THE ROYAL ENGINEERS JOURNAL.

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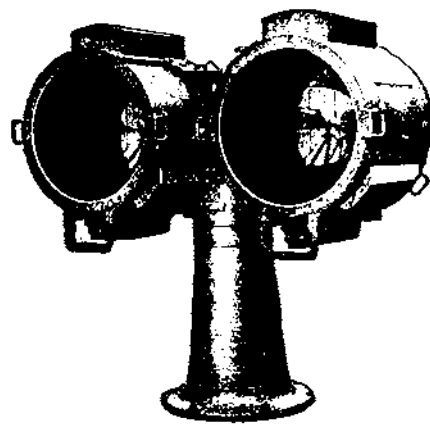

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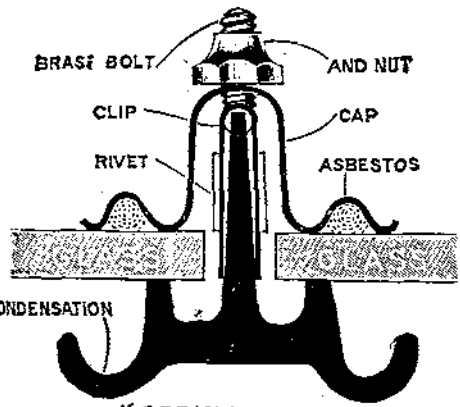

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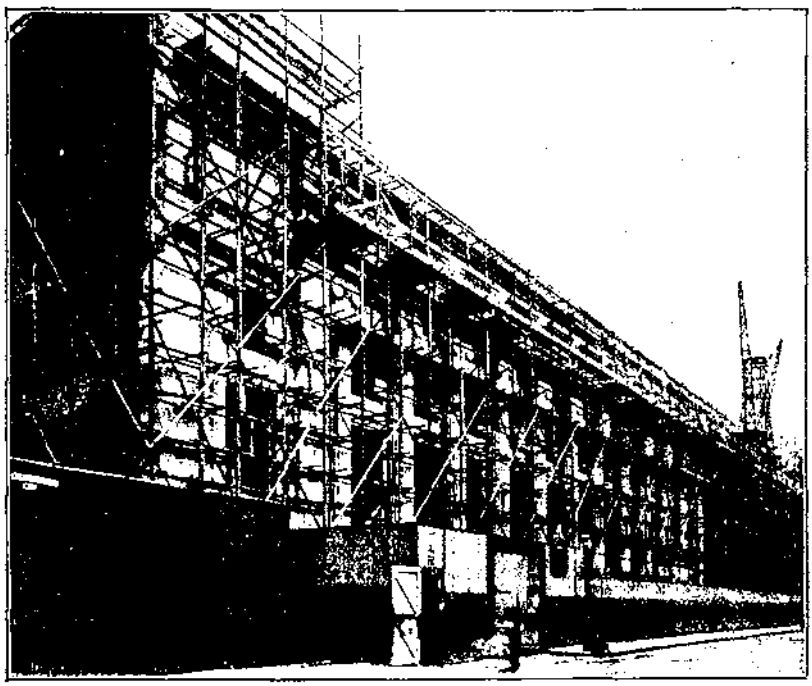

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Riveting is going on on the first span.
The second and third spans are still supported on camber jacks.

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Photo No. 2. The 6' Span in course of erection.
Showing the bottom booms just laid in position and roughly bolted up.

Photo No. 4. Hoisting a Vertical Strut into position (gussets bolted on).

GIRDER ERECTION OVER ROHI BEAS

GIRDER ERECTION OVER ROHI BEAS, PUNJAB, BY NO. 1 COMPANY, 1ST P.W.O. SAPPERS & MINERS.

By LIEUT. O. E. U. INGHAM.

THE following is a brief account of some girder work carried out in December, 1909—March, 1910, by No. 1 Company, 1st P.W.O. Sappers and Miners, on the North Western Railway.

The bridge in question has been built to carry the new double line over the Rohi Beas nullah, situated 1 mile west of the River Beas and some 60 miles east of Lahore, in the Beas (D.L.) Sub-Division of the Lahore District—Executive Engineer, Mr. E. Lister, P.W.D., and Sub-Divisional Officer, Lieut. E. P. Anderson, R.E. It is sited 100′ above the old single line bridge, which is too weak for the new engines. It consists of 2 roads of 3 spans each—total 6 spans—each 108′ 2″ centre to centre of bearings. The piers and abutments, constructed on wells, had been built by Lieut. Anderson during the previous spring.

The work for the company, which was undertaken on the contract system (*i.e.* full civil rates are paid by the employer and from the proceeds the O.C. has to pay Engineer and working pay, all expenses connected with journey to and fro, extra cost of food, etc.), consisted of "erection of girders complete including all riveting, erection and dismantling of falsework, painting and scraping of surfaces in contact, and selecting and bringing to site the girder pieces from their positions in Beas Yard." As a matter of fact only a portion of the riveting was carried out.

The pieces of each girder were lying together but much mixed, and the first span presented much the same problem as a jigsaw puzzle.

The method of erection, previously arranged by the S.D.O., was :— Build sleeper cribs to support the girders on camber jacks and to carry a track for a gantry, and then place all the members by means of the gantry.

Crib Piers.—These were about 10′ high : new Jarrah sleepers were available which made the construction of the cribs very simple. There were 6 cribs in each span, to support a pair of camber jacks on both sides of each joint in each bottom boom.

Gantry.—As will be seen from the photos, the gantry was of somewhat novel shape. Although the top joints were transversely rather weak, it had great longitudinal stability, which was often of great use in fitting in a refractory member.

Sorting, Scraping, and Painting.—The same men should be kept on this work as they get to know where all the peculiar-shaped gussets, cover plates, etc., go, and on what side they have to be painted.

Loading.—For most of the time one 5-ton crane and one line of siding only were available: this made the loading up on to trollies of the longer pieces rather awkward. With two lines—one for the crane and one for the trollies—the loading is much simplified. Any mistake, such as loading up a piece the wrong way round, entails great delay in erection.

Riveting.—This was done by the company smiths assisted by one artificer lent by another company. The senior British N.C.O., Sergt. Eltham, had had large practical experience of riveting and had also done some girder erection with the 8th Company, R.E., in South Africa. Under his supervision some good work was put in—the men picking up the work quickly. The rivets were mostly 1" with a few $\frac{7}{8}$". For nearly the whole time five sets of riveters were kept working—some smiths being required for the erection, and drifting up the joints. Each party was made up as follows:—

1 riveter	...	Smith artificer (corresponding to R.E. superior or very superior rating).
1 rivet heater	...	1st rate smith (do. skilled).
1 flogger	...	Generally 1 2nd rate smith.
2 holders-up	...	2 of other trades.
1 blower	...	Any trade.
6		

800 rivets were put in in the bottom booms and gussets of each span before erection commenced. These rivets were easier work than those "on bridge," put in after the girders were erected.

Riveting on an erected span was not commenced until all the joints had been drifted up fair, and service bolted up tight.

	In the Yard.	On Bridge after Girders were erected.
1. Average number of rivets per party per day. (This includes fitting together of plates, bolting and drifting up and also erection of staging)	37·6	28·9
2. Largest number of rivets in one day	92	62
3. Lowest do. do.	25	17
4. Number of rivets cut out after inspection	5·8%	13·8%
Total number of rivets passed ...	6,578	

Service Bolts.—The number sent out by makers with each span is small. In this case, as the erection went so much faster than the riveting, a large number were used.

Erection.—This was always started from the fixed end. The camber jacks sat down from 2″ to 3″ when the weight came, and the best way of keeping the right camber was found to be, by originally levelling the jacks 1″ to 2″ high, and then when the bottom booms were laid by raising the jacks until, judging by eye, each boom was in a nice even curve. Then when the top booms had been placed, the levels were checked again—and finally re-checked when the joints had all been drifted up. Some of the pieces had to be persuaded with a sleeper or a wooden maul, but most of them fitted excellently.

Diary of Progress.—The number of days taken was :—

Making cribs and gantry track—	
1st span and preparing pieces (scraping, painting and preliminary riveting) of 1st span for erection	12 days.
Erection of gantry	3 ,,
,, 1st span	15 ,,
,, 2nd ,, ...	7 ,,
,, 3rd ,, ...	5 ,,
Preparing for erection on upstream road including moving gantry across	6 ,,
Erection 4th span...	4 ,,
,, 5th ,, ...	3 ,,
,, 6th ,, ...	4 ,,

In addition to these days, three to four parties of three men each were engaged on each span for from three to six days drifting and bolting up all the joints fair.

Distribution of Men at Work on the Bridge.

5 riveting parties at 6	=30	100
Drifting and bolting up joints	10	
Scraping and painting	8	
Loading	18	
Erection party	16	
Cribs and gantry track for the next span ...	18	

Besides erecting the girders for the bridge, some of the carpenters and masons of the company—total 26—were employed on the erection of a 20-lever signal cabin.

The following were some points noted :—

As regards the Girders.—1. The two roads were so close together that there was not sufficient room to get a full swing with a hammer for riveting the top boom between the girders.

2. There were about 12 draughtsman's rivets in each span, *i.e.* rivets in places where they looked nice in plan but were bad for riveting.

3. For erection purposes there should be no pieces much heavier than all the others as these require special tackle.

In these girders there were in each span four pieces of top boom each weighing twice as much as any other piece in the span.

4. Every piece should be numbered clearly, stating whether the face numbered is inside or outside.

5. Bed plates should be sent from England with centre lines on them.

As regards the Erection Work.—(*a*). Bolts, rivets and drifts must be carefully looked after or they get dropped and lost.

(*b*). Enough materials—bolts, baulks, sleepers, and jacks for three or four spans are required.

(*c*). The following are required on the work :—

1. Invoice of packages and contents of same.
2. Makers' detailed drawings.
3. "Rivet and bolt list" showing the lengths and sizes of rivets to be used in each joint and the positions of the various special bolts.

(*d*). It is necessary to find out what joints and plates *must* be riveted before erection is commenced. This is not always easy.

UNDERGROUND WATER IN CRYSTALLINE ROCKS.

By Capt. K. E. Edgeworth, R.E.

With the exception of certain limestones, sedimentary rocks owe their water-bearing properties mainly to their porosity, or to their power of absorbing water. Crystalline rocks on the other hand owe their water-bearing properties to the existence of joints and fissures, the rocks themselves being practically impervious to water.

As might be expected, the extent and regularity of the jointing varies considerably even in different portions of the same rock, but it is probably not generally known that it may be sufficiently regular in certain types of rock, to enable wells to be drilled with a nine to one chance in favour of success. Joints occur in nearly all crystalline rocks when they are exposed to changes of temperature and other atmospheric influences, they frequently extend for several hundred feet below the surface, and are of sufficient magnitude to admit of the percolation of considerable volumes of water. When once a crack commences, various agencies will be at work to cause it to spread both vertically and horizontally, not the least of these being the water itself. The different cracks will intersect, and the water may thus be collected into a well from considerable distances, although the cracks will not be sufficiently large and continuous to enable the water to flow rapidly away. The cracks become less numerous as the depth increases, and the sounder part of the rock thus acts as an impervious stratum underlying the upper and water-bearing layers.

The conditions are not usually favourable for the existence of artesian or flowing wells, although certain cases in which such conditions exist will presently be described. Nor are the conditions usually favourable for the production of such large quantities of water as would be suitable for the supply of towns, as the majority of wells give less than 15 gallons per minute. Experience also shows that it is not economical to continue drilling to a greater depth than 200′ or 300′ after the surface of the rock has been struck. If the supply is insufficient, it is better to abandon the well and try again. As might be expected from the manner in which the water occurs, the wells vary considerably both as to the level and the quantity of the water supplied. Even wells close together often give entirely different results.

Information about underground water is collected by the Geological Survey Department of the United States, and is published in a series of excellent papers from which copious extracts have been made in preparing these notes.

The first State described is that of Connecticut in which a very large number of wells have been drilled and about which very full statistics are available.

CONNECTICUT.

Rainfall.—The mean average rainfall at 10 stations for the years 1893—1903 was 46″·98, and the amount is pretty evenly distributed both throughout the year and over the area under consideration.

Geology.—The greater part of the State is underlain by rocks of very great age. Unchanged igneous rocks are rare and metamorphic rock constitutes practically the whole of the crystalline areas. The metamorphic rocks are classified as crystallized limestone (marble), quartzite (compacted sandstone), phylite (an advanced stage in the development of slate), schist, and gneiss. It is in the two last named that water is generally found. The other rocks have not so far yielded satisfactory results. The terms schist and gneiss refer to the structure of the rock and not to its composition. Schist is characterized by cleavage planes which enable the separation of the rock into irregular layers of small thickness. Gneiss is more massive and implies the existence of a series of roughly parallel breaking planes along which the rock may be separated into slabs of various sizes. The production of gneiss from granite has taken place in Connecticut on a large scale. Granite masses have been stretched and squeezed, so that instead of being of uniform structure they are drawn out into sheets and definite layers, a factor which is of considerable importance in successful quarrying.

Joints.—By far the larger number of the joints in crystalline rocks are vertical or nearly so, the joints crossing each other at various angles, giving the surface the appearance of a rough screen or network. The spacing of the joints is very irregular even in the same rock. On the one hand there may be places where the joints are upwards of 100′ apart, while on the other hand there may be zones in which the joints occur every few inches. Taking an average, and counting all vertical joints in whatever direction, it is stated that the mean distance apart is probably not less than 10′ for depths up to 200′. The degree of opening between the walls of the joints is extremely variable and difficult to measure. At the surface the opening may be an inch or more, but at depths of 20′ or 30′ the joint will not usually be large enough to admit the blade of a knife. At greater depths the width of the joint is usually too small to measure, and its size can only be estimated by the amount of water which it supplies. In addition to the vertical joints, which are the most numerous and the most important from the water-bearing point of view, there is another set of joints which are nearly horizontal. They are much more regularly spaced than the vertical joints. For the first 20′ below the surface they average about 1′ apart, for the next 30′ 4′ to 7′ apart, and from 50′ to 100′ in depth 6′ to 30′ apart or even

more. Owing to the intersection of the various joints both vertical and horizontal, a system is formed by which water may travel considerable distances and which is sufficiently regular to give the well digger a reasonable hope of success. The average well will probably intersect several joints belonging both to the vertical and horizontal types.

Number of Successful Wells.—"It is probably a conservative estimate to state that not less than 90 per cent. of the wells sunk in the crystalline rocks have given supplies of sufficient amount for the use required." Owing to contamination by sea water, however, there is a larger proportion of failures near the coast.

Depth of Water.—The total average depth of the wells is a little over 100′, of which there is an average of 20′ of surface material. The average depth of the water level below the surface is stated to be:—Hills, 19′; valleys, 11′; slopes, 15′; plains, 8′.

Quantity of Water.—The average yield of 110 wells of depths up to 300′ is 13·6 gallons per minute, the maximum yield being obtained from wells whose depth lies between 100′ and 200′. The average yield in the valleys is about 20 per cent. greater than on the hills, while the yield on the slopes is less than half that obtained from either hills or valleys. The reason for this peculiarity is not quite clear.

Flowing Wells.—The surface material which overlies the rock in the valleys, forms an impermeable layer, and flowing wells are sometimes obtained when the capping is of sufficient thickness. Six cases are actually recorded, but the supply was always small and pumping was resorted to in order to increase it.

The Piedmont Plateau.

This is the name given to a belt of crystalline rocks running parallel to the eastern coast of the United States and traversing the States of New Jersey, Pennsylvania, Virginia, North and South Carolina, and Georgia. Proceeding inland from the coast this formation succeeds the clays and gravels of the Coastal Plain, and extends to the base of the Appalachian Mountains on the west.

For various reasons the number of wells sunk in most of the States is smaller, and the information about them is much more scanty than in the case of Connecticut, but the general results appear to be similar.

In North and South Carolina the conditions are favourable for the existence of flowing wells, and a considerable number are recorded. They vary in depth from 28′ to 72′, and have a pumping capacity of from 3 to 15 gallons per minute. It is stated that the underground water flows in definite streams varying in width from a few feet to (in rare cases) more than 100 yards. Generally these underground "streams" follow the topographical features, but in some cases they flow obliquely across the ravines, showing that the line of least

resistance in the rock is to a certain extent independent of the topography of the surface.

At Atlanta a well was bored in gneiss to a depth of 2,200′ and a large supply was tapped at a depth of 1,100′ which rose to within 17′ of the surface. Some years later however the water was found to be polluted and the well was abandoned. This well is of interest not only on account of its great depth and the large amount of water supplied, but also because it emphasizes the risk of pollution when water is obtained from crystalline rocks.

NEW HAMPSHIRE.

Three flowing wells in the Portsmouth-York region are of interest, in that the impervious capping is provided by the rock itself, instead of by a separate layer of overlying clay. The wells are near the coast, but the water is quite fresh. They give supplies of 1½, 30, and 65 gallons per minute at depths of 27′, 28′, and 70′ respectively. In all cases the water rises 2′ above the surface of the ground. No investigation appears to have been made as to the manner in which the water is obtained, or the reason why the normal conditions with regard to the opening of the joints should be departed from.

SWEDEN.

A successful well was sunk in granite on the island of Arche (lat. 58° 29′, long. 16° 58′ E.), and a supply of 3 gallons per minute was obtained at a depth of 100′, the water rising to within a few feet of the surface. This well is of interest in that a supply of fresh water was obtained on an island at some distance from the mainland which could not have been derived from the island itself. Six other successful wells are also reported at depths varying from 110′ to 120′.

CONCLUSION.

From the existing information several useful lessons may be learnt with regard to the water-bearing properties of crystalline rocks in general.

In the first place, it should be noticed that crystalline rocks frequently provide considerable quantities of water, and in new countries where water is scarce they should be looked upon as a possible and promising source of supply.

Secondly, it is not usually economical to drill more than 200′ after striking rock. If the well is unsuccessful, it is better to abandon it and start another well elsewhere in the neighbourhood.

Lastly, care should be taken to guard the ground in the neighbourhood of the well from possible sources of pollution.

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GIBRALTAR UNDER MOOR, SPANIARD, AND BRITON.
(*Continued*).

By Col. E. R. Kenyon, R.E.

When North Africa was conquered by the Arabs or Saracens, the greatest and most powerful native race was that of the Berbers who long held out and who, when they finally yielded to the invaders and adopted the forms of Islam, never really amalgamated with them. They were a savage and warlike people who supplied useful soldiers to the Arab Emirs. Tarik, the conqueror of Gibraltar, was himself a Berber, and his army is thus described by Scott (Vol. I., p. 225) :— It "was one of the most motley forces which had ever been assembled under the Moslem standard. . . . The bulk of the troops was composed of Berbers, fierce savages of the Atlas Mountains, proselytes reclaimed from fetichism by the policy and eloquence of Musa. . . . Every nation whose type chance, misfortune, the love of plunder, or the spirit of adventure had impelled upon the African coast, was represented in the ranks of the invaders; descendants of the Vandals and the Goths; Bedouins from the Hedjaz; political exiles from the far Orient; conspirators from Syria; apostate Byzantines who had renounced allegiance to the Emperor of Constantinople; and a considerable body of Jews." The conquest was however effected under the orders of the Arab General, Musa, and on behalf of the Caliph, whose seat was at Damascus. It was therefore correctly considered as an Arab or Saracen conquest. In the division of the spoils "the bleak sterile plans of La Mancha, Aragon, and Galicia were assigned to the Berbers, while the Arabs of Syria and the Hedjaz divided among themselves the glorious regions of the South which tradition had designated as the Elysian fields of the ancients."* The history of the Mahomedans in Spain is largely made up of the incessant feuds between the highly cultured Arab race and the comparatively savage, but very warlike Africans or Moors. For nearly three centuries and a-half the Arabs retained the predominance, but then the Berber dynasty of the Almoravids ousted the Arab princes (1090), to be in their turn overthrown by another Berber line, the Almohades (1146). The first three princes of the Almohade line were pre-eminently conspicuous for their talents, their firmness, and their political sagacity. Their reigns . . . were neither oppressive nor unjust. . . . But so capricious and disloyal was the African, that neither the enjoyment of present favour nor the expectation of

* Scott, Vol. I., p. 325.

future benefit could ensure his fidelity. He was wholly careless of the advantages of civilization. His superstition made him the facile dupe of every impostor. The Almohade sovereigns lived in constant apprehension of dethronement. If they left Africa for Spain the desert tribes were certain to rebel. As soon as they had re-crossed the strait, Andalusia rose in arms. . . . The Berber element, while abhorred by the Arabs, had yet so permeated the society of the Peninsula that every department of government, every rank and profession of men, had been infected with its poison. Under such conditions political regeneration was impossible. No reformer, no conqueror, could avert the final catastrophe—a catastrophe inevitable in the decadence of nations,—subjection to a foreign enemy actuated by religious fanaticism, military ambition, and inflexibility of purpose. The victory of Alarcos (1195) was the closing triumph of Islam in the Peninsula."* For another three centuries the Moors maintained an ever-diminishing dominion in Spain. From 1266 they were confined to the kingdom of Granada. In 1309 the Spaniards of the kingdom of Castile captured Gibraltar, but after 24 years' possession they again lost it and never recovered it until 1462 when it was captured on August 20th (St. Bernard's Day) by Alonso de Arcos, Alcaide of Tarifa, taken possession of in the name of the Duke of Medina Sidonia, and unwillingly transferred by him to King Henry IV. of Castile. Never again has it passed out of Christian hands, but its possession was not finally confirmed to the Spanish Crown, instead of the Medina Sidonia family, until 1501 when the second duke transferred it under pressure to Queen Isabella, to whom Spain owes its union under a single monarch and its freedom from Moslem rule over any part of its soil.

GIBRALTAR UNDER THE SPANIARDS.

The distinctive traces still remaining of the Spanish rule in Gibraltar are not as numerous or as prominent as one might have expected. This is, no doubt, owing partly to the almost total destruction of the town during the great siege of 1779–83, and partly to the gradual growth of the British fortifications which have in many cases altered or obliterated those of Spanish construction; and even where old works remain they have been renamed, so that there is little or nothing to mark them out.

Probably the most ancient memorial of the Spanish conquest is furnished by the coat of arms which was granted by Queen Isabella to the fortress about 1502. The original grant is still preserved at San Roque with other archives removed from Gibraltar after the capitulation of 1704 and is printed at full length in Ayala's Appendix X. In this deed the arms are described as a red castle on a shield of which

* Scott, Vol. II., pp. 315—316.

the upper two-thirds are white and the lower third red, and from the castle there is pendant a golden key over the red field. The castle is separated from the red field by a white line.

