of the current through the metal work of the car is further indicated in *Fig.* 1 by dotted lines. The coil shown is of the simple make and break or non trembler type. The battery consists of two secondary cells connected in series, made up in one casing, giving a pressure of about 4 volts. The current leaving the positive plate of one cell passes through the primary coil to the fixed contact C, through the spring S which has been pushed into contact with C by the cam K. From S it returns to the battery by the frame of the car. The contact breaker is rotated in the direction of the arrow by suitable gearing from the engine, so arranged that the cam K will allow the spring S to leave the contact C, and so interrupt the primary circuit, at fixed periods corresponding to the firing strokes of the engine ; that is, at every other revolution of the crank shaft.

At the moment when the cam K allows S to leave the contact C a high electrical pressure is induced in the secondary winding of the coil, owing, as mentioned above, to the sudden interruption of the primary current. This forces a current in the form of a spark across the sparking plug gap, the secondary circuit being completed through the metal of the engine and frame. Provided the contact breaker is correctly set in relation to the crank shaft, this spark will occur at the right moment to fire the mixture.

It will be noticed in *Fig.* 1 that a piece of apparatus called a condenser is connected across the primary make and break. The action of this condenser is so important, and so little generally understood, that it will be worth while examining it in some detail. Its function is chiefly to suppress as rapidly as possible the primary current at the moment of break. An electric current when flowing in a circuit resents being suddenly stopped, in much the same way as moving matter ; a revolving fly wheel, for instance. In consequence, unless steps are taken to prevent it, a small arc or flame will form between C and S, as soon as they are separated by the action of the cam K, owing to the electrical momentum of the primary current. This arc is injurious for two reasons. Firstly, it will rapidly burn away the platinum contacts on C and S. Secondly, the very fact that an arc forms across the contacts means that after the theoretical moment of break the current is still flowing in the primary, and will therefore die away comparatively slowly. Since the intensity of induction in the secondary depends on the suddenness with which the primary current is interrupted, it is obvious that this arc at the contact breaker will react injuriously on the spark at the sparking plug, which may even fail altogether. It therefore becomes of primary importance to suppress the arc at the moment of break, and so ensure the instantaneous cessation of the primary current. The

extinguishing of the arc could, in fact, be accomplished in other ways than by the introduction of a condenser; by some form of magnetic blow-out for instance, as is used for a similar purpose in tram and railway controllers. But besides effecting this primary object, the condenser fulfils another very valuable function which will be explained later.

The condenser consists essentially of sheets of tin foil and paper interleaved, alternate tin foil sheets being connected to each side of the break. The arrangement is indicated by the conventional sign in *Fig.* 1. At the moment of break between C and S, a rush of current flows *into* the condenser, *through* which there is no path. The behaviour of the apparatus under this rush of current is closely comparable to that of a spring when struck by a hammer. As soon as it is charged by the rush of current, it will at once expel its charge, sending a current through the primary in the opposite direction, against the battery pressure, so tending to demagnetize the core; just as a spring will rebound after a blow and throw the hammer away from it.

This action and reaction continues in the form of an oscillatory discharge from the condenser until the primary magnetizing current is brought to rest. *Fig.* 2 shows the nature of the action, the initial charge by the magnetizing current being shown by the vertical line on the left of the diagram, and the subsequent oscillations by the wave lines. The total time occupied in suppressing the primary current is extremely short, the oscillations having a very high frequency.

The oscillatory nature of the condenser discharge naturally leads us to its second important function, which is to produce a stream of sparks at the sparking plug every time the circuit is interrupted by the contact breaker. Since a pressure is induced in the secondary by every change in the value of the primary current, such a pressure will be produced by the oscillatory current from the condenser, the oscillations being so rapid as to cause a spark at the plug corresponding to each change of direction of current in the primary circuit.

The trembler type of coil is very similar in its action to the one described above, the main difference being that the actual interruption of the primary current is effected magnetically instead of mechanically. A diagram of connections for a trembler coil is given in *Fig.* 3, the trembler being shown in detail in *Fig.* 4. The contact maker, driven by the engine, consists in this case of an insulated fibre disc, in which is embedded a brass segment, the latter being in electrical connection with the metal work of the car. Rubbing on this fibre disc is a metal brush, usually in the form of a roller, insulated from the frame of the car and connected to one end of both primary and secondary windings. This metal brush completes the primary circuit at periods corresponding to the engine firing strokes, such a state of affairs being shown in the diagram (*Fig.* 3). The magnetic make and break, or trembler, consists of a hinged arm T normally held against the contact

C by the spring S. Attached to T is a piece of soft iron K. The current flows from the battery to C, then to T, round the primary coil to the contact maker and so back by earth to the battery. This current at once magnetizes the core, which attracts the iron piece K, and so pulls T away from the contact C, against the action of the spring S; with the result that the primary circuit is broken and a pressure is induced in the secondary as before. The instant that this occurs, however, the core loses its magnetism, and the spring S forces the arm T into contact with C, so that the process starts again. The result is a rapid vibration of the arm T; the circuit being interrupted a large number of times while the brush is making contact with the segment; and is manifested by the characteristic buzz of the trembler. This arrangement ensures a rapid break, and results in a considerable economy of current, since the time during which the primary circuit is closed is reduced to a minimum. A condenser is, as usual, connected across the primary break, that is the arm T and the contact C, as shewn in *Figs.* 3 and 4. The secondary circuit is completed by way of the sparking plug, and the metal work of the engine and frame.

So far we have considered the case of the single-cylinder engine. With two or more cylinders, the problem becomes more complex, owing to the difficulty of synchronizing the ignition, and so ensuring that each engine shall bear its proper proportion of the total load. A very general arrangement which is perhaps the most obvious one is to have a separate induction coil for each cylinder. Practically all car engines nowadays using battery ignition have the trembler type of coil, which is more satisfactory in practice, and naturally shows a more marked economy in current as the number of cylinders increases. Multi-cylinder ignition systems using one coil per cylinder are capable of subdivision into two types, firstly those having a separate trembler with each coil, and secondly those having a single trembler, which actuates each coil in turn. It will be convenient to consider throughout a 4-cylinder type of motor, the arrangement of wiring, gearing, etc., being easily deducible therefrom for the case of two, three, or six cylinders. In the case of a 4-cylinder engine having one coil and trembler per cylinder, the revolving contact maker has four segments, which are in connection with their respective coils, so that the contact maker will, as in the case of the single cylinder, be revolved at half crankshaft speed. A type of contact maker for four cylinders is shown in *Fig.* 5. This arrangement is a very common one, but the four tremblers require careful adjustment so as to ensure proper synchronism. A trembler which is set close, *i.e.* with the contacts nearly touching, will fire the charge earlier than one which is set wide.

The second type,—the four coils and single trembler—on the Wilson-Pilcher system, is shown in *Fig.* 6. The trembler blade is actuated, not by the core of a coil, but by a small separate electro-magnet, a

combination known as an auto-trembler. The trembler is placed in series with each coil in turn, the primary windings of the latter being connected as shown in the diagram. This does away with any synchronizing difficulties, since the same trembler actuates each coil in turn.

A third arrangement is also used with multi-cylinder engines. This is known as high tension distribution, and is the system used with the majority of high tension magnetos, as will be seen later. A diagram is given in *Fig.* 7. A single coil and trembler is used, the high tension current being fed to each sparking plug in turn by way of the high tension distributor, which is similar in principle to the low tension contact maker, but requires very much more careful insulation owing to the high electrical pressure in the secondary at the moment of induction. It is desirable to have a second trembler in reserve.

Before passing to the subject of magneto ignition, some mention may be made of the Lodge coil, an apparatus which has been in use for some time on large stationary gas engines, but has only lately been adapted to motor-car purposes. To go fully into the theory of the Lodge coil would involve a good deal of space and many technicalities, but a rough idea of its action may be of interest. Up to a certain point, as will be seen from *Fig.* 8, the apparatus is an ordinary induction coil. The ends of the high tension winding are taken to two points *a*, *a*, across which is connected the spark gap A. The points *a*, *a* are also connected to the inner surfaces of a pair of Leyden jars, which are, in effect, special forms of condensers, the inner and outer surfaces corresponding to the interleaved sheets of the ordinary flat condenser. The two outer surfaces are connected, by way of the usual high tension distributor, to the spark gaps B. These latter are the cylinder sparking plugs. Pressure is induced in the high tension winding, as usual, at the moment of primary break. A charging current flows to the inner surfaces of the Leyden jars, and at once, as before explained, recoils and discharges across the gap A. This spark takes place in a tube forming part of the coil apparatus. At the instant of the A discharge, the outer surfaces of the jars discharge with extreme rapidity across the gap B, thus firing the charge. The high resistance path L is provided to enable the outer surfaces of the jars to receive the requisite charge.

Without going deeply into the theory of these B discharges, a few words on the subject may be of interest, as it has an important bearing on the practical application of the coil. The nature of the B spark is oscillatory, the oscillations being of enormous frequency. A property of such discharges, as exemplified by lightning, is that the high resistance of an air gap, such as exists at B, offers an obstruction to their flow which is almost negligible compared to their disinclination to take an indirect path, such as would, for instance, be provided by a badly insulated sparking plug. In popular

language, it may be said that these rapidly oscillating discharges have no time to consider the path of lowest ohmic resistance, but will preferably take the most direct route. This property is of great practical importance for motor-car ignition, since faulty insulation, sooted sparking plugs, and the like have no appreciable effect on the quality of the spark.

2. *High Tension Magnetos.*—The many diseases to which secondary batteries are prone, as well as the trouble of providing for their necessary periodical recharge, led to the introduction of magneto ignition for motor-car engines. Low tension magnetos, largely used for stationary work, and whose principle will be explained later, were at first very generally employed, but have to-day almost entirely given way to the high tension type. The high tension magneto, for which a typical circuit diagram is given in *Fig.* 9, consists of two essential parts, the field magnet system and the armature, which generally revolves inside the crescent-shaped pole pieces of the field magnet. Wound on this armature, which is constructed of soft iron and is usually laminated for technical reasons which conduce to a higher efficiency, are two coils, corresponding to, and fulfilling the same duties as the primary and secondary windings of an induction coil. The armature is revolved inside the field magnet system by the engine. The ends of the primary armature winding are connected to a closed circuit, by way of the primary contact breaker, earth returns being used for convenience as in the case of battery and coil. The ignition is switched off, as shown in *Fig.* 9, by permanently connecting the armature winding to earth, so that the contact maker does not interrupt the primary circuit.

A current is generated in the primary winding by the rotation of the armature on the well-known dynamo principle, and takes the form shown in *Fig.* 10, being zero when the winding lies along the magnetic field, and a maximum when it lies across the field (*Fig.* 11).* The direction of the current is naturally reversed as the armature revolves, since the winding first moves across the magnetic field from top to bottom and then from bottom to top. The result is that an alternating current is produced having two maximum values one positive and the other negative, for each complete revolution of the armature. The contact breaker is arranged to break the primary circuit at each maximum current value, that is twice every armature revolution, as shown in *Fig.* 9. This interruption of the primary current induces in the secondary, or high tension winding, a pressure sufficient to force a current across the sparking plug gap, the double wound armature acting in precisely the same way as an induction coil. A safety spark gap is provided in the secondary circuit to prevent strain on the insulation in case of a failure of the spark at

* This figure shows the theoretical positions. The actual positions of the armature at the moments of zero and maximum current are about 20° beyond the theoretical, in the direction of rotation.

a plug. With regard to constructional details, these of course vary with the particular make of machine. Magnetos of the type under consideration,—the Bosch, Simms, Nilmelior, and many others are similar in their general arrangement. One end of the primary is connected to the armature core and thence to earth by way of a rubbing contact or brush. The other end of the primary is connected to the insulated portion of the contact breaker, the earthed contact of which normally completes the circuit. To this end of the primary is connected one end of the secondary, an arrangement generally adopted for practical reasons in these double-wound armatures as well as in ignition induction coils. The other end of the secondary is connected to a slip ring, from which the high tension current is collected by a brush and fed to the revolving portion of the high tension distributor by a second brush. The revolving part of this distributor carries a third brush which delivers the high tension current to the various cylinders in turn.

The primary contact breaker is mounted on the armature spindle and takes various forms, the Simms and Bosch types being illustrated in *Fig.* 12. In the case of a 4-cylinder engine, the magneto is driven at crank-shaft speed, the contact breaker being arranged to break the circuit twice every revolution, there being of course two firing strokes during this period. The high tension distributor is driven through a 2 to 1 gear from the armature spindle, so that the distributing brush passes two contacts per revolution. A condenser is arranged, as with battery ignition, across the primary break, and fitted as a rule in prolongation of the armature core. A sectional diagram is given in *Fig.* 13, showing the arrangement of a high tension magneto of this type.

The question of varying the timing of the ignition is not so straightforward as with the battery system. *Fig.* 10 makes it clear that the period of maximum current is very short, and it is obvious that only one position of the timing lever will give a primary break at its theoretically correct position, that is, at the moment of maximum primary current. The greater number of magnetos are provided with a variable timing gear which merely alters the moment of primary break, (*v. Fig.* 12), it being generally arranged that this break shall synchronize with maximum armature current when the ignition is retarded, or nearly so. This facilitates starting; and, although, as the timing is advanced, the break must necessarily take place when the current is not at its maximum, yet, since the engine will now be running faster and the magneto will therefore be generating a higher average current, the arrangement is to a certain extent self-regulating. Provision is made, however, in some types to ensure that the break shall always occur at the point of maximum current. This is usually done by revolving the field magnets through the same angle as the contact breaker, and has the effect of

moving the current curve along, so that the peaks always correspond with the moment of break. To this type belong the Gianoli and the Mea, the pole shoes only being moved in the former type, and the whole magnet, which is cup-shaped, in the latter.

A large number of modifications of what has been taken as a standard type exist. In the Simms-Bosch revolving shield magneto the field magnets and the armature are both stationary, but the magnetic field is forced to move by the rotation of a shield between the armature and the pole shoes, the arrangement being shown in *Fig.* 14. This has the effect of producing an alternating current which reaches a maximum value *four* times per revolution, corresponding with the four positions of the revolving shield aa', bb', $a'a$ and $b'b$. No gearing is therefore required for the high tension distributor and the contact breaker, both of which are mounted to revolve with the shield, the contact breaker being arranged to interrupt the primary circuit four times for each revolution of the shield, which is driven at half crank-shaft speed.

The Nieuport magneto also aims at abolishing the 2 to 1 gear by the arrangement shown in *Fig.* 15. The two ends of the secondary are connected to segments embedded in fibre discs, keyed side by side on the armature spindle. For clearness these are shown of different diameters in *Fig.* 15, but are in fact the same size. Two brushes are arranged at opposite sides of each fibre disc and distribute the high tension current to the plugs, as the revolving segments reach them. This results in two simultaneous sparks in series, one of which is used to fire the mixture, the other taking place in the cylinder which has just completed its exhaust stroke, where it does no harm. The high tension circuit is completed as follows: from one end of the high tension winding to segment *a*, from *a* to brush *b*, from *b* to plug *c*, from *c* to earth, from earth to plug *d*, from *d* to brush *e*, and so to the other end of the coil by the segment *f*.

The principle of connecting the ends of the secondary winding to two sparking plugs in series is also adopted in the dual ignition type of magneto. In this case, the two sparks are produced in the same cylinder, with the idea of ensuring the more rapid combustion of the charge and of facilitating starting.

A form of magneto ignition known as the single winding, or separate coil, type enjoyed considerable popularity a short time ago, but seems at present to be giving way to the double-wound type. With this system the armature has only one, a low tension, winding—the current generated being supplied to an induction coil of the ordinary type. This arrangement has two distinct advantages. Firstly it is easier to ensure satisfactory insulation for the high tension winding, where the latter is not subjected to the mechanical strains set up by the rapid rotation of the armature, and secondly, it lends itself well to alternative battery ignition. The magneto is generally geared,

just as in the double-wound armature type, to run at crank-shaft speed (in the case of a 4-cylinder engine) and the current is interrupted at the two maximum points.

The separate coil magneto may also be arranged to run without gearing, in conjunction with a trembler coil; so that it requires no setting with reference to the engine. The magneto can in this case be driven by a belt or friction wheel, generally at a considerably higher speed than the engine. The contact maker is operated by the engine, as usual, at every firing stroke irrespective of the value of the current generated by the magneto. Since the latter runs at such a high speed, the time during which the brush is closing the primary circuit will be long enough to ensure that at some point in the period of primary contact, the magneto current will reach its maximum value. This is the system on which the Rankin-Kennedy magneto works, the circuits being exactly similar to the Wilson-Pilcher already described (*Fig.* 6), a magneto being substituted for the battery. A very similar arrangement is used in the Ford cars, except that the magneto is a multipolar machine running at crank-shaft speed, which is electrically equivalent to an ordinary 2-pole magneto driven at a higher speed.

