THE ROYAL ENGINEERS JOURNAL.—SEPTEMBER, 1914. Pages 145—216.

THE ROYAL ENGINEERS JOURNAL.

Vol. XX. No. 3. SEPTEMBER, 1914.

CONTENTS.

ROYAL ENGINEERS INSTITUTE.

PATRON.

HIS MAJESTY THE KING, COLONEL-IN-CHIEF.

COUNCIL.

Elected Members.

COLONEL C. F. CLOSE, C.M.G.
COLONEL F. J. DAY.
BT. LIEUT.-COL. R. N. HARVEY, D.S.O.
MAJOR H. BIDDULPH.
CAPT. C. E. P. SANKEY.
BRIG.-GENERAL N. M. LAKE.
BRIG.-GENERAL F. J. ANDERSON.
BRIG.-GENERAL S. R. RICE, C.B.
COLONEL J. F. LEWIS.
MAJOR M. G. E. BOWMAN-MANIFOLD, D.S.O., *p.s.c.*
BRIG.-GENERAL F. G. BOND, C.B.
LIEUT.-COLONEL R. H. H. BOYS, D.S.O.
COLONEL R. U. H. BUCKLAND, A.D.C.
LIEUT.-COLONEL G. H. HARRISON.
MAJOR A. H. W. GRUBB, D.S.O.

Ex-Officio Members.

MAJOR-GENERAL G. K. SCOTT-MONCRIEFF, C.B., C.I.E., *D.F.W.*
COLONEL J. E. CAPPER, C.B., *C.S.M.E.*
BRIG.-GENERAL G. H. FOWKE, *I. of R.E.*
COLONEL R. S. CURTIS, C.M.G., D.S.O., *A.A.G., R.E.*
COLONEL W. C. HEDLEY.
MAJOR R. H. LEWIS, *Sec., R.E.C.*
MAJOR W. J. JOHNSTON, *C.I.S.*
MAJOR B. H. O. ARMSTRONG.
CAPT. B. H. WILDRAHAM, *A.I. Photography.*

SECRETARY AND EDITOR.

MAJOR W. A. HARRISON *(Ret.)*.

CONTENTS.

Authors alone are responsible for the statements made and the opinions expressed in their papers.

DEMOLITION OF MASONRY WALLS.

Photo 1.

Photo 2.

DEMOLITION

DEMOLITION OF MASONRY WALLS.

By CAPT. G. B. PEARS, R.E.

AN opportunity was recently offered to the 2nd (Field) Company, R.E., of destroying with explosive a wall some 8 ft. thick at the top, 30 ft. long and running from a height of 19 ft. at one end to 5 ft. at the other.

This wall formed part of a bastion or redoubt built some 40 years ago at the Delta Barrage, near Cairo. It projected into the river at high Nile, and the Irrigation Department desired its removal as they considered that it deflected the current and caused erosion in the river bank down stream. They therefore offered to provide the necessary explosives, transport, etc., and the opportunity thus provided was gladly taken.

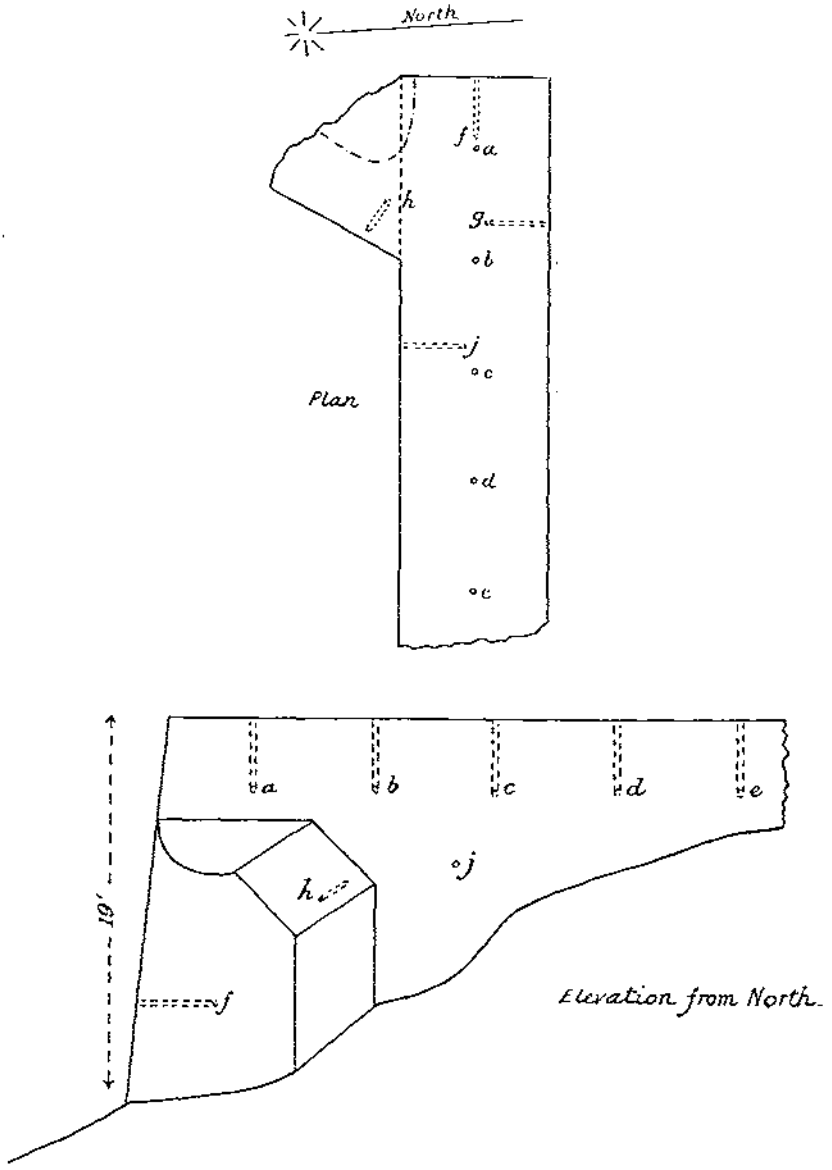
The river was low at the time when the operation was undertaken and the wall stood high and dry above water level. The wall was composed of limestone rubble set in good lime mortar. The end and the re-entrant angle (vide plan) were faced with brickwork, in the former case to a depth of 3 ft. The rubble and mortar had set in the course of years to the consistency of lime concrete, and it was found necessary to sink holes with $1\frac{1}{2}$-in. boring bars. It had been hoped at first that, in the case of the horizontal holes at any rate, it would have been possible to cut in for placing the charges with brick chisels or crowbars, but this proved impossible.

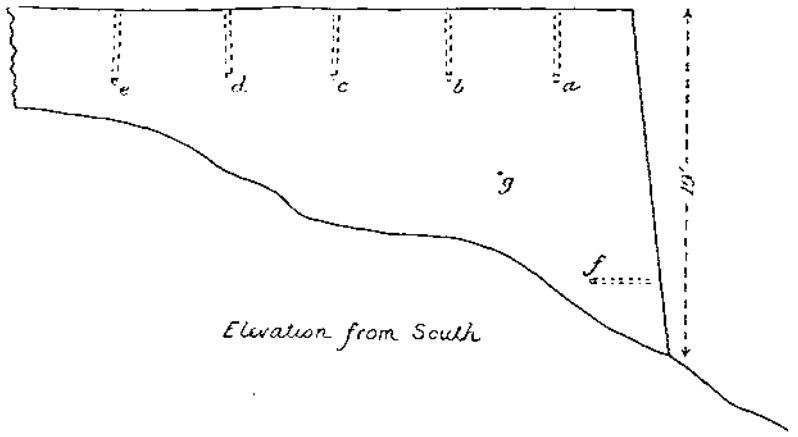
It was desired not merely to loosen the wall, as in the case of blasting rock, but to obtain fairly complete demolition, and for this purpose the *Manual of Military Engineering*, Part IV., did not give much guidance because it was not practicable to follow the procedure therein advocated, viz., to work out the value of the co-efficient K and thereby apply the table on p. 79.

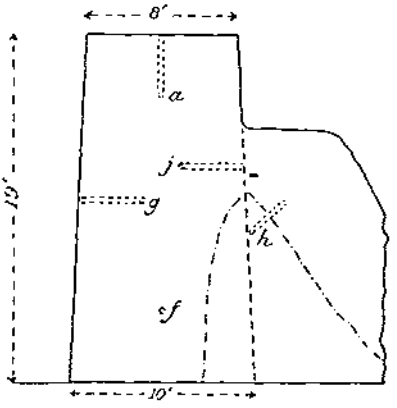
Molesworth's Pocket Book (p. 83) gives an extract from Lefroy's *Handbook of Field Service*, and the formula for the case of a masonry wall 8 ft. thick without counterforts, attacked with charges at two-line intervals, gives a result of 9·6 lbs. of powder. This seemed high; nor could any other definite data for masonry

be found in either *Hirst's Pocket Book* or Guttmann's *Work on Blasting*.

The charges were placed as shown in the plan and elevations of the wall. A total amount of 24 lbs. of gelignite was used, distributed fairly evenly between the boreholes. The average charge per borehole was just over 2·5 lbs.







End Elevation.

The chain-dotted line shews the portion left standing.

a b c d e f	@	2·5 lbs.	total 24 lbs.
g h j	@	3 lbs.	

As the cartridges of gelignite were too small for the diameter of the borehole, they were gently pressed with a wooden rammer as they were put in one by one, until the paper wrapper burst and the gelignite was forced into contact with the sides of the hole. By doing this, about 1·25 lbs. of explosive per foot-run could be put into the hole; they were then tamped with fine river sand in the usual way.

A party of 25 N.C.O.'s and men started work at 8.30 a.m., and the charges were fired simultaneously by electricity at 1 p.m. A total of $4\frac{1}{2}$ hours was thus taken to bore and charge the holes.

Demolition was complete, and the wall was thoroughly disintegrated and reduced to a heap of stones. Only a portion at the angle of the buttress remained standing and this could have been knocked down with a few blows of a pick as it was cracked in every direction.

None of the charges appear to have blown out of the boreholes and no stones from the wall apparently were projected further than 50 yards.

Photo 1 was taken while the boreholes were being drilled; *Photo* 2 immediately after the explosion. The two photographs were taken from the same spot.

DELHI DURBAR.

REPORT ON THE DRAWING UP OF A SCHEME OF CONCENTRATION AND DISPERSAL OF TROOPS FOR THE CORONATION DURBAR, 1911.

IT was recognized from the first that the concentration on, and dispersal from Delhi of the large number of units detailed to attend the Coronation Durbar, was a matter requiring considerable forethought and the co-ordination of a number of different departments and separate railway administrations. In order to effect this and also to gain experience which promised to be most valuable, it was decided to draw up the scheme on the lines already used for concentrations for war.

A special traffic officer having experience of war concentration schemes was therefore deputed from the North-Western Railway to work in collaboration with the Quartermaster-General's Office, and to draw up the tables of stock and arrange the time-tables in consultation with the railway administrations concerned.

It was first intended to concentrate all dismounted troops by rail on four stations in the manœuvre area outside Delhi, viz., at Meerut, Hapur, Khurja and Gurmukhtesar; and no cavalry or artillery were to rail. When the monsoon showed signs of failure the manœuvres were abandoned and it was decided to concentrate a reduced force of all arms by rail on Delhi itself. Subsequent rain assured a sufficiency of fodder, and it was finally decided to rail the infantry of three divisions together with a howitzer brigade, one regiment of cavalry and the most of the Imperial Service troops consisting of cavalry and infantry, all other troops being ordered to march.

The two abandoned schemes were worked out in detail, but it is unnecessary to consider them further as they were never submitted to actual test.

The problem therefore consisted in transporting to and from Delhi a force drawn from all parts of India, at the same time as the railways were exceedingly busy with public Durbar traffic. A table was prepared in the Quartermaster-General's Office showing the units, the railway over which they would travel, the number of trains they would occupy and their detraining and entraining stations at Delhi.

The method followed in drawing up the concentration scheme was as follows :—

At a meeting of traffic managers held at Delhi early in the year

it was decided to allot the period between the 19th and 25th November inclusive to the carrying of troop traffic, and not to make any engagement for other special trains between these dates until troop trains had been fixed. These dates had been fixed with regard to manœuvres, but although the manœuvres were abandoned the dates had to be retained as railways had already made their arrangements on this basis.

All broad-gauge railways agreed to accept a load of 33 vehicles, which allowed of a battalion of infantry being taken in one train. The Oudh and Rohilkhand Railway, East Indian Railway and the North-Western Railway for trains below Lala Musa, were prepared to take a load of 45. On the metre gauge, the load was limited to a maximum of 40, but the average load was 30.

The next step was to prepare a rough scheme on the basis of assumed time-tables so as to ensure that trains should arrive at suitable hours and at suitable intervals. In this the capacity of the three main camp stations, Army Camp, Cavalry Camp and Imperial Service were primarily considered and all trains were arranged to arrive by daylight. In deciding the order in which units were to arrive, the deciding factors were the capacity of the lines leading into Delhi and the necessity for the greatest possible economy in rolling stock.

The capacity of the lines had previously been ascertained from the traffic departments of the railways, with most of whom this, and similar matters, were settled by personal interview.

The question of economy of stock had not received special attention in the war concentration schemes, but for the Durbar concentration it assumed great importance owing to the heavy public demand that there was certain to be at the same time.

The arrivals were therefore so arranged as to allow of each rake of stock being used as often as possible by the same kind of unit, it being left to railways themselves to take advantage of this if they wished to do so. The time allowed for turning the stock round at Delhi was a minimum of six hours, and six hours' daylight were given at entraining stations. The system was worked out to the fullest extent on the North-Western Railway where many rakes were used four times over in the seven days concentration lasted.

The rough scheme thus worked out was submitted to railways, who worked out the time-tables to conform as nearly as possible to the proposed departures and arrivals, and finally the timings over the Durbar Railway were allotted. Meanwhile the tables of stock were under preparation, and here considerable delay was caused by the necessity for reference being made to divisions by the Quarter-master-General's branch before final figures could be supplied, as in many cases the strengths sent up were wrong and had to be sent back for correction. This, combined with the unavoidable alteration

of two or three units who had to be changed at the last moment, delayed the issue of the stock tables to railways till the beginning of November, and final corrections were sent out as late as November 10th. No attempt was made to prepare the usual diagrams showing the running of each train, but the stock tables were practically in the same form as those used for the war schemes. An abstract time-table was compiled and printed for the use of the troops.

The preparation of the scheme for the dispersal was a comparatively simple matter. Each railway had an office in Delhi and two successive meetings were arranged with the representatives of the railways and the Assistant Director of Railway Transport. The latter officer had a list of the units, and, as each was brought up in turn, its departure from the camp station and onward timings were arranged by the officer representing the Durbar Railway and the other line concerned. The necessary consideration was of course given to the available accommodation at the camp stations, but owing to the great number of public specials to be arranged for many troop trains had to leave during the night. Stock requirements were communicated direct to railways by the Assistant Director of Railway Transport, and the railways' own special time-tables were issued to troops.

Considering that out of the 81 inwards trains and 91 outwards trains which arrived between November 19th and 25th and left between December 17th and 24th, only four arrived and two left over one hour late, the schemes must be considered to have worked satisfactorily. Perhaps it is more difficult on this account to deduce lessons from them. The following observations are however offered:—

It is useless to expect that a scheme made out beforehand will be adhered to *in toto*, schemes must therefore be elastic and easily altered in detail.

The economical use of stock deserves more consideration than it has had, but must not be carried to extremes in war schemes as this is incompatible with elasticity. The form in which schemes are drawn up is probably susceptible to improvement. The train diagrams were successfully dispensed with for the Durbar. They are in any case in a form strange to railway officials, and it is for future consideration whether a diagram of the nature of a graphic time-table would not be of greater use. The graphic issued by the North-Western Railway both for concentration and dispersal was of the greatest use to the Durbar Railway Staff.