The Churches.

In Spanish times the churches were very numerous, as may be seen from the various lists of those which were in existence in 1704, one of which was given by the Vicar Apostolic in the *Gibraltar Chronicle* of April 9th, 1868, and another, slightly different, in Colonel Dewing's pamphlet on the antiquities of Gibraltar. Of only three is there now any remnant, if we except the old archway which is to be seen in Southport Street in the west end of St. Jago's* Barracks. Fortunately the three remnants belong to three of the most ancient of the sacred edifices. One is the fragment of the Chapel of "Our Lady of Europa" already described; another is the "King's Chapel"; and the third is the Church of St. Mary the Crowned.

The King's Chapel.

The "King's Chapel" which is now the principal Garrison Church, and which adjoins Government House, was originally the chapel of a Franciscan monastery which Don F. M. Montero states (p. 277) was founded in 1480, and transferred in 1531 to a site granted by the notary of the Franciscan Chapter of Madrid for the construction of a good church and convent, provided that a chapel was allotted for the burial of himself and his family. After the capture of Gibraltar by the British this convent became the Governor's residence, which has in consequence been known from that day to this as "The Convent." The front patio, or courtyard, and the buildings round it are on the same general plan as in 1753,† but at that time the building on the north side of the patio, which now forms a fine ball room on the first floor with a supper room below, was a part of the nave of the chapel; while the main staircase of Government House occupies what was then the south transept. The west doorway has been built up but may still be seen in the coach-house. Adjoining it there is in the stables a fine doorway, exactly similar to that which may be seen in Southport Street built into the end wall of St. Jago's Barracks. This doorway leads into a series of bombproof shelters built against the side wall of the old nave, on a site which is shown on the plans of 1736 and 1753 as a courtyard. It is often said that the mutilation of the church and the conversion of part of it into a ball room took place immediately after the capture of the place in 1704; but this is negatived by the above facts. Colonel James, writing in 1771 and describing the place as it was when he left in 1755 makes no mention of any part having been cut off from the church; nor does Ayala (1782) although he

* An English corruption of "Santiago."
† This plan is in the R.E. Office.

expressly speaks of the building as being used by the English for divine service, and draws attention to the fact that the other churches were devoted "to profane uses," such as barracks, storehouses and the Admiral's residence. Major Hort* speaks of "a long and lofty chamber supported by two rows of pillars in which the Duke of Kent afterwards held his 'Governor's banquets' as having 'constituted in olden times a portion of the aisle.'" There can be no doubt that this is that part of the building, already mentioned, of which the ground floor is utilized as a supper room, while the upper floor forms the ball room. The *Travellers' Handbook* (1844) mentions it as a ball room. It is therefore clear that the mutilation of the chapel took place between 1782 and 1839; and we may reasonably conclude that it was effected after the siege of 1779–83, when, no doubt, extensive reconstruction must have been necessary. The old pay lists (now at the Record Office) show that a considerable amount of work was done at the Governor's residence between April, 1783, and May, 1784.

A Garrison Order of 19th December, 1788, says that "King's Chapel" will be opened for Divine Service on the following Sunday. There is however one passage which throws doubt on the conjecture that the severance was made during the repairs after this siege. The author of a satirical pamphlet,† written in order to attack a certain lieutenant-colonel who is described as a "deputed Deputy's Deputy," says "To repair the church, he pulls down one-half of it and with the materials built storehouses on the esplanade." This acting Governor was Colonel Kane who arrived in 1720; and from James‡ we learn that the "esplanade" was on the site of the Casemates Barracks and that it was cleared of rubbish in 1731. On this site once stood the parish church of the quarter of Villa Vieja, as we see from the following passage from Portillo, quoted by Ayala (p. 62):—"There is a most ancient hermitage, and it is in the Villa Vieja with the present name of Our Lady de la Cabeza. I have also heard the oldest inhabitants of this city call it Santiago, afterwards Santa Brigida, and lastly Our Lady de la Cabeza, and it was the ancient parish church." It seems possible that this was the church referred to in the satire, and that the doorway in St. Jago's Barracks and the similar one in the stables of Government House were removed from it, which were in the north corridor of the patio but had in 1844 been covered over by the plaster.

The Church of St. Mary the Crowned.

This is the Roman Catholic Cathedral of Gibraltar, and has an interesting memento of the transfer of the city to the Spanish Crown in the shape of a slab carved with the Royal Arms of Spain, which is now to be seen on the wall of the clock-tower inside the

* *The Rock*, 1839.
† "Reasons for giving up Gibraltar," 1749.
‡ Vol. II., p. 304.

little courtyard or patio of the church—a remnant of an ancient "Court of orange trees," dating from Moorish times, which was sacrificed early in the 19th century, the site being sold to the Government for £1,000 for the widening of the street.* In 1868 this was the only Roman Catholic Church "much smaller than in 1704.† A part of the sacred edifice is wanting, also the orange square"; and, from a comparison of the church with the plans of 1736 and 1735, it is evident that not only was the orange court destroyed, but also that about 30′ were cut off the west end of the building. Portillo‡ says "This church was apparently a Moorish mosque, as is shown by the building in the court of the oranges and by the work which we saw pulled down in the nave where now is the 'Altar of the Name of Jesus.' . . . and by the marbles in that court or cloister which are similar to those of the church of Cordova in colour, length, and thickness. The tradition is that the Catholic Sovereigns ordered it to be designed and built according to the commencement which has been made." James§ describes the court as "a Moorish square" round the sides of which are "Moorish pillars and arches that support a terrass entirely in the Moorish system of building." It is possible that this was the "principal mosque" built by Abu-l-Hasan but there is no proof of it. It appears that when the conversion of the building into a Christian church was initiated by Ferdinand and Isabella, a fine bell and clock-tower were built, and that the Royal Arms were carved on its north gate,‖ but during the siege of 1779-83 all spires and towers in the town were pulled down.¶ No doubt the slab on which the arms appeared was carefully preserved and was again built into an exterior wall of the church after the war was over, although not where it now is. It was removed into its present position from one nearly exactly opposite, a few years ago. The design of Ferdinand and Isabella (which probably incorporated the whole or part of the original mosque) was never completed, being suspended in order to provide funds for pictures and other decorations;** and it is evident, both from the letter of the Vicar Apostolic, already quoted, and from a comparison of the church as it now stands with Portillo's description, that it must have suffered other mutilations besides the reduction in size and loss of the orange court referred to by the Vicar Apostolic. No doubt, like every other building in Gibraltar, it suffered severely in

* Don F. M. Montero, p. 421.

† Letter from the Vicar Apostolic (Bishop Scandella) in the *Gibraltar Chronicle* of April 9th, 1868.

‡ Writing early in the 17th century and quoted by Ayala.

§ Vol. II., p. 351.

‖ Don F. M. Montero, p. 276.

¶ Spilsbury's diary, September 15th, 1779, and also Drinkwater's history.

** Portillo quoted by Ayala.

the siege. Probably very little of the original structure still survives. The existing clock-tower was built in 1820, except the cap and crown at the summit which were added in 1874 and 1906.

In addition to the three churches already described, namely (1) Our Lady of Europa, (2) The King's Chapel, and (3) St. Mary the Crowned, the following appear to have existed in 1704 :—

Ayala mentions: (4) The Church or Hermitage of S. Juan el Verde (p. 31), which belonged to the Knights of St. John of Malta and which owed its name of "the Green" to the colour of its roof tiles. Ayala describes it as standing among the gardens which adjoined the south end of the Red Sands; and the priests now resident in Gibraltar state that it was quite close to the old cemetery at Sandpits, which agrees well with Ayala's statement.* In Bishop Scandella's list however† the church is stated to have been "near the New Mole on the site of the present Navy houses"; and in the plan of 1738 the name of "Caleta de Juan Verd" is given to the coast line between Rosia Bay and the New Mole.

(5) Near to it was a Calvary with many crosses erected by Admiral Roque Centeno in 1623.

(6) The Monastery of Our Lady de la Merced (or, Pity). This was erected in 1587 as a hospital by a rich Spanish innkeeper named Juan Mateos. In 1591 it passed into clerical hands and its accommodation was increased to 400 beds (Hennen: p. 88).

(7) The Monastery of San Juan de Dios.

(8) The Nunnery of Santa Clara which was founded in 1587.‡ It was converted into a barrack between 1726 and 1746. The Cecil Hotel now occupies its site.§

(9) The Church of San Juan de Letran (or Lateran). Bishop Scandella states that this was "probably on the site of the present Grand Store" (*i.e.* the south-west end of Southport Street) and current tradition‖ is in accordance with this. There is however also a tradition recorded in the Gibraltar Directory that the site of the Grand Store was formerly a part of the grounds of the Franciscan convent and that the Armoury (now the Garrison Recreation Rooms) which was built in 1790 was erected on the old graveyard of that convent. Many skeletons, some of them with rosaries are said to have been dug up when the foundations were excavated. Probably the explanation is that San Juan de Lateran stood there and after it had disappeared tradition merged the site of the church in that of the adjoining more important one of the Franciscan convent. The plans of 1736 and 1753 seem to countenance such an explanation, for they

* Information given by Father Jones of the Christian Brothers.
† *Gibraltar Chronicle*, April 9th, 1868.
‡ Ayala, pp. 61 and 256.
§ Dewing.
‖ Father Jones.

show a lane (as at the present time) between the south wall of the convent grounds and the other site which is marked on the 1753 plan as "Inhabitants Garden"—a use to which the grounds of an independent church might very likely have been devoted.

(10) The ancient Parish Church of Villa Vieja.

(11) The Church of San Sebastian in the ward of the Barcina which is said by Ayala to have been "very ancient." Bishop Scandella sites it at "the Green Market where the Officers' Quarters now are" (*i.e.* the R.E. Mess).* It probably stood at the south end of the Green Market (now Cornwall Parade), for the 1736 plan shows a chapel on the site of the buildings at that spot (now the "Bristol Bar").

(12) The church of the "Confraternity of the True Cross" in the main street. It was converted into a barrack between 1726 and 1746. The site is that which is now occupied by the Café Universal as appears from a comparison of the Crown Lands Register with Bishop Scandella's letter in which he says it was "in the main street on site of Mr. Weir's present wine stores: the Government sold the buildings to Mr. Breciano," and with the 1736 plan which shows a chapel on the site now occupied by that café at the junction of Horse Barrack Lane with the main street. Probably it was from this building after its conversion into a barrack that the lane derived its name.

(13) "The Hermitage in the great square, where there is a hospital named 'de la Misericordia.'" Bishop Scandella says that it was probably on the site of the Club House Hotel (*i.e.* Connaught House, as it has been called ever since the Duke of Connaught occupied it in 1875-6). It was converted into a barrack between 1726 and 1746.

(14) The Hermitage of our Lady of the Rosary.

(15) The Hermitage of Los Remedios† which is stated by Bishop Scandella to have been on the site of the present Naval Hospital. It was converted into a barrack between 1726 and 1746.‡

In addition to the above Bishop Scandella records:—

(16) The Hermitage of St. Rose "on the site of the guardhouse at the entrance to St. Bernard's College."§

(17) A Calvary on the site of the residence of the Senior Naval Officer (*i.e.* the Mount). This Calvary, or Via Crucis, is no doubt the same as No. 5, the commencement being at the Red Sands and the termination at "The Mount" where there was a chapel which

* Colonel Dewing appears to have mistaken No. 9 for this church.

† Ayala, p. 53.

‡ Ayala quotes Portillo as his authority for the whole of the above list except Nos. 4, 5, and 15.

§ St. Bernard's College here means the house of the Little Sisters of the Poor, and the guardhouse is the disused one at the entrance to Engineer Road (Father Jones).

together with the 14 crosses, was under the care of the Knights of Malta who occupied San Juan el Verde.*

(18) Bishop Scandella also states that Father Jerome of the Concepcion in his work *Cadiz Ilustrada* (Amsterdam, 1690) adds the Church of Las Angustias, and (19) the Royal Chapel of Our Lady de la Piedad on the New Mole.

(20) James records a "Chapel of Christ," which is marked on his plan in Vol. II. and also in an undated and inaccurate French plan† at the junction of the roads to Europa and Windmill Hill about where the military school now stands, though the plans differ as to the side of the road on which it was.

(21) James also describes the house in which he himself lived as having formerly been a "Chapel of Ease." A comparison of his description with the 1736 and 1753 plans shows that the building referred to is the present Staff Quarter in Bomb-House Lane, opposite Bomb-House, though it is also clear that the structure of the building has been altered by the substitution of brick or stone and plaster for the "petrified sand charged with variety of shells that took a polish," which James describes. The building probably suffered in the great siege and, like the rest of the town, was rebuilt on the old plan but with other material.

(22) The plan of 1736 shows a chapel between Pitman's Alley and City Mill Lane, but its name cannot be identified unless it was one of those mentioned above whose sites are doubtful, namely, Nos. 9, 11 (for both of which however, probable sites have been suggested) or 18.

(23) Dodd states that the Goths built a chapel near the centre of the middle hill, but there is no trace of such a building and he does not cite his authority. Possibly this belief may have arisen from the fact that the Spaniards dedicated a tower at Signal Hill to "Our Lady of Guadelupe," so named from an image which was placed in it;‡ the shrine similarly dedicated in Estremadura being one of the most celebrated in Spain.

(24) It is sometimes stated that a convent dedicated to St. James stood on the site of St. Jago's Barracks. There is however no shadow of foundation for this belief. The doorway at the west end of the barracks is clearly not in its original position but has been brought there from elsewhere. The name of St. Jago (Santiago or St. James) as applied to these barracks is derived from the fortification now called "The Flat Bastion," the original name of which was "The Bastion of Santiago" under which title it is shown in a Spanish plan dated 1627.§ It was customary with the Spaniards to name their

* Father Jones.
† In the possession of Mr. A. Hasluck.
‡ Plan of 1627 in British Museum Add. MS. 15152.
§ British Museum Add. MS. 1552.

bastions and batteries after one or other of the saints, as, for instance, the batteries of St. Peter and St. Paul on the northern defences, where they were subsequently replaced by the improved works of Hesse's demi-bastion, etc.

The building at St. Jago's Barrack, into which the old doorway has been built, is shown on the 1736 plan as an armoury, and on that of 1753 (which shows a doorway at that spot) as a storehouse. Probably the presence of this doorway, combined with the survival of the name of St. Iago, led in course of time to the growth of a belief that the building had once been a chapel; and in the pay lists of 1786 and 1787,* we find mention of work done at "the Chapel Storehouse near Southport" which very probably refers to this building.

At these barracks there is an old graveyard which may have been formerly that of "La Turba," but the earliest tombstone is that of John Williams, Master Armourer, who died in 1738. The latest is dated 1815. Of course, as La Turba was the poorest quarter of the town, it is quite possible that there might have been earlier Spanish burials there without any permanent memorials having been erected.

From the Death of Isabella to the Capture by England.

When Queen Isabella died in 1504, she left a will in which she specially charged her successors never to alienate Gibraltar from the Crown. Her grandson, Charles I. of Spain (the Emperor Charles V. of Germany), showed himself not unmindful of the value of the place; and his connection with it is still commemorated by his Coat of Arms over the South Port (or New Gate as it was originally called), and by the name of "Charles V.'s Wall" which is applied to the south wall of the City and to the upper wall which carries on the fortification to Signal Hill running parallel to, but south of, the more ancient Moorish wall. The lower portion of this wall, namely, from South Bastion to the precipice above the town, was built by the Italian engineer, Juan Bautista Calvi, who was sent by Charles to attend to the fortifications of Gibraltar in 1552. He also rebuilt the Landport and constructed "a bastion defended by a broad ditch there."† Perhaps this was on the site of Hesse's Demi-Bastion. The upper wall may perhaps have been planned by him, but it was not built until 1575 when Philip II. (Charles' son) sent another Italian engineer, El Fratino, who constructed this part of the wall and some additional bastions, one of which was that of Rosario, close to Southport.‡

To build this battery Ayala states (p. 251) that he had to destroy

* Record Office.
† Don F. M. Montero, p. 239.
‡ Don F. M. Montero, p. 241.

a very ancient Moorish gate called the "Gate of Algeciras" which had existed from the time of the conquest, and on which was sculptured the common Moorish emblem of the key (which one can still see at the Alhambra). Don F. M. Montero (p. 241) repeats this statement but in another place (p. 275) he speaks of this gate as having been in the same wall as, but above, the "New Gate." It seems probable that this latter is the more correct description, and that the old Moorish gate was at the site of the Flat Bastion, giving access to the ward of La Turba from the country, and that the New Gate or Southport was constructed to take its place.* The Rosario Bastion was so named from the hermitage of Our Lady of the Rosary which was close to it, and is shown on the plan of 1627 in Bell's translation of Ayala as being at about the site of the Ragged Staff guardroom.† Probably the Rosario Bastion is identical with that of the Ragged Staff flank.

James and Carter both speak of Charles V.'s Wall as having been built by the German engineer Speckel, but Carter probably used James as his authority; and James is far from being an accurate writer. Probably Speckel, who fortified Ulm, Strasburg, and many other places would have been consulted by Charles, and as he visited and studied the defences of many Italian fortresses it is very likely that, while he may have given or approved the general designs, the actual works were carried out by the Italians Calvi and El Fratino. The other bastions which are said‡ to have been constructed by El Fratino are Santa Cruz (now Jumper's) and King's Bastion. The *existing* King's Bastion, however, is an English work, having been built by General Boyd shortly before the great siege.

Another memento of the reign of Philip II. is given by "Cloister Ramp" at the south end of Irish Town, which preserves the memory of the Convent of "La Merced" or the Whitefriars, which was founded in 1581.§ This Convent became the residence of the British Admiral after the capture of 1704, and is shown on a plan of 1753 as "Naval Storehouse with Apartments for Officers and Clerks." It was ruined in the siege of 1789–93, after which the Admiralty bought "The Mount" for the quarters of the Senior Naval Officer; and the site of the old convent and its cloisters is now occupied by Messrs. Bland's premises.

A few years later than La Merced, the monastery of San Juan de Dios was founded.§ The site is now occupied by the Civil Hospital, which was formerly a Military Hospital, and previously the "Blue Barracks."

* To this New Gate the name of Puerta de Africa is given in the plans of 1627 in British Museum Add. MS. 15152.

† The plan is at the British Museum, and a copy is inserted in the Gibraltar Garrison Library's copy of Montero's history.

‡ *Gibraltar Directory.*

§ Ayala, p. 61.

The building known as "The Hermitage" at Rosia, recalls by its name the former existence of the hermitage of "Los Remedios" which stood on the site now occupied by the Naval Hospital; while the name Rosia, which is a British corruption of the Spanish word *rocio* or dew, recalls a little shrine dedicated to "Nuestra Señora de Rocio" which used to stand in front of the ladder leading down to Camp Bay.*

The son and grandson of Philip II., Philip III. (1598), who expelled the Moors from Spain, and Philip IV. (1621) are respectively commemorated by the Old and New Moles, which were built in their reigns.† They are now merged in the North and South Moles of the harbour, the Old Mole being defined by the remains of its English battery (to which the Spaniards gave the name of "The Devil's Tongue" because it proved such a scourge to their ships) and by the Boarding Station which stands on what was the head of the Mole. In Spanish times the Mole was 30′ shorter than under the English who added that length to it.‡ The New Mole is marked by the ancient breakwater forming its foundation and the old parapet wall standing on it.

Another interesting relic of Philip III.'s reign has been recently presented to the Garrison Library in the shape of two "Patteraras" recovered in 1905 from the remains of a sunken ship which is believed to have been one of the Spanish fleet which was sunk on April 25th, 1607, by the Dutch in an action fought close to the New Mole. In one of the guns there was still a stone shot and a charge of powder. The Spanish fleet consisted of 10 great galleons and 11 lesser war vessels under the command of Admiral Juan Alvarez D'Avila in the *San Agustin*, with a Vice-Admiral in the *Nuestra Senora de la Vega*, and a Rear-Admiral in the *Madre de Dios*; the Dutch fleet was composed of 26 small ships under Admiral van Heemskerk in the *Aeolus*, with Vice-Admiral Laurenz Alteros in the *Morning Star*, and Rear-Admiral "Pretty" Lambert in the *Tiger*.

The Spanish fleet was lying in the bay under the guns of the Rock and the Dutch approached them from the south-west corner of the bay, making their attack at about 3.30 p.m. By the first broadside fired on each side, Admiral van Heemskerk and Admiral D'Avila were killed. The battle continued till sunset, when the Spanish fleet was entirely destroyed, some of the vessels being burnt, some sunk, and some run ashore, and some 3,000 of their seamen killed; the Dutch lost no ship and only 100 men.§

An interesting description, with many plans, of the fortifications in

* Father Jones.
† Don F. M. Montero, pp. 246 and 250.
‡ Plan in *An Impartial Account of the late Famous Siege of Gibraltar*: 1728.
§ *Gibraltar Chronicle*, December 19th, 1908.

Philip IV.'s reign is contained in a MS. of 1627 in the British Museum.

Of the reign of Charles II., son of Philip IV., and last Spanish king of the Hapsburg family, there remain two relics. One is a large tablet in the King's Chapel to the memory of Doña Maria Ana de Moya Arnedo, the wife of Don Francisco de Angelo y Castro, general of the artillery of the Kingdom of Cordova and Governor of the city of Gibraltar. She died on 27th October, 1684, and (if the tablet is in its original position) is buried in the Chapel. The tablet also records her bequests to the Convent and to that of Our Lady of Mercedes (or Misericordias).

The second relic of this reign is the fountain which now stands in Castle Road. It formerly stood in the north-west corner of the Grand Parade (now called Commercial Square), whence it was removed in 1872. It was re-erected in its present position in 1886. In its original position it was the terminus of the aqueduct which supplied the town with water from the "Red Sands" and also the shipping by means of a branch pipe to the "Ragged Staff" wharf. The line of the aqueduct may be traced by the four small towers on the east side of the road to Rosia; and it still supplies water to the lower parts of the Alameda although no longer serviceable for drinking water. James (p. 307) gives 1694 as the date of the fountain, and Ayala (p. 250) gives 1571 as that of the aqueduct.