3. *Low Tension Magneto and Battery.*—This form of ignition, although nearly obsolete for car work, is often found in small launch engines, particularly in those of American make. Mention has already been made when considering the action of the condenser, of the tendency of an electric current to continue flowing, in the form of an arc across the contacts, for a short time after the circuit has been broken. This electrical momentum is more marked in a circuit, part of which is wound as a coil, particularly when the centre of this coil is filled with an iron core. Use is made of this phenomenon in the low tension type of ignition where the break is arranged to take place inside the cylinder, the resulting arc being used to ignite the mixture. The necessary coil and iron core is provided by the winding on the magneto armature. The arrangement is simple, and involves no elaborately insulated high tension circuit, but possesses the obvious disadvantage of a mechanically operated moving contact inside the cylinder. It is also harder to start the engine than with the high tension system, since only a poor arc is produced until the magneto has obtained a fair speed. For this reason, an auxiliary starting battery is frequently fitted. A low tension battery and magneto circuit are shown in *Fig.* 16. The battery in this case is usually of the primary type, working at about 6 volts. It will be noticed that a coil with core, generally known as a self-induction coil, forms part of the battery circuit, in order to increase the value of the arc, which is further improved by breaking the circuit as rapidly as possible. This is done by striking the contacts apart by the action of a spring, which is released by a cam gear driven from the engine.

Lieut.-Colonel the Rt. Hon. Sir Fleetwood Isham Edwards, G.C.V.O., K.C.B., I.S.O., Royal Engineers.

Lt COL FLEETWOOD

MEMOIR.

LIEUT.-COLONEL THE RT. HON. SIR FLEETWOOD ISHAM EDWARDS, G.C.V.O., K.C.B., I.S.O., ROYAL ENGINEERS.

By General Sir Richard Harrison, G.C.B., C.M.G., late R.E., Col. Com.

When Lord Palmerston was our Foreign Minister, he often required confidential work done that necessitated special knowledge and peculiar training on the part of those who had to carry it out. In such cases he frequently went to Sir John Burgoyne, the Head of the Royal Engineers, to obtain from him the loan of an officer. This custom he found so satisfactory that at one of his conferences with Sir John he is reported to have remarked "if I wanted an officer to fill the high appointment of Archbishop of Canterbury I expect you could supply one."

The subject of this brief Memoir furnishes one of several notable examples of how the training received by the Royal Engineers fits them not only for their own immediate business, but also for almost any career when knowledge and industry are combined with tact and modesty.

Fleetwood Isham Edwards, who was born April 21st, 1842, was the second son of Mr. Thomas Edwards, of Woodside, Harrow-on-the-Hill, and his wife Hester, daughter of the Rev. William Wilson, of Knowle Hall, in Warwickshire.

He began his school life at Uppingham, under Dr. Thring, and thence went to Harrow. He entered in the third remove of the "Shell," at Easter, 1855, being then barely 13 years old, and reached the second remove of the fifth in December, 1858. After some months' special preparation with an Army tutor at Tunbridge Wells, he passed an open competitive examination for admission into the Royal Military Academy at Woolwich. While at Harrow he had taken part in the games for which that school is famous; rackets, cricket, and football. In the two former he would no doubt have distinguished himself at the school, had he not left earlier than usual to enter the Army. In after years he was elected a

member of the "Zingari" Club and took part in many county and regimental matches.

While Fleetwood Edwards was at Harrow the Head Master was the Rev. C. J. Vaughan, who afterwards became Master of the Temple, and then Dean of Llandaff. Vaughan was in January, 1860, succeeded in the Head Mastership by Butler, who afterwards was appointed Master of Trinity College, Cambridge. Dr. Butler, who all his life took the keenest interest in Harrow, wrote in 1910 to Lady Edwards "your dear husband and Lord Spencer were among the very best Harrow men of my time. It was always a real pleasure to me to shake hands, and have a few words with him at the meetings of the Governors of Wellington College. I had watched his distinguished career with pride and admiration, knowing that his fine character must make him loved and trusted whether in office or in retirement."

After a short leave, spent in getting his outfit and making preparation for his new life, Edwards joined with the rest of his batch at Addiscombe. They were sent there, as a temporary measure, because all the available room at the Woolwich Academy was required for Addiscombe cadets who were gazetted to the Imperial list, the old East India Company and its separate army having been abolished. Six months afterwards, Addiscombe was finally closed, and all who were there were sent on to Woolwich.

After passing through the necessary probation, Edwards was appointed Senior Under-Officer at the Academy. This appointment was always considered a high honour and was much coveted, notwithstanding the nickname given by the cadets to those who held it, of "Golden Images," because of the amount of gold lace with which their tunics were adorned. Cadets who served with Edwards at the "Shop," as it is called in familiar language, all bear testimony to his character at that time. He was said to be "a delightful companion, good at all sorts of games and drills, very popular with all classes of cadets; but in whatever company he found himself, he never flinched a hair's breadth from the high ideals of the noble life he had set himself to follow, and which he steadfastly pursued."

On the 30th June, 1863, he obtained a Commission as Lieutenant in the Royal Engineers. He was tenth of a batch which supplied 12 to the Corps he joined, and 31 to the Sister Service, the Royal Artillery.

His first station was the School of Military Engineering at Brompton Barracks, Chatham. Here, with those who were commissioned at the same time, he learned the duties and responsibilities of an officer in the Army, and was put through the special courses taught there, viz.: Fieldworks, surveying, and building construction, etc. Here too I first met him. I was his senior by some eight years in the Army, and I was a Staff officer while he was under instruction. But

this made no difference in our friendship. We were drawn together by having been at the same school, and by our association in the same games. While we were together, I took him to my home near Maidstone, and also accompanied him to other places in the neighbourhood, at one of which he met the young lady who afterwards became his wife.

In his last year at Chatham he became captain of the R.E. Cricket Eleven. He is described by one* of his own "batch" as "an ideal captain, a good player, patient with his team which he handled with great tact and good judgment."

In this description I fully concur. I fancy I see him now, in his trim cricket dress, standing at his favourite position in the field, with eyes intent on the batsman, and hands ready to pick up with the greatest rapidity the swiftly-moving ball; or walking slowly back to the Pavilion after a successful innings in which, from start to finish, his bat had been kept scrupulously *straight*, worked by a cool head, and a firm yet supple arm. We used to notice that, the better the bowling, the greater seemed to be his power of resisting it. Should the tide of victory seem to be turning against us, he would take all the more pains to at least secure an honourable defeat.

I wonder if those who in after years were anxious to secure him for some Staff or other appointment took account of the qualities he displayed in the cricket field, believing that those qualities would ensure his success in the sterner duties of life? If so they were not far wrong. I could call to mind many instances to show how boys and young men who were good at games were also good at work. This was particularly so in the case of the subject of this Memoir.

On the completion of his course of instruction at the School of Military Engineering, Edwards was sent to do duty at the fortress of Dover.

His educational life at Harrow, Addiscombe, and Woolwich, and finally at Chatham, had been quietly but satisfactorily passed through, and now he was going forth at the age of 23 to take his place in the Army of his Queen, and to make practical trial of the knowledge that he had acquired, and of the character that he had gained.

At Dover he was set to do the ordinary duty of a young officer of Royal Engineers at a garrison station, viz.: the repair and renewal of the fortifications and the repair of barracks. He also took his share with those of other corps in the ordinary garrison duties, which consisted of boards, courts-martial and so on. No doubt, now and then he joined in a game of cricket, or had a sail on the uncertain waters of the English Channel; those waters which, as he soon realized in his study of fortification, take a prominent part in the defence of the

* Colonel Todd, R.E.

British Isles, and have up till now enabled this Nation to retain the proud boast of Mistress of the Seas.

After little more than a year at Dover, he was selected to be the Private Secretary and Aide-de-Camp of General Sir Frederick Chapman, Governor of Bermuda. He accompanied his Chief to that island and remained with him for over two years. An officer* of the Gloucester Regiment who at that time was stationed in Bermuda writes of him as follows: "Fleetwood Edwards came out to Bermuda in 1867 as A.D.C. to the Governor. He had then the same fascinating manner and presence that he retained through his life. We all thought him delightful, so extraordinarily tactful and thoughtful, and withal so cheery and amusing. In the Bermuda society of those days he was worth anything to the Governor and Lady Chapman, and all the islanders were devoted to him. Without in the smallest degree attempting to preach to one, he exercised a great influence for good on his friends at all times. I believe him to have been a truly religious man in the most unostentatious way. Of all people I have known, I think he retained the freshness and charm of his youth longer than anyone. Whenever I came across him at 'Court' he was the same genial light-hearted comrade; and I invariably felt, however long a time elapsed between our meetings—often some years—that we began again exactly as we left off."

From Bermuda, Edwards returned home in the summer of 1869, and was quartered for a year in Ireland in charge of the Fermoy district. He then received the special appointment of Assistant Inspector of Works at the Royal Arsenal, Woolwich. While here (in 1871) he married Edith, daughter of the Rev. Allan Smith-Masters, of Camer, Kent. But she died two years afterwards.

While Edwards was at the Arsenal the office of Inspector of Works was held by Major Scratchley, R.E., who later on became Governor of New Guinea, and was knighted. At that time the manufacturing and store departments were under the Surveyor-General of the Ordnance, a political administrator at the War Office. But the department of works of which Scratchley was the head was under the Inspector-General of Fortifications. The business that it had to do was to carry out all the building work at the great Government manufactory, where naval and military guns and carriages were designed and constructed, and where Army stores of every description were kept in charge. Just about this time the Naval Dockyard, which formerly was used for the construction of ships of war, was handed over to the Army. The alterations necessitated by this change were carried out by the works branch at the arsenal. The same branch had to superintend laying the foundations

* Lieut. Henry Tomkinson who in after years was transferred to the Royal Dragoons and became colonel of that distinguished regiment.

of the great steam hammer invented by Mr. Nasmyth, which brought about quite a revolution in heavy gun construction. Then piers had to be thrust out into the river to enable the iron vessels, which were fast succeeding wooden ones in our naval and mercantile service, to come alongside and discharge their cargoes. Shops for carpenters and smiths had to be built with up-to-date fittings, and railways had to be laid down to meet the traffic that increased in bulk and weight every day. With all this work in hand, a conscientious officer like Edwards must have found plenty to do. The occupation was what an officer of Royal Engineers was trained for, and, as far as I can gather, he did his share of it with zeal and credit. But it must have been somewhat strange to him after his experience as Aide-de-Camp to the Governor of Bermuda; and, when he was asked by Sir Lintorn Simmons the newly appointed Inspector-General of Fortifications, to take a similar place on his Staff, I can well imagine that he was quite content to accept the offer.

On August 2nd, 1875, Fleetwood Edwards went with his new Chief to call on the various authorities at the War Office: H.R.H. the Duke of Cambridge, Commander-in-Chief of the Army, Mr. Hardy, Secretary-of-State for War, Lord Eustace Cecil, Surveyor-General of the Ordnance, and others. By the middle of the month he had settled into his new position, his lodging in Jermyn Street, and his club (the Senior United Service) being quite close to his work at the Horse Guards. His appointment entailed much more work than usually falls to the lot of an aide-de-camp. The Inspector-General of Fortifications was head of the Corps of Royal Engineers, and was responsible not only for the proper training and efficiency for war of their officers, N.C. officers, and men; but also for the carrying out of the work on which, in addition to their military exercises, they were employed in time of peace. All the fortifications throughout the Empire were in his charge. He had to take steps to keep those that existed in proper repair, and he had also to bring forward for consideration such renewals and improvements as the constantly changing pattern of the arms in use among the military nations of the world rendered necessary. In order to carry this out thoroughly he had to make careful enquiry regarding any new military machines that put in an appearance, such as electric telegraphs, electric lights, submarine mines, railways, motors, and flying machines. He also had to make practical trials of those that seemed as if they had come to stay. Moreover he superintended the department that existed for the repair and renewal of barracks, and for the construction of new ones when funds were allotted for the purpose. Naturally the A.D.C. of an officer with so large a charge held no sinecure. He had to be very regular in his attendance, very methodical in his habits, and to keep himself sufficiently "primed" in regard to the many technical

and other subjects with which his Chief dealt, to be able to give an intelligent opinion when asked to do so.

For three years from 1875 to 1878, sometimes travelling with his Chief to inspect men and forts, and for longer periods conducting the office work in London in the light gained by those inspections, Edwards continued to lead an active but uneventful life. How he carried out his duties during that period can be gathered from a letter of which the following is an extract written to him by Sir Lintorn Simmons in the autumn of 1878 when he was leaving to take up other work.

"*11th September*, 1878.

"MY DEAR EDWARDS,

"It has been a great source of grief to me for some time past to know that it was probable I might soon lose you as my A.D.C. in which capacity I can truly say you have given me unalloyed satisfaction. The pain of losing you however is not unaccompanied with pleasure that you have been selected for such an honourable and responsible position as equerry, and therefore companion to a young Prince, who must be influenced by any person holding such a position for good or for evil. Looking to the great national importance of our Princes being surrounded with good influence, and having such entire confidence in you, I am glad, as an Englishman, and a subject of the Queen, that the selection has fallen upon you, but I must not allow you to imagine that I made it. Your name had been mentioned to the Queen by some other friend before I was consulted on the subject, and I then could only state what I thought of you, and express my willingness, but not without sincere regret, to place you at H.M.'s and the Prince's disposal, so that you owe your selection to your own good qualities and not to me."

But in the summer of that year, before he left the War Office, he was sent with his Chief to take part in the celebrated Congress of Berlin. This led to his making friends with the chief British representative at that Conference, and eventually brought about the appointment alluded to in Sir Lintorn Simmons' letter, viz.: Equerry to Prince Leopold.

In order to show how it came about that Simmons (with his A.D.C.) took part in the Berlin Congress I must briefly recall to mind the time when he first gained his knowledge of the "near East." It was in the autumn of 1858. He was then a junior captain of Royal Engineers, employed as Secretary for Railways at the Board of Trade, but on leave for a few weeks, with permission to travel in eastern Europe. He happened to be at Constantinople when war broke out between Russia and Turkey, and he immediately went to the Embassy and offered his services to Lord Stratford de Redcliffe who was then Ambassador there. Recognizing that such service might be of great value, Lord Stratford requested Capt. Simmons to proceed to the Danube and report on the defences of the Turkish frontier, and the condition of the Ottoman

Army that had been sent by the Sultan under the command of Omar Pasha, to resist the Russian advance. This duty having been carried out satisfactorily, Lord Stratford then requested Simmons to inspect the defences of the Bosphorus. After that he was directed to accompany Admiral Sir Edmund Lyons to the Black Sea, and report on the state of defence of Trebizond, Batoum, and other Turkish ports. His leave having by this time expired, Simmons was preparing to return to England, when intelligence was received that the Russian forces were about to cross the Danube near Galatz, and he was requested by the Ambassador to find his way as quickly as possible to Omar Pasha, and inform him of the position. Proceeding at once to Varna, Simmons rode to Schumla, and thence to Tertuchan, arriving in time to save the Turkish corps at Galatz from being cut off. From that time, throwing up his peace appointment at the English Board of Trade, he became attached to the great Turkish general, Omar Pasha, and remained with him throughout the war, becoming eventually British Commissioner with the Turkish Army. In February, 1854, France and England joined with Turkey against the Russians.

How Simmons took part in the defence of Silistria, and the crossing of the Danube by the Turkish Army, and how eventually he accompanied Omar Pasha to the Crimea, and then to Mingrelia, it is not our immediate business to relate. I only mention the facts to show the unusual opportunities that he had of studying the Eastern question in a thoroughly practical manner. It can well be understood how it was that, when Lord Beaconsfield took up that question during the Russo-Turkish War of 1876-77, and looked about for an expert to give him sound geographical and military advice, he found one in Simmons.

In January, 1878, notwithstanding a world-renowned defence by the Turks against their Northern foe at Plevna, the Russians crossed the Balkans, and were with their advanced troops almost in sight of the capital, when the Beaconsfield Ministry ordered the Mediterranean fleet to steam through the Dardanelles and anchor near Constantinople. For a time war between England and Russia seemed inevitable. Lord Beaconsfield proposed a large vote of credit for warlike preparations. The reserves were called out, and native Indian troops were brought to Malta. Meantime, in order to save his palace, the Sultan appeared ready to agree to Russia's demands, and probably would have done so had not Great Britain intervened, and demanded that the terms of peace should be submitted to a Congress of the Powers, meeting at Berlin.

To this Congress Lord Beaconsfield and Lord Salisbury went as the representatives of Great Britain. General Sir Lintorn Simmons was selected to act as military adviser to the British Commissioners, and he was accompanied by Capt. Ardagh, R.E., and Capt. Edwards, A.D.C. When the Congress assembled Edwards found that the Prime

Minister's Private Secretary, Montagu Corry (afterwards Lord Rowton), was an old Harrow contemporary and friend. This, and their association in the work of the Congress, and the fact that their natures were similar and altogether congenial, drew the two young men very much together. When the work of the Congress was over, the British representatives came home to England together and an enthusiastic reception was accorded, by the public, to Lord Beaconsfield, when they arrived at Dover.