TRAFFIC REPORT ON THE DELHI DURBAR LIGHT RAILWAY.

By CAPT. C. WATSON, R.E.

THE chief object of the Delhi Durbar Light Railway was to provide a convenient method of carriage between the more important points in the Durbar area and so to relieve the roads of road traffic. During the Durbar of 1903 the congestion on the roads was very great, and the arrangements made for 1911 therefore were on a much more elaborate scale.

The broad-gauge system was designed to serve the important areas lying round Kingsway, Army Camp, Cavalry Camp, Imperial Service, Provincial Camp, etc. : and also to carry the bulk of the spectators to and from the Durbar and Review, but this did not provide very convenient facilities for passengers between the Visitors' Camp area and Army Camp area and the neighbourhood of the Polo Ground, as it was obviously impossible to run a continuous service of trains on the tramway principle over the broad-gauge system. The light railway was therefore originally designed to run from Tis Hazari Maidan (where the terminus was in close proximity to the Delhi tramway system and the Visitors' Camps) to the Polo Ground, serving the Central Camp area, and to the Amphitheatre running through the Army Camps. It was further intended to run a subsidiary branch to Jagatpur to serve the outlying camps of the 7th Division area, but owing to the reduction in the number of troops these camps were not utilized and this branch was not laid.

It was also thought necessary to give better facilities to the Visitors' Camps lying in the neighbourhood of the north wall of the city, and this would have been best served by extending the line from Tis Hazari to Kashmir Gate. As this was impossible owing to want of space, a branch was laid at the Mori Gate which was only a few hundred yards away.

On the basis of the report of the previous Durbar it might have been expected that the railway would be largely used by passengers willing to pay a fairly high fare, but the large number of motor cars in use in Delhi during the Durbar had considerably altered the conditions, as will be seen hereafter.

Alignment.—The general alignment was as follows :—The head-quarters which included a large stabling yard, loco. yard and washing line was situated on the Tis Hazari maidan. The main platform was situated on the turning loop connecting the up and down lines, and from the loop a line took off giving access to the yards mentioned above. The Mori Gate branch had a separate platform. From Tis

Hazari a double line ran in a northerly direction between the Ridge and the Civil Lines, with stations at Hindu Rao and Flagstaff and a junction at the point where the Alipore road crosses the Ridge. From Ridge Junction the Polo line ran parallel to, and south of, the Mall, with stations as follows:—Probyn Lines where it crossed Probyn road, Mall where it crossed Kingsway and was close to Kingsway Station (broad gauge), Princes road Bandstand where it passed at some distance behind the massed bandstand on the Polo Ground, and Polo close to the west entrance to the Polo ground. Bandstand Station was intended to serve certain Visitors' Camps which were never pitched, hence it was useless as a passenger station but very necessary for train-working purposes. The distance from Tis Hazari to Ridge Junction was 2 miles and from Ridge Junction to Polo 2½ miles or 4½ miles in all. The journey including halts nominally occupied 28 minutes. The Amphitheatre line ran north from Ridge Junction, crossing the Alipur road by an overbridge, with the following stations:—Chandrawal, near the XI. Lancer Lines, Range, VII. Division in the area allotted to that division, Najafgarh where it crossed the Najafgarh drainage cut, III. Division near the south end of the III. Division Camp, V. Division close to Army Camp Station (broad gauge) and the Ordnance Park and Supply Depôt where the line turned west to Jaroda and Bhorari road on either side of the Composite Division. The distance from Ridge Junction to Bhorari road was 5·7 miles and from Tis Hazari 7·7 miles, and the normal running time including halts was 55 minutes. There was some controversy over the name V. Division which was allotted before orders were given that the V. Division would not move to Delhi. It was decided to retain the name as it appeared in the map of the *Durbar Railway Guide*, which had been issued some months before.

These lines were double throughout and a turning loop was provided at Bhorari road and Polo, so that trains were never reversed but ran continuously round in a closed curve. This arrangement allowed of the offside of the vehicles being enclosed with wire netting, which permitted the tracks being laid very close together and also prevented passengers entering or leaving the train on the wrong side.

The Mori Gate branch was a single line with a loop at each end extending from a subsidiary platform at Tis Hazari to a point outside the Mori Gate about 400 yards away. Except at Mori Gate, Tis Hazari, Polo, Bhorari road and Ridge Junction stations were provided with an up and down platform just long enough to take a train of 14 vehicles. At Tis Hazari and Polo there was a single platform on the turning loop and at Bhorari road there were five platforms in succession round the loop, only the first of which was used except on the day of the Durbar. Ridge Junction was not a passenger station as the formation of the Ridge made it impossible to get in

the necessary length of fairly level ground, so that passengers travelling between the Amphitheatre and Polo lines had to change at Flagstaff at which station there was an overbridge.

Station Facilities.—Each station was provided with a separate entrance and exit gate on each platform. Both exit gates were as a rule used, but it was quite impracticable to get passengers after taking their tickets on one side of the station to walk round to the other side by a level crossing and enter by the proper gate; in fact little attempt was made to get them to do so, as it would have entailed a larger ticket-collecting staff, and there was no difficulty or danger in allowing them to cross the line. At Flagstaff, the overbridge was used for this purpose when there was a train in the station, but scarcely ever otherwise. Special arrangements were made at Tis Hazari where the booking was very much heavier than at any other station and, until the troops arrived, was as a rule about equal to all the other stations put together. Two large pens each about 120 square yards in area were made, each having two entrances and an exit on to the platform. The entrances of one were coloured red and placarded AMPHITHEATRE and of the other green and labelled POLO. Convenient to the entrances was a booking office with two windows, and near by in the station building were two more booking windows, one of which was reserved for Upper class passengers and was close to a separate Upper class entrance direct on to the platform. Lower class passengers were induced by means of the direction boards and by men stationed at the entrances to get into the pen corresponding to the train they wanted to catch, and their tickets were checked at the entrance. As soon as a train had come in and the passengers had left by the exit gates, of which there were two, the pen corresponding to the direction the train was to take was opened, and the waiting passengers came in and filled up the train at once. As a further guide to passengers there was a green or red target on the front of each engine, a similar placard on the near side of the engine and a green or red notice displayed on the platform—these were marked POLO and AMPHITHEATRE respectively. The engine targets and placards were marked TIS HAZARI on the reverse side and were turned round at Polo and Bhorari road. At Flagstaff there was also an arrangement of notices showing the destination of the next up train and informing passengers of down trains that they had to change for Amphitheatre or Polo as the case might be. A man was also told off to call out the destination of trains and see that passengers were not overcarried. These arrangements were not in use from the beginning but were added as their desirability became apparent. The Mori Gate branch was served by a shuttle train connecting with the main line trains at Tis Hazari. Tickets issued at Mori Gate were available for a through single journey of any length, and there

was a direct connection over a level crossing between the main and branch line platforms at Tis Hazari. The line was seldom if ever used by the inhabitants of the Visitors' Camps for whom it was built, but the Lower class passenger soon discovered that by taking a ticket at Mori Gate he could escape much of the crush and congestion which was often unavoidable at the Tis Hazari booking office. It was thus a public convenience to a very limited extent, but a loss to the railway.

Train Service.—The line was opened from October 10th between Tis Hazari and Polo. Trains left every two hours between 7 a.m. and 5 p.m., *i.e.*, six in each direction, and the fares were Upper class 4 annas and Lower class 1 anna. The low fare quickly attracted a large number of sightseers from the city who used to go out to Mall and Polo Stations and thence walk to the Amphitheatre through the Chiefs' Camps or to the Polo Ground, from where they could see the various official camps. The line was also used by a considerable number of clerks and others who had business in the Durbar area and lived in the city. From the curve of earnings given it will be seen that Friday, the Mohammedan holiday, and Sunday were always busy days and this is a fair index of the type of passenger carried. By Sunday, the 15th, it was found necessary to double the train service. On the 18th a time-table was introduced giving a 30 minutes' service morning and evening and an hourly service during the day amounting to 14 trains up and down. On Sunday, the 22nd, 26 trains had to be run in each direction.

On the 1st of November the fares were doubled, *i.e.*, Upper class 8 annas, Lower class 2 annas and at the same time the Army Camp branch was opened. A half-hourly service was run to the Polo Ground throughout the day, and an hourly service to Bhorari road. It was expected that large numbers of people would take advantage of the opening of the Amphitheatre line to visit the Amphitheatre, but though the earnings did not drop, the number of passengers decreased for some time, it being apparent that the increase of fares prevented many of the original sightseers from continuing their trips. Moreover great numbers of people had already seen the Amphitheatre, having walked there from Mall Station through the Chiefs' Camps. The curve of earnings will show, however, that traffic gradually went on increasing with the same characteristic rises on Fridays and Sundays.

On November 19th troops began to arrive and, although the city was out of bounds, large numbers of soldiers made use of the line travelling to and from various football and hockey matches on the Polo Grounds and also to the bazaar which had sprung up in the vicinity of Hindu Rao. The service on the Amphitheatre branch was therefore doubled from November 20th so that there was a half-hourly service up and down in both directions between 7 a.m. and

6 p.m. and on the 22nd trains left Tis Hazari up to 9.30 p.m. Up till this time some use had also been made of the railway in conveying military working parties to and from their work and in carrying stores belonging to the Ordnance and Supply and Transport Corps.

Towards the end of November the Visitors' Camps began to fill and as the trains were being very crowded it was thought desirable, after considerable discussion, to introduce as a maximum Rs.1/- Upper class, 4 annas Lower class and 2 annas Soldiers' tickets from 1st December. In coming to this decision it was rightly foreseen that the line would not be used to any great extent by Upper class passengers except on special occasions such as the Durbar. The increase of fares did not materially reduce the number of passengers, the earnings went up with a rush and even with 15 minutes' service on each branch, which was running during the busy periods of the day at this time, trains at certain times of the day were running absolutely full. The greater number of passengers consisted of people from the city going out to the Central Camp area. Next in importance was the military traffic between the Army Camps and the Polo Ground area and civil station and when there was any football match between British units this traffic was very heavy. The hockey matches between Indian troops did not give us so much traffic as many more of the spectators seemed to prefer to walk.

It is also noticeable that the usual increase in earnings on Fridays was swamped by a marked increase on Thursdays which was the day on which troops had leave as a rule.

The total number of passengers carried was over 704,000 and the earnings over Rs.1,30,000/- during the 80 days on which the line was open for traffic.

Special Occasions.—The first break in the ordinary working occurred on December the 5th when the State Entry was rehearsed. On this date, and on the State Entry itself on the 7th, traffic was interrupted in the early morning and in the middle of the day to allow troops, Native Chiefs' escorts and the procession itself to cross the railway. In order to make the best use of the times when the line was open, stock was run out at an early hour in the morning towards Polo and Bhorari road, so that as soon as the line was open a full service in both directions could be started. It was found that the restrictions on running trains were somewhat too severe and on the day of the State Entry itself trains were run for a somewhat longer period, advantage being taken of every opportunity to get them over the level crossings. Normal traffic continued from the 8th up to the 12th, Durbar Day, for which special arrangements were made. The only other occasion on which the ordinary traffic was interrupted was December 17th, the day of the State Departure. On this occasion the line was again blocked for about two hours at

various points to allow troops and chiefs to cross, and again in the afternoon for the passage of the Royal Procession which, however, only took a few minutes.

In order to meet the demands of traffic on special occasions, trains were stabled at Polo and Bhorari road when opportunity occurred and were started off again as required. Polo trains were also cancelled and run on the Amphitheatre line and *vice versâ* as circumstances dictated.

Traffic continued heavy up till about the 20th December but in spite of the fact that the fares were reduced to 8 annas Upper class and 2 annas Lower Class on the 18th there was a sudden drop on the 21st and the train service was gradually reduced, the Amphitheatre line being closed on the 24th and the Polo line on the 28th.

Observations Class of Passenger.—The points of interest which have come to notice are as follows :—Owing to the large number of motor cars and the unexpected facilities for getting about in private vehicles by road the line was not much patronized by Upper class passengers, and had the capacity of the line been greater it seems likely that more money would have been made if lower fares had been charged, say 2 annas Upper class and 1 anna Lower class, increasing to double these amounts during the Durbar period. It was, of course, impossible to carry more passengers than we did from the last week of November till the close of the Durbar, and the capacity of the line could only have been increased by using higher capacity stock, which was not available, or by quadrupling the line between Tis Hazari and Ridge and by running more trains which was impracticable.

It was a source of loss to us that we had to reserve one vehicle at least on each train for Upper class passengers. This vehicle generally ran empty or was occupied by pass holders of whom there were a large number. If the Upper class fare had been reduced as proposed above it would probably have paid us handsomely, but with a large proportion of Upper class vehicles on a train the practical difficulty of sorting out the passengers would have been felt.

Time-Table.—The great advantage of being able to run a regular service of trains every few minutes was apparent. There was no necessity for passengers to carry a time-table as they knew they would not have to wait long for a train, and if they were constant passengers they soon got to know the time trains passed. It was often noticed at Mall Station that there was a rush for the booking office from people walking along the road whenever a train appeared, thus showing that a frequent service is in itself the best method of drawing passengers, as passengers of this class would never have dreamt of walking into Kingsway or Delhi Main and taking a ticket on the chance of there being a train ready to start.

Publicity.—Until the East Indian Railway Camp Press was opened the difficulties and expense of getting time-tables, handbills and posters printed in the bazaar were great. As soon as the press was opened, it was possible to distribute thousands of time-tables and special handbills. At the same time the want of special publicity arrangements was felt. It was impossible to arrange long beforehand what fares, time-tables and special arrangements might have to be notified, and there was no adequate means of advertising available. There was an agency in the city ready to distribute bills, notices, etc., but more than this was desirable and a special department might well have been organized jointly for the broad gauge and light railway which would have possessed an organized service of billposters, sandwich men, handbill distributors, etc., and at the same time arranged for the design and printing of the bills and notices, thus greatly relieving the executive officers. That the latter were able to do so much, is due to the invaluable services of the East Indian Railway Press.

SYSTEM OF TRAIN WORKING.

Equipment.—The whole line with the exception of the Mori Gate branch was double. At Tis Hazari, Polo and Bhorari road termini there was a turning loop so that trains had not to reverse but ran round and round with the same vehicle always leading. Each station except Ridge Junction was equipped with a double-arm main signal opposite the station building, and a station limit board 600 ft. from each end of the platforms. Ridge Junction was fitted with interlocking home and outer signals worked from a cabin. Each station was connected to the one on either side by a telephone, and Bhorari road, Polo Ridge Junction and Tis Hazari were all connected to an exchange switch board.

With the exception of two block stations, which were introduced between Tis Hazari and Hindu Rao and Hindu Rao and Flagstaff, all stations were "B" class, *i.e.*, permission to approach could be given while the station was occupied by a train. The two block huts were "A" class and permission to approach them could not be given until the previous train had passed into the section ahead.

In order to allow of stock being held in reserve against rushes of traffic at the conclusion of football matches and similar events, it was found necessary to put in relief sidings at Polo and Bhorari road. These were found to be of great value.

As a precaution against entire dislocation of traffic by derailment or break-down a cross-over was provided at Najafgarh. There was also a cross-over at V. Division to allow trains to shunt into an engineering siding, and another cross-over was put in at Tis Hazari Station on which stock or engines could be reversed.