A curious episode of this reign must be narrated before we pass to the closing scene of the Spanish dominion. In 1693 when Louis XIV. was facing the coalition of England, Germany, Holland, and Spain formed against him by William III., the allied British and Dutch fleets under Sir George Rooke were defeated off Lagos on the south coast of Portugal by Admiral Tourville. Rooke took refuge under the Spanish guns of Gibraltar. The French pursued him and bombarded the place on June 12th for nine days, driving the inhabitants on to the Heights and compelling the nuns of Santa Clara to seek shelter in the hermitage of Our Lady of Europa.* This war was terminated by the Peace of Ryswick in 1697. Three years later Charles II. of Spain died; Philip V., grandson of Louis XIV., claimed the throne in accordance with the will of Charles II. and with the support of his grandfather; and the war of the Spanish Succession broke out. England supported the Austrian claimant—the Archduke Charles—against Philip, the first of the Bourbon dynasty, which, notwithstanding various interruptions, still rules over Spain. Gibraltar itself is a lasting memorial of this reign for in it the Rock became the prize of England, to whom its possession was confirmed by the Treaty of Utrecht which closed the war in 1713.

* Don F. M. Montero, p. 252.

(To be continued).

MAJOR-GENERAL SIR WILLIAM REID, R.E., G.C.M.G., K.C.B., F.R.S.

(Continued).

By Col. Robt. H. Vetch, c.b., late R.E.

We have followed the course of the intrepid soldier of many fights and many wounds returning home in his young days only to be slighted and ignored, and we have seen him, in his maturity, once more return from a campaign in Spain, where he had held high command, and had been again severely wounded. There he had been decorated by the Queen he had served. Here he was received with chilling neglect. He was indeed restored to full pay and his place in the Corps, as had been promised, but he was left unemployed.

In the months that followed his return from Spain in 1836, Reid perfected the work which had occupied his leisure time for so long. The publication of his book on the Laws of Storms proved a turning point in his career. The neglected soldier was warmly welcomed and highly honoured by the scientific world. He had now appealed to judges of large issues. The echoes of the applause of savants penetrated even to Government offices. He was recommended for reward. The man, who had been refused the military C.B. for his most distinguished services in war against the enemies of his country, was made a Companion of the Order of the Bath, in the Civil Division, for his services in the cause of humanity in general, and of seamen in particular, in fighting against the all-powerful elements of wind and water. Appropriately enough he was also planted down in the middle of the Atlantic Ocean and enthroned as Governor of the islands of hurricane notoriety, discovered by Juan Bermudas nearly four centuries ago.

The new Governor of the Bermudas left England in February, 1839, to take up his appointment. Accustomed, as we are in the present day, to hear of a Colonial Governor leaving for his seat of Government in a first-class liner, provided with ample accommodation and every luxury for himself, his family, and his staff, it is curious to compare the want of ceremony and the sort of vessel that was considered good enough for a Colonial Governor 70 years ago.

Colonel Reid embarked at Portsmouth with his family, which now consisted of six daughters, the youngest, Grace, having been born at Portsmouth on the 11th June in the preceding year. The voyage was made in a sailing ship, carrying a cargo of bricks, and named the *Barlow*. The captain was not so temperate as he should have been. He took two hours to get out to Spithead. There was no chronometer

on board, except Colonel Reid's watch. When they had been out for over six weeks, Reid came to the conclusion that they had passed the Bermuda Islands. He with difficulty persuaded the captain to put back. When he had done so it took them a fortnight more before they at length made Bermuda after a voyage of over two months. It is not surprising to learn that the ship was lost on her next voyage.

The Bermuda Islands are not, indeed, easy to find by an unskilled navigator. About 20 square miles of surface comprise a few large and innumerable small islands; the whole are surrounded by coral reefs, the deep sea outside varying in distance from the land from ½ mile, on the south, to 9 miles on the north; the land is generally low, and reaches its highest point at about 360′ and that only at one spot; it is difficult to see from any distance, and it is yet more difficult to get into harbour by the few available and intricate channels. It is said that when it has not been possible to see the islands from a vessel approaching them on the leeward side, their proximity has been made known by the fragrance of the odoriferous cedar trees with which they are covered.

Arriving in Bermuda in April, 1839, Reid remained there, with the exception of two occasions on which he took a few months' leave of absence, for nearly eight years, and left a name among its people which will never be forgotten. Here he found a new and open field for the exercise of his unbounded energies, while, as Governor, he was in a position to exercise those energies to the greatest advantage.

The coloured population, so lately freed from slavery, was without incentive to work and without the very rudiments of education. Reid established parochial schools throughout the colony and procured annual votes from the legislature for their support. Agriculture had been neglected. The chief implement used for tilling the soil was the hoe. Little was grown beyond arrowroot and onions, and the export trade in these was limited to the West Indies. Reid realized that, with its climatic conditions, Bermuda might be made a market garden for early potatoes and other vegetables for the United States. He set to work to train the people in an improved system of cultivation. He purchased the discharge of some soldiers of the garrison who were gardeners by trade, and employed them as instructors. He imported suitable agricultural implements, and introduced the best varieties of seeds. By holding shows of produce, and competitions in ploughing, mowing and sowing, he established a wholesome rivalry for the prizes which he presented, and stimulated the people to adopt an industry which is now their main support. He also started a public library.

After Colonel Reid had administered the Government for some years he recognized that, in the interest of traders, it was most desirable that larger vessels should be able to enter the harbours, and

that, to enable them to do so, the channels between the sea and the harbours through the reefs must be deepened and widened. He, therefore, proposed to accomplish this improvement by blowing up the coral rock at the sides and bottoms of these channels. In 1844, after carrying on a correspondence for some months, he was successful in obtaining the services of Corpl. Harris of the Royal Sappers and Miners. This non-commissioned officer was an expert diver of whom Reid knew, and had shown his capabilities when the Royal Mail steamer *Tay* arrived at Bermuda, having sustained some damage by running ashore on the Cuban coast. Corpl. Harris was employed to examine her. Supplied with a diving helmet and suit from the dockyard, he went down and found part of her cutwater and keel, and some 12′ of planking on her starboard side carried away. Forty-one times he dived in repairing the injury, and in three days so effectually finished his work that the vessel was enabled to return safely to England with the mails.

By orders from home, Corpl. Harris was attached, late in the year, to the department of the Naval Inspector of Works at Bermuda, for the purpose of removing by submarine mining the coral rock from the entrances of harbours. Working under Colonel Barry, the Commanding Royal Engineer, who had the superintendence of the work for the greater part of the time, he began with the ship channel leading into the harbour of St. George. Attention was confined at first to this channel, and the work was slow and laborious.

In the course of over three years all impediments to the navigation of this channel, to vessels drawing 20′ of water, were removed by the explosion of innumerable charges of gunpowder fired by voltaic electricity. By the time this work was finished Colonel Reid had left Bermuda for the West Indies. He was gratified to learn of the success of his proposal, when an account was forwarded to him at Barbados of a practical test of the improved condition of the channel; this had been made by H.M.S. *Growler*, of 1,200 tons, Capt. Hall, R.N., on the 26th February, 1848. The *Growler* steamed into the harbour against wind and tide, drawing slightly over 15′ of water. She effected the passage of this tortuous channel with ease and steadiness, having beneath her keel, when passing the worst part of the channel, at least 5′ of water.

Reid had been promoted to the rank of Regimental Lieutenant-Colonel on the 23rd November, 1841. In 1842 he took his family home for a few months during the hot weather returning to Bermuda in October. On the 11th May in the following year, his daughter, Sophia Lonsdale Reid, was married from Government House, Bermuda, to Lieut. (afterwards Colonel) G. W. Hallewell of the 20th Regiment of Foot. In 1845 Colonel Reid again went on leave of absence, and this time he took his family for a tour in the United States, Canada, and Nova Scotia.

In the following year Reid was offered the more important Government of the Windward Islands of the West Indies. He had to consider that if he accepted this offer he would have to be seconded in the Corps and, after a further prolonged absence from military duty, might not be able to return to it. But he had got into a groove that suited him, and into a larger field of service than he could find in regimental duty in times of peace and retrenchment; so he made up his mind to accept the offer and to take up the Government of the Windward Islands at the end of the year, when it would become vacant.

That the labours of Colonel Reid in Bermuda during his Government of eight years were neither unknown, nor unappreciated, may be gathered from an article, ascribed to the pen of the late Charles Dickens, that appeared on 31st August, 1850, in No. 23 of *Household Words*, of which he was editor. This article is entitled "The Good Governor," and the following extracts will give the reader some idea of the condition of the people of Bermuda when Reid arrived there in February, 1839, and what he did to improve it.

"In a region where favourable latitude and tempering sea breezes combine to produce perpetual summer, lie 'the still vexed Bermoothes,' the Bermuda of modern navigators, where one half of the year is the fitting seedtime for plants of the tropical, and the other half of the temperate zones. These islands discovered to us by a shipwreck, with one exception, our oldest colony, offer a miniature copy of the institutions of the parent state. . . .

"Formerly Bermuda, like Virginia, from which it was an offshoot, was a slave colony, and grew tobacco. But tobacco would not pay, and every Bermudian, being born within a mile of the water, was bred amphibious. Capital cedar for shipbuilding grows on the hills, and harbours are all around to receive the craft when built. So it came to pass that the 'Mudian clippers became plentiful all over the neighbouring seas, and took a large share of the carrying trade between our American Colonies and the West Indies. . . .

"There whales abounded in the neighbouring seas, and every 'Mudian took to handling the oar, the lance, or the harpoon, at a time of life when other children were driving hoops, or riding rocking-horses.

"It was the natural result of these handy occupations in so limited a space, that the whole population, with the exception of that supported by the expenditure of the garrison, was occupied in building, or rigging, or manning, or loading, vessels of some kind, if not whaling or fishing. White or black, they were all sailors and seafaring to a man, almost to a woman. The real mermaid still lingers round Bermuda's coast. Breechless babies swaggered along with a mixture of long and short steps in true jack-tar style. Bermudian young ladies directed their maids to let out a reef in a petticoat, and officers driving tandem were bid 'put yer helm down' by native guides.

"There are no records to show when first in Bermuda seafaring arts

began to devour all others; certain it is that just as the manufacture of glass and porcelain, purple dye, and other signal utilities and ornaments have been more than once discovered, lost, and rediscovered, so were agriculture and horticulture, in the year 1839 of the islands of perpetual spring, amongst the lost arts. . . .

"There were in that year two persons in the islands who could plough, but they did not. Haymaking and mowing was a theory learned in books, just as curious enquirers in Lancashire may have read of cotton cultivation. As for the state of gardening, it was about parallel with British gardening in the time of Queen Bess, who used to send to Holland for a salad.

"So there was neither corn nor hay, and very little fruit, of the worst quality. A sort of bitter orange tree abounded through the islands. Inquisitive strangers asked 'Why not graft, or bud, sweet oranges on these luxurious stocks, or why not sow sweet seeds?' But the natives were positive that the buds would not take, and seeds would not grow.

"Such was Bermuda in 1839; somewhat depressed in its fishing, whaling, shipbuilding, sea-carrying commerce, by the competition of New Brunswick, and the United States. Although less affected than the sugar-growing island by negro emancipation, still whites, who had lived easily, although barely, by hiring out a few black artisans, were reduced to sore straits.

"It was in this year there arrived a new Governor. He travelled the length and breadth of his islands, and found all green and all barren; a light but fertile soil, bearing fine timber, and luxuriant weeds. Round the Government House was a waste of eight acres, within sight a great swamp. . . .

"According to stereotyped precedent our Bermoothean Governor ought to have first sat down and written a flaming despatch home, painting the misery of the island, detailing his plans and asking for money. . . .

"But it happened that our 'Good' Governor, as he was afterwards called with good reason, was not a stereotyped Governor, so that the people he was sent to rule became happy and prosperous. He cared not to become either rich or famous. Therefore all his proceedings were on a humble, common-place scale. Seeing that the climate was admirably adapted for oranges; which, if of good quality, would afford a valuable export, he sent for slips and seeds of the best kinds.

"In front of Government House stands a bitter citron-tree; on this, with his own hands, he budded a sweet orange. The bud, contrary to Bermudian opinions, sprouted and grew, and flourished. After the living example of the Governor's tree, it became a fashion—a rage—to bud sweet oranges; so by this simple and short cut a horticultural revolution was effected. Still working out the maxim that example is better than precept, our Good Governor beat up for gardener recruits, accepting those who knew, as well as those who knew nothing but were willing to learn. With their aid, and at his own expense, the eight acres of waste round his residence, Mount Langton, were converted into a pleasure ground adorned with plants and shrubs of the tropical and

temperate zones, which he threw open freely to the inhabitants without distinction of colour.

"The next step was to drain the great marsh, the Langton Marsh, and grow hay upon it, so as to give the Bermudians a hint on the oddness of importing hay, while fine grass land lay waste. Two men who could plough were discovered, and pupils put under their hands; at the same time ploughs were imported. Having, out of his own pocket, offered prizes for garden flowers and vegetables, for corn and hay, for the best ploughman, and the best scytheman, the performances of these two being as wonderful to these islanders as skating to an Indian Prince, or wine-making to a Yorkshireman, the Local Parliament willingly voted other prizes for the same purpose.

"It would take up too much time to detail all the Good Governor's efforts—by example, by instruction, by rewards, by distribution of books, and by the promotion of industrial schools to educate the rising generation of Bermuda in useful civilizing arts.

"A grand holiday held in May, 1846, showed that these efforts had not been without pleasant and practical results.

"Mount Langton and all the pleasure grounds created under the personal inspection and at the expense of the Good Governor, were crowded with a noisy happy population, of all ranks, all ages, and all colours, black, white, and brown, assembled to enjoy and celebrate the taking stock of the revived industry of the island. . . .

"The Queen's representative did not grudge to give up for the occasion his private domain, as that was the best site in the island. Amid the luxuriant shrubs and gorgeous tropical flowers, the gay groups wandered; sweetly the sounds of the regimental band intermingled with the shouts and whip crackings of the contending ploughmen, as they turned up the brown furrows of long-neglected soil, and with the switching of twenty-five scythemen, exhibiting their newly-acquired skill on the drained pasture of Langton Marsh. Below lay the shipping in harbour, and far beyond the golden, purple ocean was dotted over with the cloud-like canvas of the famous 'Mudian craft. Almost at once—one glance—it was possible to take in a view of the pursuits of old and young Bermuda. . . .

"In due time, after the ploughing and mowing matches, came the competition in turnips, strawberries, potatoes, dahlias, barley, pot herbs, flax and cabbages, and the parading and comparison of horse-colts, ass-colts, calves, heifers, bulls, sows, and boars.

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"Years have elapsed since the day of this well-remembered *fête*. But the Good Governor is still affectionately remembered. The Bermudians love to show passing strangers the sweet orange tree on Mount Langton, which still blooms a green and golden monument of plain, practical, and kind-hearted common sense. . . . If we would do good we must not be content with mere talk; we must not disdain to commence at our own doors by budding—a sweet orange on a bitter citron."

In December, 1846, amidst the affectionate congratulations of the

whole population on his promotion and of the deepest regret at his departure, Colonel Reid and his family left Bermuda for Barbados, the seat of his new Government. Besides Barbados the islands of St. Lucia, St. Vincent, Grenada and Tobago were embraced within the Government of the Windward Islands.

In the West Indies, as in Bermuda, Reid devoted himself to the amelioration of the condition of the coloured race, but he did so in no spirit of sentimentalism. He realized that the black man had been but recently delivered from slavery, and that it was the bounden duty of the Government to do all that was possible to promote the welfare, mental, spiritual and material, of this formerly downtrodden race. The development of the resources of the islands he felt to be of great importance for the benefit of all—white or black, and he especially endeavoured to forward the cause of education and to promote temperance. By his firm and beneficent conduct of affairs he gained the confidence and goodwill of all classes of the communities which he governed. Whatever he took up he gave his mind to it, and was enthusiastically interested in it, although his emotions were strictly controlled; this enthusiasm he communicated to others. Among the distinguished visitors who, on coming to Barbados on business or pleasure, were, as a matter of course, invited to stay at Government House, was a young man who had distinguished himself in chemistry. George Fownes had taken a degree of Phil. Dr. at Giessen and, at the early age of 27, had been appointed Professor to the Pharmaceutical Society and, soon after, Professor at University College. He was Secretary to the Chemical Society and a few years before his visit to the West Indies had published a textbook of chemistry. Now the Governor had just started a school of practical chemistry at Barbados, and his mind was full of this school and the good he hoped it would do in the promotion of the higher branches of agriculture. His difficulty at that time was to get the sort of textbook of chemistry he wanted. He poured out his hopes and fears to the young professor, who had himself taken the Actonian prize for an "Essay on Chemistry" and gained the Agricultural Society's prize for his "Food of Plants." Here was just the man Reid wanted. Whom better could he apply to for advice? His enthusiasm fired the professor, and the end of it was that Dr. G. Fownes undertook to draw up a treatise on rudimentary chemistry for the use of this school.

Having drawn up the treatise Dr. Fownes presented the MS. to Colonel Reid. It was printed for the use of the Barbadian School of Practical Chemistry. It so happened that Reid, who was a great educationalist, had many years before discussed with Mr. Weale, the London publisher, the great advantage to the public of a series of cheap, popular treatises on scientific and technical subjects, but nothing had come of it. Reid now sent him Dr. Fownes's treatise on

rudimentary chemistry as a sample of the kind of book he wanted Mr. Weale to publish. It proved to be the parent of an extensive and very valuable series of rudimentary treatises on all manner of scientific and technical subjects, published by Mr. John Weale of Holborn in red covers under the name of *Weale's Rudimentary Treatises*. With characteristic modesty, when the first edition of the *Rudimentary Treatise on Chemistry* by Dr. Fownes,* was out of print, Reid insisted that the notice of the origin of the series, which will be found in that edition, should be suppressed in any further editions.

Reid's career as Governor of the Windward Islands was cut short after less than two years' administration under the following circumstances. He was directed by the Secretary for the Colonies to proceed from Barbados to St. Lucia to enquire into certain charges against the Chief Justice there, connected with the publication in a local journal of two ribald letters. The Governor executed the duties assigned to him, first, by a patient investigation, and then by exercising the power, with which the Secretary of State had entrusted him, of suspending the judge from his office if he found that he was the author of these letters. The proceedings of the Governor were approved. But after a short lapse of time this approval was practically reversed by the reinstatement of the Chief Justice through some latent influence at home. Reid felt that the dignity of his office was compromised, and he was not the man to allow himself to be thus treated. He had too much self-respect. This reinstatement of the offender by the Colonial Office he considered practically cancelled the approval he had received from that office of his proceedings in the case. He regarded it in the light of a reflection, not on Colonel Reid, but on the Governor. He at once sent in his resignation to the Queen. Colonel Torrens, who had originally brought the charges against the Chief Justice of St. Lucia, now demanded that they should be tried formally by some competent tribunal and declared to be either true or false. The Secretary of State was in a dilemma and hesitated what to do. He requested the Governor to reconsider his decision to resign. Colonel Reid firmly refused and insisted on being relieved. He left Barbados in the beginning of September, 1848, and arrived at home in the following month.

During Reid's stay in Barbados as Governor, another daughter was married from Government House. His second surviving daughter, Maria, was married on the 17th June, 1847, to Lieut. Edward George Hore, R.N., afterwards Captain and Naval Attaché to the Embassy in Paris.

Much regret was felt by the people in the Windward Islands at

* Dr. George Fownes died in 1849 at the early age of 34 years, see *Dictionary of National Biography*.

the premature departure of the Governor. He had come to them with a great reputation from Bermuda and had stayed sufficiently long for them to know and appreciate him. Flattering addresses from the Legislative Councils and Assemblies of the islands composing his Government, and from various other bodies were presented to him. On the 14th October, 1848, Lord Grey sent a despatch from Downing Street to Reid's successor in the Government of the Windward Islands in reference to these addresses, and wrote in high terms of appreciation of Reid's services.

It does not appear that any similar appreciation of Colonel Reid's services under the Colonial Office was sent to the Board of Ordnance, as was usually done when an officer of one of the Ordnance Corps had successfully served in another branch of the Public Service. It so happened, however, that a newspaper, containing a copy of the despatch, referred to above, from the Secretary of State to the new Governor of Barbados, came into the hands of Sir John Burgoyne. He sent it to the Master-General of the Ordnance with the following minute :—

"In justice to Lieut.-Colonel Reid I beg to forward this for the perusal of the Master-General.

"J.F.B.

"*25th January*, 1849."

A memorandum referring to this despatch and giving the above minute of the Inspector-General of Fortifications, is attached to Sir William Reid's Record of Service, but the newspaper cutting containing the despatch of the Secretary of State for the Colonies is not there.

On arriving home from the West Indies, Reid took his family to Cheltenham, and while staying there, his daughter, Elizabeth Oakley Reid, was married, on the 16th January, 1849, to the Rev. Charles Gore Gambier (1824—1891), son of Admiral Robert Fitzgerald Gambier (1791—1872), and nephew of James, 1st Baron Gambier, Admiral of the Fleet (1765—1817). From Cheltenham Reid moved to Baker Street in London, and in August, 1849, he was appointed to Woolwich as Commanding Royal Engineer.

It was on the 14th June in this year that H.R.H. Prince Albert, distributing the prizes at the Society of Arts, alluded to the proposed National British Exhibition to be held in 1851; and immediately afterwards a series of events happened which led to the enlargement of this National Exhibition of Manufactures into an Exhibition of the Works of Industry of all Nations. The idea once started received a great deal of encouragement from the Prince, and in October, 1849, the Lord Mayor of London presided at a meeting at the Mansion House, at which it was resolved that it was desirable a Royal Commission should be appointed to invest the undertaking with a National sanction, and to give the world the utmost confidence that

the prizes would be awarded impartially. The Government of the day consented.

On the 3rd January, 1850, a Royal Commission was appointed to carry out an Exhibition of the Works of Industry of all Nations, to be held in London in the following year. H.R.H. the Prince Consort was its President, and the Commission was composed of all classes of society: Peers, Privy Councillors, and representatives of Science, Art, and Manufactures. A small Executive Committee of which Mr. Robert Stephenson was Chairman had been at work for some time by the appointment of the Council of the Society of Arts. The members of this Committee, although confirmed by the Royal Commission, tendered their resignations, in consideration of the changed position of affairs. Mr. Robert Stephenson was appointed to a seat on the Royal Commission, and, on the recommendation of Mr. Labouchere (afterwards Lord Taunton), then President of the Board of Trade, Lieut.-Colonel Reid, Commanding Royal Engineer at Woolwich, was appointed Chairman of the Executive Committee in succession to Mr. R. Stephenson, by Royal Warrant dated 12th February, 1850. The other members of the Committee were Mr. Henry Cole, Mr. Charles Wentworth Dilke, Mr. F. Fuller, Mr G. Drew, and Mr. M. Digby Wyatt (Secretary). Messrs. Fuller and Drew were able to devote very little of their time to the service of the Committee and the principal part of the duties fell therefore on Colonel Reid, Mr. Cole, and Mr. Dilke. The duty of this Committee was "practically to carry into effect all the decisions of Her Majesty's Commissioners, and to exercise that continued watchfulness in every department, which was requisite in so vast an undertaking, and which could only be secured by the agency of persons constantly engaged in its management, and possessing authority to dispose of such questions of detail as could not be conveniently delayed for the consideration of the Commissioners."* Colonel Reid, as Chairman, was requested to attend all the meetings of the Royal Commission which he did. Sir Henry Cole, in his *Fifty Years of Public Service*, has a great deal to say about the Chairman of the Executive Committee. As to Reid's appointment he says:—

"Writing now, thirty years and more after the event, I wish to record that this was a prudent and successful appointment, and that no better could have been made for the particular duty, which was chiefly to keep in order the various influences which had helped to produce the Exhibition. . . ."