As soon as possible, after their return, Lord Beaconsfield, accompanied by his Private Secretary, went to see the Queen at Osborne. It was probably during this visit that the question arose of the appointment of Fleetwood Edwards as Equerry to Prince Leopold. Evidently when, a few days later, Sir Lintorn Simmons' "command" to Osborne, on return from Berlin, included his Aide-de-Camp, it was with the intention that the latter should be seen by the gracious Lady on whom eventually it would rest to make the appointment. An extract from a letter written by Sir Henry, elder brother of "Charlie" Gordon, who was for many years the well-known head of the Military Store Department at Woolwich, will come in appropriately here.

"*October* 24th.

"MY DEAR EDWARDS,

"When I saw your name among the visitors at Balmoral, I said at once to my wife that you were going to be a joint assistant to Privy Purse with Pickard. I then heard it was to be an Equerry to Prince Leopold. Whichever it may be—perhaps both—be assured no one among your hosts of friends can be more delighted than myself at your good luck, and I know no one, high or low, who is so perfectly fitted to fill such an office. Urbanity of manner, combined with intelligence and zeal of no ordinary nature, are gifts that are possessed by few. You are one of them, and I wish you very heartily success."

Directly after the visit to Osborne with Sir Lintorn Simmons, Edwards was offered the appointment of Equerry to Prince Leopold (afterwards Duke of Albany). But, before he had time to fit himself out with the necessary uniform, he received a telegram from Colonel Pickard telling him not to do so for a few days. This was followed by an offer to join the Queen's Household as Assistant Privy Purse, and Assistant Private Secretary. I need hardly say that the latter offer was accepted.

The post of Equerry to Prince Leopold was later on conferred on Capt. S. Waller, R.E.

In regard to the above appointment it should be stated that, when General Grey died in 1870 he was succeeded as Private Secretary by Sir Henry Ponsonby; and when Sir Thomas Biddulph died in 1878, the whole of the responsibility of the two offices devolved on Sir

Henry Ponsonby. For this latter arrangement an assistant was necessary, and when the offer was made to Edwards it was intended that he and Pickard should be assistants to Sir Henry Ponsonby, taking the work alternately. At first the year was divided in half, to enable Pickard, who was in delicate health, to be abroad in the winter. But Colonel Pickard died in 1880, and was succeeded by Major Arthur Bigge,* after which the "waits" reverted to what was the usual custom, each of the assistants in turn being on duty for three months. This arrangement continued until Sir Henry Ponsonby's death in 1895, when Fleetwood Edwards was made Privy Purse, and Arthur Bigge Private Secretary.

All public men must live a second life. There is the official side which absorbs more or less of their energy, according to the amount of interest they take in it, or the greatness of their sense of duty in regard to it; and there is the home side where the balance of their energy is spent, but where men, as a rule, like to rest and renew their strength. In the life at Court that Edwards commenced to live in October, 1878, there were periods on duty, and periods off duty. But the former meant more than ordinary work at an office. It meant actually living in the Palace where the Queen was residing, and being at the disposal of Her Majesty at any hour. So that even when he married in May, 1880†, it was found that he and his wife could not take a separate house. Edwards had to be at the Palace during his tour of duty, at meal times, and also at night, as well as at the ordinary office hours. So the only time when a home life was possible was when he was off duty. Now and then the Queen lent them a house at Osborne or Balmoral, and when Sir Henry Ponsonby died, and Edwards was made Privy Purse, they were given the Norman Tower in Windsor Castle as an official residence. The home life was consequently somewhat tied, but the Queen was invariably kindness itself, and both Edwards and his wife were perfectly devoted to her.

I will return to the home life again later on. Meantime I will endeavour to show briefly what the official life was in its entirety, and then as far as I can what it was in detail.

As I have already indicated, it was owing to his previous service in the Royal Engineers, and especially to his conduct when attached to the British representatives at the International Congress of Berlin, that Capt. Fleetwood Edwards was in October, 1878, selected by Her Majesty Queen Victoria to assist Sir Henry Ponsonby in his work at Court. In March, 1880, he was also appointed Groom-in-Waiting to

* Now Lieut-Colonel the Rt. Hon. Sir Arthur Bigge, G.C.V.O., etc., etc., Private Secretary to the King.

† Capt. Fleetwood I. Edwards married in May, 1880, Mary, daughter of Major John Routledge Majendie, 92nd Highlanders, her mother being a daughter of George Dering, Esq., of Barham Court, near Canterbury.

the Queen. On the 30th June, 1883, he became a Major ; and on the 22nd October, 1890, a Lieut-Colonel of Royal Engineers. In October, 1888, he was made an Extra Equerry, and when Sir Henry Ponsonby died in May, 1895, he was made by the Queen, Keeper of the Privy Purse and Head of her Personal Household. The same year he was appointed by Her Majesty a Privy Councillor. In the *Times'* account of his life it is stated that "from the date of his appointment to the death of the Queen, Sir Fleetwood Edwards was perhaps the most trusted and intimate adviser of the Queen. Though shy and retiring in his demeanour, Sir Fleetwood Edwards was a man of remarkable charm, combined with a degree of steadfastness and determination which was hardly apparent to the casual observer. The life and influence of such a man must necessarily remain a sealed book to the public; but it may be stated with assurance that of the many devoted servants of Queen Victoria no one better deserved Her Majesty's confidence. On the death of Queen Victoria in January, 1901, Sir Fleetwood Edwards was named one of the executors of Her Majesty's will, a duty of extreme delicacy and importance, which he was peculiarly well fitted to perform."

It is said that he was consulted by the late King Edward VII. regarding the details of the funeral of the great Queen whom he had served so long and so faithfully, and whose body he accompanied, as one of the pall bearers, throughout the solemn and impressive three days' ceremony. Anyhow that Monarch thoroughly appreciated his services to the late Queen and thanked him personally for them. He created him a Grand Cross of the Victorian Order, and appointed him Sergeant-at-Arms in the House of Lords, granting him a pension. He also continued him as an Extra Equerry.

At the same time the Prince of Wales, who had a strong personal regard for him, offered him the post of Comptroller in his Household, but he declined the honour feeling that it would involve so much new work that he was unable to take it.

On his accession King George V. appointed him Paymaster-to-the-Household, and made him an Extra Equerry. His Majesty has also granted a pension to Lady Edwards in recognition of her husband's "great and brilliant services to Queen Victoria."

From what the *Times* states above, it will be gathered that Fleetwood Edwards' *full* life can never be written. We can give a few dates indicating when he occupied one or another of his appointments as an officer of Royal Engineers, or as an official at Court, and when he received some well-earned promotion or decoration. But, no doubt advisedly, he left behind him very few letters, and no journal. What was his daily life, and how his character grew until he acquired the influence and charm to which all who knew him bear record, we cannot tell. But we know that his official life at the Court was absolutely bound up in that of the great and good Queen to whom

he was devoted, and we feel sure that at the same time he regulated all his actions by the precepts of the Divine Teacher in whom he thoroughly believed.

It may be interesting to friends who read this Memoir to know what was the routine of his official work, and what were some of the subjects that must have come before him during the 23 years, from 1878 to 1901, that he was employed at the Court. Soon after being appointed to the Royal Household it became Edwards' duty (as I have already stated) to assist Sir Henry Ponsonby in the combined work of Keeper of the Privy Purse and Private Secretary. This entailed six months' duty in the year, not consecutive, but usually from six to eight weeks at a time, the other half being taken by his colleague.

During the tour of office he lived entirely under the same roof as the Queen. All State papers passed through his hands. All telegrams were cyphered by him, not only on State, but also on family affairs. Consequently his work was of the most confidential and personal character with regard to the Sovereign. His hours of work were not accurately defined. Whenever the Queen was in the house, the assistant was supposed to be available. At Windsor, for instance, chapel was at 9, breakfast 9.30, luncheon 2, dinner 9 or 9.15. An hour's outing was allowed in the morning and two to two and a-half in the afternoon. All the household had their meals together except those who were "commanded" to dine with Her Majesty.

No doubt the work of the office was very close, and the Secretariat were usually kept at their desks until the Queen went for her daily drive late in the afternoon. The range too of the work was very great, involving as it did *précis* of Parliamentary, and ambassador's reports, and the sifting of the mass of letters which arrive daily for the Queen from all sorts of people. Then there was all the foreign correspondence, the distribution of the Queen's charities, etc., etc. The cypher telegrams took up a great deal of time, especially on the occurrence of any political crisis, when precedents had to be looked up. It has been said that during one crisis no fewer than 2,000 telegrams passed through the Palace office in a week. A friend writing of Edwards when he was assistant to Sir Henry Ponsonby says: "He was so conscientious in his performance of duty that I used to think in his early days at Court he suffered a good deal from the strain. Although doubtless it became easier as time went on, he was, after the Queen's death, glad to be relieved from further secretarial duties." Without the off duty periods it is quite possible that he might not have been able to carry on. But these, and the great kindness of the Queen in giving him occasional happy days of recreation among the moors and streams at Balmoral, or in the coverts at Windsor, enabled him to pull through. When, after the death of Sir Henry Ponsonby, Fleetwood Edwards was appointed Keeper of the Privy Purse and

Head of the Personal Household of the Queen, he was brought into closer relations than ever with the Sovereign. His duties consisted in administering the funds of the Privy Purse, amounting to £60,000 a year, together with the income of the Duchy of Lancaster of which he was the Receiver-General. He had also charge of all the private properties of Osborne and Balmoral, the farm at Windsor, and the Queen's charities, besides the recommendation of candidates for Apartments at Hampton Court, for Brethren of the Charterhouse, and of Christ's Hospital, and for Pages of Honour, etc.

The people of interest that Edwards must have met and talked to while he was at Court were no doubt numerous. Governors and ambassadors proceeding to or from the places where they represented their Sovereign, admirals and generals taking up or relinquishing their commands, Ministers of State during their time of office, men and women of rank or distinction whom the Queen wished to honour by a "command" to stay for a night or more at the Palace. All or most of these he must have seen, many he must have known well, and made friends of. Then, connected with and made interesting by this personal acquaintance, there was all the correspondence, the reports, the despatches, the foreign confidential letters, the discussions in Parliament and elsewhere, and besides all these there were the written communications incident to appointments that had to be made by the Sovereign.

We have already stated how Edwards became acquainted with Lord Beaconsfield at the time of the Berlin Treaty. He no doubt continued his intercourse with that able Statesman and other members of the Party until the Conservatives were thrown out of power in 1880, and Mr. Gladstone became Premier with a large Liberal majority behind him. The times then were difficult. Irish questions were very much to the fore, and unexpected wars broke out in Afghanistan, in Zululand, in Natal against the Boers, and in Egypt. Edwards, I know, was particularly interested in the Zulu War, where the gallant young Prince Imperial of France, whom he knew well, went out as a volunteer, to serve with our army, and met his fate in a reconnaissance. He was also much interested in the Egyptian War of 1882, where the Queen's soldier son, the Duke of Connaught, commanded with distinction the Guards' Brigade. He was much concerned too at the delay that took place in relieving Gordon at Khartoum, which resulted in the death of that heroic leader before the British troops, under Lord Wolseley, could come to his assistance.

It need hardly be said that the debates on the Reform Acts which were eventually passed in 1884 and 1885 brought considerable additional work to the Court Secretariat. Still more excitement was caused in England, and consequently at Court, by the Home Rule Bill of Mr. Gladstone which caused several of his best known supporters such as Lord Hartington, Mr. Chamberlain, and Mr.

Bright to leave the Government, and ally themselves with the Conservatives under Lord Salisbury.

The celebration by Queen Victoria of her Jubilee reign in 1887, and again 10 years later of her Diamond Jubilee, and the fact that these events brought into closer touch than ever the Queen and her people, could not fail to add very materially to the volume and importance of work that must have fallen upon Edwards at the time. All through the later years of the Queen's life but especially during the war between Great Britain and the Boers of South Africa, the spirit of affection for the Old Country and of loyalty to their Sovereign was growing in all those great States over the sea—India, Canada, Australia and New Zealand, and many other smaller ones—that make up the British Empire. This affection would show itself in more friendly relations, more frequent intercourse between the Court and the people, and would consequently result in a larger number of letters and telegrams, and additional anxiety to all those whose business it was to control and regulate the Secretariat that exists in the Palace of the Sovereign.

In concluding the record of Edwards' official life, which may be said to have ended with the death of Queen Victoria, I cannot do better, I think, than quote the opinion formed concerning him by Sir Arthur Bigge, the colleague who had worked in conjunction with him through nearly the whole of his time at Court, and who knew probably more about him than any living man. He writes that in the Household Edwards was a universal favourite, and was at the same time greatly respected. "His was a character of the strongest moral fibre: a man of deep religious convictions but so little did he obtrude them on others that many who did not know him intimately might have been quite unaware of his almost unique nature. He was always full of fun, absolutely devoid of priggishness, ready to join in every form of sport, but with all this he never deviated one inch from the path which he believed to be right. Such a man could have no enemies." Depend upon it his example must have helped onwards and upwards many of those with whom he was associated.

Not long after Edwards took up the work under Sir Henry Ponsonby in Queen Victoria's Household, Her Majesty gave him for his life one of the small houses in St. James's Palace. This was afterwards exchanged for a larger one, the back of which looks into the court where the daily guard is mounted. This house was a private not an official residence, and while the Queen was alive, Edwards and his wife lived there very little. When he was on duty they occupied the official residence in Windsor Castle, and when he was off duty they usually went for a trip abroad, or to stay with friends in the United Kingdom. On one of these occasions, having been granted leave for three months, they went for a tour to India.

But, after the Queen's death, the house at St. James's became their home. Here they collected their pictures and books, etc., and here they lived when Edwards was carrying on his duty as Sergeant-at-Arms in the House of Lords.

From what has already been said we may feel sure that this duty was performed with as much regularity of attendance, and as much zeal, as any of the former work in which he had been engaged. But he was only required to be there while Parliament was sitting. The rest of his time he could regulate as he thought fit. I believe he liked the employment at the House of Lords because it brought him in touch with many friends whom he had made while he was at Court. It also gave him an opportunity of watching, from behind the scenes, how the machinery of Parliamentary life is worked. But it did not occupy his time as fully as had been the case in previous years, even including the extra employments of one kind and another that had devolved upon him. So he held himself available to take up charitable work when it came in his way. Moreover he never failed in helping to the best of his power those who came to him for advice and assistance. Writing of him at the later period of his time in the Royal Household one of his friends,* whom I have already quoted, says "Edwards always retained the same charming manner which he had in his younger days, and in his late times at Court was the trusted adviser not only of the Queen, but of many members of the Royal Family."

An extract from a letter written to him by his old chief, Sir Lintorn Simmons, some 12 years after the one I have already quoted, will not be out of place here, as testifying to the appreciation in which he was held by the Corps of Royal Engineers. "I was agreeably surprised on looking at the Gazette to see that you are promoted Lieutenant-Colonel, and most heartily and sincerely do I congratulate you and Lady Edwards thereon, for, although of late years, you have not performed many purely Corps duties, we all recognize in you one of our best and most distinguished officers, who is bringing fresh honours to the dear old Corps by the respect he has gained for himself, both from his Royal Mistress, and from all who come in contact with him."

In the year 1907 Edwards bought the Manor House, Lindfield, Sussex, as a place of retreat, during part of the year, from London. Here he was taken ill at the end of July, 1910, and here he died on the 14th August, the funeral taking place in the beautiful church and cemetery of Cuckfield, near Hayward's Heath.

Among the works of love that Fleetwood Edwards undertook during the last few years of his life, I will mention two, one being connected with the Corps of Royal Engineers to which he belonged,

* Colonel S. Waller, C.V.O., R.E.

and the other with the Public School where he commenced his training.

When General Charles Gordon, R.E., was killed at Khartoum, among the black people whom he would not desert in their extremity, the people of England were eager to establish some national monument to his memory. This took the form of a training school for boys. The school, called the Gordon Boys' Home, was built on Government ground near Bagshot, and the management was vested in an executive committee, with an office at 6, York Street, St. James's. The late Chairman of Committee was Field Marshal Sir Lintorn Simmons, a friend of Gordon's. The present one is General Sir George Higginson, one of the earliest and most energetic promoters of the scheme. Edwards was a member of the Executive Committee.

In the *Gordon Boys' Gazette* of October, 1910, there is the following notice :—

FLEETWOOD ISHAM EDWARDS.

It is with the greatest regret we have to record the death of one who has been on our Executive Committee for 10 years, and a member of the Home for a still longer period.

While he took as keen an interest in the well-being of the Home as any of the Committee, his never-failing courtesy and kindliness were specially remarkable, and no one who was privileged to be connected with him in this or any other public matter will ever forget his charm of manner, and his delightful—almost boyish -geniality of temperament. Those who were still further privileged to know him in his home life will have no difficuly in understanding the estimation in which he was held by our great Queen Victoria, whose devoted servant he proved himself by so many years of faithful service. A more perfect "courtier" in the highest and noblest sense of the word it is impossible to imagine.

The Harrow Mission takes charge of and endeavours to work, in a systematic and thorough manner, the parish of Holy Trinity, Latimer Road, W.

Edwards was honorary treasurer of the Mission Accounts.