System of Working.—To commence with, the system of working was the ordinary one in use on the double line where block instruments are not installed. The Station-master having a train to despatch asked the next station ahead if line was clear, and on receiving intimation that it was so together with a private code he filled in a starting permit and gave it to the driver. It was found that when the full service of trains was running the number of telephone messages involved was too great, and in order to lessen the work falling on the Station-master it was arranged that no line-clear enquiry message should be sent, but that as soon as a train arrived at a station the Station-master should send back an "In" report together with a private code. This was the authority for the Station-master in rear to send on another train as soon as he required to do so. This system worked well and greatly lessened the congestion on the telephone instruments. It was not thought practicable to dispense with the starting permit, as none of the stations were provided with a starting signal and some check on a train leaving the station without permission was found necessary. Both these systems were provided for in the Traffic Working Rules, a copy of which accompanies this report. The starting permit forms were those in use on the North-Western Railway, but the form for permission to proceed without line clear was found to be much too cumbersome, and a new form on the lines of the starting permit, but printed in red ink, was introduced.

On Durbar Day a modified system of working was introduced in order to allow of trains leaving the Amphitheatre at the quickest possible interval. This is described under a separate heading.

Working of Junction.—In order to distinguish Polo trains from Amphitheatre trains and to assist the staff at Ridge Junction to put them on the right line, the following arrangements were made:—An "Out" report for each up train from Tis Hazari was telephoned direct to Ridge Junction giving its destination. Polo trains were provided with a green target and green buffer lights on the front of the engine, Amphitheatre trains carried a red target with white buffer lights, but as these could not be seen until the train had come right up to the Ridge Junction outer signal, the staff was dependent on receiving correct information from Tis Hazari. The distinctive targets and lights were of considerable use to the public who soon got to know their signification, and these were supplemented by similarly coloured boards on the platform at Tis Hazari and Flagstaff, at which latter station passengers between Polo and Amphitheatre had to change trains.

Time-Table.—The working time-table was drawn up on the assumption that not more than 16 trains per hour could be dealt with at Ridge Junction Cabin, *i.e.*, one every 3 or 4 minutes. This gave a 7-minute service in each direction between Ridge Junction and

Tis Hazari and a 15-minute service on the two branches beyond Ridge Junction, and it was found that this was the practical limit to punctual work.

The following observations are offered on the various points which arose :—

Terminal Accommodation.—Tis Hazari Station was provided with a single platform on the turning loop, and as trains arrived and left at intervals of 7 to 8 minutes the available time for coaling and watering or changing engines or cutting off damaged stock was exceedingly limited. It would have been a great convenience had there been two or more platforms on loops parallel to the main line, so that trains could have had a longer halt.

The necessity for extra platforms at Tis Hazari was also very evident when, owing to some temporary block to traffic, down trains followed each other at close intervals. These could not be dealt with more than one at a time at Tis Hazari, and as each train had to be coaled and watered there were continual stoppages at signals and in stations in the down direction which was very aggravating to the public. The provision of extra platforms as noted above would have met this difficulty. As it was, the only method of surmounting it was to shunt trains out into the stabling yard on arrival at Tis Hazari and keep them there until normal traffic was restored. This required a certain amount of previous arrangement and could not always be done on the spur of the moment.

Signalling and Block Working.—In order to deal with as heavy traffic as eight trains an hour in each direction, which was the full time-table between Tis Hazari and Ridge, it would have been more satisfactory to have had starting signals and to have done away with the starting permit, and an ordinary three-position block instrument would have been a great convenience so as to do away with the necessity of telephone messages. These could probably have been borrowed from the North-Western Railway without incurring extra expense, and when it is considered that the passage of 16 trains an hour over sections of only a quarter of a mile in length necessitated the interchange of at least 32 telephone messages per hour and the filling in of 128 entries in the train registers and 16 starting permits, it will be understood that the Station-master's work was heavy and delays to trains were difficult to avoid.

Telephones.—Telephonic working gave some difficulty at first as the staff was not used to it and great difficulty was experienced in transmitting the private letter code. This was obviated by using a number code instead, and after some practice all went well. At first there was great difficulty in getting the telephones properly installed and maintained owing to the great strain under which the Telegraph Department was working. Latterly a separate inspector was detailed to attend to the light railway after which

failures were exceptional. It is certain nevertheless that it would have been much more satisfactory if the North-Western Railway Signal Department had installed and maintained the installations. They could have supplied a more suitable type of instrument and a better-trained and more adequate staff.

Traffic Working Arrangements on Durbar Day, December 12th.

Facilities.—The object to be attained was to convey the greatest possible number of people to and from the Amphitheatre, from and to Tis Hazari and intermediate stations. To attain this object it was arranged to concentrate all resources on the Amphitheatre line and close down the Polo line, the Central Camp area being sufficiently well served by the broad-gauge system. There was thus left a double line consisting of 13 sections, the longest of which was ·6 of a mile, most of them being ·5 mile or less. At the Amphitheatre there were five successive platforms. The first of these was the ordinary Bhorari Road platform used daily. Of the others the fourth only was designed for detraining passengers and was named AMPHITHEATRE, but the whole were intended to be used for entraining. Only two platforms therefore were fitted with exit gates and all five had two entrances each. These entrances were of the type found by experiment at Tis Hazari to be the most suitable, and consisted of a narrow passage wide enough for only one passenger at a time, with a gate at the end.

The object of the five entraining platforms was to be able to entrain as many people at a time as possible and to get them on the move. In order to allow of trains getting away five at a time in this way it was necessary to abolish line-clear working for a portion at least of the down journey, and as the country was level and fairly open as far as Range Station this portion of the line was worked on flag signal.

Special Instructions.—The following are extracted from the rules which were issued, and explain what the system of working was intended to be :—

1. The line between Ridge Junction and Polo will be closed down until all spectators have left the Amphitheatre which will not be until late in the afternoon.

2. Commencing as soon as passengers begin to arrive at Tis Hazari, probably between 4 and 5 o'clock, trains will be run out to the Amphitheatre branch at 5-minute intervals, see time-table.

3. The last train carrying passengers will leave Tis Hazari at 10.15, but as the last few trains are reserved for passengers holding special tickets, booking must be stopped some time before this. In order to let the station staff know when to stop booking, a special

white board marked thus + in red will be placed in front of the engine of the third last train by which passengers can be booked. As soon as it passes booking must be stopped and the passengers who have already been booked will be cleared by the next two trains. After these two trains have passed the special trains will come. Only passengers with special passes showing their proper seats in each train will be allowed to go on the platform. Each pass shows the number of the train, the letter on the carriage and a sketch showing the seat in the carriage. Each special train has a number on the front of the engine, and a letter on the carriage. The special trains will be numbered as follows:—The last four to arrive at Amphitheatre are for veterans and will have no mark on the engine (two of these trains will be stabled in Chandrawal Siding early in the day). Before these comes Special No. 12 marked

before No. 12 will be No. 11, etc. It is expected there will be less than twelve specials so that the first will probably be No. 7 or 8. The carriages will be lettered A to O from the front to the brake van.

4. The arrangements at Bhorari Road for up traffic are as follows:—All trains will run direct up to the AMPHITHEATRE Platform (No. 4) and will not stop at the usual BHORARI ROAD Platform (No. 1). Driver must observe the signals on both No. 1 and No. 4 Platforms.

As soon as they have been emptied, they will at once start for Tis Hazari. During daylight they will run as far as RANGE Station by flag signal and will not get any line clear. The method of working is as follows:—Flag signalmen with red and green flags will be posted along the line and men will be posted at the down main signals on the platforms. These men will show a green flag or lower the main signal so long as there is no train between them and the next signalman ahead; as soon as a train passes them they will show a red flag, or raise the main signal to danger until the train has passed the next signalman ahead, when they will again show a green flag or lower the signal. Drivers will go ahead until they come to a red flag or to a main signal at danger. Then they must come slowly up and halt *close to the flag or the end of the platform* on which the signal is. When a driver sees that the next train is far ahead he should run fast, if it is near he should run slow so as to avoid having to stop at signals. Empty trains returning to Tis Hazari need not stop at any station. At RANGE Station drivers must get line clear to Chandrawal and work on line clear as usual to Tis Hazari.

5. As soon as special train No. 9 has arrived, down empty trains will be stopped and Nos. 9, 10, 11, and 12 and the four veterans' trains will be kept at Amphitheatre. These will be stabled there

under the orders of the Station-master, Mr. Murphy. The remaining trains will return to Tis Hazari and will be worked up again to Jaroda, from where they will be piloted up by their guards towards Bhorari Road and will draw up close behind the next train in front on the main line. Ordinary passengers may be booked by these trains for any station up to Jaroda.

6. The arrangements for down traffic are as follows :—As soon as the Ruling Chiefs have left, spectators in the official stands will be allowed to leave. Those who brought Rs.4 tickets will each be told the number of the platform to which he should go, and the same number of trains will be run back for these people as were required to bring them up. Gate-keepers must see that only 116 people are let in by each gate for each of these trains. Each ticket collector will be advised of the number of reserved trains. After the reserved trains have left, ordinary Upper and Lower Class trains will be run and 140 people may be admitted to each train.

7. There will be a train on each platform to commence with, and as soon as it is loaded the guard will stand on the *right*-hand side of his engine, and on getting the signal from the officer starting the trains he will order his driver to start. The driver will at once move off running to flag signals as explained in para. 4, and must try to regulate his speed so as to keep moving the whole time, *i.e.*, if the train in front is near he must go slowly, but if it is well ahead he should run fast. As soon as the five platforms are clear five more trains must move up *at once* and the guards of the five waiting trains must always be on the alert to pilot their trains up immediately on receiving the signal, *all trains stabling on the line behind must also keep moving up one by one and guards are responsible for doing this* without waiting for orders.

8. The following are the instructions regarding booking :—All Rs.4 tickets for special trains are being issued from the District Traffic Manager's Office at Tis Hazari. Only return tickets (Rs.2 Upper Class and As.8 Lower Class) are to be issued by stations. If Soldiers' Tickets are required two should be issued to each soldier, or if return Upper or Lower tickets run short, two may be issued to each passenger. If any passenger wishes to travel back who has not got a return ticket he will have to buy a ticket at Amphitheatre, paying single fare. Booking clerks will be placed on each platform to charge anyone found without a ticket at the entrance gate.

9. Fifteen rakes will be required for the up traffic time-table. Two spare rakes will be sent out early to Chandrawal Siding and stabled ready for the veterans, and two will be sent to Mori Gate for the Visitors' Camps specials Nos. 9 and 10. The two remaining rakes for the veterans' trains will run out from Tis Hazari immediately behind special No. 12.

Up Traffic.—Traffic started at 4.30 a.m. and soon became very heavy, and, although the eighteen available rakes were put in service and those mentioned in Rule 9 quoted above were not taken out of running till the last moment, it was not found possible to maintain a five minutes' service. The up train registers show the greatest number sent in a single hour was 11, and the total number run up to and including the four specials for the veterans was 46. This was somewhat disappointing and is partly due to an engine which got into difficulties with its fire and lost a lot of time at the most critical time of the day. But for this misfortune four more trains at least could have been run which would have earned some Rs.1,500/- at least. As the trains arrived at the Amphitheatre they were emptied either on the Amphitheatre Platform (No. 4) or, if that was occupied, on the Bhorari Road Platform (No. 1). There was some confusion outside the railway fence as the first comers all occupied the reserved blocks on the Spectators' Mound whether they had tickets or not, there being none to prevent them. When the troops arrived to keep the gates, these were all turned out and for a long time were not allowed to get on to the Mound again whether in the reserved blocks or not, some few went straight back by train, many others never got on to the Mound at all.

Down Traffic.—In order to clear away as many as possible of those who failed to get a place on the Mound and so reduce the crowd when the Durbar was over, the first eleven trains were started off commencing at 1.30 p.m. By the time these had left, the Durbar was over and there remained five ordinary trains, one for each platform, and two reserved specials in the relief siding for the Visitors' Camps. It was expected that before these had left the first trains should be returning from Tis Hazari, *i.e.*, at about 2.45 p.m., but by this time the first train had only just reached Tis Hazari having lost about 30 minutes on the journey, and it did not arrive at Bhorari Road till about 3.45 p.m. There was thus a long pause of over half an hour during which there was no train on the platform. In order to help the returning empty trains as much as possible, line-clear working in the up direction was suspended and trains were run to a time interval as provided for in the Appendix to the Rules. There was of course considerable delay to down trains at Range Station where they had to commence working on line clear, and this was greatly aggravated by the late running of the first train, so that even had there been more rakes in reserve passengers would not have reached their destination any sooner, and the train registers show a continuous flow of trains out of Range Station at the rate of about ten trains per hour. By 5.30 p.m. 38 trains had left and the crowds had been cleared.

It was noticeable that although trains might be standing on all the platforms, passengers always made for the nearest one.

Five platforms were rather too many to control without previous practice. Arrangements had been made to deal with a much greater crowd than actually assembled and probably three platforms would have been enough.

Observations.—The total number of passengers carried to the Amphitheatre was approximately 13,000 so that, although all that was hoped for was not accomplished, the result was not unsatisfactory.

Ticket Issuing and Collecting Arrangements.

Tramway System.—When the line was first opened for traffic and before all the stations were equipped with their full staff, tickets were issued by the guard of the train in the ordinary way adopted on tramways. It was found that this system had its limits and as soon as the traffic began to increase it was found necessary to issue tickets from booking offices. These were cancelled at the entrance gate and collected at destination.

1903 *System.*—It had, however, been decided by the Railway Board that the ticket-issuing and collecting arrangements in use at the last Durbar should be again introduced. These were as follows:—

Passengers provided themselves with a ticket in the usual way and this was collected from them on entering the platform and placed at once in a sealed box. These boxes were collected daily and tickets checked against issues at each station. The main feature of the system was that tickets were not collected at destination and there was thus no delay or crowding at the platform exits. Although the system was said to work satisfactorily there was reason to believe that a considerable amount of irregularities had taken place and the problem to be solved was how to make this system more susceptible to check.

1911 *System.*—It will be seen that as soon as a passenger got on to the platform no one could question his right to be there nor could it be ascertained whether he had ever bought a ticket or whether he had come in by some unauthorized entrance. It was, therefore, proposed and approved by the Examiner of Accounts that tickets when issued should be dated at both ends and that on entering the platform one half should be torn off and placed in the collected ticket box and the other half retained by the passenger for production when required by the travelling ticket examiner, of whom there were two. Moreover, as the tickets had no station name printed on them and were available for a single journey of any length each station stamped a serial identification number along with the date on each ticket. This provided the following check:—Every passenger had to produce when required a ticket of the proper date and bearing the serial number corresponding with a station from which he could have travelled by that train. The tickets were torn in half at the

commencement of the journey and could not be used again by a passenger once he had left station limits. As the ticket collector only retained half tickets he could not hand them over to the booking clerk for re-sale. This system was introduced on October 30th. It worked exceedingly well and was soon introduced on the broad-gauge system also. The total number of tickets issued under this system was 580,473 out of which only 5,732 or ·97 per cent. were not accounted for in the sealed boxes.

Description of Tickets.—The tickets themselves were of three classes, Upper Class, white, stamped fare Rs.1/-, Lower Class, yellow, some stamped with 4 annas and others without any value. Soldiers' tickets, red, stamped 2 annas. As the Upper Class fare was only 8 annas after the Durbar period a rubber stamp was used to surcharge the correct fare. The Lower Class tickets without any value stamped on them were used when the fare was other than 4 annas, and a certain number of the 4-anna tickets were surcharged in the printing press with 2 annas. The Soldiers' tickets were always issued at face value.

Return tickets were also printed value Rs.4/- and these were issued on Durbar Day only for special reserved trains. In order to provide return tickets at the ordinary fares on this occasion the Rs.1/- and 4-anna tickets were surcharged with a special rubber stamp and this answered very well.

Coupon books of Upper, Lower and Soldiers' single tickets were also on sale but there was no demand for them. Season tickets were not issued.

As the tickets for each class were available for a single journey of any length and the fares were varied from time to time, it would have been quite sufficient to have had tickets with no value at all stamped on them and to have notified the current cost of the ticket by placards at the booking offices and in the carriages. This was done and acted quite satisfactorily in the case of the Lower Class tickets which had no fare stamped on them.