In another place he writes:—

"He was a brave soldier, and had much more than a mere soldier's sense of implicit duty. He was a man of great caution, and yet

* Extract from First Report of the Commissioners for the Exhibition of 1851.

determined self-will, especially when conscience acted on him. He was a man of science; he was a philanthropist with beneficent tendencies; he had instituted most useful works and exhibitions of industry in the West Indies; he fully believed in the superior abilities of his Corps, the Royal Engineers, and by introducing them to the work of the Exhibition did excellent service to it. He was very simple-minded, gentle, and with feelings of high honour, perhaps, a little bordering on severity at times. His principal work in the Exhibition was pouring oil on troubled water. Someone who knew him, wrote in a colonial newspaper:—

"'It was curious to see the enraged and frantic exhibitor (the foreigner particularly), swearing at the injustice and favouritism which had consigned his article to some obscure corner, or some bad light, or some other fancied disadvantage, pass into the presence of the Chairman of the Executive Committee, and presently emerge all cheerfulness and contentment. It almost seemed as if he had passed through some talismanic process to have undergone the change, but such was the wonderful tact and temper of the Chairman, that nobody ever left him otherwise than pleased and convinced that justice had been done to him.'

"I recollect his marble attitude towards an indignant maker of agricultural implements, a stalwart Quaker, who fiercely threatened to write to *The Times*, but was reduced to the submission of a child."

As Sir Henry Cole justly observes, Reid fully believed in the abilities of his brother officers; and for the employment at the Great Exhibition of the Industry of All Nations of 1851 of so large a number of officers of the Royal Engineers and of non-commissioned officers and men of the Royal Sappers & Miners, these Corps were entirely indebted to Colonel Reid. Receiving the cordial concurrence of his civil colleagues on the Executive Committee, he represented to Prince Albert and the Royal Commissioners the advantages of military co-operation in carrying out the subordinate details of the work. The Commission approved, and in September, 1850, Colonel Reid obtained the permission of the Board of Ordnance to the employment of a small detachment of Royal Sappers & Miners under Capt. H. Cunliffe Owen, R.E., to assist the Executive Committee. They were found so useful that in the course of the next two months two complete companies were added, the 5th and 22nd Royal Sappers & Miners, under the command respectively of Capt. Owen, who was appointed General Superintendent, and of Capt. Gibb, R.E., who was placed in charge of the Workmen Organization and of the Fire Department. Further a separate detachment, composed of details from other companies, under command of Lieut. G. M. Stopford, R.E., was added later, and Lieut. Stopford was appointed adjutant to the force of Royal Sappers & Miners employed.

Other officers were added to assist the Executive Committee in its multifarious duties, which were steadily becoming more and more

arduous, until some 17 officers and 200 non-commissioned officers and men were employed. The names of the officers, besides those already mentioned are :—

Capt. S. Westmacott, Superintendent of the Military and Naval Class.
Capt. J. B. Collinson, Superintendent of the British Side.
Lieut. E. W. Ward, Secretary of the Jury Department.
Lieut. C. Pasley, Assistant to General Superintendent.
Lieut. H. W. Tyler, Persian, Chinese, and Colonial Department.
Lieut. G. E. L. Walker, Civil Engineering and Architecture.
Lieut. G. H. Gordon, Correspondence.
2nd Lieut. E. F. Du Cane, Machinery.
2nd Lieut. W. Crossman, Allotment of Space.

Ensign Craster
Ensign Soady
Ensign Brownlow
Ensign Trevor
} Of the Hon. E.I. Company's Engineers with some N.C.O.'s and sappers and miners of the same service.

Among the many varied duties upon which the Sappers were employed was the drawing of plans on a large scale of the ground floor and galleries, showing the exhibits and all particulars necessary to find the way from one part of the Exhibition to another. These were displayed at the points where they would be of most convenience to visitors. Referring to the Sappers who made these detailed and general plans, *The Times* of the 2nd July, 1851, says :—

"The training which, under Sir Charles Pasley's system, they undergo, admirably prepares them for this description of work, and they have brought to it the practical experience acquired during the Irish, Scotch, and English surveys, which, it will be recollected they were employed upon in compliance with a most valuable suggestion to that effect made by Colonel Reid. The plan to which we allude is a highly creditable specimen of the skill to which the Sappers have attained in the art of surveying."

Opposition was raised in *The Times* newspaper and in the House of Commons to the proposed site of the Exhibition building in Hyde Park. Prince Albert was much worried about it, and let it be known that if the site selected was not affirmed he was prepared to give up the Exhibition. Mr. Cole took the most active measures in support of the site selected. He canvassed for signatures to the petition that had been drawn up protesting against any change in the site ; he personally investigated the question of damage by depreciation in value of the houses overlooking the Park, of which a great deal had been said ; and he used all his energy and powers of persuasion to further the acceptance of the Park site.

It is not difficult to understand that this fussy, enthusiastic advocacy

of the Commission's choice by a member of the Executive Committee was very distasteful to the Chairman, and Cole naively, because unconsciously, lets his readers see that it was so in the following quotation from his (Cole's) diary :—

"*5th July*, 1850.—J. Bell, the sculptor, called to hear fate of division on the site. 162 for to 47 against. Palace Yard; Reid (who had the boldness of a lion with the timidity of a hare) said to me, 'Henceforth we must not be the focus of any agitation. Committees must not be asked by *us* to support the Commission about site or anything else. Mayors of Birmingham or Bradford must do it.'"

The trees both old and young on the site in the Park gave a good deal of trouble, as the Office of Woods and Forests would not allow them on any account to be felled. Cole says :—

"On the 22nd February, 1851, the young trees, worth, as Paxton says, about five shillings each, projected through the stairs. I requested Colonel Reid to see two stumps in the way, but, like Nelson, who would not see signals at the Battle of the Nile (Copenhagen?) he declined to see them, 'in case they should be removed.'"

Two days later these stumps were removed. As time wore on there was some anxiety as to whether the building would be ready by the 1st May, the day fixed for the opening by the Queen in person. Cole says :—

"On the 27th February it appeared obvious that the painting would not be completed by the 1st May. Colonel Reid with Mrs. Reid came, and I called the Colonel's attention to the slow progress of the painting. It was simply a question of numbers of painters and scaffolding. Mrs. Reid valiantly urged her husband to recommend that an extra £1,000 should be offered to Fox & Henderson for speed. I found out from Mr. Fox that he could and *would* hasten the work if paid £1,000 extra. Lord Granville and Mr. Cubitt agreed that he should be tempted by the bribe. Mr. Fox hastened the work, but, I am happy to record, flinched from taking the money, and afterwards told me that he could not take it. On the 20th March the painters were vigorously at work painting with plenty of scaffolding. Again I note, 7th April, 'Painting and removal of scaffolding very behindhand; wrote to Fox & Henderson and told Mr. Fox that the painters *must* be out by the 14th April, or the Sappers would enter, take away the scaffolding and turn men out.' 12th April 'Scaffolding not yet out,' but it was all down before the 30th April."

The Prince Consort was a frequent visitor to the Exhibition while it was building and sometimes the Queen accompanied him. On these occasions Colonel Reid was generally in attendance, or one of the other members of the Executive Committee.

The Great Exhibition was opened with pomp and State by the Queen in person on the 1st May, and remained open to the public until Saturday, 11th October, 1851. A few days after it was closed

Lord Canning reported the Juries' decisions. Lord Granville offered to Colonel Reid in acknowledgment of his services an honorarium of £3,000 which he declined. Lord Granville also told him that the Knight Commandership of the Order of the Bath was to be bestowed upon him by the Queen. Reid was gazetted a K.C.B. of the Civil Division on the 25th October, 1851, and two days later was appointed Governor of Malta.

"It has been said," writes Lefroy in the *Proceedings of the Royal Society*, "that Reid's singular simplicity of manner and total absence of pretension caused the distinguished men with whom he was associated on that occasion (the Great Exhibition of 1851), to wonder at first what had led to his selection for the office. They soon discovered under that simplicity, the patient but genuine enthusiasm, the varied experience, the calm and even temper, and the devotion to the duties of the moment, whatever they might be, which eminently fitted him for it.

"It is not too much to say that his judicious arrangements contributed materially to the success of that great undertaking, and they were fitly rewarded by the ribbon of the K.C.B. and his appointment to the important military command of Malta. It may be remarked that the Exhibition was on the eve of being closed when the same Minister (Earl Grey), who had to lay Colonel Reid's resignation before the Sovereign on the ground of his having been badly used, now submitted to his Royal Mistress that he should be entrusted with the Government of Malta."

On leaving the Exhibition to take up the Government of Malta the command of the Corps at the Exhibition devolved on Capt. H. C. Owen. Sir William Reid in bidding farewell to the men said:—"I have the most perfect confidence that you will continue to the end of this service to perform your duties with the same zeal which you have hitherto invariably shown, and with the same considerate and forbearing conduct towards all with whom you have been connected in this arduous undertaking."

The crowning testimony to the useful services of the officers of Royal Engineers and the non-commissioned officers and men of the Royal Sappers & Miners employed at the Great Exhibition, under Sir William Reid, was graciously given by H.R.H. Prince Albert, as President of the Royal Commission, in a letter to the Marquess of Anglesey, the Master-General of the Ordnance. In promulgating this letter, a copy of which follows, his lordship expressed his confidence that this high testimonial in approbation of the valuable services of those immediately concerned, would be received with feelings of pride and gratitude by the whole Corps of Ordnance.

"WINDSOR CASTLE, *29th October*, 1851.

"MY LORD,

"I have the honour, as President of the Royal Commission for the Exhibition of 1851, to convey to your lordship, both in my own name, and in that of the Commission, our thanks for the cordial aid you lent

us in allowing several officers of the Corps of Royal Engineers, and two companies of Royal Sappers & Miners to assist the Executive Committee in the arrangement and management of the Exhibition.

"Her Majesty's Commissioners consider it due to the officers of Royal Engineers, and to the non-commissioned officers and privates of the Royal Sappers & Miners, who have been thus employed, to express to your lordship, in strong terms, the sense they entertain of the admirable conduct of the whole body while engaged in this novel, delicate, and responsible duty.

"The officers of Engineers have, in the able assistance rendered by them, afforded another instance of the useful manner in which a military body may be employed in civil services during a time of peace.

"The Royal Commissioners, being desirous of marking their sense of the share which the different persons employed in connexion with the Exhibition have had in bringing it to a successful issue, have requested the various civilians so employed to accept a certain sum of money in recognition of their services. We have ascertained from Colonel Reid that such a course would not be agreeable to the feelings of the Engineer officers, who have similarly given their assistance, and to whom we could have wished to offer a similar token.

"With regard to the non-commissioned officers and privates it gives me much pleasure to state, that at the period of preliminary arrangements when the labour required was sometimes excessive, their exertions were always cheerfully made. During the course of the Exhibition, they practically demonstrated the great value of their schools of instruction by the many useful plans which they drew; and by carefully acting always in subordination to the civil police force, they established for themselves a character for good conduct and attention to the exhibitors and visitors, greatly to the credit of the Corps to which they belong.

"The Royal Commissioners have therefore thought fit to award a sum of £600 to be laid out either in drawing or mathematical instruments, or in other suitable lasting memorial of their connection with the Exhibition, for the non-commissioned officers and privates of the Royal Sappers & Miners, to be distributed by the officers in such manner as your lordship and the Inspector-General of Fortifications may approve; and we trust that you will give your sanction to the acceptance of these testimonials of their good conduct.

"I have, etc.,
"ALBERT,
"*President, Royal Commission.*

"FIELD MARSHAL THE MARQUESS
OF ANGLESEY,
"Master-General of the Ordnance."

While employed on the work of the Great Exhibition of 1851, Colonel Reid had resided at Kensington Gore, and it was about this time that Mrs. Reid pathetically made a list of the many places she had lived in since her marriage, and the frequent moves necessi-

tated by her husband's appointments. She says at the end of the list, "This exactly averages one general move a year for 31 years, because it makes 33 moves, of which two only were made when I had a home, and did not need to remove bag and baggage, *i.e.*, the journey to England in 1842, and the journey to the United States in 1845, each from and returning to Bermuda. A gentleman, I knew, left the Army because he had packed up his toothbrush 14 times in one year, and therefore this is not an average for H.M. Service in the Line, at all, either in number of moves, or difficulty."

Colonel Reid was gazetted to the Government of Malta on the 27th October, 1851, and the following month left England for the Mediterranean.

The Executive Committee of the Great Exhibition of 1851 was dissolved in April, 1852, when H.R.H. the Prince Consort wrote to inform Sir William Reid and to thank him in the name of the Commissioners for his services as Chairman of that Committee :—

"*From H.R.H. the Chairman of the Royal Commission for the Great Exhibition,*

"*To H.E. Colonel Sir William Reid, Governor and Commander-in-Chief, Malta.*

"BUCKINGHAM PALACE,

"*28th April*, 1852.

"SIR,

"I have the honour to acquaint you that Her Majesty's Commissioners for the Exhibition of 1851 adopted a minute at their meeting on the 24th inst., to the effect that as the executive labours of the Commission with respect to the carrying out of the Exhibition might be looked upon as terminated with the presentation of the report to Her Majesty, the present executive staff should be discontinued.

"In communicating to you the above resolution of the Commissioners, it affords me much satisfaction to be the medium of conveying to you the assurance of the high sense entertained by us of the eminently zealous and efficient services rendered by you in your capacity of Chairman of the Executive Committee, in whose labours you bore so large a share until the period of your departure from England as Governor of Malta.

"The Commissioners fully appreciate the zealous and unremitting exertions of the acting members of the Executive Committee to which the success of the Exhibition is mainly owing, and they feel that they are much indebted for the harmony and good feeling that has prevailed in the execution of the duties assigned to the different officers of the Commission, to the conciliatory yet firm manner in which you at all times exercised the authority entrusted to you as Chairman of that Committee.

"Very faithfully yours,

"ALBERT."

MEMOIRS

MAJOR-GENERAL EDWARD RENOUARD JAMES, ROYAL ENGINEERS.

(Continued).

By Col. Robt. H. Vetch, c.b., late R.E.

We have seen that, after his release from captivity, James travelled to Malta from Constantinople in the s.s. *Emperor* with several brother officers of the Corps, among whom was Major Stanton who was on his way home. This officer had been promoted Brevet Lieut.-Colonel, and during the peace negotiations had been appointed the British Commissioner for the delimitation of the new boundary between Russia and Moldavia, consequent on the cession by Russia to the new State of Roumania of a portion of Bessarabia. Lieut.-Colonel Stanton having returned to the Crimea, James applied to him for the post of assistant to the Commissioner, of which there were to be two. That he had travelled in Russia and had learnt to speak French was in his favour; and what was, perhaps, more important still, he was an adept at topography and had shown how good a draughtsman he was in the plans he had prepared of the Sebastopol siege operations. His 1″ to a mile coloured plan of the whole operations and of the country west of the Tchernaia River to the sea is a very pretty bit of work. He and his friend Charlie Gordon were appointed Colonel Stanton's two assistants and sailed for Constantinople with him in the transport *Kangaroo* on the 16th May.

Of Colonel Stanton James says:

"No more fitting selection could have been made to represent England, as he possessed great ability and sound sense, and, in addition to these very necessary qualifications, was gifted with a handsome face and figure, and an especially prepossessing manner."

Of Gordon he writes:

"Only six months my junior in the Army we had been intimate friends at Woolwich and ever since. With his absolute sincerity and bright winning way, no one who knew him as well as I did could help loving him.

He had already gained a reputation in our Corps for his extraordinary energy; at the Siege of Sebastopol, where he was employed at the Left Attack, there was not a day on which he did not go to the trenches—as an amateur, if he could not do so in the course of his duty. As a young man his constitution was of iron, and although he had exposed himself recklessly from first to last, his health had not suffered in the smallest degree. His ability as a student at the Academy had not been remarkable, although he succeeded in gaining his commission in the Royal Engineers, an object on which he had set his mind to please his father, General Gordon of the Royal Artillery, rather than to store his memory with knowledge, in his opinion of doubtful use in his future career. And we, who knew Charlie so well, soon learnt to recognize in his character, in the firmness of purpose he displayed in conquering this first obstacle, an earnest of his indomitable will in all he undertook; and we felt certain that he only needed opportunities to gain a brilliant reputation. But we could not help seeing that there was no little danger that he might mar his fortune by the obstinacy of his strong will."

The British Commissioner only remained in Constantinople to receive his instructions from the English Ambassador, the famous Eltchi, Sir Stratford de Redcliffe. Meanwhile James and Gordon occupied themselves in getting the necessary equipment for the work before them. The English section of the Commission went by water to the Sulina mouth of the Danube, and up that branch to Galatz, where they stayed to provide themselves with travelling carriages (britschkas) and a "fura," or wagon, to carry camp equipage, luggage, etc. For the four sappers, the interpreter, the Greek cook, servants and grooms who accompanied them, local vehicles were requisitioned as required. The Commission was to meet at Bolgrad, the centre of the new frontier line, about 50 miles from Galatz and the British party arrived there on the 8th June.

James describes the Commissioners and their assistants. There was General Fanton de Verrayon, the Russian, who was assisted by Colonel Stackelberg. The General was a handsome man with a pleasant word and a courteous smile, always in uniform, and a pattern of neatness. He was a trained diplomatist. His assistant was a blunt and taciturn soldier of rather brusque manners. The Turkish representative, Dervisch Pacha, was a clever man with a fine military record, a poor diplomatist, indolent and apathetic, and quite satisfied to allow the other Commissioners to settle matters. Prince Stourdza of Roumania represented that new State. He was a fine handsome man with the most genial manner and, being fond of sport, was liked personally by the Englishmen, but he was a mere tool in the hands of the Russian.

The Austrian Commissioner was Colonel Count Kalik, and his senior assistant, Capt. Count Wimpfen. Both were men for whom

the English Commission entertained the highest respect, and with whom their intercourse was of the pleasantest kind. Men of breadth of view, which comes from culture and education, open and straightforward, they were also manly, and good sportsmen. Count Kalik was a fine soldier who fell in the Slesvig-Holstein War of 1864. Count Wimpfen was a nobleman of a very good family and was gifted with the highest abilities, a charming companion and an admirer of the English, with whose language and literature he was thoroughly acquainted.

Finally there was Colonel Besson, the French Commissioner, a splendid old soldier, who had risen from the ranks and nothing more. He invariably sided with the English. He had no assistant and, with great tact, Stanton invited him to become a member of the English Mess during the Commission. As he did not speak English this close companionship made it incumbent on James and his brother officers to speak French continually, much to their benefit, as the work of the Commission was carried on in French. Colonel Besson was vivacious and genial with all the bonhomie of a Frenchman, and was never out of temper. James says: "He afterwards served in the campaign of North Italy, in 1859, as Chief of the Staff of a French Corps, and commanded a brigade during the Franco-German War of 1870. Taken prisoner at Sedan he was interned in Germany until the end of the war, and at that time Gordon and I used to send him copies of the *Times* newspaper, in which he declared he could find better reports of the progress of the war than in any of the French papers." He lost his life at Paris in the operations against the Communists. His soldier servant was invaluable to the English Mess as their caterer and Mess waiter, and with their Greek cook, Francesco, who could "make raised pies worthy of the luncheon table of the Rag," the English Commission fared very well.

The Commission was given excellent quarters in the houses of the peasantry in all the villages where it halted and rarely was under the necessity of using tents to sleep in, though the marquee was used for sitting in during the day, and for the Mess.

Among the Russian subordinates of the Commission there were several young officers with whom James and Gordon daily came into contact in the course of the surveying operations on the frontier. Two of these, Lieuts. Ogranovitch and Effimovsky, they became intimate with, and saw more of them later. Another very young Russian officer was attached to the British Commissioner personally, and was in command of the small detachment of Cossacks which acted as his escort. He was a bright, lively boy, most willing to help, and proved of great assistance as an interpreter.

I do not propose to enter at any length into the work of the Commissioners. They travelled along the entire line of the new frontier

and discussed on the spot questions that arose, using a large scale Russian general map to be corrected later, if necessary, by the topographical officers in making the detailed survey. James made an excursion to the ancient fortress of Ismail on the shore of the Kilia Channel, stayed there two days, and made notes and sketches of the place. These were forwarded by Colonel Stanton to the Foreign Office, where they were deemed worthy of being laid before the Queen, and James was much gratified when Her Majesty's gracious approval of them was conveyed to him.

The Commissioners retraced their steps along the line of frontier to carry out the field-work. They then went to Kischenief in October, having completed the surveying operations in about two months' time. At Kischenief, the capital of Bessarabia, during the winter the plans and records were prepared. The Russian map that had been provided proved very accurate, and the insertion on it of the new boundary was an easy matter.

In carrying out the survey the topographical officers established pyramids at intervals to mark the line, and kept a *cahier de specification* to record the details. As each angle and bearing was recorded by the various topographical officers it became the subject of discussion. The English officers worked at first with a theodolite; the Russians used the plane table, and the Turks had an antique brass affair they called a *boussole*—a sort of rude azimuth table quite a century old, which they did not know how to use, and their work had to be ignored. The Russian officers were not instructed in the use of the theodolite, so the British officers put it aside after the first few days, and also used the plane table. While they marched up the Yalpoukh Valley plenty of time was found for shooting wild fowl.

During the winter at Kischenief the time of James and Gordon was very fully occupied. The plans to be drawn were about 35 in number, large and small, and they had to make three sets, one for the Foreign Office, one for the War Office and the third, through Colonel Stanton's amiability to Colonel Besson, who had no assistance from his Government, was for the French Foreign Office.

When most of the work of the Commission was finished and time could be spared, Prince Stourdza organized a grand *chasse au loup* 25 miles from Kischenief.