In the *Harrow Mission Magazine* of September, 1910, the Vicar[a] writes :—

"The death of Sir Fleetwood Edwards is a terrible blow to us, and I have tried in the following notice to explain how much he has done for us. His was a wonderfully unselfish life, lived one felt sure, always in the Presence, and always giving happiness to his friends, a man of infinite courtesy and kindliness."

[a] The Rev. Edgar Stogdon, M.A.

SIR FLEETWOOD EDWARDS.

Very few people probably in the parish know how much help Sir Fleetwood Edwards gave us: he never liked it to be known that he was doing anything to help, and yet as treasurer of the Mission accounts he did a very great deal of work for us, and however busy he was, for he did numberless unrecorded acts of kindness, he was always ready to give up time to us. The keeping of accounts is proverbially dull, yet it was always pleasant to go and talk over business matters with him, because of his cheerfulness and humour. He was intensely keen about the Mission work and by his death we lose an invaluable helper, and a real friend.

Readers of the short Memoir that I have put together cannot fail to notice how the character that Edwards showed as a boy, trained as it was in a great public school and in a great military college, and tested during a diversified Army career, peculiarly fitted him for the employment that fell to his lot at the British Court. Whatever else he did, before and after, those 23 years that he spent in the service of Queen Victoria were without doubt the real work of his life.

How he did that work cannot be better told than by a quotation from the speech made by the Archbishop of Canterbury when, at a dinner given to Lord Hardinge, the newly appointed Viceroy of India, in November, 1910, His Grace had to propose the toast of Harrow School. He said "I cannot refrain to-night from alluding to two intimate personal friends of my own who within the last few months have passed away. One* of them was my exact contemporary at Harrow—and the other, in later years a still closer personal friend of my own, a man who, with singular reticence of dignity in his life, enabled few people perhaps to understand all that he was, and all that he was doing—Sir Fleetwood Edwards. I doubt whether many Englishmen realize what, during the later years of Queen Victoria's life, were the responsibilities devolving upon Sir Fleetwood Edwards, and how they were carried out. The quiet dignity of the man who held that position, and said nothing about it; the intimate personal counsellor and friend of Queen Victoria, the Private Secretary and Keeper of the Privy Purse, left as her executor when she died, the most marked token that could have been given of personal confidence, when, with a quietness and self-suppression which were beyond all praise, he filled the duties of one of the most difficult situations which any man could be called to fill. Few people outside his own immediate circle, or the immediate circle of those who were bound to know, realized either the greatness of the work that was being done, or the eminence, or the capacities of the man who was doing it."

A facsimile of two letters written to Edwards by the Queen herself, a list of the special appointments that he held, and a list of the honours that he received, are given in the Appendices.

* Sir Lewis Tupper.

APPENDIX I.

List of Appointments, Etc., Held by Sir Fleetwood Edwards.

Aide-de-Camp and Private Secretary to the Governor of Bermuda. 1867–69.
Assistant Inspector of Works, Royal Arsenal. 1870–75.
Aide-de-Camp to the Inspector-General of Fortifications. 1875–78.
Attached to the Special Embassy at the Congress of Berlin. 1878.
Assistant Keeper of the Privy Purse, and Assistant Private Secretary to H.M. Queen Victoria. 1878–95.
Groom-in-Waiting to H.M. Queen Victoria. 1880–95.
Extra Equerry to H.M. Queen Victoria. 1888—1901.
Keeper of Privy Purse to H.M. Queen Victoria. 1895—1901.
Sergeant-at-Arms in House of Lords and Extra Equerry to H.M. King Edward VII. 1901–10.
Paymaster to Royal Household, and Extra Equerry to H.M. King George V. 1910.
Trustee of Queen Victoria's Jubilee Institute for Nurses.
Member of Council of Duchy of Lancaster.
Governor of Wellington College.
Royal Commissioner for Exhibition of 1851.
Member of the Council of the Royal Albert Hall.
Member of the Council of Queen Alexandra's House.

APPENDIX II.

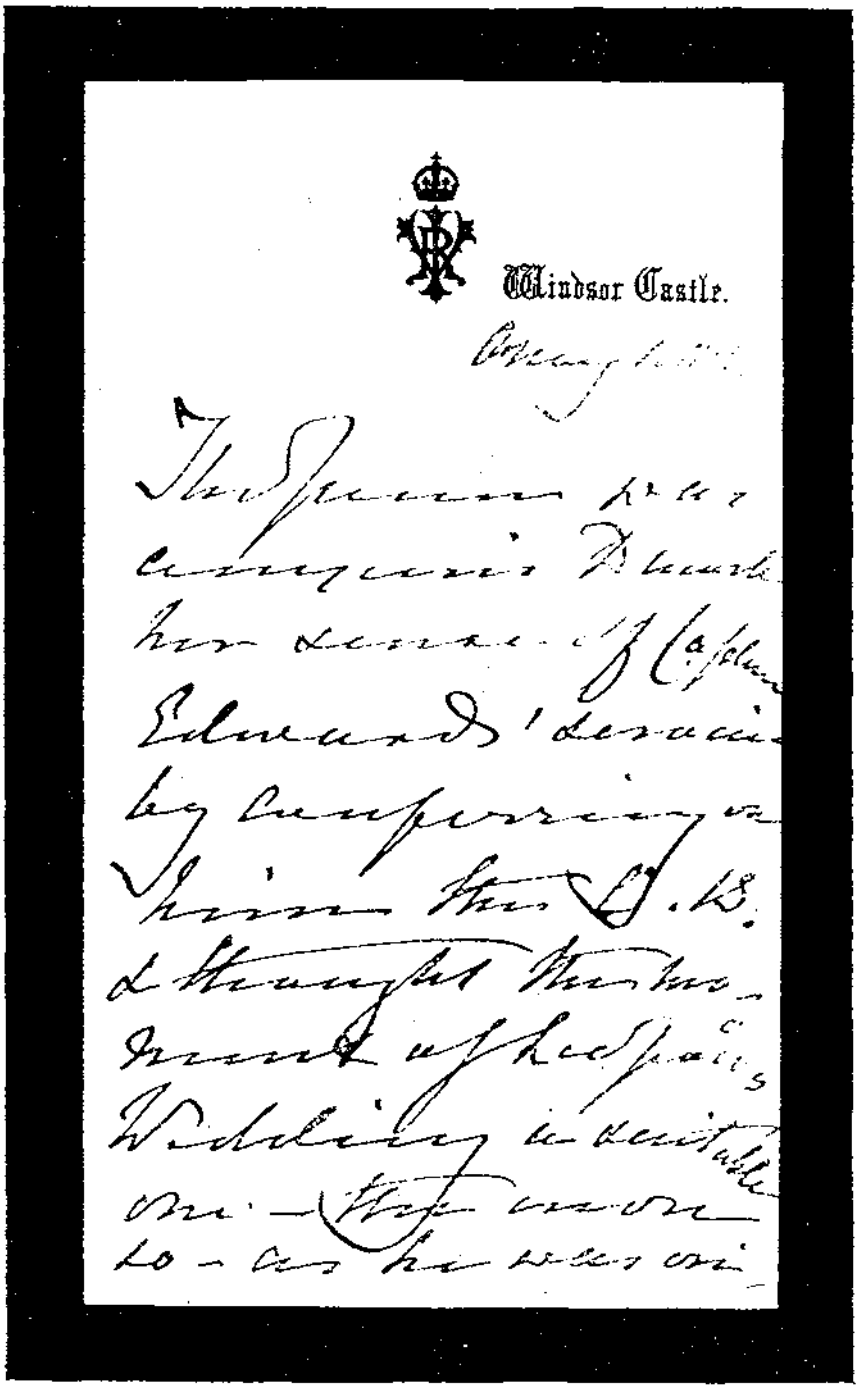
List of Decorations and Honours Awarded to Fleetwood Edwards.

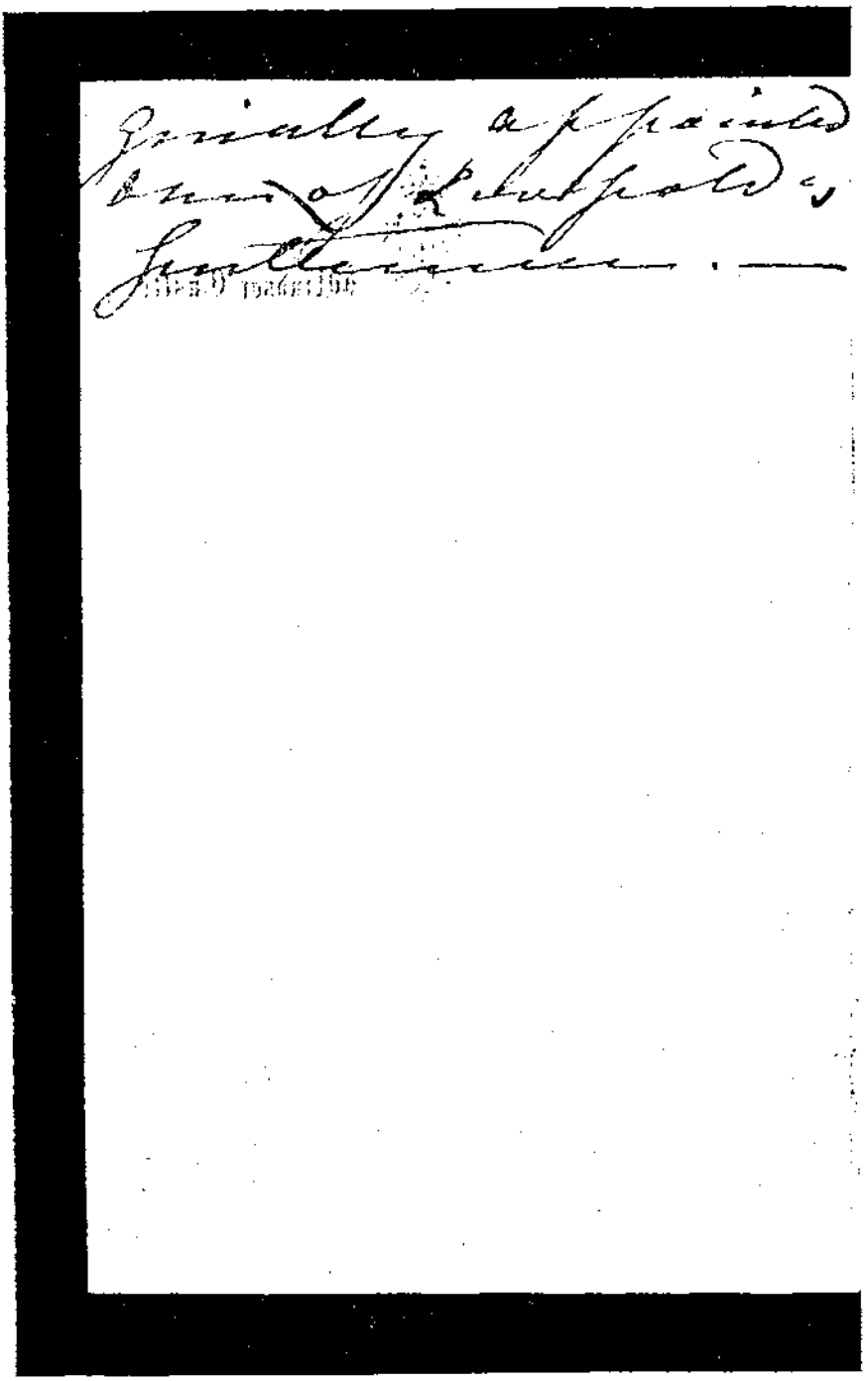
Companion of the Bath. 1882.
Knight Commander of the Bath. 1887.
Appointed a Privy Councillor. 1895.
Grand Cross of the Victorian Order. 1901.
Imperial Service Order. 1903.

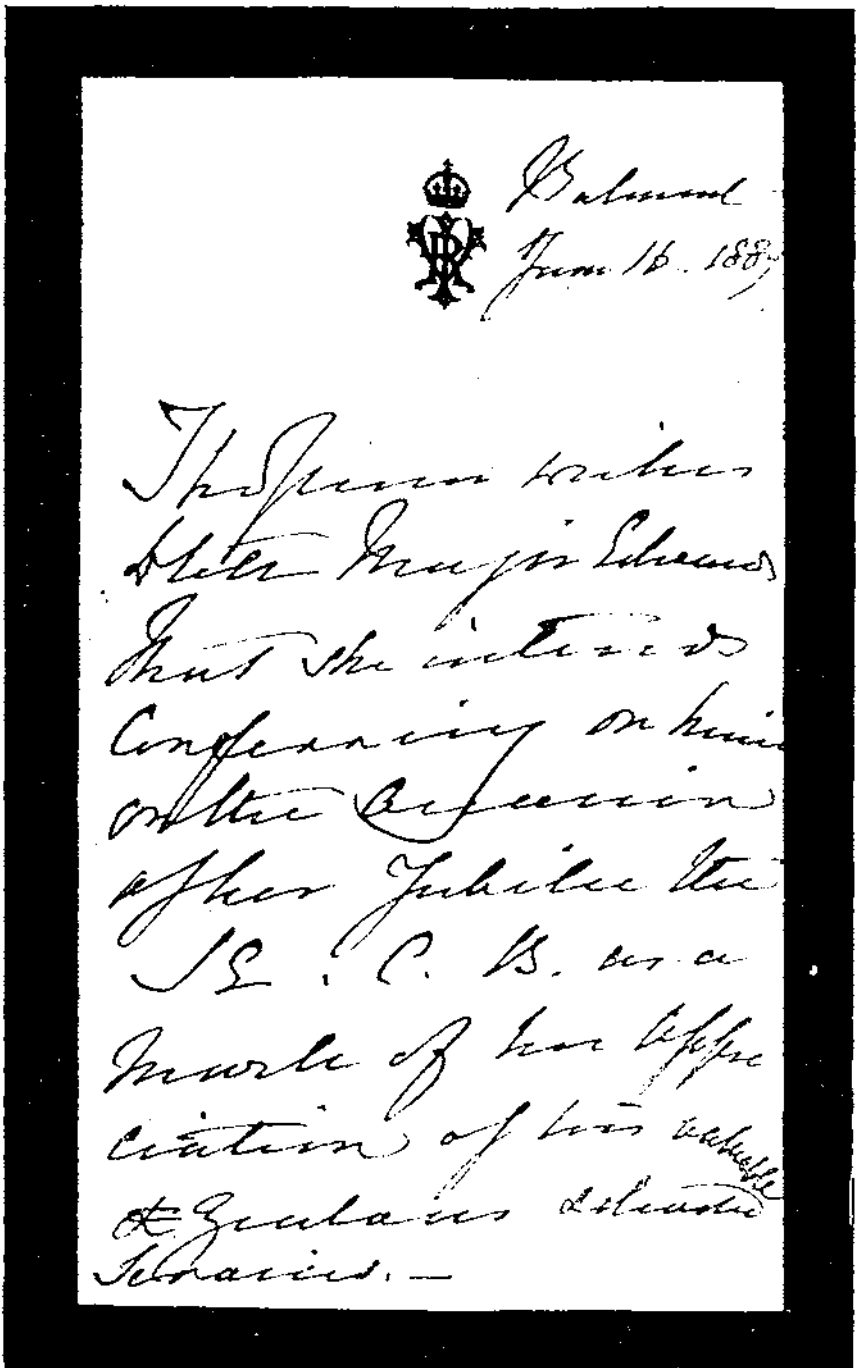
And the following foreign orders:—
2nd Class of the Prussian Order of the Red Eagle, with Star.
The Coburg Order.

APPENDIX III.

Facsimile of Two Letters Written to Fleetwood Edwards by Her Most Gracious Majesty Queen Victoria.


Windsor Castle.





TRANSCRIPT.

MOBILE DETACHMENTS.

By Major A. Buddecke.

(Transcript from the Supplement to the *Militär-Wochenblatt*).

The further an army becomes removed from its own experience of war, so much the more must it draw on military history for guidance in its work in peace. This is especially indicated at all exercises which serve for training in the leading of troops. Mere imagination is not able to replace actuality in the framing of the schemes, and can but give rise to scenes which bear only the garb of war while having little in common with its essence. There is also the danger of falling into "cut-and-dried" methods, leading to one-sidedness. The scheme will only approximate to, and therefore form, a true preparation for the real thing when they are drawn from the fresh source of military precedents.

It is a striking phenomenon, that the schemes for great manœuvres favour situations in which a mixed force is situated independently or only in loose connection with the main body, and therefore appears as a mobile detachment. This kind of scheme finds its explanation in the fact that the situation of a detached force is able to be clearer defined than that of one in close co-operation with the main force, and sets the leader of it a completely independent decision to make. Great as are the advantages offered by such a scheme, it is yet only justified so long as it is based on reality, and does not do violence to facts through either setting up a force as detached, which as a fact is not detached, or by assuming a detachment, which is not justified by the military situation.

It should therefore be of interest and value to investigate the latest military history, and to find in what cases mobile detachments have been employed, what their experience was, and what signification they will have for the war of the future.