Collected Tickets.—The locked ticket boxes were collected by the first train every morning and opened in the District Traffic Manager's Office and checked by special clerks. The number collected was compared with the number issued by each station which was given on a slip of paper placed by the booking clerk in the ticket box. The check was carried out as follows :—

All tickets were first examined for correct date and station code number. The total number was then counted and checked against the number issued as shown by the opening and closing numbers on the slip enclosed in the ticket box. The tickets from as many stations as possible were then put in serial order and any further discrepancies noted. These results were tabulated and handed to the District Traffic Manager for scrutiny on the same afternoon.

There was thus a constant check on the performance of each station and any large irregularities were at once brought to notice and the staff taken to account.

Earnings.—The daily earnings were collected by the first train every morning and paid into the cash office, which the Examiner of Accounts, North-Western Railway, had opened at Tis Hazari. The station accounts were kept on the North-Western Railway system and were constantly checked by a Travelling Inspector of Accounts, with the result that there were no discrepancies of any importance to be adjusted when the line was finally closed.

ESTABLISHMENT.

Source of Supply.—The staff was drawn from various sources. During the preceding months, men had been engaged on North-Western Railway Districts in excess of requirements and these were drafted to Delhi as required, but were nearly all employed on the broad-gauge system. The Oudh and Rohilkhand Railway had promised to provide as many men as possible for the Light Railway but could not send nearly enough to equip the line so that local recruitment had to be resorted to. It was feared that there would be difficulty in getting sufficient men locally of a type suitable for Station-masters and the only available source of supply appeared to be the Army. Arrangements had already been made for the employment of British non-commissioned officers and men as platform inspectors and ticket collectors, but the difficulty in arranging for them to live in their stations made it impracticable to employ them as Station-masters. As it was desirable that Station-masters should be able to speak some English the Indian unit which seemed most likely to be able to supply suitable men was the 2nd (Q.V.O.) Sappers and Miners. Enquiries were at once made and the Commandant arranged to send a detachment of 1 Indian officer and 30 men.

Numbers Employed.—When the line was first opened on October 10th, only sufficient staff was employed to open three line-clear stations. Tickets were issued by the guards at first, but, as the traffic increased, booking clerks were engaged and more line-clear stations were opened; the staff engaged thus kept pace with the volume of traffic. On 27th and 28th October the Oudh and Rohilkhand Railway sent their first batch of men. On November 4th the Sapper and Miner party arrived and after being instructed in their various duties commenced work on the 7th. From November 15th three platform inspectors and 31 ticket collectors were provided from British units not attending the Durbar.

The full staff employed during the Durbar period for equipping 20 stations and running a daily train service of 120 trains in each direction was as follows:—

	No.	Source of Supply. Local or from N.W. & O.R. Rys.	Military.
Supervising and Office Staff.			
District Traffic Manager	1	1	
Assistant Traffic Manager	1	1	
European Chief Clerk	1	1	
Correspondence Clerk	1	1	
Checkers for Collected Tickets ..	4	4	
Indian Officer, Sappers & Miners (Jemadar)	1		1
Running Staff.			
Guards	20	11	9
Travelling Ticket Examiners ..	2	2	
Station Staff.			
European Station-masters ..	3	3	
Platform Inspectors	3		3
Indian Station-masters	20	14	6
Booking Clerks	38	38	
Ticket Collectors	38	21	17
Telephone Clerks	28	16	12
Points and Signalmen	37	37	
Chowkidars	10	10	
Assistant Station-masters	26	20	6
Total ..	234	180	54

Note.—The District Traffic Manager and Chief Clerk were not wholly employed on Light Railway work.

Two guards were provided by the 25th Company, Sappers and Miners, and one by the 26th Company. Sanitary staff was provided by the Engineering Department. All level-crossing gates were under the Engineering Department.

The European Station-masters were posted at Tis Hazari, Mall and Polo.

The Jemadar of Sappers and Miners was posted at Jaroda and was in general charge of the six stations, VII. Division, to Bhorari Road of which the Sappers and Miners were in charge.

Observations.—Although the staff was such a mixed lot the work they did was surprisingly good. There were few cases of indiscipline or irregularities requiring punishment and the one or two who showed themselves incompetent were at once discharged.

The work done by the party of the 2nd (Q.V.O.) Sappers and Miners was most gratifying. None of them had any previous experience of traffic work, but they turned out in every way satisfactory. The men lent by the North-Western Railway and Oudh and Rohilkhand Railway all did well and were as a rule employed in the stations having the heaviest traffic.

SIEGES AND THE DEFENCE OF FORTIFIED PLACES BY THE BRITISH AND INDIAN ARMIES IN THE XIXth CENTURY.

(Continued).

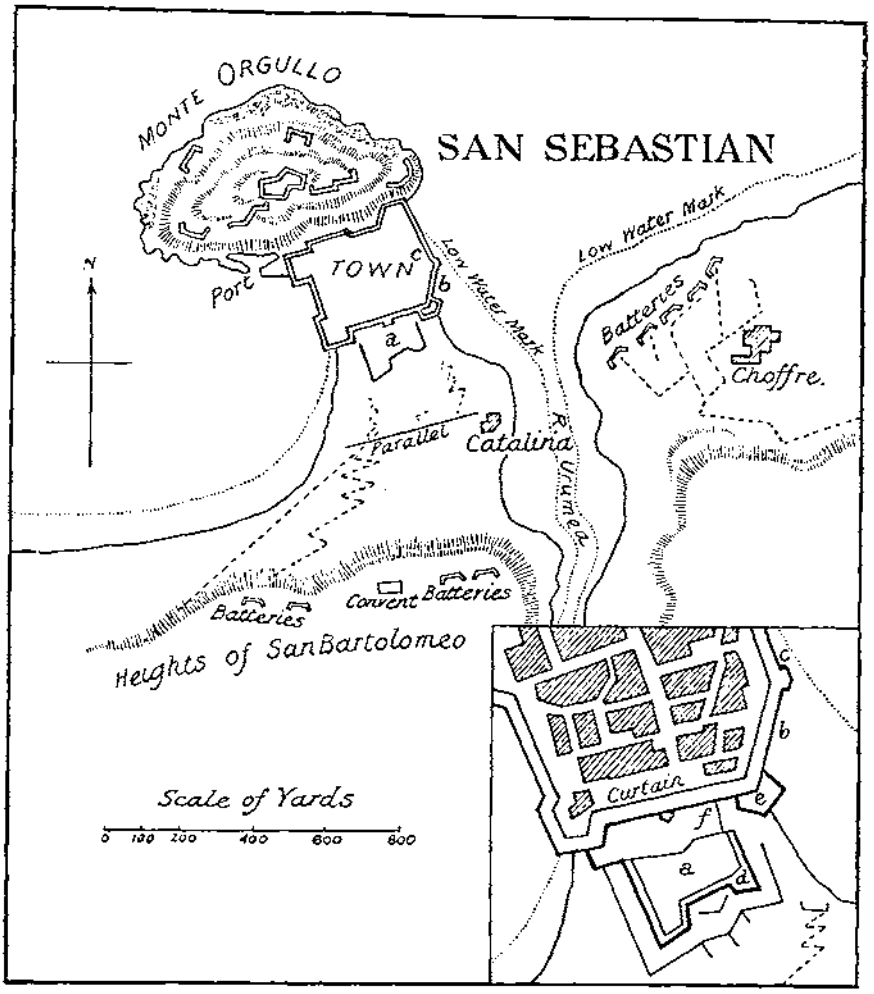
By COLONEL SIR EDWARD T. THACKERAY, V.C., K.C.B. (LATE R.E.).

SIEGE OF SAN SEBASTIAN, *July*, 1813.

In June, 1813, the Anglo-Portuguese troops were detailed by Lord Wellington to cover the Siege of San Sebastian, and the blockade of Pampeluna, while the Spanish divisions attacked Santona on the coast, and the Castles of Daroca, Morella, and Zaragoza in the interior. Pasages was the only port near the scene of operations suited for the supply of the army, but as it was between the covering and besieging armies, the stores and guns once landed were in danger from every movement of the enemy; the Deba River between San Sebastian and Bilbao was unsuitable for large vessels, and no permanent depôt could be established nearer than Bilbao. At that port therefore, and at St. Auder and Corunna, the great depôts of the army were fixed, the stores being transported to them from the establishments in Portugal. But the French held Santona, their privateers interrupted the communication along the coast of Spain, and American privateers did the same between Lisbon and Corunna. The intercourse between San Sebastian and the ports of France was scarcely molested, while the most urgent remonstrances failed to procure a sufficient naval force on the coast of Biscay. It was in these circumstances that Wellington commenced the Siege of San Sebastian.

This fortress, built on a low sandy isthmus, had the harbour on one side, the river Urumea on the other. Behind it rose the Monte Orgullo, a rugged cone 400 ft. high washed by the ocean, its southern face, covered with batteries and overlooking the town, being cut off from the latter by defensive walls. It was crowned by the small castle of La Mota which was itself commanded at a distance of 1,300 yards by the Monte Olea rising beyond the Urumea. The land front was 350 yards wide, stretching quite across the isthmus, and it consisted of a high curtain or rampart very solidly constructed, strengthened by a lofty casemated flat bastion or cavalier placed in the centre, and by half-bastions at either end. A regular hornwork was pushed out from this front; and 600 yards beyond the hornwork the isthmus was closed by the ridge of San Bartolomeo, at the foot of which stood the suburb of San Martin.

On the opposite side of the Urumea were certain sandy hills called



the Choffres, through which the road from Pasages passed to the wooden bridge over the river, and thence by the suburb of Santa Catalina, along the top of a sea wall which formed a *fausse braye* for the hornwork. The flanks of the town were protected by simple ramparts; one washed by the water of the harbour, the other by the Urumea, which at high tide covered four of the 27 ft. of this height of the wall. This was the weak side of the fortress, for though covered by the river there was only a single wall badly flanked by two old towers and the half-bastion of San Elmo, which was situated at the extremity of the rampart close under the Monte Orgullo. There was no ditch, no counterscarp, no glacis; the wall could be seen to its base from the Choffre Hills, at distances varying from 500 to 1,000 yards; and when the tide was out the Urumea left a dry strand

under the rampart as far as St. Elmo. However the guns from the batteries of Monte Orgullo could cover this strand. The other flank was secured by the harbour, in the mouth of which was a rocky island called Santa Clara, where the French had established a post of a few men.

Before the Battle of Vittoria, San Sebastian was nearly dismantled; many of the guns had been removed to form battering trains or to arm similar ports on the coast, there were no bomb-proofs, palisades, or outworks; the wells were foul, and the place supplied by a single aqueduct. Joseph's defeat restored its importance as a fortress. Emanuel Rey entered it the 22nd June, with the escort of the convoy which quitted Vittoria the day before the battle. The town was then filled with emigrant Spanish families, ministers, and other persons attached to the court; the population ordinarily 8,000, was increased to 16,000 and confusion prevailed. Rey pushed by necessity, immediately forced all persons not residents to march at once to France, granting them a guard of 100 men; the people of quality went by sea, the others by land, and fortunately all arrived for the partidas would have given them no quarter.

Rey then burned the wooden bridge and both the suburbs, and commenced fortifying the heights of San Bartolomeo, which the Spaniards attacked on the 29th and were repulsed.

On the 1st July the Governor of Gueteria abandoned the place and secretly left a lighted train which exploded the magazine and destroyed many of the inhabitants. His troops, 300, entered San Sebastian, and at the same time a vessel from St. Jean de Luz arrived with 56 cannoneers and some workmen, the garrison was thus increased to 3,000 men, and all persons not able to provide sustenance for themselves were ordered to quit the place. On the 3rd the frigate *Surveillante*, with a sloop, and some small craft blockaded the harbour; yet the French vessels from St. Jean de Luz continued to enter by night. The same day the Governor made a sally with 1,100 men to obtain news, and after some hours' skirmishing returned with a few prisoners. On the 9th Graham arrived with a corps of British and Portuguese troops. Before his arrival the French had constructed a redoubt on the heights of San Bartolomeo, and connected it with the convent of that name which they also fortified. These outworks were supported by posts in the ruined houses of San Martin behind, and by a low circular redoubt formed of casks on the main road half-way between the convent and the hornwork. Hence to reduce the place, working along the isthmus it was necessary to carry in succession three lines of defence covering the town, and a fourth at the foot of Monte Orgullo, before the Castle of La Mota could be assailed. These works had 76 pieces mounted, and others were afterwards obtained by sea from France.

The besieging army consisted of the 5th Division under Oswald, the independent Portuguese brigades of J. Wilson and Bradford, reinforced by detachments from the 1st Division, artillerymen, some seamen commanded by Lieut. O'Reilly of the *Surveillante*, and 100 regular Sappers & Miners (now for the first time used in the sieges of the Peninsular), making in all nearly 10,000 men. There was a new battering train, originally prepared to besiege Burgos, consisting of fourteen iron 24-pounders, six 8-in. brass howitzers, four 68-pound iron carronades, and four iron 10-in. mortars; six 24-pounders lent by the ships of war, and six 18-pounders which had moved from the army from Portugal, making altogether 40 pieces, commanded by Colonel Dickson. The distance from the siege depôt at Pasages to the Choffres was 1½ miles of good road, and a pontoon bridge was thrown over the Urumea River above these hills; but from thence to the height of Bartolomeo there was more than 5 miles of very bad road.

Early in July the fortress had been twice closely inspected by Major Smith, the Engineer who had so ably defended Tarifa. He proposed a plan of siege, founded upon the facility furnished by the Choffres, to destroy the flanks, rake the principal front, and form a breach with the same batteries; the works being at the same time secured, except at low water, by the Urumea. Counter-batteries on the left of that river, were to rake the line of defence in which the breach was to be formed; and against the castle and its outworks he relied principally upon vertical fire. This plan would probably have reduced San Sebastian in a reasonable time without any remarkable loss of men; Wellington approved of it, though he doubted the efficacy of the vertical fire and he ordered the siege to be commenced. Although anxious to save time, he did not urge the Engineer beyond the rules. *Take the place in the quickest manner, yet do not from over-speed fail to take it.*

During the night of the 10th two batteries were commenced against the convent, and the redoubt of San Bartolomeo; and next night four batteries, to contain twenty of the heaviest guns and four 8-in. howitzers, were marked out on the Choffre sandhills, at distances varying from 600 to 1,300 yards from the eastern ramparts of the town. Two attacks were established, one on the right bank of the Urumea for the Portuguese brigades; one on the left bank for the 5th Division.

On the 14th a French sloop entered the harbour with supplies, and the batteries of the left attack opened against San Bartolomeo throwing hot shot into that building. The besieged responded with musketry from the redoubt, with heavy guns from the town, and with a field piece which they had mounted on the belfry of the convent itself. On the 15th Sir Richard Fletcher took command of the Engineers. This day the batteries set the convent on fire,

silenced the musketry of the besieged, and so damaged the defences that the Portuguese of the 5th Division were ordered to feel the enemy; they were however repulsed with great loss, the French sallied, and the firing did not cease until nightfall.

On the 17th the convent being nearly in ruins, the assault was ordered. The storming party was formed in two columns. Detachments from Wilson's Portuguese, supported by the Light Company of the 9th British Regiment, and three companies of the Royals, under General Hay, were destined to assail the redoubt; General Bradford leading the other column, composed of Portuguese, supported by three companies of the 9th under Colonel Cameron were to assail the convent.

Assault of San Bartolomeo.