"We slept," says James, "at a village in the forest in the hilly district dividing the basins of the Dnieper and the Pruth, and reached the scene of the battue soon after daylight on a December morning, the snow on the ground being hard and crisp, and the trees covered with rime. All the inhabitants of the neighbouring villages acted as beaters, but 60 of them, who possessed single-barrelled flintlock guns, were allowed to join the shooters. The guns were extended along the margin of the forest, between 80 and 90 altogether.

"Most of the contingent from the Commission had double-barrelled pieces of the best construction, but in those days they were muzzle-loaders with nipples for percussion caps, the loading of these arms being rather a slow process, so that we had to nurse our charges. At first we were advised to load our right barrel with small shot and the left with slugs, in order to be prepared for whatever game might come. We were not allowed to speak loudly, and stood perfectly still under the trees for what seemed a long time, until at last the cries of the beaters and the distant cracking of boughs denoted that we might soon expect something to fire at. Some roe-deer appeared first, and eight soon fell. The hares came by hundreds, but we let most of them pass, as we did not wish to miss the chance of a wolf. . . . I am sorry that I did not get the chance of one, but Stanton was successful in killing two. Game of all sorts passed in rapid succession and for half an hour our excitement was immense. Then the beaters came up and all was over. We counted the bag and found it to be 5 wolves, 8 chevreuil, 9 foxes, 80 hares and a variety of birds. It was a very remarkable fact that the head of game which fell to the three British guns, exceeded that killed by the whole of the remaining guns. This is explained by our having quicker loading appliances, and also because we fired at whatever we saw on the move. The peasants with their single barrels, and in the desire not to waste their very precious cartridges, only aimed at fixed objects, and took a long time to reload. Their plan of killing a hare was peculiar, if not sportsmanlike; when running along a sudden 'whist' will cause the hare to stop and cock its ears to find out where the sound comes from, and while it is in this position the peasant makes a very careful pot shot. While they executed this feat, we often 'wiped their eye,' as the saying is, knocking the hare over as it ran, which was considered very unfair on our part."

Sleighing began in November and when the sky was clear and there was no wind and the frosty air was bright and crisp, no mode of travelling did the Commission find more pleasurable or less fatiguing, and trips were made in this way to verify work on the frontier. James kept a daily register of the temperature which fell below freezing point at night from November to March. On the 8th January, 1857, he noted a temperature at Kischenief at 8 a.m. of 6° below zero (Fahr.); at noon on the same day the maximum for the 24 hours preceding was 12° (Fahr.) or 20° below freezing point. While in summer on the 4th August, 1856, he registered a maximum in the shade of 93° (Fahr.).

During the winter the British Commission was enlivened by a two days' visit from W. H. Russell, the *Times* correspondent, who had been to the Coronation ceremonies at Moscow, and was returning home by way of Odessa and Bessarabia to gather information about the new boundary and the Austrian occupation of the Danubian provinces. They also attended in the spring some manœuvres of the Austrian troops at Jassy, on the invitation of the General Command-

ing. The journey to Jassy took two days to perform. James writes of this visit :—

"The snow had all melted and the wheels were replaced on our carriages; the weather was mild and the drive through the hilly, wooded country in Northern Bessarabia was very pleasurable. I recall an incident which happened on the road. In descending the steep hill down to the Pruth, it was necessary to put the iron shoe on the wheel of the carriage I was sharing with Gordon. At the bottom of the hill he got out to remove it, and not remembering that it must have become nearly red hot, he handled it incautiously, and burnt his hand so badly that I imagine he must have been scarred for life With his usual insouciance he made very little of the circumstance, though I am certain he suffered terrible pain, and the wound was not cured for some time. . . . We crossed the Pruth by a ferry. . . . We were given splendid quarters at Jassy and were hospitably entertained while there. . . . The manœuvres lasted three days. On our return to Kischenief we found little work left to be done. The Russian Commissioner raised difficulties to the very last, and succeeded in obtaining an important concession as compensation for having to give up Bolgrad, by gaining a small area near the Pruth at Kotomori. There is not much more to write about Kischenief. . . ."

The labours of the Commission came to an end in March, 1857, when the final documents were signed and ratified, and after an exchange of civilities the members dispersed.

Before James said good-bye to his colleagues on the European Russo-Turkish Boundary Commission at Kischenief, he heard of the death of his grandfather, General the Hon. W. H. Gardner, Colonel Commandant of the Royal Artillery, to whom reference has been made in the paper on the Fyers Family. "To him," says James, "I owed my nomination to Woolwich; and my sword, lost on being made a prisoner in the Crimea, was his present to me when I got my commission. He took a great interest in me, and I had sent him from time to time notes on the progress of the Crimean Campaign which he was very pleased to get. In the last years of his life he lived at Bishopsteignton, surrounded by his married daughters and their families. The Ponsonby Moores, in whose house he was; my mother at Exeter; and the Buckner family at Topsham."

James had no sooner done with one International Boundary Commission than he found himself attached to another. At the end of the Crimean War the Great Powers in the Conference of Paris determined that the time was opportune for delimitating the Asiatic boundary between Russia and Turkey. In the war with Turkey in 1828 Russia had annexed a large tract of Asiatic Turkey and also the Persian province of Erivan. These annexations had never been formally recognized, or, indeed, precisely defined. Wide areas of

country remained since the war of 1828 in a semi-lawless condition. The nomadic Kurds, especially those on the Ararat range, were able to defy the Governments of both Russia and Turkey. It was hoped by the delimitation of the boundary to make each sovereignty responsible for its own territory, and so put an end to this unsatisfactory state of affairs.

On finishing his work as British Commissioner on the Bessarabian Boundary Commission, Colonel Stanton had returned to England but his two assistants, Lieuts. James and Gordon, were directed to proceed to Constantinople to join the International Commission for the settlement of the boundary between Russia and Turkey in Asia Minor. Lieut.-Colonel (afterwards Field Marshal Sir) J. Lintorn Simmons had been appointed British Commissioner, and James and Gordon were attached to his staff. Travelling from Kischenief to Galatz by road, they embarked with their men in the Austrian Lloyd steamship, *Persia*, on the 19th April, 1857, for Constantinople arriving there two days later.

The party of the British Commissioner consisted of Lieuts. James, Gordon, and Helsham-Jones, R.E., for surveying duties; Capt. de Norman of the Foreign Office for clerical work, etc.; Assistant Surgeon Woodfull, R.A., medical officer; Messrs. Stabb (Hungarian) and Hidaiet (Pole), interpreters; Sergt. Fisher, R.E., and a party of 10 sappers, which included those employed in Bessarabia; Stauri, head servant and mess-waiter; Francesco, the Greek cook, who had been with the Bessarabian Commission; and a number of servants, syces, muleteers, etc.

The British Commissioner, Lieut.-Colonel J. L. A. Simmons, R.E., had distinguished himself in the recent war as the Chief Staff Officer of the Turkish Commander-in-Chief, Omar Pasha, first on the Danube, and afterwards at Eupatoria and Kertch, and more recently in the campaign in Mingrelia, where the victory of Indour was credited mainly to him. The Turkish soldiers would have followed him anywhere and fondly nicknamed him Kizil Bash from the ample red beard worn by him.

Capt. de Norman was a genial and intelligent comrade much liked by his companions. He ended his life a few years later in the saddest way, having been tortured to death as a prisoner in the hands of the Chinese, during the Anglo-French Expedition to Pekin in 1860.

The medical officer, Capt. Woodfull, was an invaluable member of the party, not only on account of his great professional skill, but also because of his cheerful disposition. "He was," says James, "a typical Mark Tapley, and I can never forget the way he brightened many a fatiguing march with his endless repertory of song and anecdote. He was never so tired that he could not sing at the top of his voice, and he seemed to know the music and words of every opera and every popular song."

Stabb and Hidaiet were good interpreters, the former having a competent knowledge of seven languages at least, and his English being very good. One of these languages was Armenian which made him most useful.

Having made all their preparations in Constantinople, buying horses and stores, and preparing camp equipage, the British section of the Commission left Constantinople on the 1st May in a dirty and uncomfortable Turkish coasting steamer, the *Kars*, which afforded the only means of getting to Trebizond, whence the march into the interior of Asia Minor was to begin. They arrived at Sinope on the 3rd and had time to land.

James writes of Sinope :—

"The little harbour, which is only open to the north-east, is sheltered from the north by a rocky hill, separated from the mainland by a low sandy neck, on which the ancient town lies. It has a singular interest, for many of the modern houses have the remains of Greek capitals and friezes embedded in their walls. On the west side of the town the place is defended by an old Genoese fort on rising ground. The anchorage in the bay is good for ships of light draft, and before the late war the sailing ships of the Turkish Navy lay there often. In 1853, the Turkish Squadron, which was anchored there under command of Muzafir Pasha (Admiral Slade), was attacked and destroyed by the Russian Fleet under Admiral Nachimoff. Scarcely any resistance was offered by the Turks, and nearly every ship was sunk. . . . The remains of the wrecked ships were still lying round the bay in all directions. The inhumanity of the Russians was much commented on at the time. It was alleged that Admiral Nachimoff was drunk, and that the crews of the sinking ships, struggling in the water were massacred unmercifully by his order. In the heated passion of war, such statements are sometimes made on insufficient evidence, and I should be sorry to believe this to be true. But I can say that I never heard a contradiction of it in Russia, though I was, more than once, told, as a good joke, how the Czar Nicholas had sent a pipe of wine as a present to Nachimoff after the battle. This Admiral was one of the most distinguished amongst the defenders of Sebastopol; he was killed at the Malakhoff, and we must try and ignore the accusation made against him of brutal inhumanity at Sinope."

Arriving at Trebizond on the 5th, the English Section disembarked and encamped outside the town. The transport beasts and private horses together numbered about 110, and with 30 individuals, besides muleteers in charge of contract pack animals, the camp was a large one.

The French Commissioner had already arrived. He was a brother of General Pelissier, the French Commander-in-Chief in the Crimea. He was old and rather infirm and unfitted for the arduous work and frequent exposure to be encountered. He had often to be carried in a litter. Sometimes he stopped in his quarters, while the Com-

mission was engaged surveying the frontier, but, although he spared himself in this way whenever possible, the hard life and the long marches affected his already shattered constitution so seriously that he survived the expedition only a few months. He had an able assistant in M. Sailliard of the French Diplomatic Service, who was young, active, clever, and accomplished, and, as he spoke English with fluency and was a good rider and a keen sportsman, he was a great acquisition to the society of the party.

The Turkish Commissioner, Hussein Pacha, arrived the next day, accompanied by Osman Bey, Suleiman Effendi, a large *entourage* of ragged followers, and a squadron of cavalry to act as escort. James says:—"We were on excellent terms with our Turkish colleagues, and they trusted Colonel Simmons especially, on account of the great reputation he had made for himself with their army.

After spending a few days at Trebizond to exchange formal visits with the other Commissioners, and to organize the Caravan, the party started on the 9th May on their journey through Asia Minor to the frontier, where they were to meet the Russian Section of the Commission. There were then no carriage roads in Asiatic Turkey and everything had to be carried on pack horses. "Our head muleteer," says James, "was a person of great importance, a solemn old Turk, but a very fine specimen of humanity; he was enlaced in gold embroidery and much beturbanned and armed. Riding a good horse covered with decorated saddlery, he smoked his long-stemmed pipe; he did not condescend to put his hand to any work, but gave orders to his men with the most perfect dignity.

"At the head of the train, as is customary, was an old horse which carried no load, whose duty it was to trace the path. Every caravan has such a leader, a very old horse who has traversed the caravan tracks backwards and forwards for many years. He is worth a high price for he has been sanctified by the blessings of the Mullahs. . . . Knowing by long experience every yard of the road and never making a false step his value, when a dangerous pass has to be crossed, is incalculable. The heavily laden horses behind him are roped from tail to head in a long string, and each in succession plants his feet into the marks left by the leader; when snow covers the track the foot-marks become hard, while the snow to the right and left of the path may be so soft that a wrong step may be fatal."

The British Section was provided with theodolites, sextants, transit instruments, mountain barometers, boiling-water thermometers, and they carried with them a large wheel, which was pushed along by a man on foot, and recorded the distances as they marched. The men took this duty in turn grumbling much at having to do it and christened the instrument the "plough."

But space will not admit of a detailed account of the march to Erzeroum. They got over the dreaded Zigana Pass 6,678′ above sea

level, without accident, but I extract from James's diary an itinerary which gives the bare particulars of the journey :—

Dates.	Stages.	Altitudes in Feet.	Distances in Miles.
1857.			
9 May	Trebizond to Djevislik.	330	18
10 „	Rested.		
11 „	Yelkupri.	4,190	14½
12 „	Over Zigana Pass	6,678	17½
	to Ardessa.	3,087	
13 „	Gümüsch Tchaneh.	3,626	15½
14 „	Khaleh.	4,915	16¾
15 „	Over Tchadrak Pass	5,847	16½
	to Balichor.	5,102	
16 „	Baiburt.	4,932	14½
17 „	Rested.		
18 „			
19 „	Massat.	5,262	20¾
20 „	Over Khoshabounar Pass	7,536	22
	to Khoshabounar.	6,429	
21 „	Potchik.	5,850	14
22 „	Erzeroum (camp outside town).	5,840	13
		Total miles ...	183

The altitudes calculated from the barometer readings and the distances measured with the surveying wheel.

During their stay at Erzeroum the officers enjoyed the genial hospitality of Mr. Hughes, the British Vice-Consul, who was a great Oriental scholar with considerable experience of Eastern life ; while a marsh, on the plain near the camp, afforded them good sport.

On the 31st May the British Section moved on from Erzeroum to Kars and the following is the itinerary :—

Dates.	Stages.	Altitudes in Feet.	Distances in Miles.
1857.			
31 May	Erzeroum Camp over	5,840	
	Devèhbouinou Pass to	6,300	21¾
	Hassan Khaleh.	5,043	
1 June	Ardost.	4,900	26½
2 „	Yenikioi.	5,977	21½
3 „	Halted.		
4 „	Over Saghanli Dagh	7,533	24¼
	to Tcherpakli.	6,164	
5 „	Kars (Camp).	5,416	29½
		Total distance...	123½

The march on the 4th June was one of the most difficult made during the whole summer, being very up and down with few level intervals. James says:—"As we neared the two summits of the Saghanli Dagh, between which we were for a short distance on the slope of the Tchoruk Sou basin, the loose scoriæ, lava and obsidian which covered the surface of the track, made it most dangerous for the horses, and had they not been shod with flat plates of iron, in the Turkish manner, their feet inevitably must have been badly cut. Obsidian is a black stone with a sharp conchoidal fracture, and we might as well have marched among broken bottles. At the second summit, the higher of the two, we came again to the slope of the Caspian basin, which we did not leave for some months. The scene in itself was most dreary, but the distant view was magnificent. Our descent to the village of Tcherpakli, on the edge of the level plain of the Kars Tchai, was very rapid. The track followed the steep banks of a torrent, the horses sliding and stumbling along."

On the declaration of peace in 1856, Kars, the garrison of which had held out against an overwhelming Russian force under Mouravieff for over five months, in spite of much suffering from cholera, was restored to Turkey. It was at this siege that Major-General Sir W. F. Fenwick Williams of the Royal Artillery, nominally British Commissioner attached to the Turkish Army, but, by the influence he had gained, really the commander, so greatly distinguished himself. Helped by a handful of Englishmen—Colonel Lake, young Christopher Teesdale of the Artillery, Thomson and Sandwith, and by General Kmety, the Hungarian, Williams held out till the brave Turkish garrison was literally starving. When at last he capitulated Mouravieff, addressing him, said:—"You have made yourself a name in history, and posterity will stand amazed at the endurance, the courage, and the discipline which this siege has called forth in your army."

James and Gordon were left for a fortnight with their sappers in the camp outside the walls of Kars, while the British Commission, with Helsham-Jones and de Norman, went on to Alexandrapol to meet the Russian Section. Their orders were to make a survey of the town of Kars and especially of the outer forts and positions which had been the scene of the operations of the recent siege.

Leaving Kars on the 18th June they easily reached Alexandrapol or Gumri, only 32 miles distant, on the 20th. It was during this journey that James had his first view of Mounts Ararat and Alagos, the first, 80 miles away, and the second, half that distance; a signal proof of the wonderful clearness of the atmosphere in the region of the grand mountain, with which he was to be more intimately acquainted.

At Alexandrapol they were given quarters in a Russian house and, while the Commissioners were exchanging credentials, enjoyed the society of ladies for the first time since leaving Trebizond. They

made the acquaintance of the Russian Section, of which General Tcherikoff was the head and Colonel Ivanine his assistant. These officers seem to have reminded James of the Russian representatives on the Bessarabian boundary. Attached to the Commissioners was a large body of Cossacks of the Black Sea, to act as their escort on the Russian side of the frontier. It was commanded by Colonel Kratchefteski, "a jovial old soldier" who became a great favourite. Then there were the two topographical officers, Ogranovitch and Effimovsky, who had been with them in Bessarabia, and were greeted as old friends.

On the 24th June, 1857, the United Commission started down the course of the Arpa Tchai, which, for 45 miles to its junction with the Araxes, was the undisputed frontier line. James writes :—

"We had left the ordinary routes and the country was strikingly picturesque. Our first night's halt was at Baindöur, 9 miles, and the second at Kazar Abat, 7 miles, and I remember how Gordon, near this place, displayed the fearlessness of his character in attacking a mountain bear, riding after it, and hacking at its head with his sword. The bear turned on him, and the incident might have ended seriously, if some of our party had not hastened to his assistance and driven the infuriated beast away.

"The third night's halt was at Kizil Kilissa, our camp being above the left bank of the river, at a height of 4,975'. We stopped an entire day there to explore the ruins of Ani, opposite where we lay. The last march had only been 8 miles, so that we were taking it very easy in comparison with the long days we had travelled in the journey from Trebizond to the frontier. . . . Our colleagues were not fond of hard work; a march of 10 miles was as much as could be endured without inconvenience; and fatigue, they thought, quite out of the question."

(*To be continued*).

Major Philip Cardew,
Royal Engineers.

MAJOR PHILIP CARDEW

*MAJOR PHILIP CARDEW, ROYAL ENGINEERS.**

I. Life and Character.

To attempt to sketch the character of Philip Cardew in a brief memoir must appear a useless task to those who knew him well, because his was a personality certain to remain for long clearly stamped on their memories; whilst it is peculiarly difficult to give an idea of his strong individuality, combined with a true underlying modesty of mind, to those who knew him not. He was descended from an ancient Cornish stock, and he himself associated with his Keltic ancestry his almost passionate love of the sea, together with a certain lack of "push," to use his own expression; whilst he also attributed certain less amiable characteristics, which in truth he did not possess, to the same source. His paternal great-grandfather, Dr. Cornelius Cardew, appears to have been a remarkable man, who rose no higher than the head mastership of Truro Grammar School, perhaps because of his hampering love of his native county. Cardew's grandfather was, like himself, an officer in the Royal Engineers, whilst his father served for some years in the 74th Highlanders. On his mother's side Cardew's ancestry was also that of a kind likely to stamp its mark on succeeding generations; for his grandfather was Lord Westbury, the famous Lord Chancellor, a man charming to meet in private life, but with a tongue capable of cruelly lashing an opponent. Such were Cardew's ancestors, and in his case, at all events, it is true that a man cannot be thoroughly kn as long as his ancestry remain unknown.

Philip Cardew was born at Oxshott in Surrey on the 24th of September, 1851, whilst most of his youth was spent at Southsea and in a country house in that neighbourhood. A great deal of his time was, however, passed with his brothers on his father's yachts, the experience thus gained being undoubtedly a very valuable part of his

* Part I. compiled by Major L. Darwin from papers supplied by the family, from notes furnished by Sir W. Preece (concerning the work as a Consulting Engineer), Brigadier-General Wingfield-Stratford (concerning the episode at Sheerness), Mr. A. P. Trotter (concerning the Board of Trade), Major-General Ruck, and others. Part II. by Colonel G. A. Carr.

early education, the beneficial effects remaining with him for life. After a year or two at various preparatory schools, he was sent to Guildford Grammar School, where the education was mostly classical; and at the age of 15 he passed on to a crammer's, with the idea of working for Woolwich. Here he made remarkable progress in mathematics; for, starting from nearly complete ignorance, he had learnt more than any of his batch at Woolwich ever knew before he passed in first to the Academy in 1868 when not quite 17 years of age. Although one of the youngest of its members, Cardew maintained his positon at the head of his batch during the whole of the two years and a-half spent at Woolwich; and all felt that this was as it should be on account of the unquestionable superiority of his natural abilities. In these circumstances, and having served as senior responsible under officer, both the Pollock Medal and the sword of honour obviously fell to his lot. It may be worth noting that he considered that the stricter discipline and simpler life of the Woolwich of those days afforded a better training for the soldier than that now given in our military schools.

Cardew joined at Chatham early in 1871, his first commission being dated January 4th of that year, and he appears to have thought highly of the course of instruction given at the School of Military Engineering at that time, where two full years were passed. But here again it is possible that he would have said that his yachting experiences with the R.E. Club, "teaching readiness in resource, self-confidence, and habits of observation and carefulness" were equal in value to anything he learnt in the schools. Certain it is that this element in his life at Chatham bulked largely in his memories of those days, for he had never lost a chance, summer or winter, of a run with one of the three small yachts then kept. His interest in the club was long maintained, and it was due to him that in 1882 the *Buccaneer*, a larger yacht than any of those previously owned by the club, was bought, and remained their best boat for 14 years.

From Chatham Cardew was ordered to Bermuda, a station "unrivalled in its suitability for small boat sailing," where he became the owner of a 5-tonner, and an expert in local navigation. It was in 1876 at this station that we first hear of him in connection with the science of electricity, in the pursuit of which he was eventually to do his most notable work; for in that year he was placed in charge of the military telegraphs of that island, whilst in the following year he joined the Submarine Mining Service. Once started in this line of life his progress was rapid; for in 1878 he became the assistant instructor in submarine mining and telegraphy at the School of Military Engineering, whilst in 1883 he succeeded to the instructorship in electricity.

Without entering into technical details it is impossible to give any

idea of the value of Cardew's technical work in the Corps, an aspect of his life which is therefore best dealt with separately. Here it is sufficient to remark that what he had to do often had a practical side to it, nearly all the arrangements for the move of the Electrical School from the R.E. Institute to St. Mary's Barracks, for example, which occurred 1885, in fact falling on him.