Independent forces are to be found in all stages of a war. Even at the commencement of a campaign their application may be necessitated by the political situation—if several opponents and menace from several directions have to be reckoned with. Desirable as it was in 1866 for Prussia to concentrate all her forces in the main struggle with Austria, yet the attitude of Hanover, Hesse, and the South German States, rendered mobile detachments imperative. But when the situation was materially improved through the disintegration of the Hanoverian Army, the decision of the Prussian Headquarters to unite the detached divisions of Beyer, Goben and Manteuffel to the Army of the Main, was of decisive importance. The use of these concentrated forces led to the overthrow of the South German armies, which, though twice as strong, were not concentrated.

The situation was similar at the commencement of the campaign in 1877–78. Here too on the Turkish side the political situation, the preceding battles with Servia, and the internal unrest, led to a dispersion of force, which compelled the use of divided armies against the Russians. Although the Turks obtained herewith the advantages of exterior lines and could

operate against the flank of the enemy who had pressed across the Danube, they were only able to check the Russian offensive for a space, since they could make no concentrated use of their forces. Even Osman Pasha's bold flank stroke was very soon to be paralyzed by defensive action, to end finally in a severe reverse at the hands of the Russian forces, which steadily increased in numbers and tended to surround him. This example shows at the same time, that operations of separate portions of a force against the the flanks of an army that is concentrated, have little value if they do not go hand in hand with powerfully conducted operations against the front.

Geographical conditions, also, the one portion of the frontier projecting into the enemy's country, may result in allotting an independent *rôle* to the forces mobilized in that part. Thus the Austrian Headquarters at the beginning of the 1866 campaign, was able to derive advantage from the isolated situation of the 1st Austrian Corps and the Saxons. In the event of the Austrian Commander-in-Chief deciding to fall on the Prussian Army as it emerged from the mountains, with his main body, it would have fallen to the task of the 1st Austrian Corps and the Saxons to oppose the Prussian 1st Army and Army of the Elbe at the entrenchments of the Iser, until the Crown Prince's army had been disposed of; in the event of the Commander-in-Chief desiring only to hold the 2nd Prussian Army with a detached force, in order to throw himself with the main body on the advancing 2nd and Elbe Armies, the 2nd Austrian Corps with the Saxons had to hold the enemy till the main body of the army arrived. The vague ideas of the Austrian Commander-in-Chief and his indefinite orders for the conduct of the detached Corps had, however, the result that the latter, after showing a false front at the Iser, renounced this strong position and the road to Gitschin to the enemy, and by so doing exposed themselves to no inconsiderable tribulations. From this situation we learn how *much* with detachments of this sort depends on the orders, and how necessary it is not to leave the leader in doubt about one's own intentions.

The position of detached forces takes a particularly difficult shape when the Headquarters, as in the Russo-Japanese War, is forced to locate the place of concentration of the army very far to the rear. Thus, the pushing forward of a solitary portion of the army is only justified if there is an absolutely definite object, as the defence of a strong point of support, an important line of communication, or to prevent a landing. Tasks of a general nature, such as obtaining touch with the enemy, observation and the harassing of his advance, must remain in the domain of cavalry. According to this, on the Russian side, the despatch of strong detachments to Liaotang and to the Ussuri territory for the defence of Port Arthur and Vladivostock as necessary points of support for the fleet, was absolutely imperative, but the despatch of the Eastern Detachment under General Sasulitz to the Yalu was a strategical error. Its infeasibility is evident in the very instructions, which directed General Sasulitz to hinder the Japanese advance to the Yalu and later in the Schanboschan Mountains, but to refuse a pitched battle. It condemns the leader to some extent to the unattractive *rôle* of procuring his own defeat, even though he may see the possibility of victory. But even when the leader, suppressing all personal ambition, strives earnestly to act according to his chief's orders, it will in every case be difficult for him to form a sound

judgment of when a fight may be undertaken and when it must be broken off. The boundary line between delaying and decisive action is very hard to draw and is easily overstepped even against the wish of the leader. For the heavy reverse at the Yalu therefore General Sasulitz is less to blame than the Russian Headquarters, which exposed their corps, in a position 200 kilometres in front of their main army, to the attack of superior Japanese forces. This kind of application of advanced corps can be designated "strategical advanced position," which is as little justified as the discredited "tactical advanced position."

Under otherwise normal conditions, operations of separate detachments can be introduced when the barrier of the frontier defence is to be pierced in order to obtain an insight into the enemy's dispositions, to hinder his mobilization and advance, or to secure a local advantage. Such operations, which are often worked out in war games, contain in themselves great dangers, especially if one has not got a start in preparedness so as to be able to establish or utilize advantages that are won. But they can be every bit as fateful, if they are only to cause embarrassment, as for instance to satisfy public opinion. In this connection the opening move of the French in 1870 affords a warning example. Froissard was able to do little against Pestel's detachment, but ran the danger at Spicheren of being destroyed by the advancing corps of the 1st and 2nd German Armies. So too the pushing forward of Abel Douay's Division at Weissenburg for the purpose of observation proved faulty.

Generally speaking the use of independent detachments in advance of the army at this stage of a war is not justified. The work of reconnaissance and observation is best left to the cavalry divisions, and the defence of the frontier to fairly weak detachments of all arms. Thus the detachments of von Pestel and von Steubert in 1870 and Count Stolberg and von Knobelsdorf in 1866, did good service and not only held the enemy at a distance but also deceived him as to the movements of their own army.

At the commencement of operations, detachments are best confined only to those found most necessary, for they always weaken the main body and may give the enemy a chance of a partial success.

In this connection the Russian conduct of the operations in 1904 affords a warning example The threat against Port Arthur induced the Russian Commander-in-Chief to forsake his original plan of assembling the army first of all at a distance from the enemy in order to subsequently crush him with superior numbers; he therefore started off for Port Arthur with the forces he then had available. For this march Stackelberg's Corps, which had been sent ahead, should to some extent have served as advanced guard. The task, which was given this corps, must consist in an offensive movement energetically carried out, the success of which was to be reaped by the army following behind. Only in this way could one hope to obtain a success over the Japanese forces in the field, and simultaneously to delay the investment of the fortress by acting in combination with the troops at Port Arthur. Instead of this General Stackelberg received instructions which gave his undertaking the character of a demonstration. "The corps under your Excellency's command is commissioned to advance in the direction of Port Arthur and draw to itself as many as possible of the enemy's forces and in this way to weaken

their army operating in the Kwantung Peninsula. Therefore your advance against the troops pushed forward northwards for purposes of security must be quick and energetically carried through, so that these latter may be defeated as early as possible, it being understood that they prove to be weak. When you meet superior forces of the enemy the fight must not be fought to a finish, and the whole of the reserves must not be thrown into the fight so long as the circumstances are not completely clear." It is not to be wondered at that General Stackelberg with such an undefined task did not dare to act energetically when he encountered Oku's army of approximately equal strength to his own, and the opportunity was let slip of a victory which could turn the general situation to the favour of the Russians. So this "adventure," as Stackelberg's Chief of the Staff strikingly terms it, shares the fate of similar undertakings: the detached corps is beaten and thrown back on the main army with many losses. By this the Russian Commander-in-Chief was impelled not only to relinquish his active intentions, but also to withdraw the army again into its defensive position at Liaoyang. This first success however encouraged the opponent to assume the offensive which bestowed on him a lasting superiority over the Russians. The one and only advantage, which the move on Port Arthur brought, was a short delay to the investment of the fortress. The example also shows what dangers befall the strategical advanced guard.

Quite different is the case when at the commencement of operations the military situation of the opponent exposes weak points, of which use can be made, and when there is the possibility of seizing some point of importance for the course of the campaign, such as a bridgehead or a pass. Then it may be of great importance to push forward a separate portion of the army. Such a task was accomplished at the beginning of the Russo-Turkish War of 1877–78 by General Gurko, when he was sent with a mixed force of 12,000 to the Balkans after the Russian Army had crossed the Danube, in order to lay hands on the important Shipka Pass for the intended offensive movement of the army against Constantinople. The surprising raid of Gurko's, which, utilizing energetically the unprepared position on the Turkish side, not only took the mountain pass but also a considerable strip beyond it to the south, would have been able to bring the Russians in the shortest time to the final objective of their operations, if only the army had followed hard on the heels of this army advanced guard. But the available forces were not brought along so long as any threat on the flanks was possible, so that Gurko's success was partially discounted by the gradually increasing superiority of the Turks.

However this undertaking favourably influenced the issue of this war, and offers in its conduct a particularly typical example for a corps detached with a similar task.

A separation of forces, leading to a detachment of single corps, may also be justified if the advance against the enemy necessitates the passage of a considerable obstacle, such as a great river, a mountain chain, an arm of the sea, a swampy stretch of country, or one that is cut up by canals or a line of forts. The forcing of the crossing and the necessity of appearing on the far side of the obstacle with strong forces may necessitate advancing on a broad front in several columns. In this case

one counts upon one column opening the way for the others, or upon its successfully deceiving the enemy as to the crossing place of the main body. Such an operation becomes the more audacious and difficult in proportion to the enemy's readiness for war. In this connection the Prussian invasion of Bohemia in 1866 remains an example for all time. The deployment of the 2nd Prussian Army from the mountains shows especially how very much the separate columns in such a case must depend upon themselves, so that they appear as if detached, and how much the success or failure of one column influences the fate of the others.

Such an advance can also mislead the opponent into making detachments if he has not fully mobilized his main forces, or if he is thinking of employing the latter in another direction.

The Austrian Commander-in-Chief found himself in such a situation. Intending to effect the concentration of his army at Josephstadt and then to advance against the army of Prince Frederic Charles, Benedek pushed forward the 6th and 10th Army Corps to Nachod and Trautenau, with instructions to attack with all their energy the columns of the 2nd Prussian Army as they emerged from the mountains. The course of the operations however shows that strong detachments are not indicated in such a situation. The victory of the 10th Austrian Corps over the 1st Prussians at Trautenau was amply compensated for by the defeat of the 6th Austrian Corps at Nachod and of the 8th Austrian Corps at Skalitz. In such a situation the defender will have more prospects of success if he keeps his forces concentrated, so as to defeat successively the portions of the enemy's army as they debouch. One must, to be sure, in this case act in such a way that the enemy can obtain no advantage from the possession of the exterior line. The passage of the Balkans by the Russians in 1877–78 teaches this. The united Turkish Army was waiting on the southern side of the mountain range for the Russian columns under Skobeleff and Mirski, which were advancing separated. It did not however succeed in defeating the Russian columns before they united. The result on the contrary was that the Turkish force, superior to each Russian column separately, was first of all tackled by one column, then surrounded by the others and finally forced to capitulate in the open country.

The passage of a river in view of the enemy, usually necessitates the use of detachments, if only for the object of making a demonstration. Thus the Russians at the passage of the Danube in 1877 acted in such a way that, in order to screen the main crossing which was to be effected west of the Turkish Quadrilateral, they made the 14th Army Corps cross the river east of the Quadrilateral and occupy the Dobrudscha, whence General von Zimmermann was to delay the operations of the Turks against the Russian communications to the rear, and by assuming the offensive to attract the attention of the Turks to himself. This detachment, which was shortly reinforced by one division, fully achieved its object. It had however subsequently the great disadvantage, that these 1½ Army Corps remained here idle during the campaign and were lost for the main operations, so that the latter could not be carried through with the desired rapidity. Though, at this crossing of the Danube, the dispersion of the Turkish forces was to the advantage of the Russians, the more ready opponent in the Austro-Italian Campaign of 1866, managed to

hinder the Italians at the forcing of the passage of the Po. Here too a force under General Cialdini was detached against the lower line of the Po, in order to deceive the enemy as to the offensive measures to be undertaken. The intention however failed and led to the great disadvantage that this force, five divisions strong, was paralyzed and did not take part in the main decisive action.

The commencement of the campaign of 1864 shows the successful forcing of a great frontal obstacle. Here too the advance of the Allies against the Danewerk and Schlei line was effected in several separate columns. The force under Prince Frederic Charles operated on this occasion quite independently, and by its crossing of the Schlei forced the Danes to evacuate the Danewerk position without a fight. In the later course of this campaign, also, the Allied Headquarters sought to utilize detachments in that it decided, on the advice of General von Moltke, to cross a force over to Alsen for the support of the attack on the Duppel fortifications, and for the preparation of a complete defeat of the main forces of the Danes

Separated objectives too may lead to a division of the forces, as taught by the proceedings on the Armenian theatre of war in 1877–78. The Russians here operated in four columns, each of about 25,000 men, against Batoum, Ardagan, Kars, and Bajaste. They were thus able to act decisively nowhere, whilst a united offensive undertaken against the Turkish Field Army would have promised a certain success, from which the attainment of their secondary objectives would naturally have resulted.

The marches to the main decisive battle are carried out in the closest concentration as a rule with the purpose of preparedness for action, while utilizing fully the network of roads. This procedure is particularly indicated if accurate information as to the enemy's situation is lacking. One then has at least the intention of concentrating superior force at one place. Napoleon owes his greatest successes (*e.g.* Jena) to obedience to this principle. When he acted contrary to it, as in the winter campaign of 1806–7 at Pultusk and Eylau, his attack lacked the power to *annihilate*. A departure from this rule can however be occasioned by the difficult nature of the country. Thus the corps of the 2nd German Army in 1870–71 during the advance on Orleans, and later on Le Mans, were kept apart through the peculiarity of the country and so resembled detachments, so that a series of local engagements took the place of a general decisive action. This situation offers therefore a quantity of examples for independent action by subordinate leaders.

During the advance of separated groups of an army from different directions it may be advisable to fit in a connecting link, in the manner that the Japanese Headquarters during the advance on Liaoyang introduced as an independent force the Takushan detachment, consisting of the 10th and half the Guard Divisions, for the purpose of connecting the 1st and 2nd Armies.

The protection of the flanks against neighbouring hostile forces or against fortified places, can also lead to the use of detachments which must act offensively or defensively according to the situation. But the smaller the forces that are used to carry out this subsidiary task, the better is it for the main operations. The conduct of the Japanese in 1904 offers a noteworthy example of this, since they only left one division opposite Port Arthur after the capture of the Nan Shan position and

marched off with all the remainder for the main decisive action. They were justified in this boldness, as they could well hope in that strong position to be able to maintain the investment of Port Arthur from the land side until the troops told off for the siege had arrived. A similar task fell to the Baden Division in 1870, which in the advance of the 3rd Army against the Upper Moselle was left as a protection against Strasbourg and the French forces which had appeared in Upper Alsace.

The Italian Headquarters in 1866 fell into the error of making too strong a detachment, when 3½ divisions were left opposite the weakly held fortresses of Mantua and Peschiera during the advance across the Mincio for the decisive battle. The lack of these forces was sorely felt at Custozza.

In the phase of the main decisive action mobile detachments are but seldom found, since both sides act on the principle that one cannot be sufficiently strong for the main decisive action. Envelopment of the enemy, which is so much sought after and so often decisive, is almost always effected solely by outflanking in advancing on a broad front, or by pushing up portions that have been held back, as shown by the development of the battles at Worth and Sedan by the Germans. But the defender will seldom so lay himself out on the operating table, that he leaves the attacker time to make up his mind in advance where he has to apply the knife. One must count on a mobile adversary, and will not as a rule have such extensive information about him that an envelopment can be reckoned on with any certainty when arranging the advance.

Thus, the German Headquarters on the 18th August, 1870, were only able to make their arrangements for the envelopment, in accordance with the reports coming in during the course of the day about the position of the enemy's right wing, and the envelopment therefore could only be brought about by a further drawing up of the portions of the army that were in rear. In this case it may occur that one is completely deceived as to the situation of the enemy's wing, and that the troops allotted to the enveloping movement strike the enemy in front, like the IX. Corps at Amanvilliers and the 16th Infantry Division at the Hallue. In the latter case General von Manteuffel was thrown, by this error, from an intended offensive into the defensive, and was only enabled to overcome the strength of his opponent by a stubborn resistance.

In fact but few instances are to be found in modern military history, where, as at Bautzen, detached forces have given the decisive blow in the main battle by coming in on the enemy's flank. Even "marching to the thunder of the guns," so beloved by the Germans, to which we owe a portion of our successes, leads only in exceptional cases to a real envelopment. Thus at Spicheren the wide turning movement of the 14th Division through Volklingen and Rossel on Forbach, did not have the desired result, as it came too late and was not carried through sufficiently energetically. Leaders of such detachments, especially if they are not kept sufficiently informed as to the state of the main fight, allow themselves only too easily to be intimidated and held up by the determined resistance of even weaker hostile forces. An exception to this is shown in the action of General von Lestocq at Eylau, who held off the advance of Ney by a detachment, and intervened with his corps in the main battle.

Only an extraordinary situation, such as led to the Battle of Vionville,

offers one of the few historical examples where the battle arises from the successive intervention of detached forces. But here too it appears that the leaders of the detached corps, feeling their weakness, are inclined rather to seek close touch with the troops already engaged than to operate independently against the enemy's flanks.

In the above crisis the departure of a single portion of the army out of the frame of the whole is always dangerous, as evidenced by the defeat of Mortier's Corps before Austerlitz in 1805, and especially so is the pushing forward of part of the army for the purpose of a reconnaissance in force. Such action involved the Austrians in 1859 in a partial defeat at Montibello without their having cleared up the situation in the manner desired.