At 10 o'clock in the morning two heavy 6-pounders opened against the redoubt, and a sharp musketry fire from the French, announced their resolution to fight. The allied troops were assembled behind the crest of the hill overlooking the convent, and the first signal was given; but the Portuguese advanced so slowly at both attacks that the supporting columns of the 9th Regiment, passing through them, fell upon the enemy with the usual impetuosity of British soldiers. Cameron leading his grenadiers downhill was exposed to a heavy cannonade from the hornwork, but he gained the cover of a wall 50 yards from the convent and there awaited the second signal. His rapid advance, which threatened to cut off the garrison from the suburb, caused the French to abandon the redoubt; Cameron's force then cleared the wall and assaulted both the convent and the houses of the suburb. At the latter a fierce struggle ensued and Capt. Woodham of the 9th was killed in the upper room of a house, but the grenadiers carried the convent with such rapidity that the French unable to explode some small mines, hastily joined the troops in the suburb. There the fighting continued, and the affair was becoming doubtful, when the remaining companies of the 9th Regiment arrived, and the suburb with much fighting was won. At the right attack the company of the 9th though retarded by a ravine, a thick hedge, the slowness of the Portuguese, and a heavy fire, entered the abandoned redoubt with little loss; but all the troops were then, contrary to Oswald's orders, rashly led against the cask redoubt, and were beaten back by the enemy. The French lost 240 men. On the British side the companies of the 9th under Cameron alone lost 7 officers and 60 men killed or wounded, and the whole operation though successful was an error. The battery on the Urumea was not opened, so that either the assault was precipitated or the battery was not necessary, but the loss justified the conception of the battery.

When the action ceased, the Engineers made a lodgment in the redoubt; and commenced two batteries for eight pieces to rake the hornwork and the eastern rampart of the place. Two other batteries, to contain four 68-pounder carronades and four 10-in. mortars, were also commenced on the right bank of the Urumea. The besieged then threw up traverses on the land front to meet the raking fire of the besiegers, and the latter dragged four pieces up the Monte Olea to fire into the Mirador and other batteries on the Monte Orgullo. During the night a lodgment was made on the ruins of San Martin; the batteries at the right attack were armed, and two additional mortars dragged up the Monte Olea; on the 19th all the batteries of both attacks were armed, and that night two approaches were commenced from the suburb towards the cask redoubt, from whence the French were driven.

On the 20th the whole of the batteries opened fire, the greatest part being directed to form the breach.

Smith's plan was similar to that followed by Marshal Beresford a century before. He proposed a lodgment on the hornwork before the breach should be assailed, but he unknowingly fixed the breaching point precisely where the wall had been most strongly rebuilt after Berwick's attack. This was the first fault, yet a slight one, because the wall did not resist the batteries very long; it was a more serious matter that Graham, at the suggestion of the commander of the artillery, began his operations by breaching. Smith was opposed to it, but Fletcher acquiesced reluctantly, on the understanding that the destruction of the defences was only postponed, an understanding afterwards forgotten.

The result of the first day's firing was not satisfactory. The weather was bad, the guns mounted on ship carriages failed, one 24-pounder was rendered unserviceable by the enemy, another useless by an accident, a captain of Engineers was killed, and the besiegers' shot had little effect upon the solid wall. During the night however the ship guns were mounted on better carriages, and a parallel across the isthmus was projected, but the greater part of the workmen sought shelter in the suburb of San Martin, and when day broke only one-third of the work was performed.

On the 21st the place was summoned, but the Governor refused to receive the letter, and the firing was resumed. The main wall still resisted, yet the parapets and embrasures crumbled away, and the batteries on Monte Olea plunged their fire into the hornwork, with such effect, although at 1,600 yards distance, that the besieged having no bombproofs were forced to dig trenches to protect themselves. The counter-fire directed solely against the breaching batteries was feeble, but at midnight a shell thrown from the castle into the bay gave the signal for a sally, and during the fire which ensued several French vessels with supplies entered the

harbour. This night the besieged also isolated the breach by cuts in the rampart and other defences. On the other hand the besiegers' parallel across the isthmus was completed, and in its progress laid bare the mouth of a drain, 4 ft. high and 3 ft. wide, containing the pipe of the aqueduct cut off by the Spaniards. Through this narrow opening Lieut. Reid of the Engineers, a young and zealous officer, crept as far as the counterscarp of the hornwork, but there finding the passage closed by a door returned without an accident. Thirty barrels of powder were then placed in the drain, 8 ft. being stopped with sandbags to form a globe of compression, which was designed to blow sufficient rubbish over the counterscarp to fill the narrow ditch of the hornwork.

On the 22nd the fire from the batteries, unexampled by its rapidity and accuracy, opened what appeared to the besiegers a very practicable breach in the eastern flank wall. The counter-fire of the besiegers then slackened, yet the descent into the town from the breach was more than 12 ft. perpendicular, and the garrison was seen from Monte Olea diligently working at the interior defences to receive the assault. The besiegers now placed four 68-pound carronades in battery to play on the defences of the breach, but the general fire slackened because the guns were greatly enlarged at the vents with constant firing.

On the 23rd, the sea blockade being null, the French vessels returned to France with the badly wounded men; and that day the besiegers judging the breach between the towers quite practicable, turned the guns to break the wall on the right of the main breach. Smith opposed this, urging that no advantage would be gained by opening a second opening to get to which the troops must first pass the great breach, that time would be lost to the besiegers, and there was a manifest objection on account of the tide and the depth of water at the new point attacked. His counsel was overruled and in the course of the day, the wall being thin and the fire heavy and quick, a second breach 30 ft. wide was rendered practicable. Then the fire of the besieged being much diminished, the 10-in. mortars and 68-pound carronades were turned upon the defences of the great breach. The nearest houses were soon in flames which spreading rapidly destroyed some of the defences, and menaced the whole town with destruction, and the assault was ordered for the next morning; but when the troops assembled the burning houses appeared so formidable that the attack was deferred. The batteries then fired again, partly on the second breach, partly on the defences, partly to break the wall in a third place between the half-bastion of St. John on the land front and the main breach.

During the night the vigilant Governor mounted two fieldpieces on the cavalier in the centre of the land front, and he still had on

the hornwork a light piece, and two casemated guns on the flank of the cavalier. Two other field pieces were mounted on an entrenchment, and a 24-pounder looked from the Tower of Las Mesquitas; two 4-pounders were in the Tower of Hornos, two heavy guns were on the flank of St. Elmo, and two others placed on the right of the Mirador.

Thus 14 pieces were still available for defence, the retaining sea wall, or *fausse braye*, which strengthened the Urumea flank of the hornwork and between which and the river the storming parties must necessarily advance, was covered with live shells to roll over on the columns, and behind the flaming houses near the breach other edifices were loopholed and filled with musketeers. However the fire extended rapidly and fiercely, greatly injuring the defences; the French withdrew their guns until the moment of attack, while the British artillery officers declared they could silence the enemy's fire in daylight, and keep the parapet clear of men Graham thereupon renewed the order for

The Assault.

During the night of the 24th 2,000 men of the 5th Division filed into the trenches on the isthmus. This force was composed of the 3rd Battalion of the Royals under Major Fraser, detailed to storm the great breach; the 38th Regiment under Colonel Greville for assailing the lesser and most distant breach; and the 9th Regiment under Colonel Cameron, to support the Royals. A detachment selected from the Light Companies of all these battalions was placed in the centre of the Royals under the command of Lieut. Campbell of the 9th Regiment; he was accompanied by Lieut. L. Machell of the Engineers and a ladder party and was to sweep the high curtain after the breach should be won.

From the trenches to the point of attack was more than 300 yards along a contracted space, the ground was strewed with rocks covered by slippery seaweed, the tide had left large and deep pools of water—the parapet of the hornwork was entire as well as the retaining wall—the parapets of the other works and the two towers which closely flanked the breach, although injured were far from being ruined, and the walls and defences were fully manned. The difficulties indeed were obvious.

While it was still dark the storming columns moved out of the trenches, and the mine in the drain was exploded against the counterscarp and glacis of the hornwork with great effect. The garrison astonished by this unlooked for event abandoned the flanking parapet, and the Allies rushed onwards, the storming party for the main breach leading and suffering more from the fire of the batteries on the right of the Urumea, than from the enemy. Major Fraser and Lieut. Harry Jones of the Engineers first reached the breach, and as the

enemy had fallen back in confusion behind the ruins of the burning houses, those brave officers rushed up expecting that their troops would follow, but not many did for it was extremely dark, and the natural difficulties of the way had contracted the front and disordered the column in its whole length, the soldiers, straggling and out of wind, arrived in small disconnected parties at the foot of the breach. The foremost gathered near their gallant leaders, but the depth of the descent into the town, and the volumes of flame and smoke which still issued from the burning houses behind awed the stoutest, and more than two-thirds of the column harassed by the flank fire, had broken off at the demi-bastion to commence a musketry combat with the enemy on the ramparts.

Meanwhile the shells from the Monte Orgullo fell rapidly, the French rallied and with a smashing musketry from the ruins and loopholed houses assailed the head of the stormers, while the men in the towers took them on the flank; and from every quarter came showers of grape and hand grenades, shattering them in a terrible manner.

Fraser was killed on the flaming ruins, the intrepid Jones stood there a while longer amid a few heroic soldiers, hoping for aid, but none came, and he and those with him were struck down; Lieut. Machell was killed early, and the ladder bearers fell or were dispersed. Thus the rear of the column was in confusion before the head was beaten, and it was in vain that Greville of the 38th, Cameron of the 9th, and many other regimental officers attempted to rally their discomfited troops and refill the breach; it was in vain that Lieut. Campbell breaking through the tumultuous crowd with the survivors of his chosen detachment, mounted the ruins—twice he ascended, twice he was wounded, and all around him died. The Royals endeavouring to retire, got intermixed with the 38th and with some of the 9th, who had unsuccessfully tried to pass them and get to the lesser breach. Then swayed by different impulses, pent up in the narrow way between the hornwork and the river, the mass reeling to and fro could neither advance or retire until the shells and musketry, constantly plied both in front and flank, had thinned the concourse when the trenches were regained in confusion. At daybreak a truce was agreed to for an hour, during which the French, who had already recovered the gallant Jones and some of the wounded men from the breach, carried off the more distant sufferers lest they should be drowned by the rising of the tide; but during the contest some grenadiers rushed out of the breach and stabbed several wounded soldiers lying there.

Five officers of the Engineers including Sir Richard Fletcher, and 44 officers of the Line with 520 men, had been killed, wounded, or

taken prisoners in this assault, the failure of which was signal. The causes were obvious and may be classed thus :—

1st. Deviation from the original project of siege and from Wellington's instructions.

2nd. Bad arrangements of detail.

3rd. Want of vigour in the execution.

Wellington having visited the Choffre trenches on the 22nd had confirmed his first approval of Smith's plan, and gave that officer final directions for the attack finishing thus "*Fair daylight must be taken for the assault.*" These instructions were repeated by Smith in the proper quarter, and were not followed; no lodgment was made on the hornwork, the defences were nearly entire both in front and flank, and the assault was given in darkness. Smith had ascertained by calculation and consultations with the fishermen, that the ebb of tide would serve exactly at daybreak on the 24th; yet the assault was only made the 25th and before daylight, when the high water, contracting the ground, increased the obstacles and forced the assaulting column to march in a narrow front and a long line, thus making a difficult progress. The rules of art being thus neglected the operation failed.

During the night the troops filed out of the long narrow trenches, a tedious operation, and were at once exposed to a fire of grape from their own batteries on the Choffres. This fire should have ceased when the mine was sprung, but owing to the darkness and noise the latter was neither seen nor heard, and though the Portuguese advanced to the ditch, where a vigorous escalade would probably have succeeded, they had no ladders. The stormers of the great breach marched first filling up the way, and rendering the second breach, as Smith had foretold, useless, and the ladder bearers never got to their destination.

There was also a neglect of moral influence. Deferring the assault from the 24th to the 25th, expressly because the breach was too difficult, rendered the troops uneasy; they suspected hidden danger. In this mood emerging from the trenches they were struck by the fire of their own batteries; and then wading through deep pools of water, or staggering over slippery rocks, and being close under the enemy's flanking works where every shot told with fatal effect, how could they succeed? A second and more vigorous assault on the great breach might have been effected by a recognized leader; but no general or staff officer went out of the trenches, and the isolated exertions of the regimental officers failed.

Wellington repaired immediately to San Sebastian. The causes of failure were apparent, and he would have renewed the attack, but was compelled from want of ammunition to defer it, until powder and additional ordnance, should arrive. Next day other events caused him to resort to a blockade, and the battering train was

transported to Pasages, two guns and two howitzers only being retained on the Choffre and Monte Olea. This operation was completed during the night of the 26th, but at daybreak the garrison made a sally from the hornwork, surprised the trenches and swept off 200 Portuguese and 30 British soldiers. To avoid a repetition of this disaster the guards of the trenches were concentrated in the left parallel, and patrols only were sent out, but one of these also was cut off on the 1st August. Thus terminated the first part of the Siege of San Sebastian in which the Allies lost 1,300 soldiers and seamen, exclusive of Spaniards during Mendizabel's blockade.

Renewed Siege of San Sebastian.

Villette's demonstration against Louga on the 28th July had caused the ships laden with the battery train to put to sea, but on the 5th August the guns were re-landed and the works against the fortress resumed.

The old trenches were repaired, the heights of San Bartolomeo were strengthened, and the Convent of Antigua, built on a rock to the left of those heights, was fortified and armed with two guns to scour the open beach and sweep the bay. The siege however languished for want of ammunition; and during this forced inactivity the garrison received supplies and reinforcements by sea, repaired their damaged works, made new defences, filled their magazines, and put 67 pieces of artillery in a condition to fire. Eight hundred and fifty men had been killed or wounded since the commencement of the attack in July; but fresh men came by sea, and more than 2,600 good soldiers were still present under arms.

However the general firing was severe upon the castle and the town works and the defences were damaged; the French guns were nearly silenced, additional mortars were mounted at the Choffre, making in all 63 pieces of which 29 threw shells, and the superiority of the besiegers was established. Now however the Urumea was discovered to be fordable by Capt. Alexander Macdonald of the Artillery, who had waded across in the night, and passed close under the works to the breach. A few minutes would suffice to bring the enemy into the Choffre batteries, and therefore to save the guns from being spiked their vents were covered at night with iron plates fastened by chains.

This day the materials and ordnance for six pieces, to take the defences of the Monte Orgullo in reverse, were sent to the island of Santa Clara; and from the Choffre some guns played on the retaining wall of the hornwork; but with low charges to shake down any mines constructed there without destroying the wall itself, which offered cover for troops in an assault. The trenches at the isthmus were now wide and good, the sap was pushed close to the hornwork; and

the sea wall, supporting the high road into the town, which had in the first assault lengthened the run and cramped the columns, was broken through to give access to the strand and shorten the approach to the breaches. The crisis was now at hand, and during the night of the 29th a false attack was ordered, to make the enemy spring his mines. This desperate service was executed by Lieut. Macadam of the 9th Regiment; the order was sudden and no volunteers were demanded, no rewards offered, no means of excitement resorted to; yet such is the inherent bravery of British soldiers, that 17 men of the Royals, the nearest at hand, immediately leaped forth ready and willing to encounter what seemed certain death. With a rapid pace, all the breaching batteries firing hotly at the time, they reached the foot of the breach unperceived, and then mounted in extended order shouting and firing; the French were too steady to be imposed upon, their musketry laid the party low, and their commander returned nearly alone to the trenches.

On the 30th the sea flank being open from the half-bastion of St. John to the most distant of the old breaches, 500 ft., the Choffre batteries were turned against the castle and the other defences of the Monte Orgullo. The battery on the isthmus in conjunction with the fire from the Choffre, also demolished the face of the St. John's Bastion and the end of the high curtain above it; thus the whole of that quarter was in ruins. The San Bartolomeo batteries then broke the demi-bastion of the hornwork, and Wellington after examining the defences decided to make a lodgment and ordered the assault for the following day at 11 o'clock, when the ebb of the tide would leave space between the hornwork and the water. The galleries in front of the advanced batteries on the isthmus were now pushed to the sea wall; and three mines were formed with the double view of opening a way for the troops to reach the strand, thus rendering useless any subterranean works the enemy might have made in that part. At 2 o'clock on the morning of the 31st they were sprung, and opened three wide passages; these were immediately connected, and a traverse of gabions, 6 ft. high, was run across the mouth of the main trench on the left, to screen the opening from the grape shot of the castle. Everything was now ready for the assault, but before describing that terrible event it will be fitting to show the exact state of the besieged in defence.