In 1879 Cardew married his first cousin, May, daughter of Mansfield Parkyns, the well-known Abyssinian traveller. A happy married life, whilst either party lives, is too sacred a thing to be discussed; though, if anything whatever is to be said concerning Cardew's private life, this side of it cannot be passed over in complete silence. His home surroundings must at any rate be noted as amongst those elements which, by completely satisfying his desires, led to that indifference to public fame to be noticed presently. After establishing himself in a quiet house near the Medway, yachting still continued to be an important part of his life. Indeed all his summer holidays were henceforth spent afloat with his wife, the size of the boats he owned increasing with his family and his means, the last and largest, the *Lilith*, a cutter of 44 tons, forming for 10 years a summer home for themselves, their two daughters, and any available son. The account of Cardew's connection with the sea may be fitly brought to a close by the following narrative, given on the authority of an eye-witness, of an episode which needs no comment.

Cardew was in charge of submarine mining operations off Sheerness in 1877, and was directing the work from the deck of a small steam vessel known as a "Miner." There was a very strong tide running at the time, the steamer being in the middle of the channel, a long way from shore. A sapper, named White, fell overboard, and, being swept away by the current, which was running like a mill race, before a rope or lifebuoy could be thrown to him, and being unable to swim, it looked as if he must be drowned. Cardew took in the situation at once, and dived straight into the water without removing even his cap. He reached Sapper White when unconscious and once again disappearing, and, treading water, he managed to keep the man's head above the surface. It now seemed as if both would be drowned, so far away from the steamer had they been swept by the current. But the Miner fortunately having a dinghy in tow, Sapper Penrose with great promptitude jumped into it, let go the painter, and with a single scull over the stern reached them in time and brought them back in safety to the Miner. It was some while before Sapper White recovered consciousness, whilst Cardew, after changing his clothes, went about his work as usual. No one knew better than he did the fearful risk he ran in diving into that racing current with all his clothes on and with no help near. Yet he risked his life without

a moment's hesitation to save another's, and his modesty when the deed was done was in keeping with his character. Seldom has a nobler action been performed.

Although Cardew did not actually retire from the Army as a Major until 1894, his connection with the Royal Engineers ceased in 1888, when he was appointed the first electrical adviser to the Board of Trade. He took up the new appointment at the moment when legislative changes for the first time gave to electrical lighting companies a reasonable prospect of financial success, and when, therefore, the first rapid development was about to commence. The boom following the first legislation of 1882 had quite died out, but the recollection of it made the authorities cautious, and one of Cardew's first duties was to sit with Major Marindin on a long enquiry into the various proposals for the electric lighting of London, and, at its conclusion, to draw up a set of regulations concerning the supply of electricity for power and light. In framing these rules he had little to guide him, either as to the nature of the dangers to be anticipated, or in the existence of any similar regulations affecting other industries, and yet in many cases his actual wording is still retained, a proof at all events of his singular facility in drafting. Moreover, subsequent events have convinced those best able to judge that he exhibited very remarkable judgment with regard to the nature of the restrictions to be imposed. For example, he had to create purely arbitrary categories of "high pressure" and "extra high pressure"; and, not only have the limits he laid down been subject to no great changes since that date, but, as regards the higher limit of 3,000 volts, he hit off in a wonderful manner the point at which subsequent experience has proved that special precautions are necessary. The most surprising example of his foresight was, however, in devising the regulations to be applied to electrical tramways in order to prevent electrolysis; for the limit he suggested of 7 volts fall of potential in the rails, now appears to have been almost like an inspiration, because it has never proved to be a burden on the engineer whilst it has afforded effectual protection to gas and water pipes. He also devoted much of his time, when at the Board of Trade, to the establishment of the electrical standards laboratory.

Cardew retired from the service of the Government in 1898 in order to enter into partnership with his friend, Sir William Preece, and his sons, thus forming the well-known firm of consulting engineers bearing their names. He remained connected with that firm during the 12 last years of his life; and, as they were frequently consulted by the Colonial Office, the War Office, the Crown Agents for the Colonies, and the Admiralty, the work in hand was always of a very important character. In recent years he was

especially actively engaged in connection with certain Admiralty orders, involving an expenditure of over £1,500,000, every Government dockyard in the British Empire having received his personal attention either as regards electric power or light, whilst Gibraltar, Malta, and Hong Kong were visited by him in this connection. He also represented the Crown Colonies upon the International Conference respecting electrical units held in London in 1908, as well as serving on numerous committees considering questions of importance concerning electrical industries. Finally, he was retained by the Postmaster-General to assist the Post Office in the purchase of the National Telephone Company's system in 1911, a duty he was destined never to perform.

The work of this firm of consulting engineers was, however, by no means confined to business for the Government departments, and Cardew himself was particularly interested in electrical railways, tramways, and power schemes. Indeed, he was one of the few English engineers to recognize the advantages of the 3-phase and the single-phase systems of railway workings upon main lines. He was associated with the preliminary work upon the District Railway before the financing of its electrification was taken up by the Americans, and he was employed as an expert before several Parliamentary Committees on private bills. He, moreover, joined the Board of the London, Brighton and South Coast Railway in 1902, where his assistance was highly valued, and doubtless he had great influence as regards the electrification of the Victoria and London Bridge portion of this company's line upon the single-phase system.

Cardew's writings though not numerous were always of value. As early as 1881 he wrote a paper on the application of dynamo electric machines to railway rolling stock; in 1894 he contributed a paper to the Royal Society on unidirectional currents to earth from alternate current systems; and in 1901 he delivered the Cantor lecture before the Society of Arts on electric railways. He also contributed several papers to the Institute of Electrical Engineers, on the Council of which he served for many years, being elected a vice-president in 1901–2.

Having already on one occasion gone to Sydney in connection with the electrical installation undertaken by the Corporation of that city, Cardew set out again for Australia on the same errand early in 1909. Though unknown to himself, he was in truth in ill-health when he left England on this latter occasion. He was however able, though not without difficulty, not only to complete his work in the colony, but also to visit his son in Japan on his way home *viâ* that country and Siberia. Soon after his return to England he had to undergo a very serious operation, from which he never really recovered, and

after further operations he died in May, 1910, after having borne his long illness with extraordinary fortitude.

In the foregoing chronological sketch of Cardew's career, one element has escaped notice, an element which in truth was never absent, and that was his deep love of music. He must have begun to learn to play the 'cello fairly early in life, for many of his contemporaries at the S.M.E. will remember not only the strains issuing from his barrack room, but also the workings of his mobile face when trying a new and difficult passage. He undoubtedly became a good performer, and being a member of a family of exceptional gifts in this direction, he had many opportunies of enjoying concerted music. Some of our bandsmen may, moreover, still remember the interest he took in the R.E. Band all the time he was stationed at Chatham. Space forbids more being said on this subject, though these few words give but an utterly inadequate idea of the important part that music played in his busy life.

The reader who has read this memoir without having known the man it attempts to portray must be asking why it was that his name was not better known to the world at large, and why he never received any public recognition from the Government he served so well. His own answer, at all events, to this question would have been that the confidence placed in him by all the officials with and under whom he had served had been an ample reward for all his services; for, whether this was so or not—and we may well doubt it—he himself in truth cared but little for mere fame or notoriety. A man with only one aim in life must almost of necessity be ambitious, whilst one who is lucky enough directly his work is done to be able to find complete satisfaction in yachting, in music, or in home life generally, will have comparatively little difficulty in brushing aside any passing thought as to the possibility of his merits not being adequately recognized. No doubt Cardew was not a ready speaker, and this may perhaps have somewhat lessened the temptation to take part in public life of any kind. But it is in truth in that somewhat rare unselfishness which he showed with regard to his fellow workers, combined with his very kindly nature, that the key to his shrinking from publicity must be sought. Gentle and considerate were the terms most often applied to him in the many letters of condolence written after his death, epithets which are seldom heard in connection with those, who in reality hold in reserve large stores of determination and self-confidence ready for use in times of need.

A man does good less "by the mark which he may make on public affairs than by simply being himself. The impression made upon his contemporaries by a man of strong and noble character is something which cannot be precisely estimated but which we

often feel to be invaluable." These words, written by a man of great ability of a man of great power, apply with equal truth to Philip Cardew.

II. Technical Work in the Corps.

In attempting to form a proper estimate of Cardew's technical work in the Corps it is essential to bear in mind what was the state of electrical knowledge and practice in the world at large at the time when his work began. So rapid has been the advance in this subject during the last 30 years that it requires an effort, even on the part of one who had personal experience of those early days, to form a correct picture of the state of affairs.

In 1879 the Commandant, S.M.E., undertook to experiment for the R.E. Committee with various electric light apparatus, the bulk of the electrical work falling on the late Colonel R. Y. Armstrong, the Instructor in Telegraphy, and on Lieut. (as he then was) Cardew, his assistant. The dynamos for trial were four patterns of Gramme and two patterns of Siemens dynamo, all of which gave continuous currents and were series-wound; and three patterns of Wilde dynamo, all of which gave alternating currents, one being of the type that was then in naval use for searchlighting. This may be said to have comprised samples of nearly, if not quite, all the dynamos suitable for searchlighting then in existence.

At this time there were no incandescent electric lamps: no secondary batteries: no transformers: no rules as to the current-carrying capabilities of conductors of various sizes. The idea of the magnetic circuit had not been broached. So-called ohms, which were really B.A. units and rather smaller than the ohm, were available; but there were no voltmeters; no ammeters. Indeed at that time the ampere was called the "weber"; and the reputed volt was affected by the same error which caused the B.A. unit of resistance to differ from the true ohm. Clark's cell existed as a standard of E.M.F., but did not then perhaps command the confidence which it has since proved itself worthy of. The only measuring instruments of precision that were available for making the electrical measurements were the late Lord Kelvin's reflecting galvanometer and reflecting electrometer. Needless to say neither of these instruments had been designed for such work, the former reading in microamperes up to about half a milliampere, and the latter up to about a couple of volts. A transmission dynamometer had to be improvised with two pulleys and a steelyard.

The accuracy of the results obtained is believed to have been of a high order. But the process of obtaining them was tedious in the

extreme. They were embodied in a voluminous report rendered at the end of 1879.

Soon, however, it became apparent that the improvements which were continually being made in the design and construction of dynamos would entail experiments, involving electrical measurements, that would extend over several years. The need for more convenient instruments for measuring the large currents and differences of potential involved in such work was very severely felt. It was not long before Cardew designed a galvanometer for this purpose. This he described in a paper read before the institution now called the Institution of Electrical Engineers on 25th May, 1882. This galvanometer was used for several years at the S.M.E. and proved a great improvement on former methods. It never came, however, into general use. In course of time it was superseded by superior instruments designed by the late Lord Kelvin.

Almost simultaneously with the production of this galvanometer Cardew evolved the idea of the hot-wire voltmeter, an instrument which proved of the utmost value in the Service and also in civil life. It is this instrument which made his name familiar to all electricians throughout the world. It is too well known to require description here. What is perhaps not so well known is the amount of careful experimental work that was devoted to it to establish the proper conditions to ensure accuracy in its working. Major-General Porter in his *History of the Corps of Royal Engineers* mentions that Cardew was awarded the gold medal at the Inventions Exhibition for this instrument.

One original idea of Cardew's in connection with dynamos may also be mentioned here. It relates to a method of finding the efficiency of a dynamo. Two dynamos are mechanically connected. Power is supplied electrically to one of them from any convenient adequate source and this power is carefully measured. This dynamo, acting as a motor, drives the other dynamo which in its turn gives out power electrically, and this power is also carefully measured. Then the combined efficiency of the system consisting of one machine acting as a motor and the other as a generator can easily and accurately be determined. Moreover if the efficiency as a motor of the dynamo so used is known, or if the dynamos are alike in all respects and it is assumed that their efficiency as motors is the same as their efficiency as generators, the coefficient of efficiency of the dynamo acting as a generator is easily ascertained. If desired the same instruments can be used for the measurement of both "in-put" and "out-put." This method has a family likeness to the well-known Hopkinson method and to several others largely used in civil life.

Before quitting the subject of Cardew's work in the Corps in connection with electric lighting, mention must be made of the large

amount of work he did in connection with electric light projectors. Much of this related to the question of so mounting projectors as to expose them as little as possible to an enemy's fire; part to the question of the kind of reflector to be adopted, more particularly in view of the very heavy cost of the better class of reflectors then on the market. Mention must also be made of his work in the early days for determining the current-carrying capabilities of conductors of various gauges.

Turning now to Cardew's work in the Corps in connection with telegraphy, the following extract from Major-General Porter's *History of the Corps* gives a good account of his vibrator system of telegraphy.

"Its utility for military purposes has been demonstrated in more than one of our recent campaigns. During the Nile Expedition, at the most critical period, just after the fall of Khartoum, a serious fault occurred near Dongola. Communication was, in spite of this, maintained by the vibrator system for nearly 48 hours, until the fault was removed, although no signals could be obtained from any other instrument. It was also successfully worked for a considerable time on several lines consisting of bare wire laid on the ground without insulation, owing to the want of poles, etc. In other cases of faulty lines it also proved most valuable. The message announcing the victory of Tel-el-Kebir was sent from the field of action by a vibrator. It also did good service in working through broken-down lines on the Postal Telegraph system after the great snow-storm in the winter of 1886. The vibrator derives its extreme sensitiveness from the use of the telephone as a receiving instrument, and in order that the signals should be best adapted for this receiver, the currents are not steady in each signal, as in the ordinary systems, but are broken up into a succession of impulses of current which, when received on the telephone, cause it to give out a musical note of corresponding pitch. This is effected by the use of an instrument called a Vibrating Transmitter at the sending end, somewhat similar in principle to the ordinary electric bell. This forms a divided circuit with the line, and the impulses to line are thereby considerably strengthened over what they would be if the battery current were simply made and broken by an instrument not in the circuit, as is the case in the Elisha Gray vibrating system. The invention consists in the combination of the instruments for the purpose, and in the form of transmitter used."

The Indian Government wrote spontaneously to speak of the great value to them of this vibrator in war—in fact it had saved thousands of lives—and to suggest that Major Cardew should be rewarded and offered a money reward themselves. Eventually he received such a reward, half from the Imperial and half from the Indian Government.

The utility of this system of telegraphy is much extended by his

further invention of "separators" consisting of a combination of "choking coil" and two condensers. These instruments enable a vibrating telegraph circuit to be superimposed on an ordinary Morse circuit without interference between the two, thus doubling the message-carrying capability of the line. Some very satisfactory results of this description were obtained some 10 years ago in Ceylon.

Cardew's "apparatus for testing lightning conductors," which was introduced into the Service, must not be forgotten among his other inventions.

TRANSCRIPTS.

THE ASKHABAD COURSE OF INSTRUCTION FOR OFFICERS OF RAILWAY TROOPS.

Translation of an article appearing in the *Razvyedchik* of 24th May, 1910.

In 1905, a course of instruction for the officers of the Turkestan Railway Brigade was established at Askhabad, by the then Commandant of the brigade. The object of the course was to give officers of railway troops technical instruction in their special work. The experience of the recent war with Japan has shown that, in addition to general military knowledge, the officers of railway troops must acquire a really practical acquaintance with the construction and working of field railways, and of tramways (with both mechanical and horse traction) in time of peace, in order to ensure their thorough competence in time of war. None of the military colleges had furnished training of this nature.

The course held at Askhabad, lasts for one year. The subjects dealt with include:—theoretical and practical mechanics; the elements of hydraulics; water supply; steam engines and their construction; elementary surveying; building construction; railway construction; bridges, roadmaking in the field; excavation and tunnelling; demolitions; telegraphy; traffic management in its commercial, military and technical aspects.

The practical work includes:—preliminary surveys for railways of both narrow and broad gauge; the design of bridges; excavation work; engine driving over a distance of not less than 660 miles; the construction and repair of telegraph and telephone lines; and actual duty in railway stations in superintending traffic.

The course is under the supervision of the Officer Commanding the Turkestan Railway Brigade. The instructors are engineers on the Central Asian Railway, and officers of railway troops who are thoroughly qualified in the subjects dealt with.

The class consists of 12 officers selected from the 2nd, 3rd and 4th Russian, the 1st Caucasian, and the 1st and 2nd Trans-Caspian, Railway Battalions. Each of these units sends two officers annually. Lectures are delivered twice a week, and two half-yearly examinations are held.

Apart from the question as to how far this particular course satisfies the requirements of the case, it is obvious that as long as special railway troops exist, some special course of technical instruction for the officers, is essential. Railway work in the field makes very extensive and varied demands upon the knowledge and capability of the officer. One day he may have to make a survey and plan a line; the next, he may be called upon to travel on the footplate of a locomotive; or to repair telegraphs, to organize traffic, or to carry out engineering work. The necessary theoretical and practical knowledge for such varied duties can only be acquired by a special course of instruction in railway work.

THE RECONNAISSANCE OF A FORTIFIED POSITION.

Translation of an article by Colonel V. Polyanski in the February, 1909, number of the *Eenzheenernee Zhoornal.*

Reconnaissance or scouting in the attack is properly speaking a duty which belongs to the cavalry, but such are the conditions of modern war that it has become impossible for the cavalry to deal with all the questions which have to be answered before the plan of attack can be decided upon. The modern arrangements for the fortification of a position are so complicated, and reconnaissance is rendered so difficult by means of masking and the use of dummy works, that none but Engineer specialists can understand from long distances the intention and character of the various fieldworks with which the enemy may have added to the strength of his position.

That special Engineer reconnaissance is necessary first became evident during Russo-Japanese War. In the month of September, 1904, when attack operations were in contemplation it was decided to form Engineer reconnaissance detachments, and these were recruited from among the officers of the Engineer and Sapper units.

In the following article a scheme for the organization and execution of this form of reconnaissance is presented, which is mainly based on the experience gained in this war. It must be allowed that many people refuse to allow their inclinations and confidence to be guided by the experience of the war, saying that in their opinion it was an exceptional war and not in keeping with any regular rules. To the Engineer however, who has had the good fortune to verify his theoretical training on those battlefields, the experience appears to be the very Alpha and Omega of up-to-date instruction in military engineering, and whether the war was an exceptional one or not, it is certain that the experiences of future wars and future battles (which will also be exceptional, and hardly ever under the exact conditions of theory) will more greatly resemble the war of 1904–5, than that of 1877–78, not to mention the wars of the beginning and middle of the last century.

These proposals for organizing this form of reconnaissance are therefore moulded on what was actually done by the Russians during the war of 1904–5. The sketches attached (see *Plate*) were actually made in the field by the author, when reconnoitring the Japanese positions on the Shaho on 25th November, 1904, but the shape of the ground has been slightly altered. The information about the nature of the works on German field positions has been obtained chiefly from the official "Instructions in Entrenching," from the works of Major von Fritz, lectures to the Berlin Military Academy, and from articles in the journal *Mittelungen über Gegenstände des Artillerie und Geniewesens*, 1907.

THE ESTABLISHMENT OF RECONNOITRING DETACHMENTS AND THEIR WORK.

The preliminary reconnaissance of a position is generally allotted to a special party which should consist of officers of Engineers, Artillery and the General Staff. This party must not be large, as it must not attract the attention of the enemy by the large number of its horses. It moves with the mounted scouts and will act under the usual conditions of scouting service.

The task allotted to this party will be to explore the more distant approaches and the ground in front of the enemy's position, and if there is no map of the ground to make an eye sketch or a panoramic drawing of it. If the enemy is entrenched, it should discover the front and flanks of his position, the nature of his works, the sites of his strong points and obstacles, and the actual or probable positions of his batteries.

This done, the reconnaissance party can decide what local objects might serve as strong points in the defences of the locality which can be occupied by the attacking force, what are the most convenient approaches, and where there are suitable positions for the attacking batteries.

But as it is certain that the front of the enemy's position will be covered by cavalry and infantry outposts, the mounted reconnaissance party as above constituted will hardly succeed in obtaining sufficient details to serve as materials for drawing up the complete plan of attack, and consequently it is necessary to call upon the services of specialist Engineer and Sapper officers, and to form them into Engineer-reconnaissance parties, with the following duties.

1. To decide whether there are front positions, or front-lying strong points (Vorpostenstellung).

2. To decide the direction of the front of the main entrenched position (Hauptslellung), and its flanks.

3. To define its more important sections, and its strong and weak localities.

4. To locate the strong points, trenches, batteries (machine gun, mortar and howitzer), artificial obstacles and observation stations.

5. To endeavour to make out what are dummy works (Scheinanlagen), and the true positions of removable prominent objects, (Geländemarken), and

6. To decide the directions in which it would be advisable, under the peculiar local conditions, to carry out the attack, and to find out the most suitable approaches and observing stations.

When carrying out a reconnaissance of this kind it is necessary to bear in mind the fundamental rules for the fortification of a field position, as they are accepted by the Germans, and by their pupils the Japanese.

They agree in *occupying one line only and in strengthening it by all available means*. The preparation and occupation of a front position is recommended only in exceptional cases. These front positions (Vorgeschobene Stellungen) must be sited at such a distance from the main position, that the troops occupying the latter are not necessarily drawn into a battle started in the front position, in spite of the intentions of their commander, *i.e.* they must at any rate be at the distance of artillery range.

The front strong points which are sited *near* to the main line should be strongly fortified and weakly garrisoned, and should be supported by the fire of the main position.

The defences of the various sections of the position will generally take the form not of continuous lines, but of *groups* which are able to deliver *flanking* as well as frontal fire.

Fortified groups (Befestigungsgruppen) consist of systems of rifle trenches with their flanks inclined and echeloned backwards, and are intended for garrisons of not less than one battalion each. Fieldworks, such as redoubts, are only included in these groups in exceptional cases. In rear of the rifle trenches there are shelters for the reserves, and these are connected with the former by communication trenches. The crests of hills, villages or woods serve as local strong points. These strong points should be entirely surrounded by artificial obstacles, except only for masked approaches in their rear.

In rear of the more dangerous sections, if local conditions are favourable, special strong points (Stützpunte) may be constructed, to act as reserves.

Masking will receive especial attention. Dummy works are recommended, and prominent objects (Gelandemarken) will be made removable.

Field artillery will be placed in open or concealed positions according to its tactical objects and to the ground. *Heavy* artillery (mortar and howitzer batteries) will always occupy concealed positions, as near as possible to the roads. Great importance is attached to *safe observing*.

The very lowest parapets are recommended—·3 to ·5 metres,—and only where the object is to safeguard some point against a sudden attack, unsupported by artillery, are closed strong points with *higher parapets*, surrounded by obstacles, allowable.

The general character of the fortification of a position will consist of sections prepared for a purely passive defence; the active attacks being directed from their flanks.

Officers carrying out the reconnaissance must bear in mind these details, in order that they may correctly understand what they see before them.

Special Points about the Reconnaissance of Strong Points and Local Objects.