The writer then proceeds to deal with the use of detachments in the pursuit, in the further advance into the enemy's country after the first successful battles, and, in the case of the unsuccessful side, in retreat.

In conclusion he says: On the whole after this glance at recent military history it may be said that mobile detachments have found a place in all the stages of the conduct of war, but frequently, being incorrectly applied, have proved disadvantageous. Though there are therefore only exceptional cases, when the despatch of independent forces has proved advisable, yet in future in a European theatre of war there will be still less opportunity for their use.

The characteristic of coming events of war will be the massing of large numbers in a narrow space, which will be manifested not only in the stage of the decisive battle, but even in that of the preliminary movements, since the constricted area and considerations of simultaneous action compel this. The saying "Separate to march, unite to fight" could only maintain its full meaning so long as the portions of an army were smaller and more mobile and had sufficient room. But in the future the forward movement of a deployed army will present the spectacle of a single, almost unbroken wave, rolling on the opponent. The decision in the gigantic battle will ensue chiefly in a frontal struggle, and will consist of a number of local successes wherein the pushing of forces into and behind the battle front will play a great *rôle*, as has already been manifested in the decisive battles of the Russo-Japanese War at Liaoyang and Mukden. With the great distances prevailing it will be impossible to count, with certainty, upon the timely arrival of detached forces at the decisive place, even though in highly cultivated countries the development of the network of railways is able to some extent to compensate for the clumsiness of the movements of armies. So it follows that with the modern utilization and composition of the cavalry divisions, the latter in many cases may be able to replace mixed bodies of troops, and be in a position to keep hostile detachments at a distance from the decisive battlefield. But subsidiary successes, which in former times could bring about a complete change in the military situation, scarcely count any longer as compared to the decisive battles.

With the growth of army masses, therefore, the possibility and suitability of mobile detachments diminish. The subordinate leader will for the most part act in close co-operation and will seldom find opportunity for completely independent action.

E. G. WACE.

REVIEWS.

EXPANDED STEEL FOR REINFORCED CONCRETE CONSTRUCTION.

The Expanded Metal Company, of York Mansion, York Street, Westminster, have produced a new pamphlet illustrating and describing the materials manufactured by them.

This pamphlet contains tables giving full details of the various forms of expanded steel both in the commonly known diamond mesh form and also, in their latest products, rib mesh expanded steel and expanded (p. 233 of pamphlet) steel bars. These tables give all the information necessary in ordering expanded steel in any form and the notes giving the standard sizes of sheets are most valuable.

Some brief notes are given on the advantages of expanded steel in its various forms as a reinforcement for concrete, combined with a short specification for cement and aggregates with clear directions as to laying.

This pamphlet also contains tables of foundations and slabs, giving the necessary thicknesses under various conditions of loading, illustrated clearly and showing how the results are obtained. The calculations throughout being based on the R.I.B.A. formulæ and a low value assigned to the resistance of concrete in compression, the thicknesses given are well on the safe side.

There are many excellent illustrations showing the uses to which expanded steel can be put in the shape of floors and roofs, domes, silos and coal hoppers, water tanks, bridges—*Fig.* 1 (p. 142)—reservoirs (circular and rectangular), pipes, aqueducts and sewers. Also expanded steel and concrete watertight canal beds (*Fig.* 2).

A use which may be of considerable interest to R.E. officers is the use of expanded metal in combination with concrete in coast defence works. There can be no doubt that properly placed reinforcement must materially assist concrete to withstand the disintegrating effects of waves, and a reinforcing material such as expanded steel is eminently suited to this purpose.

Expanded steel has also been used in the construction of many things not usually made in concrete—even combined with steel, as examples *Fig.* 3 (p. 225) shows a reinforced concrete barge constructed in Italy of concrete reinforced with round bars and expanded metal. *Fig.* 4 (p. 230) shows railings and a figure on p. 228 some details of sleepers, all constructed of concrete reinforced with expanded metal.

REINFORCED CONCRETE BRIDGE AT ABERSYCHAN.

EDWARD WHITWELL ESQ., ABERSYCHAN - Engineer.

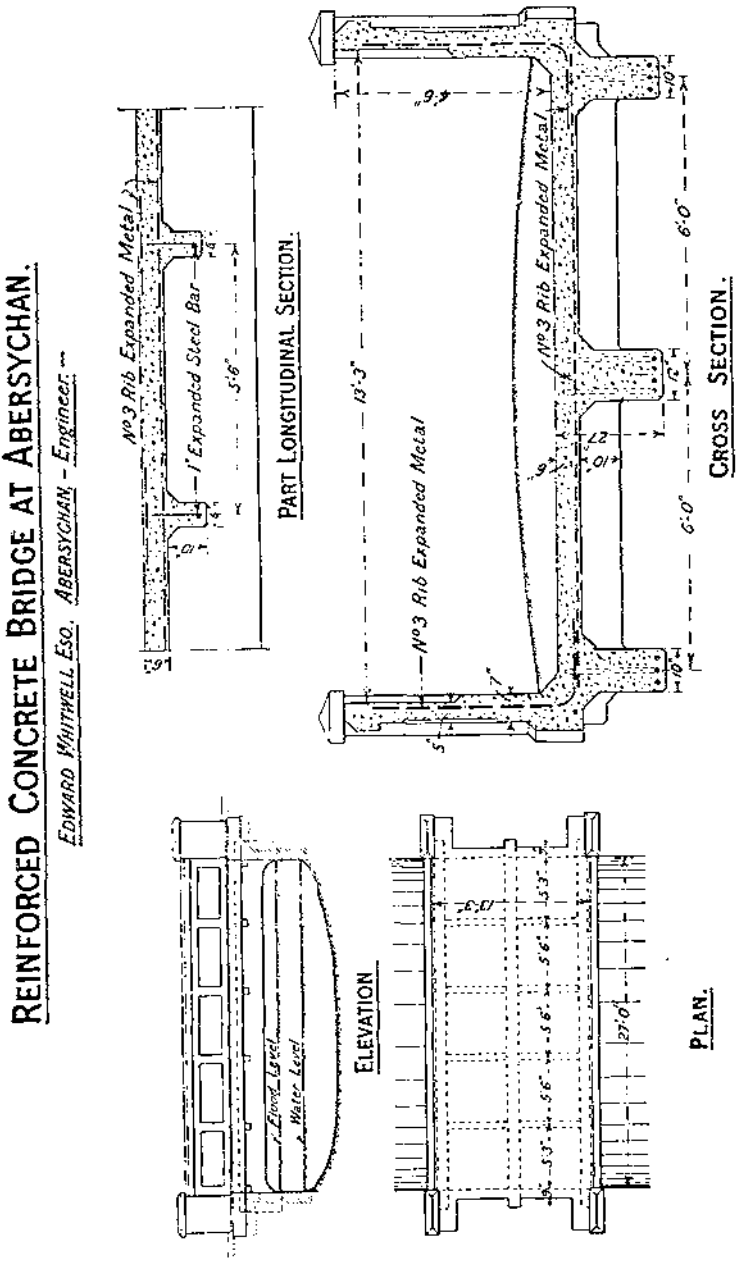
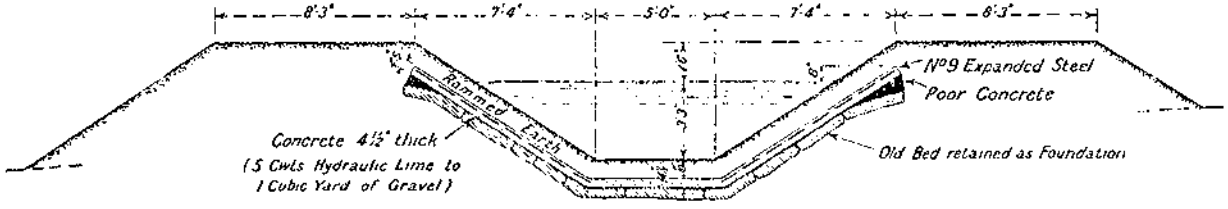
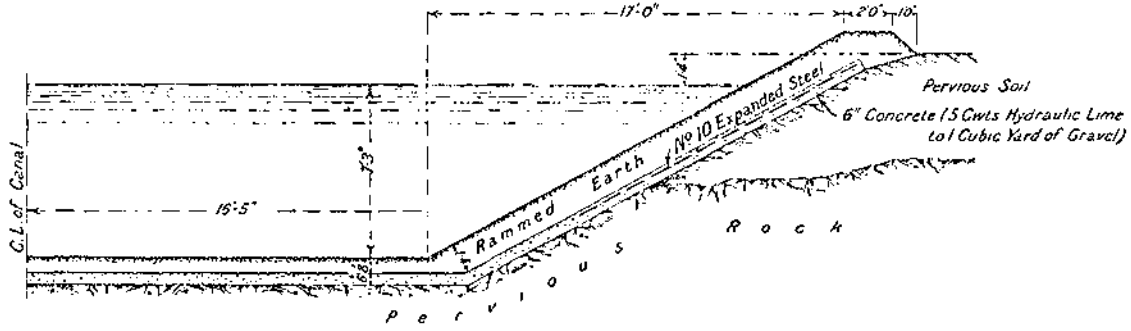


FIG. 1.

BURGOYNE CANAL,— EXPANDED STEEL & CONCRETE WATER-TIGHT BEDS.



CROSS SECTION OF SUPPLY CHANNEL AT CHAZILLY.



HALF CROSS SECTION OF CANAL.

FIG. 2.

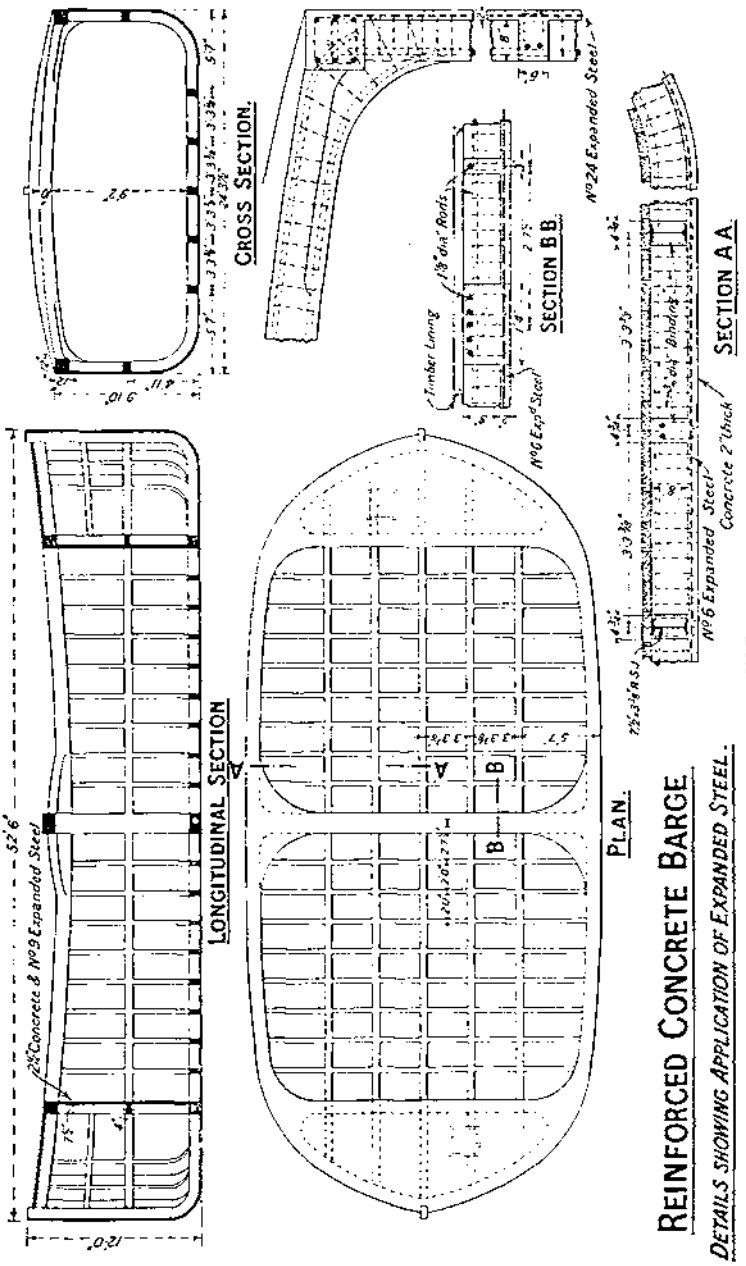


FIG. 3.

REINFORCED CONCRETE BARGE

DETAILS SHOWING APPLICATION OF EXPANDED STEEL.

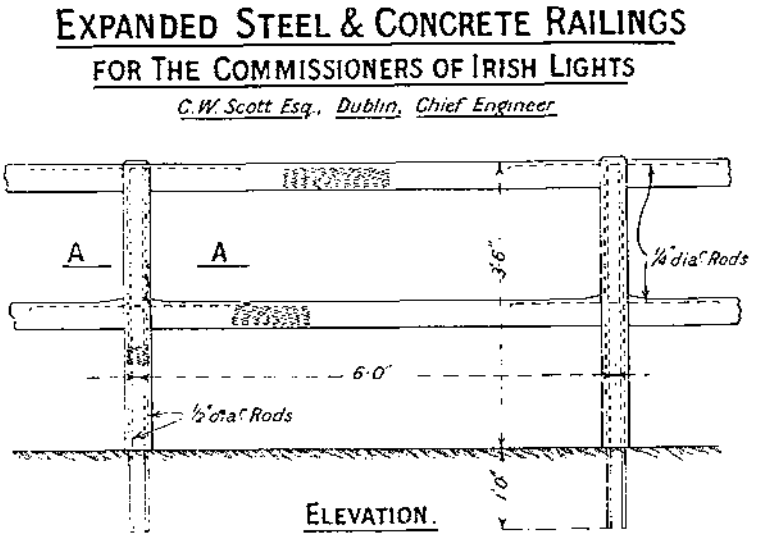


FIG. 4.

The information given in this pamphlet illustrates very clearly the many uses to which reinforced concrete can be applied, and shows to what a number of uses expanded steel can be utilized as a means of reinforcement, and the book itself is strongly recommended to the notice of all R.E. officers.

J.G.F.

DANCING ON SKATES.

By Colonel H. V. Kent, R.E.—(R. Ward & Sons, Ward's Buildings, High Bridge, Newcastle-upon-Tyne. Price 1s.).

In this little book Colonel Kent has recorded in print two things for which officers who have served at Halifax will be grateful, first the various figures of the Lancers as danced on skates, and secondly the style of waltzing on ice in vogue in Canada. The booklet can easily be carried in the pocket and should be invaluable to parties of skaters who want to acquire the art of dancing the Lancers either on rollers or on the ice. A sub-title is "A Plea for the Circular Waltz." The English style of waltzing requires everyone on the rink to be practised waltzers, and does not admit of full advantage being taken of the power of wide sweeping movements with little exertion conferred by skates. The Canadian style is easier to learn and more enjoyable when learnt. Colonel Kent will be a public benefactor if he secures its introduction in rinks at home. The 20 diagrams illustrating the letterpress are on the right hand of each page facing the verbal descriptions of the figures, making the book very convenient to consult when learning the figures in the rink. All skaters who want to dance may well expend a shilling on it.

A.M.H.

RECENT PUBLICATIONS OF MILITARY INTEREST.

JANUARY, 1911.

(Published Quarterly).

THE following extracts from the list compiled by the General Staff, War Office, are published in the *R.E. Journal* by permission of the Army Council.

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*PART II.**

SECTION I.

AERIAL NAVIGATION.

THE FLYING MACHINE (Plus lourd que l'air. La Machine Volante). By Capt. Jules Raibaud. 178 pp. Paris. A. Lahure. 3s. 2d.

This is a useful little book for anyone wishing to gain some elementary knowledge of the theory and principles of aeroplanes. The opening chapter gives a very brief account of the early experiments of Lilienthal, Ader, Wright and other pioneers. The author then proceeds to explain the principles of the aeroplane, and in some 30 pages discusses the reasons for the elevating and steering rudders, the "ailerons," and closed compartments of certain biplanes, and similar problems. This is the most valuable part of the book, and the text is illustrated by diagrams. In Chapter III. the various existing types of aeroplanes are explained. Another 40 pages are devoted to the actual theory of heavier-than-air machines, but only a mathematical expert can follow the author. The remainder of the book deals with the employment of aeroplanes and the probable lines on which they will be improved.

BOOKS OF REFERENCE.

THE JAPANESE ARMY IN 1910 (Die Japanische Armee im Jahre 1910). Austrian translation from original Russian work by Lieut.-Colonel J. Romanowski, by Colonel Pruszynski, Austrian Army. 97 pp., with 9 appendices and table of contents. 8vo. Vienna, Teschen. Leipzig, Karl Prochaska. 4s. 6d.

The translator has previously published several useful works concerning the Japanese Army, and the writer was joint-author of Schwarz and Romanowski's well-known work on the siege of Port Arthur. The different portions of the book deal with – I. Field troops (higher staffs, the various arms, technical troops, reserve formations); II. Armament and munitions of war; III. Training regulations; IV. Protection, marches, cantonments, defences.