Graham had been before the place for 52 days, during 30 of which the attack was suspended. All this time the garrison had laboured incessantly; and though the besiegers' fire appeared to have ruined the defences of the enormous breach in the sea flank such was not the case. A perpendicular fall behind of more than 20 ft. barred progress; and beyond, amongst the ruins of the burnt houses, was a strong counter-wall 15 ft. high, loopholed for musketry and parallel with the breaches, which were also cut off from the sound part of the rampart

by traverses at the extremities. To evince their confidence, the besieged celebrated the Emperor's birthday by crowning the castle with a splendid illumination, encircling it with a fiery legend to his honour in characters so large as to be distinctly read by the besiegers.

On the 19th after a delay of 16 days the battering train arrived from England, and 15 heavy pieces were placed in battery, 8 at the right attack, 7 at the left during the night of the 22nd. A second battering train came on the 23rd augmenting the number of pieces of various kinds to 117, but with characteristic negligence this enormous armament had been sent out from England with no more shot and shell than would suffice for one day's consumption.

In the night of the 23rd the batteries on the Choffre were reinforced with four long pieces and four 68-pound carronades; the left attack had six additional guns. Ninety sappers & miners had come with the train from England, the seamen under Lieut. O'Reilly were again attached to the batteries, and part of the field artillerymen were brought to the siege. The Choffre batteries were also enlarged to contain 48 pieces, and two batteries for 13 pieces were begun on the heights of Bartolomeo. These last were to breach at 700 yards distance the faces of the left demi-bastion of the hornwork, that of St. John on the main front, and the end of the high curtain; for these works rising in gradation one above the other, were in the same line of fire. The approaches by the isthmus were pushed forward by sap, but the old trenches were still imperfect; and before daylight on the 25th, the French coming from the hornwork, swept the left of the parallel, injured the sap, and made some prisoners.

On the night of the the 25th, the batteries were all armed on both sides of the Urumea, and on the 26th 57 pieces opening with a general salvo, continued to play with astounding noise and rapidity until evening. The fire from the Choffre Hills destroyed the revetment of the demi-bastion of St. John, and nearly ruined the towers at the old breach together with the wall connecting them; but at the isthmus the batteries, although they injured the hornwork, made little impression on the main front, from which they were too far distant.

Wellington, present at this attack and discontented with the operation, then ordered a battery for six guns to be constructed amongst some ruined houses on the right of the parallel, 300 yards from the main front. Two shafts were also sunk with a view to drive galleries for its protection against the enemy's mines; but the sandy soil made this work slow.

Early on the 27th the boats of the squadron under Lieut. Arbuthnot of the *Surveillante*, carrying 100 men of the 9th Regiment under Capt. Cameron, attacked the island of Santa Clara. The troops landed with some difficulty under a heavy fire, but a lodgment was made with the loss of only 28 officers and men, of whom 18 were seamen.

In the night the French sallied against the new battery on the isthmus; but were met with the bayonet by men of the 9th Regiment under Colonel Cameron on the very edge of the trenches. The attempt failed but it delayed the arming of the battery. At daybreak the renewed fire of the besiegers was extremely heavy, and the shrapnel shell were supposed to be very destructive; but the practice with that missile was uncertain, the bullets frequently flew amongst the guards in the parallel and one struck the field officer. In the course of the day another sally was commenced, but the enemy being fired upon did not persist. The trenches were now furnished with banquettes and parapets as fast as the quantity of gabions and fascines would permit; but the work was slow because the Spanish authorities neglected to provide carts to convey the materials from the woods, and this hard labour was performed by Portuguese soldiers.

Wellington visited the works again, and the advanced battery was armed with four guns and opened next morning; but an accident prevented the arrival of one gun, the enemy dismounted another, and only two instead of six guns as Wellington had designed, smote the demi-bastion of St John, and the end of the high curtain.

The only really practicable way into the town was by the narrow end of the high curtain above the half-bastion of St. John. About the middle of the great breach stood the Tower of Los Hornos, still capable of some defence, and beneath it a mine charged with 12 cwt. of powder. The streets were all trenched and furnished with traverses to dispute the passage and cover the retreat to the Monte Orgullo; to reach the main breach it was also necessary to form a lodgment in the hornwork, or pass as in the former assault, under a flanking fire of musketry for 200 yards; and the first step was close under the sea wall at the salient angle of the covered way, where two mines charged with 800 lbs. of powder were prepared.

Besides these retrenchments and mines, the French had still some artillery in reserve. One 16-pounder mounted at St. Elmo flanked the left of the breaches on the river face; a 12 and an 8-pounder, preserved in the casemates of the cavalier, were ready to flank the land face of the half-bastion of St. John; many guns from the Monte Orgullo could play upon the columns, and there was a 4-pounder hidden on the hornwork to be brought into action when the assault commenced. Neither the resolution of the Governor or the courage of the garrison was abated; but the overwhelming fire of the past few days had reduced the number of fighting men; and Rey who had only 250 men in reserve, demanded of Soult whether his brave garrison should be exposed to another assault. "The army would endeavour to succour him" was the reply, and he abided his fate.

Storming of San Sebastian.

To assault the breaches without having destroyed the enemy's defences, or established a lodgment on the hornwork, notwithstanding the increased fire and greater facilities of the besiegers, was obviously a repetition of error. And the same generals who had before publicly disapproved of such operations, now more freely dealt out censures, not ill-founded, but very indiscreet since there is much danger when doubts expressed by their commanders reach the men. Wellington thought the 5th Division had been thus discouraged. He was incensed and demanded 50 volunteers from each of the 15 regiments composing the 1st, 4th, and Light Divisions, "*men who could show other troops how to mount a breach.*" Such was the phrase employed, and 750 gallant soldiers instantly marched to San Sebastian in answer to the appeal. Colonel Cooke and Major Robertson led the Guards and Germans of the 1st Division; Major Rose commanded the men of the 4th Division; Colonel Hunt, who had already earned his promotion at former assaults, was at the head of the fierce rugged veterans of the Light Division; yet there were good officers and brave soldiers in the 5th Division.

It being at first supposed that Wellington designed only a simple lodgment on the great breach, the volunteers and one brigade of the 5th Division only were ordered to be ready; but at a council held at night, Major Smith maintained that the orders had been misunderstood, as no lodgment could be formed until the high curtain was gained. General Oswald, being called to the council, was of the same opinion; whereupon the remainder of the 5th Division was brought to the trenches; and General Bradford having offered the services of his Portuguese brigade, was told he might ford the Urumea and assail the farthest breach if he thought it advisable.

Leith had now resumed command of the 5th Division, and directed the attack from the isthmus; but he was extremely offended with the volunteers, and would not allow them to lead the assault; some he spread along the trenches to keep down the fire of the hornwork, the remainder was held in reserve with Hay's British and Sprye's Portuguese brigades of the 5th Division. To Robertson's brigade the assault was confided; it was formed in two columns, one to attack the old breach between the towers, the other to storm the bastion of St. John and the end of the high curtain. The small breach on the extreme right was left for Bradford's Portuguese, who were on the Choffre Hills; some large boats filled with troops were directed to make a demonstration against the sea line of the Monte Orgullo, and Graham overlooked the whole operations from the right bank of the river.

Heavily the morning of the 31st broke, a thick fog hid every object and the besiegers' batteries could not open until 8 o'clock;

from that hour however a constant shower of missiles was poured upon the besiegers until 11, when Robertson's brigade quitted the trenches, and passing through the openings in the sea wall was launched against the breaches. While the head of this column was still gathering on the strand, 30 yards from the salient angle of the hornworks, 12 men under a sergeant, whose heroic death has not sufficed to preserve his name, rushing forward leaped upon the covered way with intent to destroy the enemy's mines. The French startled by this sudden assault fired the train prematurely; but though the sergeant and his followers were all destroyed and the high sea wall thrown with a dreadful crash upon the head of the advancing column, not more than 40 men were crushed by the ruins, and the rush of the troops was scarcely checked. The Forlorn Hope had before passed beyond the play of the mine, and now hurried along the strand amidst a shower of grape and shells, the leader, Lieut. Macquire, of the 4th Regiment, conspicuous by his long white plume, his fine figure and his dash, bounding far ahead of his men in all the pride of youthful strength and courage; but at the foot of the great breach he fell dead, and the stormers swept over his body, many died however with him, and the passage of wounded men to the rear was incessant.

This time there was a broad strand left by the retreating tide, and the sun had dried the rocks, but the latter still disturbed the order and closeness of the formation, and the main breach was 200 yards distant. The French seeing the first mass pass the hornwork, regardless of its broken bastion, crowded to the river face and poured their musketry into the second column as it rushed along a few yards below them; but the English returned this fire without slackening their speed. Then the batteries of Monte Orgullo and the St. Elmo sent down showers of shot and shell, the two pieces on the cavalier swept the face of the breach in St. John, the 4-pounder mounted in the hornwork was suddenly mounted on the broken bastion and poured grape shot into the rear. Thus scourged with fire from all sides, their array broken alike by the shot and by the rocks they passed over, the troops reached their destination. The first column soon reached the top of the great breach, but the unexpected gulf below could only be passed at a few places, and the deadly French muskets clattering from the loophole and wall beyond, strewed the crest of the ruins with dead. In vain the following multitude, covering the ascent, sought entrance at every part; to advance was impossible and slowly sinking downwards the mass remained stubborn and immovable on the lower part of the breach. There they were safe from the musketry in front; but from isolated points, especially from Los Hornos under which the great mine was placed, the French still assailed them with small arms, and from Monte Orgullo came shells and grape without intermission.

At the half-bastion of St. John the access to the top of the high

curtain being quite practicable, the efforts to force a way were more persevering and constant, and the slaughter was in proportion, for the traverse on the flank was defended by French grenadiers who would not yield. The two pieces on the cavalier itself swept the front of the opening, and the 4-pounder and musketry from the hornwork swept the river face.

Some Sappers and a working party attached to the assaulting columns endeavoured to form a lodgment; but no artificial materials had been provided, and most of the labourers were killed before they could form the loose rocky fragments into a cover. During this time the counter-fire of the British artillery killed many; and the reserve brigades of the 5th Division were pushed on by degrees to feed the attack, until the left wing of the 9th Regiment only remained in the trenches. The volunteers, who had been with difficulty restrained in the trenches, called out to know why they had been brought there if they were not to lead the assault. These men who had given such offence to Leith that he would have kept them altogether from the assault, being now let loose went like a whirlwind to the breaches and the crowded masses swarmed up the face of the ruins; but on reaching the crest line they came down again like a falling wall, crowd after crowd were seen to mount, to totter, to sink, the French fire was unabated, the smoke floated away, and the crest of the breach bore no living man!

Graham standing on the nearest of the Choffre batteries, beheld this frightful destruction with a stern resolution to win at any cost; and he was a man to have put himself at the head of the last company and die sword in hand upon the breach, rather than sustain a second defeat; and neither his confidence nor his resources were exhausted. He directed an attempt to be made on the hornwork, and turned all the Choffre batteries and one on the isthmus, that is to say the concentrated fire of 50 heavy pieces, upon the high curtain. The shot ranged over the heads of the troops now gathered at the foot of the breach; and the stream of missiles thus poured along the upper surface broke down the traverses and in its fearful course, shattering all things, strewed the ramparts with the bodies of the defenders. When this flight of shot first swept over the heads of the soldiers a cry arose from some inexperienced people "to retire because the batteries were firing upon the stormers"; but the veterans of the Light Division under Hunt were not men to be so disturbed; and in the very heat and fury of the cannonade they effected a solid lodgment in some ruins of houses actually within the rampart on the right of the great breach.

For half an hour this horrid tempest smote against the works and the houses behind; and when it ceased the clatter of the French muskets showed that the fight was renewed. At this time also the 13th Portuguese Regiment, led by Major Snodgrass, and followed by a detachment of the 24th under Colonel Macbean, entered

the river from the Choffre. The ford was deep, the water rose above the waist, and when the soldiers reached the middle of the stream which was 200 yards wide, a heavy gun struck the head of the column with a shower of grape, the havoc was fearful but the survivors closed up and moved on. A second discharge from the same piece tore the ranks from front to rear, still the regiment moved on, and amidst a confused fire of musketry from the ramparts and of artillery from St. Elmo, from the castle and from the Mirador, landed on the left bank and rushed against the third breach. Macbean's men following with equal bravery reinforced the great breach 80 yards to the left of the other, although the line of ruins seemed to extend the whole way.

Then the fighting became fierce and obstinate again at all the breaches; but the French musketry still rolled with deadly effect, the heaps of slain increased, and once more the great mass of the stormers sunk to the foot of the ruins unable to win; the living sheltered themselves as they could, and the dead and wounded lay so thickly that it could hardly be judged whether the injured or uninjured were the most numerous.

It was now evident that the assault must fail unless some accident happened; for the tide was rising, the reserves all engaged, and no greater effect could be expected from men whose courage had been already pushed to the verge of madness. In this crisis fortune intervened. A number of powder barrels, live shells, and combustible materials which the French had accumulated behind the traverses for their defence, caught fire. Soon a bright consuming flame wrapped the whole of the high curtain, a succession of loud explosions were heard, hundreds of the French grenadiers were destroyed, the rest were thrown into confusion; and while the ramparts were still enveloped with suffocating eddies of smoke, the British soldiers broke in at the first traverse. The defenders bewildered by this terrible disaster, yielded for a moment, but some rallied and a close desperate struggle took place along the summit of the high curtain; the fury of the stormers, whose numbers increased every moment, could however not be stemmed. The French colours on the cavalier were torn away by Lieut. Gethin, of the 11th Regiment; the hornwork, the land front below the curtain, the loopholed wall behind the great breach were all abandoned; the soldiers of the Light Division who had already established themselves in the ruins on the French left, penetrated to the streets, and the Portuguese at the small breach mixed with British who had wandered to that point seeking for an entrance, burst in on their side.

Five hours the dreadful battle had lasted at the walls, and now the stream of war went pouring into the town. The undaunted Governor still disputed the victory for a short time with the aid of his barricades; but several hundreds of his men were cut off and taken in the hornwork, and even to effect a retreat behind the line

of defences which separated the town from the Monte Orgullo was difficult; however a crowd of his troops flying from the hornwork along the harbour flank of the town, broke through a body of the British which had reached the vicinity of the fortified convent of Santa Téresa. This post was the only one retained by the French in the town, and it was thought that Monte Orgullo might have been carried, if a general to direct the troops had been at hand; but whether from wounds or accident no officer of that rank entered the place until long after the breach had been won; the battalion chiefs were thus embarrassed for want of orders, and a thunderstorm coming down from the mountains with unbounded fury immediately after the place was carried, added to the confusion of the fight.

The capture of the town was marked with much violence and brutality and although many officers exerted themselves to preserve order, and many men were well conducted, the rapine and violence commenced by villains spread; the camp followers soon crowded into the place, and the disorder continued until the flames following the steps of the plunderer, put an end to his ferocity by destroying the whole town. Three generals, Leith, Oswald, and Robinson, had been wounded in the trenches; Sir Richard Fletcher, Chief Engineer, a brave man who had long served his country honourably, was killed; Colonel* Burgoyne, Second Engineer, was wounded, and the carnage at the breaches was appalling. The volunteers though brought late into action had nearly half their number struck down; most of the regiments of the 5th Division suffered in the same proportion, and the whole loss since the renewal of the siege exceeded 2,500 officers and men.