When observing a strong point in a hostile position it is necessary to decide:—

i. Its character, whether a system of trenches, a fieldwork or a local object, such as a village or wood;

ii. Its position with reference to the neighbouring sections and to the observer; its size, shape and the number of its garrison (infantry, artillery and machine guns);

iii. Its profile, the revetments of its slopes, blindages, the bearing of its principal firing line, whether there are obstacles, natural or artificial, and whether these have frontal or flank defence;

iv. If there are any convenient approaches leading towards it, and dead ground in its vicinity.

When observing a village it is necessary to decide :—

i. Its name (by interrogating the inhabitants, to verify the map), size, nature and materials of the houses (whether of stone, brick, or mud), number and width of its streets, the open spaces and the environs;

ii. The nature of the surrounding ground, whether dry or boggy, the approaches, and the nature of the defences.

When observing a wood it is necessary to decide :—

i. Its form, length, breadth, nature and size of trees, thickness, the direction, length, form and nature of the edges; whether there are open spaces, their width and direction, glades, ravines, rivers, streams.

ii. Whether it is prepared for defence, the nature of the works, abattis, second line of defence, salient angles; also the approaches to it.

When observing a defile it is necessary to decide :—

i. Its nature, whether open (bridge) or concealed (mountain pass), its length and breadth, nature and dimensions of exits, and if there are any side roads by which it can be turned;

ii. The character of its defences, *i.e.* whether it is obstructed (passive defence), or rendered secure (active defence); and the approaches to it.

When observing a river :—

i. Its name, direction of current, width, depth, rate of current, nature of banks and bottom, passability at fords, nature of bridges and their number, whether there are dams, locks or other means of crossing. Which of the banks is the higher and what is the height of the banks above the surface of the water. Where and what roads cross the river, and whether any roads run along its banks.

ii. Whether the crossings are fortified (obstructed, or rendered secure); the nature of the works and the approaches to them.

When observing a marsh :—

Its extent, length and breadth; nature, *i.e.* depth, dry localities, rivers, streams, overgrown places; the paths which cross it, their direction and quality; whether it can be crossed without paths, where a crossing can be constructed; where the enemy has fortified it, the nature of his works and the approaches to them.

When observing a ravine :—

Its direction, length, breadth, whether its banks are accessible, their nature and the command afforded by them; where it can be crossed without roads, whether it is possible to go round it, and what local means exist for crossing it.

When observing a bridge :—

i. Its situation with regard to its surroundings, its length, breadth, height above water level; construction, number and length of bays, siting and dimensions of piers, girders, struts, ties, superstructure;

ii. Character of bridgehead defences, nature of surrounding ground, approaches to bridge, proposals for its demolition.

METHODS BY WHICH ENGINEER OFFICERS CAN CARRY OUT RECONNAISSANCES.

The reconnaissance may be carried out on horseback, in an armoured automobile, from a balloon or dirigible, or on foot.

i. Mounted reconnaissance is carried out when time is pressing and other means are impossible, and can give only general information. It consists in making eye surveys or hand sketches of the ground, on which everything noted by the observer is reported.

ii. Reconnaissance in an armoured automobile can only succeed and be of any material use when the enemy's position is badly guarded, when good roads exist along his front, when the ground is well known, or when his outposts are driven in by a reconnaissance in force. This is in reality not a reconnaissance, but a rapid observation of the enemy's dispositions, carried out with the object of elucidating and obtaining greater details concerning some doubtful point in a reconnaissance already made. Success is only to be obtained by bold, determined and rapid action.

iii. Reconnaissance from a balloon or dirigible will probably give the fullest and most accurate results. It requires practice and such reconnaissance can only be carried out by balloon specialists.

iv. Reconnaissance on foot is the only kind which can give good results when balloons and dirigibles are not available. For this reason it is now proposed to deal with this method in greater detail, and to give a few practical hints which may *partially* make up for want of practice in peace time.

Reconnaissance by Engineer Officers working on Foot.

The Engineer reconnaissance detachment is divided into parties each consisting of two officers and a mounted orderly. Each officer must be provided with a plane table (sketching case) with compass and paper marked in squares, a field notebook, coloured pencils, pair of compasses, the latest map of the ground, if one exists, in a cellulose wallet, to enable it to be used in the rain, and field glasses.

The reconnaissance is organized as follows:—The commandant of the Engineer reconnaissance detachment allots the ground to the various parties, giving to each 600 to 900 yards of front. He communicates to each officer the information about his own section which has already been gained by the mounted scouting parties, and points out to each the objects of his reconnaissance and the special information which he is required to obtain.

Having received their work, each party, moving cautiously and secretly behind folds of the ground and any other natural cover, endeavour to ride as near as possible to the enemy's position. As a precaution the hoofs of the horses should be muffled with rags, and care should be taken that all accoutrements are well fastened and do not rattle. If the ground is well known the start should be made before dawn, so that the party may move under cover of darkness and reach their observing point ready to begin work at daybreak.

In order not to miss the way they should always be able to take their bearing by the ground and to interpolate their position. The following are some useful methods of taking bearings:—

i. By means of map or plan. This is done by making a study of the ground before starting on the reconnaissance, and learning the relative positions of the various local objects.

ii. By compass, for which it is necessary to know the bearing of the line in which one has to move.

iii. By watch and sun, by turning the hour hand towards the sun and mentally bisecting the angle between it and the figure XII. This gives approximate south.

iv. By the sun, which is to be found:—

	March.	June.	September.	December.
East at	6.0 a.m.	4.0 a.m.	6.0 a.m.	8.0 a.m.
South-east at ...	9.0 a.m.	8.0 a.m.	9.0 a.m.	10.0 a.m.
South at noon all the year round.				
South-west at ...	3.0 p.m.	4.0 p.m.	3.0 p.m.	2.0 p.m.
West at ...	6.0 p.m.	8.0 p.m.	6.0 p.m.	4.0 p.m.

v. By the moon, which is to be found:—

	In First Quarter.	At Full.	In Last Quarter.
East at	—	6.0 p.m.	12.0 m.n.
South at	6.0 p.m.	12.0 m.n.	6.0 a.m.
West at	12.0 m.n.	6.0 a.m.	—

vi. By the Pointers of the Great Bear, which show the direction of the Pole Star.

vii. By local objects:—the moss growing on trees shows the north, the altars of all Christian churches are towards the east, those in mosques towards the south, etc.

When it is impossible or inadvisable to go any further on horseback, for it is easy to fall into an ambush, the officers dismount, and leaving their horses under cover with the orderly, endeavour to work further forward on foot and to choose a suitable place for observation. The success of their reconnaissance will depend on the result of this search. The point should first of all be chosen roughly on the map, but the final choice must be made upon the ground itself. In choosing it should be remembered that a place which may appear to be exceptionally good may be so conspicuous that it will draw on itself the attention of the enemy, and that a better concealed place may be more suitable for safe prolonged observation, so long as its field of view is large enough to allow the carrying out of the special task in hand.

As soon as they are conveniently and secretly posted, the observers begin their work. One of the officers prepares a rough survey sketch of the ground, and the other a panoramic sketch. This done, each shows on his sketch the point from which he is observing, and then begins to fill in the details of the hostile position as they gradually become evident to him.

The *survey sketch* must show graphically everything that concerns the object of the reconnaissance, and nothing more. The roads, rivers, villages, heights and other local objects are drawn in from the map, and the sketch is then completed by observation, care being taken that everything is shown absolutely to scale. Whatever cannot be shown graphically is written in on the side, heights and distances are given in figures.

The scale of the survey sketch, for a length of front of about 800 yards, should be 100 yards or 200 yards to the inch; plans of special localities

and strong points should be made to a larger scale, 50 yards, or less, to the inch.

The flanks of neighbouring sections of reconnaissance should overlap to facilitate the connecting up of all the sections into a general plan. It is extremely important to take bearings to various points along the hostile position, in order that the positions of these points may be found by intersections on the general plan.

Panoramic sketches, or sketches of the shape of the ground on a vertical plane, are useful in addition to survey sketches as giving a clearer representation of the hostile position. They must show accurately the form of the country and all sharply defined objects, such as trees, houses, roads, churches, etc., and, with especial care, the hostile position in the aspect in which it presents itself to the observer.

The paper on which the panorama sketch is drawn should be prepared with 10 to 15 vertical lines at equal distances of 1 or $\frac{1}{2}$" apart, and with 3 to 5 horizontal lines drawn on the lower part of the paper at equal distances apart of one-half those of the vertical lines.

For estimating the relative positions of local objects a "perspective scale" is necessary. A simple method, which is in common use in the Artillery, is to extend the right hand to full extent and turn the three centre fingers vertically upwards. For all men the breadth of these three fingers, held close together, is approximately ten times their distance from the eye, so that the width of ground concealed by these fingers is one-tenth of its distance from the observer. In the same way the width of ground concealed by the whole hand is ·2 of the distance, and the width covered by the extended fingers and thumb is ·3 of the distance. Any one of these measurements can be taken as the width represented by the intervals between the vertical lines on the paper, but whichever is chosen should be distinctly noted at the foot of the sketch.

The writer suggests another method by which the object is not concealed during the operation, as it is with the raised fingers or hand. This is done by extending the arm and raising the thumb only, and then observing the object with first one eye and then the other. In this case also the interval between the eyes is approximately ·1 of the distance between the eyes and the thumb.

In making a representation of the ground upon the paper thus prepared, the top horizontal line will show the extreme sky-line and the bottom one the immediate foreground. Some sharply defined local object is put approximately in the centre of the picture, and serves as a referring object when filling in the various details. The name of this object should be noted in the left corner of the sketch, and also its compass bearing from the observer. In filling in other details their distances from the referring object are found by means of the fingers. In this way a series of objects gradually appear on the sketch. The contour of the hills is finally filled in, and in doing this their characteristic peculiarities should be shown generally, and not small folds in great detail.

All survey sketches and panoramas should be completed with scale, north-point, time and the signature of the observer.

Everything noted by the observer should be shown on survey and

panorama, but if anything excites his doubt or uncertainty he should note the fact by means of a mark of interrogation.

The information required of an Engineer reconnaissance of the enemy's dispositions on a position can only be obtained by patient, attentive and prolonged scrutiny. Not only before a battle, but even during a modern battle, is the utter *emptiness* of the field of battle noticeable, and for this reason observing is extremely difficult, and success will depend mainly on the choice of the observing point, the eyesight of the observer, his field glasses, and above all on the *practice* he has had at his work.

Reconnaissance is more easy in hilly country than in the level, partly because better observing stations are obtainable and partly because of the greater difficulty in concealing works of fortification. Trenches for instance encircling a hillside show up as dark lines, however well they may be coloured to match their surroundings. This is due to the effects of light and shade upon the sloping ground. Obstacles also are easily seen, as it is difficult to conceal them on high ground. A battery firing from a concealed position may be located by the dust, which rises in a light cloud from behind the mask; this also may disclose the site of the enemy's camping ground.

If there is any movement on the hostile position, if works are being thrown up or men are noticeable, then the reconnaissance is greatly facilitated, and it is only necessary to follow attentively the movements of the men. Masks and dummy works can be discovered by noticing the dispositions of the men with relation to them.

If men appear to remain a long time without stirring, they are probably dummies. In the late war the Japanese often made dummy batteries of carts and logs, with detachments of dummy men, while the actual batteries were placed somewhere near by, but outside the spheres of danger of the dummy batteries. To complete the illusion they used to fire pyroxilene cartridges in the dummy batteries, so that the flashes and dust should give the effect of firing. All such dummy works may be discovered by careful and prolonged scrutiny.

In level ground observing is very much more difficult. The observing points will have to be in trees, (but not isolated ones as in these he will be seen at once) the roofs of houses, observatories, church towers, etc. A well-masked trench, especially if without a parapet is very hard to see; felled bushes, trampled-down grass or corn may reveal it; if the trench is loopholed it is very quickly seen. A wood, put in a state of defence, may be recognized by felled trees and abattis, which are very difficult to hide. Villages, like those in Manchuria, which are surrounded with walls of mud or brick, are usually adapted for defence by piercing loopholes in the walls of the houses. These loopholes can be seen from a great distance, and by counting their number it is possible to estimate the amount of fire which can be developed from the village in any particular direction. Villages like those in Russia, which are not surrounded by walls, are prepared for defence by digging trenches in their outskirts, or in front of them, and from this it can be decided whether they are held or not.

During reconnaissances in force Engineer officers must use every possible opportunity of getting close to the enemy's fortified position, in

order to amplify the information which they have already gained by reconnaissance.

The reconnaissance parties must send in detailed reports of their reconnaissances, with their survey and panorama sketches, to the commander of the Engineer reconnaissance detachment, who will prepare the general combined report, which he will present to the staff of the attacking force as material on which to prepare the plan of attack.

In conclusion the author mentions some of the reasons which urged him to write this article.

Reconnaissance by Engineer reconnaissance detachments was practiced to a large extent during the late war, especially in the second half of it, and produced very good results. Detailed and accurate sketches of the enemy's fortified positions were prepared in this way by Engineer officers, and General Kuropatkin often referred to them. Besides this it is quite evident that in these days of long-range projectiles, which can hit at a greater distance than a man can see, it will be possible on fewer and fewer occasions to get near enough to a hostile position to observe, accurately and in detail, what has been done upon it in the way of fortification. Only specialists well acquainted with the technical and tactical methods of the enemy can appreciate and *understand* what they see in front of them, especially when it is remembered how widely dummy works of every kind will be applied in the future. The cavalry and other scouts may report that such and such a village is occupied, there trenches are visible, elsewhere entanglements, etc.; but they cannot give a general, complete picture of the fortified position, with its mutually supporting chain of strong points.

There is no doubt that in the future reconnaissance by Engineer parties will be widely applied, but the success of the work, as has been said above, depends mainly on *practice*. The specially favourable circumstances of the late war gave the Russians opportunities for learning in the field, but experience showed that the early results were wretchedly bad, and the knowledge was gained at a price which was heavy and sometimes bloodstained.

But the circumstances of the late war may not occur again, and in a future campaign the troops may find themselves in action with no more experience than has been studied and mastered in peace time.

Meanwhile no practice at all is being gained in peace time in the Engineer reconnaissance of a position. Very few Sapper officers, who did not take part in the war, have ever seen what is the appearance of a rifle trench on a hill or on the level, at various distances.

It is suggested that this deficiency should be remedied by training the Sapper and Engineer officers in the following way: —

i. At the Engineer School. When the students are, during the summer, solving tactical-fortification problems in the field, they should be practiced concurrently in defining the distances of local objects by eye (from their apparent size) and by help of the fingers as described above; in deciding the heights and dimensions of hills, the steepness of their slopes, the approaches to them and the ground near and distant, which is defiladed from them; in fixing the enemy's probable artillery positions and observa-

tion stations; in noticing the appearance of front-lying ground when seen from a commanding height and from the level, and in obtaining bearings without a compass, etc.

Several of these exercises are extremely simple, but they should be gone through at least once, as otherwise in spite of their simplicity they might not occur to the student when required.

It would also be useful, for example, when visiting an artillery range or field firing ground to train the students to tell by the burst of a shell or shrapnel what is its calibre; at present they only learn what gun makes most noise, which has absolutely no military value. By the trajectories of the shrapnel bursts the distance of the battery which is firing can be gauged, and by the character of the fire some idea may be gained of the target at which it is firing. All of this is very interesting and necessary for reconnaissance observation and exercise. At the same time the student would obtain at least an approximate acquaintance with the circumstances of a modern battle.

ii. At the Engineer Academy. During the tours carried out for the study of fortress fortification, the reconnaissance of a small section of the fortress belt should be included in the programme with fixing bearings, defining distances, approaches, etc., and the preparation of survey and panorama sketches. Only one day would be devoted to this work, and its utility would be great.

iii. During Sapper camping periods it is recommended that Sapper officers should learn the appearance of the different fieldworks from various distances, and should also practice obtaining bearings, estimating distances by eye and by the help of the fingers, etc.

The late war was a searching examination in all the methods of peace training, and impartial opinions agree that the Russian engineering troops, in spite of a few deficiencies, as a body passed this examination splendidly. But the war unfortunately only produced examples of retirements and defence without counter-attack.

In future it is to be hoped that, following the maxim of the great Suvorov, the attack will be the rule. And in the conditions of the modern battle *Reconnaissance in the attack plays a pre-eminent part, and takes the place of the personal reconnaissance by the Commander-in-Chief of the probable field of battle.*

In order that they may again pass the examination of war, Engineer officers *must learn the reconnaissance of the battlefield in peace time.* In war it is too late to learn. "La campagne serait terminée que notre instruction commencerait, mais au prix de quels résultats? Malheureux sans doute."

F. E. G. SKEY.

NOTICES OF MAGAZINES.

Boletin Militar.

Two copies have been received of the *Boletin Militar*, a new military periodical the first number of which appeared last January, and which will be issued monthly by the Ministry of War and Marine of the United States of Venezuela.

Each number consists of about 40 pages, and part of the matter is supplied by the military and part by the naval branch of the Ministry. The number for May contains a description of the Steward Telemeter; tables showing the admissions to and discharges from the Military Hospital at Caracas during the first three months of this year; a note on the means of determining the error of eccentricity in sextants; a short description, chiefly hydrographical, of the Peninsula of Araya; some notes on the Schneider-Canet 15-c.m. Q.F. gun; a short description of the Island of Toas; instructions for the employment of the Barr and Stroud Range Finder; and a short note on the employment of oil fuel in the British Navy.

'M.'

Nature.

August, 1910.

Cordite.—The production of a smokeless powder was ever the dream of the military strategist, and with the discovery of guncotton the conclusion was hastily arrived at that the ideal propellant was found, only to be rudely dissipated by numerous serious disasters. Guncotton for a long time resisted all attempts to render its combustion sufficiently under control for it to be adapted as a propellant, yet to-day it is the basis of the smokeless powders of all nations. Its early failures were entirely due to the retention in the nitrated cotton of the physical characters of the parent cotton, for even after reduction to an extremely fine state of division during the process of manufacture, the fibrous nature of the cotton persisted. Success has only been obtained by the destruction of this fibre, and the smokeless powders of all nations may be classed either as simple gelatinized guncottons, in which soluble nitro-celluloses have been gelatinized by treatment with an ether-alcohol mixture, or as nitro-cellulose nitro-glycerine colloids, in which the nitro-cellulose employed may be of the soluble variety, as in ballistite or the insoluble (true guncotton), as in the case of cordite.

The introduction of blasting gelatin by Nobel (1875) consisting of some 90 per cent. nitro-glycerine with 10 per cent. of soluble nitrated cotton in a gelatinized form, was the first step towards the production of powders of the cordite type. The high percentage of nitro-glycerine rendered blasting gelatin unsuitable for use in guns, but by incorporating the two constituents in equal proportions, Nobel gave to the world the first successful smokeless powder of this class, ballistite.

Cordite was the work of the late Sir Frederick Abel and was patented a year later than ballistite, in 1887. The essential difference between ballistite and cordite is, that while the former contains soluble nitro-celluloses, cordite contains the insoluble or tri-nitro-cellulose. This change in the character of the nitro-cellulose employed, entailed the introduction of acetone in the manufacture of cordite. Soluble nitro-cotton and nitro-glycerine can be thoroughly incorporated in the presence of water without the aid of any solvent, but the ingredients of cordite can only become incorporated in the presence of a mutual solvent. It is essential that the solvent shall be sufficiently volatile to admit of its removal at a low temperature from the finished powder, and acetone, which boils at 50° C., fulfils all the conditions best.

Nitro-glycerine is the only explosive containing an excess of oxygen, all nitro-celluloses being deficient in this element to give complete combustion of carbon to carbon dioxide and hydrogen to water. It follows that the incorporation of these two explosives with each other is desirable. The total change in physical characters of both brought about when mixed entirely alters the character of their explosion; singly, both constituents are beyond control, once combustion is started; gelatinized together, combustion is regularly progressive throughout the mass, an essential condition for a propellant.

Cordite at first consisted of 68 per cent. nitro-glycerine, 37 per cent. nitro-cellulose, and 5 per cent. of vaseline, but this caused serious erosion in the guns due to the rapid motion of the gaseous products at a very high temperature. This led to the introduction of modified cordite—called MD—30 per cent. nitro-glycerine, 65 per cent. nitro-cellulose, and 5 per cent. vaseline, a reversal of the former proportions of the ingredients. Vaseline reduces the metallic fouling in the gun and provides just the slight lubrication needed, it also acts as a "stabilizer" in the cordite.

In the manufacture of (MD) cordite, the guncotton is dried at a temperature of 40° C. and is then mixed by hand with the due proportion of nitro-glycerine, and passed through a sieve. This paste is then kneaded for about seven hours with acetone and vaseline in a machine originally designed for kneading baker's dough, the acetone causing this mass to assume the consistency of dough. The dough is then "squirted" by hydraulic pressure through slits of suitable diameter, cut into lengths and taken to the drying chamber when the evaporation of the acetone at a temperature of 105°, causes it to lose its plasticity and converts it into the semi-horny mass from which its name is derived. The size in use for rifle cartridges being only ·0375" in diameter, is, however wound on reels, and not cut into lengths until required in the cartridge-loading room.

One of the most important considerations with reference to any explosion is its stability under ordinary conditions of temperature. The explosive properties in such substances as nitro-cellulose and nitro-glycerine depend entirely on molecular rearrangement, which is practically instantaneous when detonation occurs.

Slow decomposition occurs in most nitro compounds of the explosive class at temperatures not greatly above the normal with the production of oxides of nitrogen, and it has been shown that these oxides act catalytically on the explosive; in other words their effect becomes cumulative and may lead to ignition. "Stabilizers" have been introduced capable of absorbing these nitrogen compounds and the vaseline in cordite appears to perform this useful function.

W. E. WARRAND.

REVUE MILITAIRE DES ARMÉES ÉTRANGÈRES.

February, 1910.

MILITARY NEWS FROM DIVERS COUNTRIES.—*Austria.*—The mountain artillery is in process of being re-armed with a new 10-centimetre howitzer. The howitzer is a long-recoil weapon, and can be separated into three parts for transport purposes, each part weighing about 300 kilogrammes. It is protected by a shield made in two parts.

Belgium.—The new military law, passed on the 1st December, is to provide a fighting force of 42,800 men always under arms, the average time of service for each man being 23·3 months.

Germany.—The following new courses have been instituted at the Infantry and Musketry School:—(1). An "information course," for senior officers of the infantry and cavalry. (2). An "instructional course" for captains and lieutenants. (3). A machine-gun course, for the commanders of battalions to which machine guns are attached. (4). A "practice course," for young infantry officers, and cavalry N.C.O.'s.