Appendices deal with :–

(1). Number of divisions in army.
(2). Constitution of a division.
(3). Data concerning artillery.
(4) to (9). Uniforms and distinctive marks.

* The titles of all books are given in English; this does not indicate that the books have been translated. The original title in the language in which a work is written, if not in English, is given in brackets.

Some of the data given concerning artillery differ from those supplied from official sources, *e.g.*, horse batteries are stated to consist of six instead of four guns. There are some errors in the book. The distinctive badge of Staff College graduates is said to be that of the General Staff. The divisional artillery is said to consist of three instead of six batteries. The organization of heavy artillery is erroneously described.

The distinctive flag of the second battalion of a regiment is given as that of the third battalion, that of the first as second, that of the third as first. Engineers wear crimson and not chocolate-coloured gorget patches. The unit of three (two) batteries is translated as "division," the usual Austrian term.

Despite the few slips referred to the book forms a valuable work of reference.

FORTIFICATION AND MILITARY ENGINEERING.

WORK ACCOMPLISHED BY THE ITALIAN MILITARY ENGINEERS IN THE LOCALITIES AFFECTED BY THE EARTHQUAKE OF DECEMBER, 1908 (L'Opera Prestata dalle Truppe del Genio nelle regioni colpite dal terremoto Dicembre, 1908). By Lieut.-Colonel Nicoletti-Timari. 2 vols., one of 78 pp., one of photographs and diagrams. 8vo. Rome, 1910. Voghera.

The Italian War Office despatched 34 companies of Engineers to the scene of the earthquake in December, 1908. These were eventually organized in four groups, with headquarters at Reggio, Palmi, Bagnara and Messina respectively.

This book gives a vivid idea of the variety and extent of the work that these companies were called upon to do. Not only had they to construct over 400 huts for the accommodation of the inhabitants, but to them also fell the duty of demolishing unsafe buildings, repairing the roads and railways, re-establishing the telegraph and telephone systems and constructing landing stages and jetties. The photographs and diagrams give a clear idea of the nature of the work done.

HISTORICAL.

THE DEFENDERS OF SEVASTOPOL. By General P. F. Rerberg. Vols. I., II., III. 418 pp. Profusely illustrated. Oblong 8vo. St. Petersburg, 1903, 1904, 1907. Golke & Vilborg.

In 1901, General Rerberg of the Imperial Russian Engineers, a veteran of the Crimean War, announced his intention of compiling a representative collection of portraits of officers and men of all ranks who took part in the defence of Sevastopol. The collection is now completed and is dedicated to the defenders of Sevastopol. The three albums contain altogether 1,332 portraits, accompanied in most cases by a short biography of the individual; a number of these portraits date from the period of the Crimean War.

The collection includes photographs of Sevastopol taken at the time of the Siege, and some interesting groups taken in 1905 of veteran survivors of the campaign.

General Rerberg has forwarded a presentation copy of his work to the Imperial General Staff.

THE SPANIARDS IN MOROCCO, 1909 (Les Espagnols au Maroc en 1909). By General de Torcy. 279 pp., with 1 map, 5 sketches. 8vo. Paris, 1910. Berger-Levrault. 4s. 2d.

General de Torcy acted as chief of the staff to the French expeditionary force in Madagascar, and much of his brilliant military career has been passed in Algeria: the distinguished record of the author thus lends great weight to his comments on the Spanish Campaign at Melilla in 1909.

The book is divided into three parts. In the first is traced the history of the Spanish North Africa possessions: the second part deals with the operations, which are clearly and instructively described. The third part is reserved for the comments of the author.

In the third part which constitutes a miniature handbook of warfare in North Africa, stress is laid on the value of the doctrines originally laid down by General Bugeaud and

subsequently developed by his successors in Algeria. These doctrines had not been followed by the Spanish commanders, who consequently clung to the old methods of lines of small entrenched posts and did not realize the fatal effects of undue delay and hesitation in operations of this nature.

General de Torcy speaks in terms of admiration of the gallantry, discipline and power of endurance of the Spanish troops, but considers them to be rather lacking in dash and elasticity, while their system of military training leaves a good deal to be desired.

RECOLLECTIONS OF THE RUSSO-JAPANESE WAR. By Colonel E. I. Martinov. 8vo. 402 pp. Maps. Plotsk Government Press, 1910. 5s. 3d.

Colonel Martinov was appointed to the 143rd Zaraiski Regiment on the outbreak of the war, and commanded it throughout the operations of 1904. In this book he relates at length the part played by the Zaraiski Regiment in the great actions, and in the various minor operations of the campaign. The book throws a very interesting sidelight on the interior economy of a Russian unit in the field. The Zaraiski Regiment had, apparently, a considerable regimental fund. The foresight of the commanding officer added to the regimental transport by local purchase, furnished the men with garments of Chinese linen for the summer, and with fur-lined jackets for the winter, with extra boots, and with a cobbler's depôt in Mukden for their repair. When the divisional intendance reduced the meat ration, the Zaraiski Regiment made up the deficiency from their own *store beasts*; and when the divisional general showed a weakness for utilizing too often the mounted section of regimental scouts on detached duty, Colonel Martinov solved the difficulty by forming a duplicate scout section for his own use. The field kitchens were always on the spot when needed, and when the situation did not admit of their being sent up to the front line, the men received their cooked rations in haversacks. Any lull in the fighting was taken advantage of to issue a meal, or to order the men to sleep, and finally when the regiment went into winter quarters on an entrenched position they built themselves baths and a laundry. Such details scattered throughout the book, in spite of its modest tone, reveal the fact that the Zaraiski Regiment was fortunate in its commanding officer, whom it lost when he was appointed chief staff officer to the IIIrd Siberian Army Corps.

The book is interesting, and is written in simple style and in very easy Russian. The student of this language will find it valuable for the introduction it gives to military life, and also for the many military terms which it contains. The print is very good and the sketch maps are clear.

HAVELOCK'S MARCH ON CAWNPORE, 1857; A CIVILIAN'S NOTES. By J. W. Sherer, C.S.I. 367 pp., with 1 portrait. 12mo. London, 1910. 1s.

An entertaining little book, in which interesting sidelights are thrown upon some of the events of the great rebellion.

RUSSIAN OFFICIAL HISTORY OF THE RUSSO-JAPANESE WAR. Vol. I., Part I. (Guerre Russo-Japonaise 1904—1905. Historique rédigé a l'état-major-général de l'armée russe). 665 pp., with 2 maps. 8vo. Paris, 1910. Chapelot. 12s. 10d.

The French edition is as nearly as possible a translation *in extenso* from the original Russian. The work is being carried out by 20 officers, principally officers of the staff, under the superintendence of the Headquarter Staff.

Vol. I., Part I., contains five chapters, *i.e.*, half of Vol. I. of the Russian original. The five chapters treat of:—

Chapter I.—Events prior to the outbreak of war.
Chapter II.—The theatre of operations.
Chapter III.—The Russian strategic deployment and plan of campaign.
Chapter IV.—Reinforcement of the Russian troops.
Chapter V.—The Japanese Army.

The account of the events prior to the war seems on the whole fair. The reader is struck by the contrast between the future combatants—in Japan a Government urged by the people and the Press to war—in Russia the people indifferent and a Government hopeful of gaining its ends by diplomacy, though urged as early as October, 1903, by the man on the spot, the Viceroy in the Far East, to mobilize in Siberia. Admiral Alexyeev understood that no arrangement compatible with the dignity of Russia would satisfy Japan, and the Russian Military Attaché sent frequent warnings to St. Petersburg of the activity at the Japanese Ministry of War.

Yet when the rupture came Russia, whose Foreign Office had striven to the last for peace, was unprepared. Diplomacy, gambling on the possibility of peace had neglected to provide for the eventuality of war, and the army was left to fight without allies. Great Britain, Germany and China, whose attitude was of primary importance were either semi-hostile or held aloof and the rear in Europe, the right flank and even, to a certain extent, the rear in Manchuria gave cause for anxiety. On the other hand Japan had won, if not the active alliance, at all events the moral support and sympathy of Great Britain and America, the two Powers with the strongest fleets and the longest purses.

Pages 107 to 198 of Chapter II. are devoted to a minute description of the theatre of war.

The remainder of the chapter contains an interesting criticism of the gaps in the Russian intelligence concerning the army and resources of their future enemy and of the probable theatres of war. Military Attachés at Tokio complained of the difficulty of obtaining information in Japan. Compared to the people of western nations, the Japanese were extraordinarily secretive, secret agents were unobtainable, there was no military Press and the translation of the few documents that came to hand offered exceptional difficulty. Russia remained to the end without precise information regarding the strength of the Japanese first line troops, the organization of the reserves and the wonderful *moral* of the army. It is a common Russian fault to keep secret matters which should be communicated to a large number of officers. Hence though much information had been collected about Manchuria, its publication had been delayed and conditions in the Far East brought many surprises for the bulk of the troops called upon to serve there.

Chapter III. contains a summary of the various plans which were drawn up for a campaign against Japan from 1898 to 1903, in which years conditions in the Far East were constantly changing owing to the rapid growth of the naval and military power of Japan, the steady but slower increase of the Russian forces and the improvement of communications in Manchuria.

Pages 320—328 set forth the main lines of the scheme drawn up by the Viceroy's staff in the autumn of 1903 and some interesting remarks thereon by General Kuropatkin, then Minister of War. Admiral Alexyeev's appreciation of the situation was optimistic. He assumed that Russia would retain the command of the sea and that the Japanese Army would be unable to land N. or W. of Chinampo. Kuropatkin considered that the Japanese would probably try to capture Port Arthur and would then await the assumption of the offensive by the Russians on the line Gensan-Pingyang. He foresaw that the Russian forces would be in an inferiority in Manchuria for the first six months after the outbreak of war and that the Liao-tung Peninsula would be isolated from perhaps the second month. He advocated the reinforcement of the garrison of Port Arthur and the bold employment of the field army which should endeavour to tire out the Japanese by means of its overwhelming force of cavalry and by frequent resort to operations by night. On the other hand he emphasizes the necessity of avoiding encouragement to the Japanese by partial successes at the outset of the campaign.

Pages 328—331 give the origin of the initial distribution of the Russian fleet. The object of the main squadron, which was based on Port Arthur was to prevent a Japanese landing on the coast of the Liao-tung Peninsula, that of the Vladivostok detachment was to raid the enemy's rear and the weakly fortified ports of the Japanese coast and to act as commerce destroyers.

On the 15th February, Kuropatkin in a note to the Emperor (pp. 360—362) sketched the probable course of the war, laying particular stress on the necessity for caution pending the concentration of sufficient force and the need for light railways. On the following day he was selected by the Emperor as Commander-in-Chief in the field from a list of 10 officers which he had himself drawn up on the 9th February.

Chapter IV. gives some idea of the difficulties under which the Russian administration laboured when it at length understood that war was inevitable. On page 462 and subsequent pages will be found a detailed statement of the strength and distribution of the Russian troops in the Far East at the outbreak of the war.

Chapter V. starts with a short account of the growth of the military power of Japan from the year 1871 and of the organization of the army in 1903.

Page 535 and the following pages, which contain a candid and searching analysis of the Russian intelligence of Japan prior to the war, will probably be found the most interesting in the volume.

Principally owing to the impossibility of obtaining precise information of the reserve formations, the Russian estimate of the available strength of the Japanese Army fell far short of reality. The official handbook considered 320,000 to be the highest number that could be mobilized and the most liberal estimate in the reports amounted to 634,000. In the war itself, the Japanese mobilized and employed 1,185,000 men.

The failure, however, to estimate adequately the numerical strength of the Japanese forces was of trifling importance, compared with the inability to appreciate their training, endurance, patriotism *and moral*. The attachés at Tokio previous to 1900 reported the astonishing progress of the army, but in that year Lieut.-Colonel Vannovski was appointed Russian representative.

The new attaché's first report contained the opinion that "decades, perhaps centuries" must elapse before the Japanese Army would be able to fight on equal terms with the feeblest of European Powers. A note on this report by the Minister of War (Kuropatkin) complimented the author on his common sense and on the absence in his report of evidence of the fascination exercised by the Japanese Army upon former military attachés. Whether Vannovski saw Kuropatkin's note or not is unknown, but his reports continued in the same strain and his preconceived opinions affected the judgment of the Russian observers who attended the Japanese manœuvres in 1901. Apart from animadversions on the poor quality of the horses and the miserable horsemanship of the mounted troops, their reports dwelt on the "feebleness of the tactical training," the absence of bayonet attacks, the distaste for operations by night, the disregard of cover, the want of proper measures of protection, the lavish expenditure of ammunition, the absence of all directing criticism at manœuvres, the want of discipline, the inability to withstand extreme cold, the ignorance of the military arts and the conceit of the officers. It was stated that the Japanese were a nation "without a future," and that their army was an "army of babies."

General Jilinski, Q.M.-General at Army Headquarters—a position corresponding to that of our Director of Military Operations—somewhat discounted these reports but still even he stated that "there can be no doubt that the Japanese Army cannot possibly be compared to the chief European armies and especially to the Russian."

In September, 1902, Vannovski was replaced by Lieut.-Colonel Samoilov, who took a more favourable view. Kuropatkin's impressions of the army gathered during his visit to Japan in 1903 will be found on pp. 584—585. He commented on the absence of religious sentiment in the country as a weakening factor.

Pp. 594—603 contain nothing new, but set forth clearly and forcibly the disadvantages under which the Russians laboured at the outset of the war as compared with their opponents.

THE STORY OF THE FRANCO-PRUSSIAN WAR, 1870-71. Part II. Metz to Sedan. By Lieut.-Colonel H. M. E. Brunker. 70 pp., with map. 8vo. London, 1910. Forster, Groom & Co. 3s. 6d.

This book has been written to assist officers in reading for the Special Campaign papers in the promotion examinations to be held next year, and for the entrance examination to the Regular Army in October, 1913, and March, 1914.

The information it gives is put in a concise form.

NAPOLEON'S EUROPEAN CAMPAIGNS, 1796—1815. By Capt. F. W. O. Maycock, D.S.O., The Suffolk Regiment. 169 pp., 23 maps and plans. 8vo. London, 1910. Gale & Polden, Ltd. 5s. nett.

This book gives in a concise form an outline of the European campaigns in which Napoleon himself took a leading part.

It is clearly illustrated by rough sketch maps of the principal battles, and should prove of service to officers who wish to obtain an idea of the sequence of military events in those days as a preliminary to more detailed study.

ORGANIZATION AND ADMINISTRATION.

NAPOLEON AS AN ORGANIZER (Der Feldherr Napoleon als Organisator). By Lieut. H. Giehrl. 177 pp. 8vo. Berlin, 1911. Mittler. 4s.

Under this heading the author describes the manner in which Napoleon carried out his office work both in peace and in war, his method of issuing orders in the field, the various means he adopted for obtaining information, the importance he attached to maps and map-making, and the measures he took to construct public roads (chaussées) and canals.

The author makes a few comments in the last chapter, and shows how Napoleon's methods must necessarily be modified to suit modern conditions.

The Appendix gives a plan of Napoleon's office and an illustration of the signalling apparatus in vogue in 1795.

ARMY ORGANIZATION AND ADMINISTRATION. By Capt. H. L. Pritchard, D.S.O., R.E. 300 pp. 8vo. Maps and diagrams. London, 1910. Clowes. 10s.

This is not an account or a criticism of any existing system of army organization and administration, but a study of an imaginary system devised by the author.

Starting with the axioms that "the germ of every section of war organization must exist in peace, preparing for war and ready to expand": that "on the outbreak of hostilities there must be no handing over of duties from one department to another, no creation of new branches entirely non-existent in peace": and that "an army is created and maintained for war"; he divides his study into Part i., War, and Part ii., Peace; and in Part iii. examines the application of the principles he advocates to the armies of the British Empire and to the South African War, the defence of India, and small expeditions.

The style is somewhat dogmatic and there is little argument; for instance he says "when we examine Napoleon's methods we find him dealing direct with several men besides Berthier . . . " "The Commander-in-Chief, therefore, divides his head-quarter staff work between five principal officers—of whom the Chief of Staff is one."

In many cases, however, no reasons whatever are given for the proposed arrangement of work.

Roughly his system, compared with the existing British one, to which, however, he does not allude, would hand mobilization and organization from the Adjutant-General to the General Staff. A Department of Communications would take the place of the Quartermaster-General's and deal with transport movements, and "correspondence": by which the author means post, telegraphs, signalling and kindred matters. The supply duties of the Quartermaster-General would be handed over to the Master-General of the Ordnance, re-named the Director-General of Supply and Material. The Inspector-General would become Commander-in-Chief, which office would be revived and combined with that of Minister of War: "It has been shown that command cannot be divorced from administration and financial responsibility"; and "Inspection cannot be divorced from responsibility and power to remedy defects."