When the town was taken the steep and rugged Monte Orgullo with its citadel remained to be assailed. It presented four batteries connected with masonry in first line; and from the extremities ramps protected by redans led to the Santa Téresa Convent, which offered a salient point of defence. On the side facing Santa Clara, and behind the Orgullo were some sea batteries, and if all these works had been of good construction and guarded by fresh troops, the second siege would have been difficult. But the force of the garrison was shattered by the recent assault, most of the Engineers had been killed, the Governor and many others wounded, 500 men were sick or hurt, the soldiers fit for duty did not exceed 1,300, and they had 400 prisoners to guard.

The castle was small, the bombproofs scarcely sufficed to protect the ammunition and provisions, and only ten guns remained in a condition for service, three of which were on the sea line. There was very little water, and the troops had to lie out on the naked rock, exposed to fire, or only covered by inequalities of ground; Rey and his brave garrison were however resolute to fight, and they received

* Afterwards Field Marshal Sir John Burgoyne, G.C.B.

nightly by sea small supplies of ammunition. Wellington arrived the day after the assault. Regular approaches could not be carried up the steep naked rock, he doubted the power of vertical fire, and ordered batteries to be formed on the captured works of the town, intending to breach the enemy's remaining lines of defence, and then storm the Orgullo. Meanwhile seeing the Santa Téresa would enable the French to sally by the rampart on the left of the Allies, he composed his first line with a few troops strongly barricaded, and placed a supporting body in the market place with strong reserves on the high curtain and flank ramparts. But from the convent, which was actually in the town, the enemy killed many of the besiegers; and when after several days it was assaulted, they set the lower parts on fire and retired by a communication made from the roof to a ramp on the hill behind. All this time the flames were licking up the houses, and the Orgullo was overwhelmed with a vertical fire of shells.

On the 3rd September the Governor was summoned but his resolution was not to be shaken, and the vertical fire was therefore continued day and night. The British prisoners suffered as well as the enemy; for the officer commanding in the castle irritated by the misery of the garrison, cruelly refused to let the unfortunate captives make trenches to cover themselves. The French complained that their wounded and sick men lying in an empty magazine with a black flag flying, and having the English prisoners with their red uniforms placed around to strengthen the claim of humanity, were fired upon.

Guns for the new batteries were now brought, by night, from the Choffre across the Urumea; but the difficulty of struggling with the water in the darkness was great and transport by day was carried out although within reach of the French batteries which fortunately did not fire. The flaming houses impeded the works, but the river furnished cover for marksmen to gall the French, and the guns on Santa Clara were augmented and worked by seamen. With the besieged, ammunition was scarce, the vertical fire subdued their energy, and the besiegers laboured freely until the 8th, then 59 heavy pieces opened at once from the island, the isthmus, and the hornwork, and the Choffre, and in two hours the Mirador and the Queen's battery were broken, the French fire extinguished, the hill torn and furrowed in a frightful manner; the bread ovens were destroyed, a magazine exploded, and the castle crowded with men was overlaid with the falling shells. Then the Governor proudly bending to fate surrendered. On the 9th this brave man and the garrison reduced in number, and leaving 500 wounded in the hospital, marched out with the honours of war. The Spanish flag was hoisted under a salute of 21 guns, and the siege terminated after 63 days of open trenches, just when the tempestuous season commencing would have rendered a continuance of the sea blockade impossible.

(To be continued).

TRANSCRIPTS.

THE SIEGE OF ADRIANOPLE.

From an article by V. N. Polyanski, in the September, 1913, and subsequent numbers of *Injenerni Jurnal.*

(*Continued*).

CHAPTER IV.

The Assault and Capture of the Fortress, 23rd—25th March, 1913.

The writer commences this chapter with an apology that he is unable to vouch for the absolute accuracy of everything included in it. The Bulgarian official accounts spoke very little of the actions of the Allies, and he was unable to obtain the Servian ones, as they had not yet been edited by the "supreme authority." The data from which this chapter was compiled were the written and verbal accounts of credible witnesses of the events, and the comparison of the various information in conjunction with a personal inspection of the battlefields.

On the 12th March the comparatively fine weather commenced and the re-grouping of the heavy artillery, which had been going on for two months, was completed. If therefore it is asked whether the Allies could not have assaulted the fortress *on its East Front* at an earlier date, it may be replied that the utmost possible difference could only have been that of a few days.

Included in the careful preparations for the assault was the *selection of a commandant* for the most important (East) Front, who must be a suitable man, combining in himself a strong will and resolute character, with knowledge and skill in arranging all technical details and in disposing of all units in the attack. The man selected was Engineer Major-General Vazov, a graduate of the St. Petersburg Nikolaev Academy, who fully justified the confidence reposed in him. He took the most important share in the working out of all the details of the preparation, and to him belongs the honour of the success obtained. It may here be mentioned that in order to keep the date chosen for the assault a complete secret, not only from the Turks but also from the Allies' own troops, for some days previous to it General Vazov was apparently allowed to be away on leave, and a notification to that effect had been published in orders.

In view of the fact that there existed between the Commander of the Siege Armies, General Ivanov, and Headquarters some difference of opinion on the question of the assault, the former advocating more vigorous action, the order issued by the latter was of a very guarded character, and *only the first task*—the capture of the advanced positions on the East Front—*was detailed.* Subsequent orders were to be issued as conditions changed in the course of the operations.

On the 22nd March, at 7 p.m., General Headquarters sent the following order by telegraph to the staff of the siege armies :—

"The IInd Army, in the forenoon of 23rd March, will attack and occupy the advanced positions of the enemy on the East Sector with the troops of that sector. All the remaining Sectors will support this attack by a simultaneous attack."

On receipt of this order the Commander of the Siege Armies issued, on the same date, at 11.30 p.m., the following order to the siege armies :—

"On the army entrusted to my charge has been imposed the task of taking the advanced positions of the enemy and of throwing him back upon his fort line. I therefore order :—

(1). In the forenoon of 23rd March, at 1 p.m. (*sic*), the artillery preparation by all siege and field guns of all the Sectors will commence.

In the night, 23rd—24th, the infantry, with the support of the siege and field artillery, will attack and occupy by dawn the advanced positions of the enemy, in accordance with the instructions issued by me on 12th March." (These instructions are not in the possession of the writer).

At the time of the assault there were concentrated in the *East* Sector seven infantry brigades (14 regiments), with 22 q.f. field batteries (88 guns) and 98 siege guns. The following units of the Chatalja Army had been temporarily transferred :—One brigade, 4th Division (43rd and 44th Regiments) and one brigade, 3rd Division (29th and 31st Regiments). The composite cavalry brigade also operated on this front.

In the *South* Sector, which was that chosen for the subsidiary attack, and which was consequently the second in importance, there were concentrated two infantry brigades (of General Kirkov's Division), with 12 q.f. field batteries (48 guns) and 30 siege guns (28 Servian and 2 Bulgarian).

In the *West* Sector, there were three regiments of the Servian Danube Division, with their own field artillery and six heavy guns; in the *North-West*, four regiments of Servian infantry (Timok and Danube Divisions) with field artillery and eight siege guns, and one Bulgarian regiment (55th). These fronts, having been chosen for the demonstration attacks only, were the third in importance.

In round numbers the Bulgarians numbered 105,000 men, and after deducting sick and ineffectives they remained 88,000 men with 240 field and 102 siege guns. For the Servians the numbers were :—Approximate total 47,000 men, effectives 32,000, with 60 field and 38 siege guns. The Servian siege park consisted of 10 long 10·5-c.m. guns (1897 pattern); eight 15-c.m. and twenty 12-c.m. q.f. Schneider howitzers (1907 pattern).

Events of 23rd March.—Exactly at 1 p.m., in accordance with the order, the artillery cannonade began in all the Sectors, except that in the East Sector it was decided that the fire *of the heavy guns* should not be opened, in order to mislead the enemy as to the direction of the main attack. The guns fired common shell for the purpose of demolishing cover, and at the same time showered shrapnel over the Turkish batteries and advanced positions.

The Servian howitzers shelled the Turkish concrete batteries and advanced infantry positions with great accuracy. The Turkish batteries replied energetically throughout the whole fortress area, but owing to the measures taken—the overhead cover—there were no losses in the batteries of the attack; while the Turkish gunners suffered heavily.

There was no general direction of the Turkish artillery fire, they had no good observation stations and no co-operation with the infantry. The batteries may be said to have fired at random, striving to find the well-concealed batteries of the Allies, and *paying no attention to their observation stations.*

The artillery fight continued up to 8 p.m. when the batteries of the attack on the East and South Sectors ceased fire, in order to allow their infantry to take up positions from which to start for the capture of the enemy's advanced positions, and at the same time to deceive the defenders. On the other sectors the artillery fire continued. This completed the events of this day.

In the night 23rd—24th the infantry attack began in all the sectors. On the approach of darkness General Kirkov's Division led the way by making an energetic attack on the South Front, with the endeavour to capture the Turkish advanced positions Pamuk-Sirti and Doudjaros. The attack was signalized by great resolution, but the heavy fire of the defence stopped the attacking troops, who forthwith actively entrenched themselves.

At the same time the Servians opened attacks on the North-West and West Sectors. Their artillery, after battering the Turkish advanced positions during the day, continued effective fire during the infantry attack, with the result that the infantry without great loss captured the Kadin-Keui and Yekmekchi-Keui positions on the North-West Front, but they failed against Uch-Tepeler.

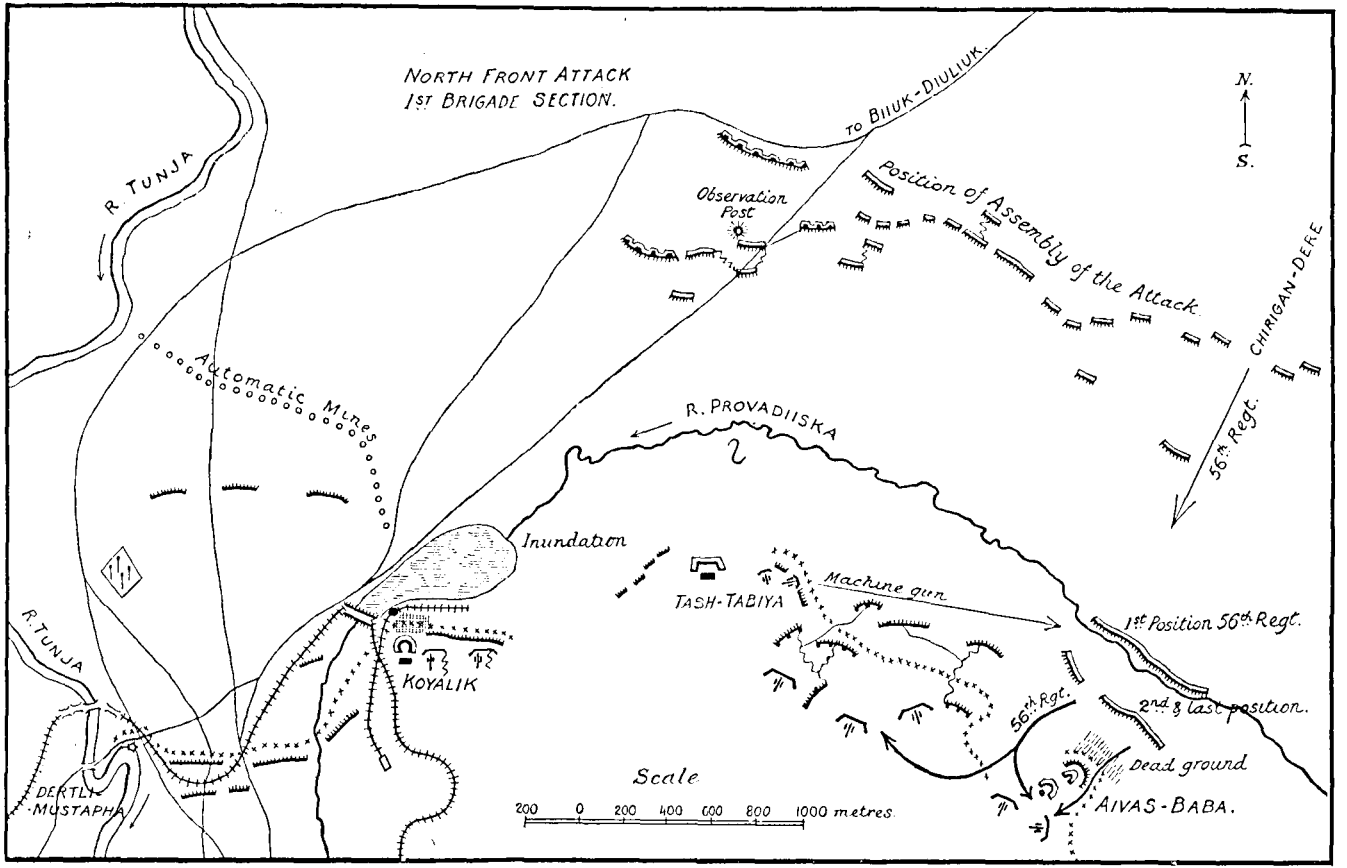
On the West Front the attack was met with very heavy fire from the Turkish front trenches, and by daybreak after a hard fight the Servians had moved forward but 300 metres from their starting position.

These events took place in the sectors of secondary importance, but the attack on the important front made itself felt considerably later. This circumstance, in conjunction with the fire of the Servian heavy artillery and the bold attacks of General Kirkov's Division, deceived the fortress staff as to the principal front of attack. Feeling confident as to the safety of his East Front, where he had "strong forts" and ground generally "not easily accessible to assault," Shukri Pasha looked anxiously towards the South Front, where there were only "weak rifle trenches," not always protected by obstacles. Here he brought his reserves, as with only one bridge spanning the Maritza, it was impossible to transfer troops rapidly from one bank to the other.

Meanwhile the decisive events were maturing on the east, and at 3.30 a.m. on the 24th the infantry moved in perfect silence into the valley of the Kum-Dere Stream. The regiments advanced at battalion intervals, with three battalions in front line and the fourth as regimental reserve in rear, each battalion in two-company columns, covered in front by a thick skirmishing line. They directed their advance by the moon which was behind them, and they also had lamps, and were led by scouts who had recently well reconnoitred the ground.

On the North Section, opposite the line Tash-Tabiya—Aivas-Baba, parties of the 11th Division moved down the wide valleys of the Chirigan-Dere and Kurudji-Dere, which led them directly upon the points of attack assigned to them. (See *Plan* I.).

At 4.15 a.m. the troops on the East Section had crossed the Kum-


NORTH FRONT ATTACK
1st BRIGADE SECTION.
TO BIIUK-DIULIUK.
N.
S.
R. TUNJA
Observation Post
Position of Assembly of the Attack.
CHIRGAN-DERE
56th Regt.
Automatic Mines
R. PROVADIISKA
Inundation
TASH-TABIYA
Machine gun
1st Position 56th Regt.
R. TUNJA
KOYALIK
56th Regt.
2nd & last position.
Dead ground
DERTLI-MUSTAPHA
AIVAS-BABA.
Scale
200 0 200 400 600 800 1000 metres.
CONVENTIONAL SIGNS.
Turkish trench with traverses.
Bulgarian trench with traverses.
Turkish trench with communication trench.
Wire entanglement.
Battery.
Fortress railway.
Metalled and unmetalled roads.

PLAN I.

Dere, while those on the North had reached the Provadiisca, and in the still-reigning darkness attacked the Turks. These latter met the attack, when within 800 metres, with heavy rifle, machine-gun, and artillery fire; but when *at 5 a.m.* there opened unexpectedly upon them the fire of a hundred heavy guns, raking their positions with enfilade fire, they turned and fled from the advanced positions towards their main fort line, pursued by the Bulgarians. But they soon encountered their own wire entanglement, and here many of them fell from the enemy's fire, while others surrendered themselves prisoners.