The Imperial manœuvres will take place this year, between the 8th and 10th September, on the east of the Vistula, between that river and the Passarge.

Italy.—After several experiments on the organization of the machine-gun sections, the Italian Government has at last decided to adopt the system of two-gun sections equipped with maxims carried on pack saddles. Each Alpine battalion, infantry or cavalry regiment has a section attached to it. A manual on the employment of machine guns has been issued. The section is to be regarded above all as a reserve fire unit at the disposal of the battalion, etc., commander, which he is to use chiefly against very visible moving targets, or at critical moments in the fight.

An aeronautical course, for the training of airship pilots has been instituted, and can be attended by any artillery or engineer subalterns who desire to do so. The qualifications required to be allowed to attend this course are:—(1). To have sufficient scientific and technical knowledge

to be able to go through the course with advantage: (2) to be physically fit: *i.e.* not to suffer from any nervous, cardiac or pulmonary complaints, and to have good eyesight and good hearing. The course will be divided into two parts:—(*a*). The theoretical training, which takes place at Rome and lasts 45 days. In this part of the course, the candidates are taught all about the construction of balloons, and dirigibles, and special attention is given to the putting together and dismantling of propellers, motors, and propelling gear. (*b*). The practical course lasts 6 months, and takes place in the Vigna di Valle, north of Rome. The course may be finished by a cruise on a sailing ship, to enable the future air-pilots to familiarize themselves with the working of sails, and to improve their physical condition.

March, 1910.

MILITARY NEWS FROM DIVERS COUNTRIES.—(1). *Austria.*—The use of the ski, which before 1907, was practically unknown in the army has gradually increased in importance. In the winter 1909–10, 60 officers and 60 N.C.O.'s were put through a ski-course, and, as a result of experiments made in 1909, an official manual on the military use and employment of skis and snow rackets was issued. Experiments were made in the transport of machine guns on the backs of ski-ers, and on the connection of posts by means of men on skis. It was found possible to reduce the load on each man to about 20 kilogrammes, and by this means the machine guns could be carried to the tops of hills too steep to be practicable for ordinary pack animals. As regards the second experiment, it was found possible to transmit a message over a distance of 34 kilometres in 1 hour and 40 minutes by using five groups. Seven officers and 46 men were thus employed. The message was sent through on a day when there was a blizzard.

The first Austrian wireless telegraph station was opened to the public in February, 1910; it is at Pola, has a normal range of 500 kilometres, and is provided with all the latest improvements in the radio-telegraphic line. Two other stations will shortly be opened on the Adriatic coast line. Each infantry and rifle company is issued with 16 small and 4 medium wire nippers, and each squadron with 8 small and 2 medium ones. The small nippers are intended solely to cut wire, the medium to cut branches or creepers as well. The small size weigh 289 grammes, and with them two men should be able to cut through a network of wire 12 metres broad in 15 minutes.

(2). *Germany.*—In February, a 10 days' training was carried out by the Communication troops of the German Army, in the Harz Mountains with the object of finding out the facility with which motors, and motor bicycles can operate in hilly country in the winter, when the ground is covered with snow or frost. In many cases, as the depth of the snow exceeded 1 metre, it was found necessary to use men and even horses to extricate the vehicles.

On May the 11th the German automobile corps carried out, in conjunction with the Austrian automobile corps, a series of trials between Dresden and Vienna.

A corps of volunteer motor cyclists has just been raised. Its members must be of German nationality, have served their time in the regular army, and be in possession of a serviceable motor bicycle, with tools, etc. In the event of mobilization, they will receive an indemnity of £10, be supplied with clothing and equipment, and receive a salary of 10s. in Germany, or 12s. in foreign countries. Their bicycle is bought by the Government on the outbreak of war, and they are allowed 1s. per diem for running expenses.

(3). *Italy.*—Two annual courses of optical telegraphy, each lasting two months and starting on the 1st March and 1st May respectively, have just been instituted in the Italian Army. They are open to officers and N.C.O.'s of the coast and fortress artillery, and to those of the Alpine regiments.

(4). *Argentine Republic.*—The infantry has just been reorganized and is to consist of 10 brigades each of two regiments; two brigades are allotted to each military district. The first battalion of each regiment is to supply the regimental staff. Only the regiments with odd numbers (1, 3, 5, etc.) are however to have two battalions.

(5). *Russia.*—Definite age limits for the retirement of officers have at last been instituted. They are determined not by the rank of the officers, but by the appointments which they hold, and are such that an officer cannot be appointed to any billet, if age will force him to retire from it before he has held it for three years. In time of war the rules are to remain in abeyance; they are also waived aside in the case of officers who won the military order of St. George in the Manchurian campaign.

April, 1910.

(1). The Operations Round Melilla.—This and the previous number contain a long account of the operations round Melilla. The following notes are taken from the remarks at the conclusion of that article, on the conduct of the campaign.

(*a*). The Spanish Government showed remarkable tenacity of purpose in carrying through the campaign, in spite of the opposition it met, especially after the first reverses, which were a great blow to the national pride.

(*b*). The war had been well anticipated by the Government in the matter of *matériel*, but the *personnel* was not as well trained as it should have been, owing largely to the practice of granting long periods of leave to the troops, with the result that the existing units were nothing more or less than cadres. As such they had not the necessary training to fit them for service in the field. This disadvantage was however to a certain extent counter-balanced by the policy of the War Office in sending to the front, not isolated battalions, or companies, but whole brigades from one spot, *i.e.* troops trained to work together.

(*c*). There was considerable difficulty throughout the campaign in properly combining the action of the artillery and infantry. This was in a large measure due to the tactics of the Riffians, who having once experienced the effects of artillery fire, retired after the opening of the fight in very open order, thus taking its target away from the artillery, and forcing the infantry to advance, and bear alone the brunt of the fight.

(*d*). The proportion of cavalry in this campaign, (17 squadrons) was very large, considering the mountainous nature of the theatre of operation. The cavalry was hardly ever used as is laid down in most modern field service regulations, *i.e.* pushed well forward so as to undertake the duties of protection and reconnaissance. The squadrons were singly attached to portions of the column and protected them, thus their sphere of action was but small. When the occasion arose, the cavalry charged the enemy with a bravery and temerity worthy of the oldest traditions of the Spanish nation.

(*e*). As a rule at night the outposts were placed too near to the main body, and too much reliance was placed on mechanical alarms, such as networks of wire, searchlights. The result was that false alarms frequently kept large bodies of troops the whole night under arms.

(*f*). Machine guns were found to be of the greatest use during this campaign. They might however have been still more useful had they been pushed further forward into the firing line. The failure to do this is ascribed to lack of training.

(*g*). The proportion of artillery was a comparatively small one—only 2 guns per 1,000 men—but the services rendered by both field and mountain batteries were very great.

(*h*). The expeditionary force was accompanied by a large number of engineer troops, and thanks to the attaching of a company of telegraphists to every infantry brigade, communications were remarkably well kept up. The balloon company was also of great use to the force both for reconnaissance and in assisting in mapping out the Gurugu massif.

(*i*). The only branch of the army which did not prove itself entirely satisfactory was the medical corps. The doctors themselves performed their duties with enthusiasm and devotion, but there were not enough mules or carts to carry the wounded from the battlefield, and from the field dressing stations to the head hospital at Melilla.

(*j*). After the campaign the Spaniards immediately began to construct roads joining Melilla to the principal posts in the district, and to organize a corps of native troops under European officers, so as to minimize the number of European troops in the province.

(2). MILITARY NEWS OF DIVERS COUNTRIES.—*Germany*.—A new manual on the methods of feeding an army in the field has just been brought out. It consists of:—A preface indicating the general principles on which to carry out the feeding of an army in war time. Part 1:—which gives the rates to be paid and the scale of issue of rations. It also points out the various means of obtaining those rations, *i.e.* by billeting the troops on the inhabitants, by issuing rations to the troops, or thirdly by giving the troops money and letting them buy food for themselves. These methods can all be used concurrently, if necessity arises. They are normally to be employed as follows:—In Germany, method (*a*) for troops on the march or in cantonments, otherwise methods (*b*) or (*c*): in an ally's country his own methods will have to be employed: in an invaded country, method (*a*) will be employed as much as possible, otherwise method (*b*). Part 2 deals with the supply of forage. The

regulations are very similar to those affecting the supply of rations. Part 3:—Organization and accounts.

Italy.—Lieutenants of the infantry, cavalry, artillery or engineers, who aspire to promotion by selection, have to undergo two special examinations, viz. a preliminary and a final exam. The preliminary examination includes:—essays on a tactical subject, history, and geography, and a sketch. The final examination includes six tests:—An examination in a foreign language: a practical test of the candidate's skill in handling troops on the ground: a tactical exercise with skeleton formations: a riding examination: a written exercise on the employment of the three arms: an oral discussion on the subjects of the written tests. Staff officers need not undergo this examination. As a result of the examination the seniority lists will be altered.

A. H. Scott.

Rivista di Artiglieria e Genio.

May, 1910.

French and German Opinions on the Military Employment of Dirigibles and Aeroplanes.—This article contains extracts from a report published in the *Revue d'Artillerie* of last December. The application of dirigibles to military purposes may be referred to under the following headings:—

1st. At the commencement of mobilization a dirigible stationed at one of the frontier posts can be placed at the disposition of the Commander-in-Chief for reconnoitring the enemy's points of concentration, lines of communication, etc.

2nd. In a campaign in the field, a dirigible may be assigned to an army for reconnoitring purposes and will prove useful during the march and can be pushed forward in advance.

3rd. In siege warfare, the dirigible may be employed for reconnoitring the lines of investment under conditions much more favourable than those of a captive balloon, because it can be transported wherever its presence is necessary, and the inequalities of the ground will not cause any impediments to observation.

4th. The dirigible can establish communication between a besieged place and the interior of the country either by day or by night.

5th. The employment of dirigibles for offensive action by the discharge of explosives on certain points of the ground occupied by the enemy may also be considered. The trials made with the "Lebaudy" in this direction demonstrate the possibility of such employment, but it still seems premature to transform the dirigible into an actual fighting factor, its powers of destruction being limited.

6th. Finally, by the several uses referred to above the dirigible may produce a considerable moral effect. The army that is not assured of

the dominion of the air will remain always under the demoralizing effect of a continuous threat.

The dirigible can ascend to a height of about 1,500 m. and can maintain itself in the air for several hours with an average velocity of 50 k.m. Its radius of action should be about 200 k.m., according to its distance from the ground, and its velocity, its own vulnerability is lessened, without diminishing its power of observation. By the action of its motor it has the certainty of being able to alight outside the zone occupied by the enemy.

The military aeroplane is chiefly a machine for exploration, and in the future may be destined to carry an observer who should be free from the charge of conducting the machine, and who should be able to devote his attention entirely to taking notes and photographs of the enemy's position, etc. In case of stoppage of the motor the machine should be able to take the ground without danger to the *personnel* or to the material. These conditions of security are most necessary, since an aeroplane destined to work in connection with troops would only prove a permament danger to them if it was forced to descend in their midst. It would then be necessary that a military aeroplane should be provided with two motors, either of which would be capable of sustaining the machine in event of injury to the other. The machine should be capable of ascending to a height of at least 400 or 500 metres. The aeroplane may also serve as an organ of communication between an army corps and detachments charged with special missions, such as divisions of cavalry. It travels at a greater rate than an automobile, which has generally to follow an itinerary less direct and frequently on roads in an encumbered and wretched state, so that there would be less chance of its being captured by the enemy. It would also be able to establish communication between a besieged fortress and the external world. With boldness and a little good fortune it might easily find means of passing over the investing lines without being exposed to the enemy's fire.

With regard to the instruction of the pilots and the observers, considering that the use of aeroplanes in war cannot be effected without danger to the *personnel*, the preparation of such *personnel* in time of peace is a very delicate operation, and should be conducted with great prudence to avoid the danger of loss of life and material. The preliminary exercises should be executed in connection with the manœuvres, so that the machines now existing may be able to participate in the manœuvres without danger to the aviators or to the troops. It is evident that the instructors should be selected from amongst the officers.

In conclusion, the dirigibles in France are destined, without doubt, to render great service to the national defence, and the machines heavier than air will in the near future add greatly to the means of communication now existing in the army. The aeroplanes at present in use may render useful service in war, but only to a limited extent since they are deficient in the requisites necessary for military purposes. Under these conditions it is indispensable that the military administration should consider seriously the solution of these problems, in which the services for war are particularly interested.

EDWARD T. THACKERAY.

CORRESPONDENCE.

A SPANISH WINDLASS.

SIR,

In the *Scientific American* of April 16, 1910, there appeared a short article on a "Spanish Windlass" with a sketch as shown in *Fig.* 1. The windlass simply consists of two spars or pickets, one, *A*, vertical, and one, *B*, held horizontally against it. A rope is fastened from the weight to be moved to an anchorage, the windlass put up on the line of the rope, and a bight of the rope taken round *B*. The weight is moved by walking round on *B*. No lashing is required. The toe of *A* moves towards the anchorage as the weight is pulled in.

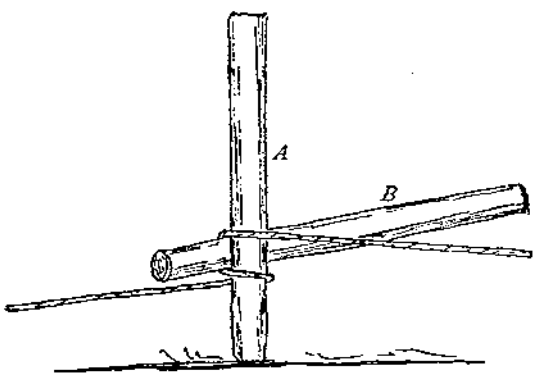

FIG. 1.

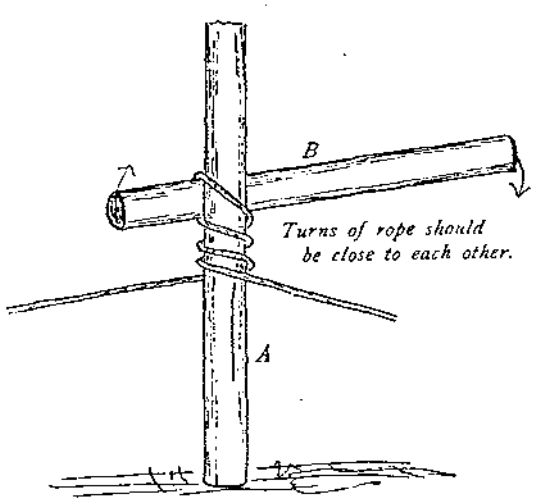

FIG. 2.

This improvised windlass will be found exceedingly useful. The following points should be noted :—

(1). The rope on both sides, to anchorage and to weight, must come away from *A* on the same level, below *B* for choice, as shown in *Fig.* 2. Otherwise the moment set up prevents *A* being held vertical. It will be found that with a little adjustment, the ropes wind themselves round *A* absolutely correctly.

(2). The windlass must be exactly between the weight and the anchorage.

(3.) *A* must have a blunt end, otherwise it will bore into the ground, and not move along. An occasional kick from the man holding it is usually all that is required to keep it in place.

(4). The ground must be fairly hard.

Yours faithfully,

A. L. PARIS,
Capt., R.E.

The Editor, *R.E. Journal.*

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WINDMILLS AND WIND MOTORS; HOW TO BUILD AND RUN THEM. By F. E. Powell. 6d. Percival Marshall & Co., 26—29, Poppin's Court, Fleet Street, E.C.

THE WAR OF SECESSION, 1861—1862; BULL RULL TO MALVERN HILL. By Major G. W. Redway. 5s. Swan, Sonnenschein & Co., 25, High Street, Bloomsbury, 1910.

THE ARMY ANNUAL AND YEAR BOOK, 1910. Edited by Major B. F. S. Baden-Powell and Lieut.-Colonel H. M. E. Brunker. 7s. 6d. Wm. Clowes & Sons, Ltd., 23, Cockspur Street, S.W.

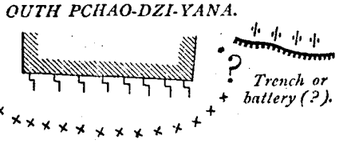
LOGARITHMIC LAND-MEASUREMENT. By J. Wallace. 5s. E. & F. Spon, Ltd., 57, Haymarket, London, 1910.

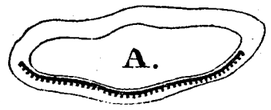
THE CONSTRUCTION OF A HOUSE. Being the Study of Building Construction presented by means of 40 plates containing plans, elevations, sections, and detail drawings, with descriptive text, of a design for a country house, together with motor house and chauffeur's lodge. By Chas. Gourlay. 6s. in portfolio; 6s. 6d. bound. Batsford, 94, High Holborn, W.C.

THE RECONNAISSANCE OF A FORTIFIED POSITION.

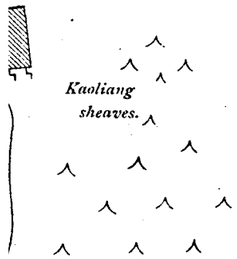
SOUTH OF VUDZHANIN.

OUTH PCHAO-DZI-YANA.





PCHAO-DZI-YANA.



Field of kaoliang in sheaves.

e tem e in ANDIANTUN.

Trenches of Bugulminski Regt.

NOTES.

(1). Observing point in VUDZHANIN native house

(2). Clearly visible 75 loop-holes in north wall of NORTH PCHAO-DZI-YANA and 25 loop-holes in wall of BEZIMANNAYA.

(3). Trench on knoll A with loop-holes.

(4). Single shots heard from cemetery, where the enemy has an observation station.

(5). Enemy's trenches are of full profile, *i.e.* men moving in trench not visible. Height of parapets + ½ to ¾ arshins (*i.e.* 1′ to 1½′).

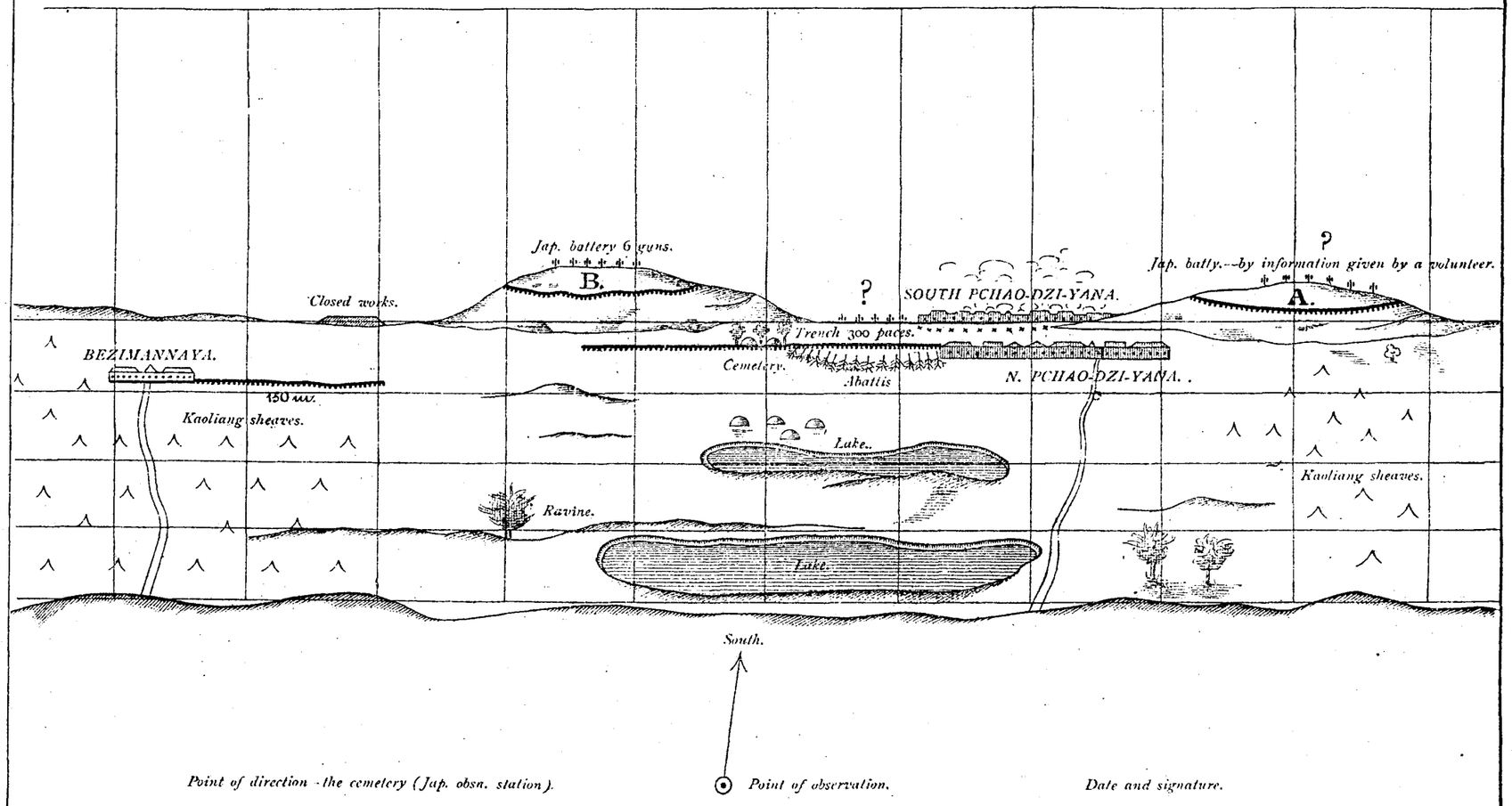
(6) Trenches of Bugulminski Regt. shelled by occasional Shimoze fire from battery behind knoll B; battery masked with kaoliang but dust and flashes seen.

(7). To S.E. of B there is a closed work. Men seen carrying beams for blindages (?).

(8). Fire of SOUTH PCHAO-DZI-YANA impedes reconnaissance. Some buildings and wire entanglements visible.

Date and signature.

VIEW OF JAPANESE POSITION TO SOUTH OF VUDZHANIN.



Point of direction - the cemetery (Jap. obsn. station).

Point of observation.

Date and signature.

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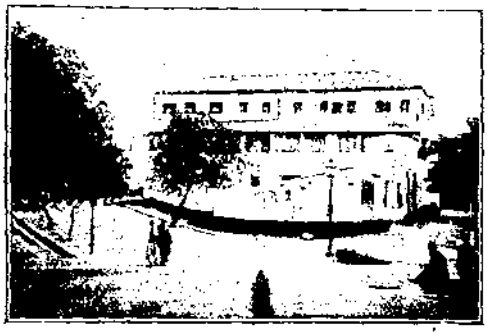

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