"To put the matter in a nutshell: if a nation wishes to fight other nations, it must have an efficient army and to possess this it must have that army entirely controlled by the best soldier (the author does not define the qualities required to gain the right to this absolute superlative), who has a seat in the Cabinet and is War Minister to the Government. If on the other hand a nation is more frightened of its own army than those of foreign Powers, then it will wish to reduce it to inefficiency by refusing money for the army's upkeep, and by appointing a civilian amateur to control it, at the same time making things more difficult for the civilian by placing alongside him a Commander-in-Chief in an anomalous, undefined position without any real power." The author deals with the party and financial objections to having a permanent military War Minister by the argument that "the holder of the purse-strings holds the army . . . as long as Parliament controls the purse, it controls the army."

POLITICAL.

PEACE OR WAR EAST OF BAIKAL? By E. J. Harrison. 545 pp., 3 maps and numerous illustrations. 8vo. Yokohama. Kelly & Walsh, Ltd. 21s.

The author, a journalist who has resided many years in Japan, has given a singularly impartial account of the conditions in the Far East consequent on the Russo-Japanese War, and the recent Agreements and Conventions affecting the political situation in that part of the world.

The question asked in the title is answered in the first chapter, where the writer gives it as his opinion that peace is likely to last for a decade at least, but that the final struggle for hegemony is inevitable. According to him Japan has no intention of provoking a conflict. On p. 14 he says:—

> "I cannot share the Russian belief that these preparations for war in Korea and Manchuria necessarily imply a resolve to force a conflict upon Russia on some entirely frivolous pretext. Japan on her side has an equal right to assert that the construction of the Amur railway is but preliminary to a war of revenge on the part of Russia against Japan."

The subjects dealt with in the books are:—

Chapters II. and III.—The Russian advance eastwards and the events leading up to it, the net result of which is that "a second Russian armed frontier in the remote east of Siberia from Baikal to the Pacific Ocean, in spite of the economic weakness of that country, has become an inevitable necessity."

Chapters IV. to IX.—East Siberia and a voyage down the Amur river. Vladivostok, the writer says, has improved beyond recognition since the war. It suggests a "live" city more than any other port in the Far East; but, quoting the opinion of Mr. Panoff, a Vladivostok journalist with a lifelong experience of the Far East, he points out the precarious position in which that city would find itself, should the network of railways now being constructed by Japan be completed before the Amur railway. He adds that the Amur railway alone will be insufficient to guarantee Russia against attack. A Japanese advance from Kirin, a town which will soon be connected by rail with Ch'ang-ch'un on the west, and with the Korean port of Chong-jin on the east, in conjunction with a descent upon the Maritime Province, would squeeze Vladivostok in a vice. A fleet strong enough to resist attack from the sea is therefore a vital necessity.

Chapters X. to XIII. deal with Russia in North Manchuria.

Chapters XIV. to XVIII. with Japan in South Manchuria. The writer considers that the enormous vested interests that Japan is building up in Dairen (Dalny) will make it impossible for China to buy her out at the expiration of the lease.

In Chapter XVIII. is discussed the Knox proposal of January, 1910, to neutralize the Manchurian railways. This seems to have left a bad impression on the public mind in Japan. He shows that with a growing population expansion has become a necessity for her, and that, like every other Power, she will expand along the line of least resistance, *i.e.*, Korea and Manchuria. America has always closed her doors to Japanese immigration on the Pacific Coast, and it is not surprising that a proposal from this quarter, which would have the effect of placing her influence in Manchuria on an equal footing with that of any of the six Powers, should have excited bitter feelings in Japan.

Chapters XIX. to XXI.—The Japanese in Korea. Railway projects in Korea are clearly described: the following are likely to be commenced at an early date:—

(1). Mokpo to Koang-ju, in south-west Korea, ultimately to be linked up with the Seoul-Fusan line at Taiden.

(2). Seoul to Gensan. Chong-jin, on the north-east coast, to Hoiryong; thence to be connected with Ch'ang-ch'un by the Kirin-Ch'ang-ch'un railway, now under construction, thus constituting a third line of advance from the sea into the centre of Manchuria.

Texts of recent Treaties, Agreements, and Conventions relating to the Far East are given in appendices.

There is a good map of Korea and Manchuria. In the railway map of the Far East the portion showing railways in China is misleading. Railways are shown as completed from Tsi-nan Fu and Kiao-chow to Hi-chan Fu (Yi-chou Fu?). This is incorrect. That from Kiao-chow to Yi-chou Fu is projected only, while that from Tsi-nan Fu to Yi-chou Fu is a portion of the Tientsin-Pu K'ou railway, which is now under construction.

STUDIES OF INDIAN LIFE AND SENTIMENT. By Sir Bampfylde Fuller, K.C.S.I., C.I.E. 360 pp., with map and index. 8vo. London, 1910. John Murray. 6s.

Sir Bampfylde Fuller's work is one which should be read by all who take an interest in and are willing to try and understand the real India. Almost every phase of Indian life is touched upon; Indian problems are discussed and explained in a manner which cannot fail to be understood even by those who have not had the opportunity of visiting the country; whilst, at the same time, the wealth of detail and accurate description contained within the covers of the book, are never redundant. The great lesson which Sir Bampfylde seems to convey in this work is that India is not a country inhabited by a nation, homogeneous, compact and self-contained, but a vast sub-continent wherein dwell multitudes of races, differing from each other in every way that it is feasible for human beings to vary from each other. This book possesses the rare merit of accuracy. The reader cannot fail to be impressed with the feeling that he has presented before him the results of a wide experience, close observation and deep study.

STRATEGICAL AND TACTICAL.

CANADA AND CANADIAN DEFENCE. By Major-General C. W. Robinson, C.B. 186 pp., including index. 3 maps. 8vo. London, 1910. Hugh Rees. 6s.

General Robinson's able book will perform good service if it tends to the diffusion throughout the Empire of reasoned information about one of its most important components. One of the principal factors making for closer union of our world-wide Empire is the spread of knowledge of and added interest in the aims, hopes and aspirations of its several parts. In a series of addresses during his visit to Canada in the fall of 1908, Lord Milner pointed out how inadequate human imagination was to enable the separated parts of the Empire to feel acutely the more immediate needs of each other. If there were more books of the nature of *Canada and Canadian Defence* this inadequacy would be lessened, and it would not then be Utopian to hope for a common public opinion upon one at least of our joint problems—the military needs of the Empire.

Unthinkable as is war with the United States, General Robinson points out that Canada must pay a proper regard to the fact that for practically 4,000 miles her frontier marches with that of a powerful nation. His views upon the present needs for the protection of that frontier are based upon the lessons of the war of 1812-14, and he brings in support the opinion of the Duke of Wellington, an opinion which he rightly avers is not greatly affected by the scientific and military advance of 100 years. The outlines of the campaign referred to are set forth in brief and lucid form, lessons are deduced therefrom, and the changes since 1814 affecting these deductions are all carefully considered in the work. In the consideration of these changes and the manner in which they affect Canada's position to-day, much useful information regarding canal and railway construction and general progress in the Dominion is given in enlightening form.

The book contains three useful maps illustrating the events of the war of 1812-14 and the character of a most important part of the Canadian frontier; while Appendix III. contains useful information regarding the harbours and ports of the great Dominion.

MANŒUVRES PRIOR TO GREAT BATTLES (Vers la Bataille). By Capt. Becker. 138 pp., with 15 maps. 8vo. Paris. Berger-Levrault. 6s. 3d.

Although this book contains no original ideas, it is a good summary of the present French ideas on strategy. After a lengthy preface, in which the necessity of thorough national preparation for war is insisted on, the author discusses such subjects as the strategical plan, *rôle* of cavalry, operations of a covering force, strategical advanced guard, concentration, etc. He deals mainly with the probable actions of a Franco-German war, and gives numerous examples from military history, although, like many other writers, he is apt to strain facts.

TRAINING AND EDUCATION.

MILITARY LAW. By Major T. King. 72 pp. 8vo. London, 1910. Forster Groom. 2s. 6d.

This is a book of questions and answers on military law, arranged to assist officers in working up the subject for examinations.

TRAVEL AND TOPOGRAPHICAL.

MAP TO ILLUSTRATE THE INDIAN MUTINY, 1857, WITH NOTES AND REFERENCES. London, 1910. Forster Groom. 2s. 6d.

This publication is one of the "Whitehall Series of Military Maps," specially produced for Military History Examinations. It consists of a folding map of India, showing the communications and garrisons as they were in 1857, with an inset showing the present Indian railway systems. Three pages of notes on the Mutiny, giving a general *résumé* of the whole situation, are attached to the inside of the cover. The notes include a few observations on the lessons to be drawn from the operations. Small flags to assist the student to mark the dispositions of the forces during the campaign are contained in an envelope enclosed with the map.

The work will be of assistance to the student of Military History.

CORRESPONDENCE.

BRIDGING AT HARTY FERRY.

SIR,

Since writing the notes on the above, which appeared in the February number of the *Journal*, I have learned that the method of placing a number of trestles simultaneously in bridge, devised at Harty by Capt. Sankey, R.E., to suit the local conditions, had already been tried in Ireland at Athy by the 17th Company, R.E., earlier in the same month. In this case the method was thought of and marked out by Lieut.-Colonel J. A. Tulloch, R.E., and Lieut. E. B. Fox, R.E., with successful results.

I am, Sir, etc.,

J. C. MATHESON,

Major, R.E.

Chatham, 14. 2. 11.

The Editor, *R.E. Journal*.

MOTOR CAR IGNITION SYSTEMS.

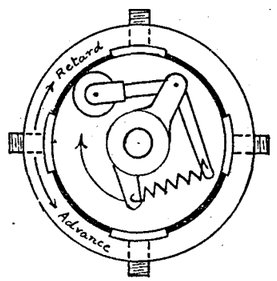

FIG. 5.—*Type of 4-Cylinder Contact Maker.*

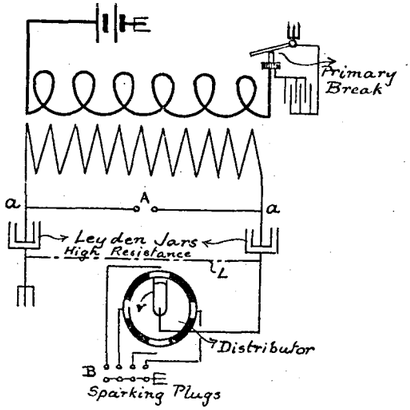

FIG. 8.—*Lodge High Tension Coil.*

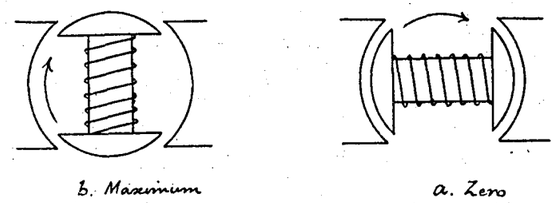

FIG. 11.—*Theoretical Positions of Armature at Moments of Zero and Maximum Current.*

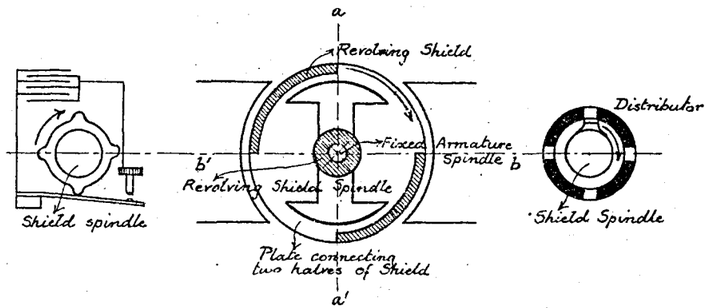

FIG. 14.—*Revolving Shield H.T. Magneto (Windings not shown).*

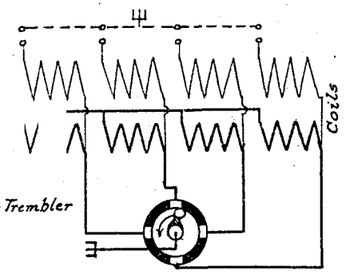

FIG. 6.—*Four Coils with Single Trembler.*

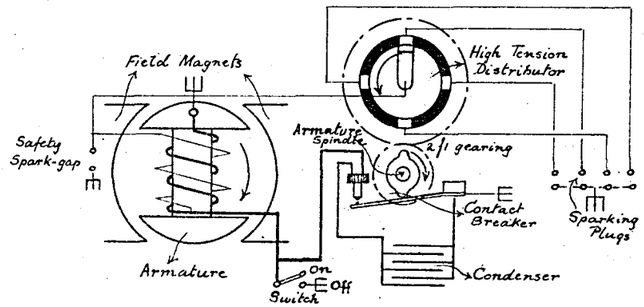

FIG. 9.—*Circuits of Typical High Tension Magneto.*

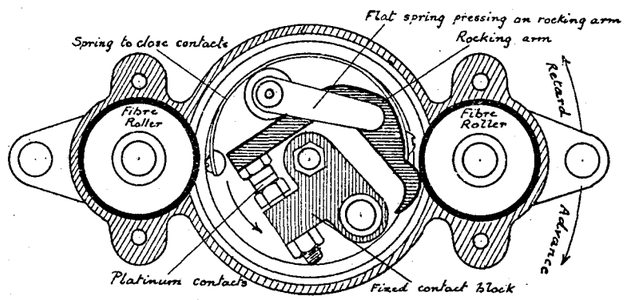

FIG. 12.—*Type of H.T. Magneto Contact Breaker.*

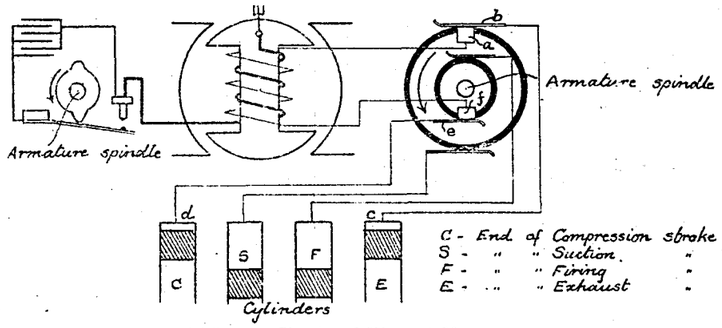

FIG. 15.—*Circuits of Nieuport Magneto.*

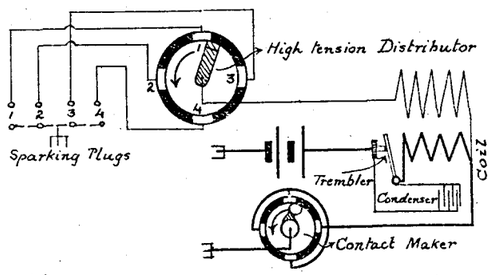

FIG. 7.—*Single Coil with High Tension Distributor.*

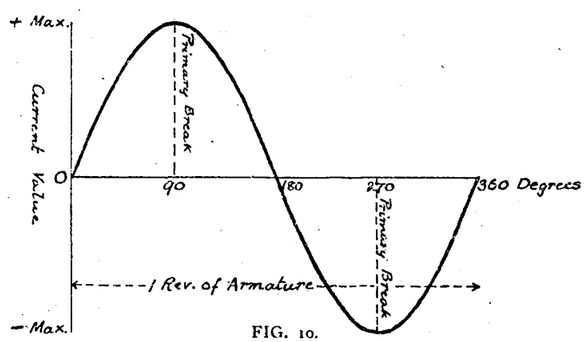

FIG. 10.

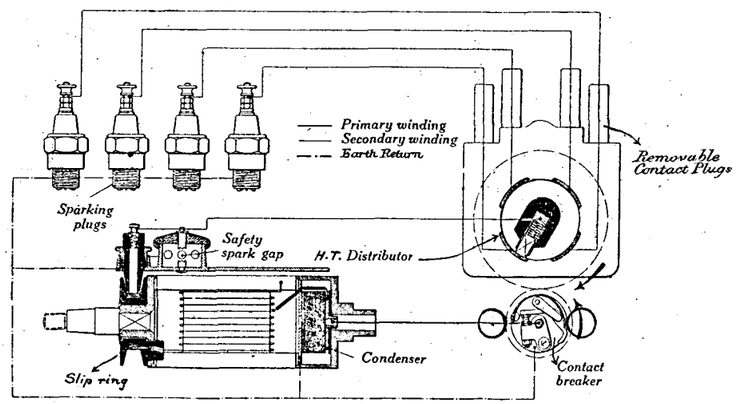

FIG. 13.

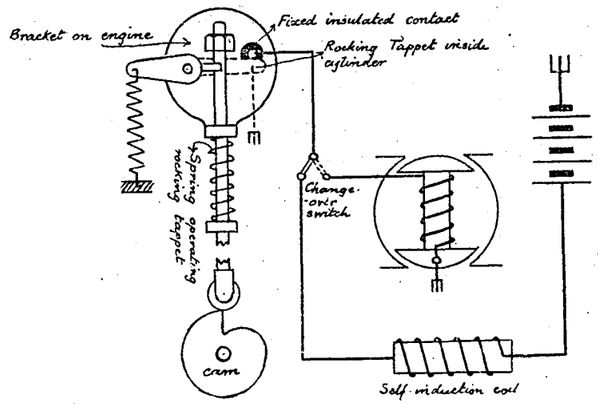

FIG. 16.—*Low Tension Battery and Magneto.*

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