By 6 a.m. all the advanced positions of the East Front from Maslak to Demir-Kapu had fallen into the hands of the Bulgarians, who here captured 20 guns and several machine guns, which were immediately turned upon the retreating Turks. But circumstances were not so favourable for the northern groups. Dawn found them in the Provadiisca Valley, and with it the Turks opened upon them a very heavy fire from the direction of Tash-Tabiya, striking the 56th Regiment in flank with machine-gun fire. The fire of the heavy guns of the attack, belonging to the North-East (No. 2) Group, struck this section of the Turkish front in enfilade; their forts and batteries were quickly reduced to silence, but some *short lengths of trenches* on the slopes of Tash-Tabiya, *with machine guns concealed in them*, prevented the 56th Regiment from moving further forward.

By 7 a.m. the devastating effect of the siege artillery fire had exceeded even the expectations of the Bulgarians themselves. All the Turkish batteries of the East Front were silenced, and their gun crews had either been slain by the shrapnel, as there was no head cover, or had fled in panic. Their infantry also, deprived of cover, as the casemates of the forts had been demolished by the artillery fire, fled in large numbers, so that their rifle fire also almost ceased, and only small groups remained *in the interval trenches*.

This moment would have been a very favourable one for the further attack of the main Turkish position, but the Bulgarians did not avail themselves of it. Their attacking troops were in disorder and their reserves were still far distant, a heavy fog had arisen and it had become difficult to find their bearings, and furthermore they were unaware of the results of the artillery bombardment.

They nevertheless took advantage of the fog to work their way somewhat forward and to entrench.

By dawn, therefore, on the 24th, the task which had been set them, that of capturing the advanced positions of the East Front, had been accomplished.

At 10 a.m. the fog rose; the Turks had taken advantage of the respite allowed them and had regained order, and now opened a heavy fire on the front parties of the Bulgarians who were entrenching at the foot of the ridge, while the fortress batteries sited in the neighbourhood of Kuru-Cheshme and to the south of it, which had suffered least, opened fire on the advanced positions, now occupied by the Bulgarians, the ranges of which they had already ascertained accurately. The troops in the Maslak and Mal-Tepe positions suffered especially heavy losses.

As soon as he recognized what was happening, the Commander of the Siege Armies decided that the time had come for giving the final blow

and for capturing the fortress, and with this object he issued the following short order :—" Attack the forts of the East Front and capture them."

The attack was fixed for 2 p.m., simultaneously with attacks in the other Sectors, but later the staff recognized that an attack by daylight, even though the defenders were badly shaken, would entail heavy losses, as some of the trenches and some well-concealed machine guns in the intervals between the forts were still firing. The attack was therefore postponed to 10 p.m. after the moon had risen.

The fire fight continued the whole day in all the Sectors. General Kirkov's Division, hearing of the success on the East Front, tried again and again with great resolution to capture the positions on the South Front, but without success. Still, entrenching themselves step by step, parties of the 30th, 51st and 12th Regiments drew nearer to the Turkish trenches.

The Servian 15-c.m. howitzers continued to shell the concrete batteries, and although the latter were well concealed the accuracy of the firing was very great. Only the flashes of the discharges from the batteries, and the guns of Battery No. 62, were visible. These batteries were soon silenced, but others of the Turkish batteries continued firing.

The artillery of the attack on the South Front failed to obtain the range of the well-concealed trenches on Pamuk-Sirti and Tokat-Bair, which were sited on ground of low relief, but on the East Front the Bulgarian guns continued to batter the forts and batteries sited on the sharply defined ridge. In these batteries it is said that as many as four reliefs of their gun crews were destroyed. By evening the batteries and forts of the East Front were silenced, *but the trenches in the intervals between them still remained active.*

The state of affairs by evening on the 24th March was as follows :— In the North Section of the East Front the 56th Regiment passed the whole day in the ravine of the Provadiisca, digging " Boer " holes in the river bank, in order to obtain cover from the machine guns which enfiladed them from the direction of Tash-Tabiya.

On the East Section the forward parties lay in trenches dug *at the foot of the ridge* within 150 to 200 metres from the fort line. The greater numbers were collected in the dead ground near Hasan-Aga in the Provadiisca Valley, and the reserves in rear of the crest of the ridge containing the advanced positions, which latter were now adapted to the service of the attack.

On the South Front the advanced positions had not fallen. In the section of the 30th Regiment one battalion had dug themselves in within 200 paces from the Turkish trench on Pamuk-Sirti. The 12th Regiment attempted by daylight to drive the Turks from their front trench at Doudjaros, but could not get through the wire entanglements. They were driven back with heavy losses and dug themselves in within 300 paces from the fatal trench.

On the West Front the Danube Division fought all day on Papas-Tepe, and by evening were entrenched 500 paces from the front trenches of the Turks.

On the North-West Front the troops still held the captured positions Kadin-Keui and Yekmekchi Keui, but had advanced no further forward.

Events of the Night of the 24th—25th, and of the 25th March.—On the

approach of darkness the Bulgarian pioneers set to work to drive passages through the wire obstacles. As the artillery continued battering the Turkish positions with heavy enfilade fire, the pioneers suffered little loss, not more than about 60 men being hit on the whole North-East Front. The writer was able to obtain accurate information of the organization of this work in the first brigade section of the 11th Infantry Division (54th and 56th Regiments), which attacked the section from the Tunja to the Fort Aivas-Baba, inclusive.

In this section the pioneers belonged to the half-company under the command of Capt. Silvestrov. The men were divided up into parties of four or five, to each of which there were attached some infantry from the 54th and 56th Regiments. The parties were equipped with wire cutters.

It was decided to make *not one wide passage, but a number of narrow passages disposed at short intervals from one another*, along the whole front of attack, so that the attacking troops should not crowd the passages, but should cross the obstacle on a wide front. The small parties were sent forward at intervals of 20 paces, and the following table shows the results obtained, all the measurements being given in metres :—

No. of Passage.	Distance from Preceding One.	Width of Passage.	Remarks.	No. of Passage.	Distance from Preceding One.	Width of Passage.	Remarks.
1		6	30 metres from the beginning of Tash-Tabiya, working eastwards. Both metal and wooden stakes were met with.	24	25	2	
				25	6	2	
				26	8	3	
				27	12	3	
				28	40	6	
				29	280	8	Wire cut and poles bent down.
2	50	4					
3	30	2		30	200	6	
4	8	3		31	450	6	
5	30	8		32	60	2	Wire cut by artillery fire.
6	35	6					
7	15	4		33	25	2	
8	20	6		34	30	3	
9	10	4		35	10	6	At the beginning of Aivas-Baba.
10	15	4					
11	10	2		36	6	20	
12	20	4		37	20	3	
13	30	4		38	50	3	
14	20	4		39	80	30	
15	30	6		40	10	1	From five shells which fell one behind the other.
16	15	8					
17	50	2					
18	10	3		41	30	6	
19	5	4		42	60	6	
20	35	4		43	25	4	From two shells and wire cutters.
21	20	4					
22	15	25		44	20	3	
23	20	2					

The large distances between Nos 29, 30 and 31 were due, it appears, to the fact that here the Turkish trenches were in front of the wire entanglements.

Near Fort Aivas-Baba there was a passage (No. 36) 20 metres in width, which was made in the section of the wire entanglement which had here been erected *in dead ground* in front of the front face of the fort. In this place the pioneers were able to do their work completely at their leisure.

The parties were equipped with the light shields, but the latter were of no use. Corpses of sappers were found afterwards whose shields had been pierced by the sharp-nosed bullets

Concentrated charges of pyroxiline had been got ready on light barrows with long handles, but these were not used.

At moonrise the general assault of the fortress began in all the Sectors.

On the North-East Front a heavy bombardment of the fort line by the artillery began at midnight, under cover of which the Bulgarian infantry moved forward.

The 10th Rodopski, the 23rd Shipka and the 56th Regiments were detailed for the attacks on Forts Aivas-Baba, Aidji-Yolu and Tash-Tabiya, and these were met with heavy fire from the trenches in the intervals. Owing to the terribly destructive effect of the artillery fire the infantry were able to traverse the obstacles without serious losses (only about one hundred corpses lay near them along the whole front of attack), as the Turks were obliged to evacuate the greater part of their positions and fall back in disorder.

After this the fire of the heavy artillery was directed upon the rear side of the ridge in order to prevent the approach of the Turkish reserves.

At about 2 a.m. Fort Aidji-Yolu, the first to fall, was captured by the 10th Regiment, who found it already abandoned by the Turks, so that here no hand-to-hand fighting took place. In the attack on Aivas-Baba the 23rd Regiment came under the fire of an unfinished work which was in the interval between it and Aidji-Yolu, and of a short trench containing a machine gun. The fire of these apparently negligible works stopped the frontal attack, in spite of the fact that the forts and batteries had long been evacuated by the Turks, who had been driven out by the fire of the artillery.

The artillery fire was once more concentrated upon this section, showing clearly the importance of a general direction of fire, and at the same time an attack in flank was begun from the direction of the captured fort. As a result of these measures the fort was finally taken at dawn, four hours after the fall of Aidji-Yolu.

This was the critical period of the fight for the Bulgarians, as the Turks, now knowing the true objectives of the attack, might yet have taken measures to paralyze their success. But Shukri-Pasha would not believe that it was possible to carry the forts of the East Front by assault, and he was still deceived by the desperate nature of the fighting on the South Front.

As a consequence of the fall of the first two forts, Tash-Tabiya was taken at dawn without serious difficulty. The Bulgarians at once brought up field artillery to the captured sections of the position, both guns and howitzers, and opened fire on the retreating Turks. All the forts of the East Front fell by 8 a.m., and the Turks in large masses fled in panic through the town, in the direction of the North-West Front, throwing away their rifles along the road.

The commandant, now recognizing the fall of the fortress as inevitable, gave orders to demolish everything possible, and at 8.30 a.m. the first explosion occurred, that of a concrete magazine in the neighbourhood of the Shaitan Tarla Group.

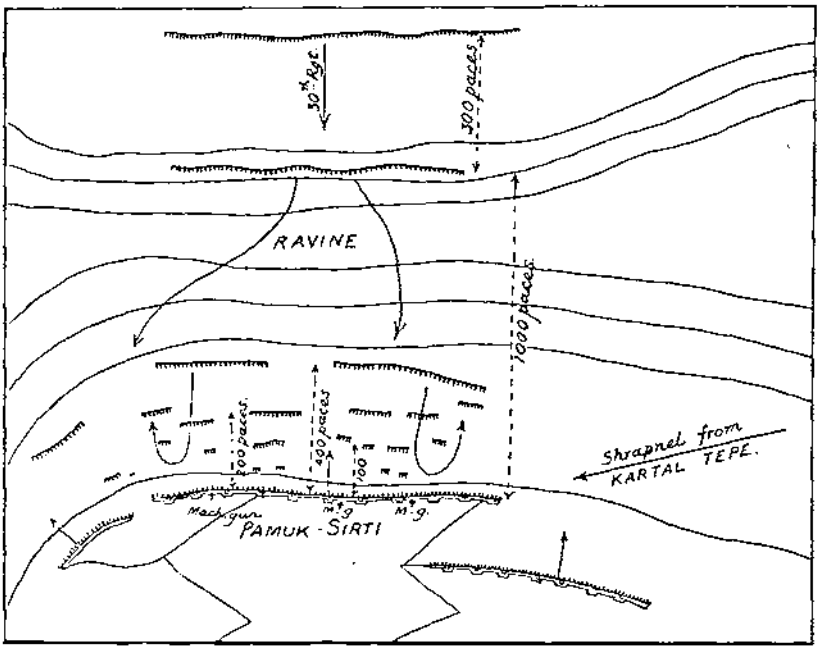
Some Turkish batteries of the North-West Sector, near the Yanlik-Kashli Barracks, opened fire on the eastern forts, where a crowd of Bulgarian troops were seen to be collected.

The composite cavalry brigade, under Colonel Markolev, containing

squadrons of the Bulgarian Guards and of Servian cavalry were, by order of the Commander of the Siege Armies, the first to break into the town. They galloped through it, though it was still full of Turkish soldiers, losing about 25 men, and were followed at 9.30 a.m. by the 23rd Shipka Regiment with their band. Part of the Bulgarian troops crossed the Tunja and halted near the Yanlik-Kashli Barracks for the purpose of disarming the Turkish prisoners.

Up to this time the fighting in the other sectors still continued. During the night, on the North-West Front, the Servians succeeded in capturing Uch-Tepeler, but in the other sections of this Front no further advance was made. The action of the Danube Division, on the West Front, was far more energetic. Having concentrated very heavy fire on the strong point on the summit of Papas-Tepe, the Servians moved along the low ground to envelop both flanks of the position, and thus compelled the Turks to evacuate the strong point. By dawn they had retired to the summit of Bekchi-Tepe.

On the South Front the attack on the advanced positions continued all night. The 30th Regiment (11th Company) reached the fatal trench on Pamuk-Sirti, but were thrown out again with great loss, and the greater part of the men lay down in trenches within 200 paces of the Turks. But a few dare-devils crept up to within 30 or 40 paces, and entrenching there kept up a spirited fire fight with the enemy.



Attack of 30th Regiment on the Pamuk-Sirti position.

At dawn, seeing the fall of the East Front, the 12th Regiment. in the Daudjaros Section, burst in a crowd from their trench, which was, as mentioned above, within 300 paces of the Turks, and with a loss of 480 men got up to the wire entanglement, which they began to demolish with their hands, pulling down the wooden stakes. Seeing this the

garrison put up the white flag; but it was too late, for the Bulgarians with cries of "Hoorah!" broke into their trench and slew them all, not sparing even those who had run for shelter to the dug-outs.

At this time conferences began, treating of surrender in the sections of the 30th and 51st Regiments, which had not succeeded in capturing the Turkish positions opposed to them.

On the North-West Sector the Turks proposed surrender on certain conditions, but the Servians insisted on unconditional surrender, and to this the Turks consented. At 10 a.m. the troops occupied the line of forts without fighting, and at noon the second fort line. The South Sector had surrendered at 11 a.m.

By 1 p.m. the firing and explosions had ceased. By order of the Commander of the Siege Armies the troops halted on the positions which they had occupied.

At 2.30 p.m. Shukri-Pasha and his staff surrendered officially to the Commander of the Siege Armies, his place of residence having been discovered during the morning by the cavalry scouts.

Thus was the assault successful, and the fortress entered from the east, where the Bulgarians stormed the forts. *The other fronts were not captured* in spite of the great efforts of the Allies, but fell under the threat of attack in the rear.

The losses of the Allied troops were declared to have been as follows :—

	Killed.		Wounded.	
	Officers.	Men.	Officers.	Men.
In the East Sector	16	949	62	5209
In the South Sector	8	325	20	1364
Total losses of the Bulgarians ..	24	1274	82	6573
In the North-West Sector	4	69	2	360
In the West Sector	2	199	5	806
Total losses of the Servians ..	6	268	7	1166

The losses of the Bulgarians amounted to 8·5 per cent., and those of the Servians to 4·5 per cent., of the troops who were present in the action. These losses may be considered very moderate, a result due to the clever organization of the assault, and to the technical errors in the construction of the works of defence.

The Turks lost, during the whole siege, about 15,000 killed and wounded; the prisoners numbered 60,000 rank and file, 14 Pashas and 2,000 officers. The spoils included 14 stand of colours, more than 600 guns, 20 motor lorries, and great quantities of provisions and munitions of war.

Notes made on an Inspection of the Scene of the Fighting after the Assault.

The North-East Front was the chief sufferer from the artillery fire of the attack, and especially the Forts Tash-Tabiya, Aivas-Baba and Aidji-Yolu, in which the greater part of the brick casemates were demolished.

All the ground in rear of these forts was literally ploughed up with the explosions of high-explosive shells, but a sector magazine, which was very close to Aivas-Baba on the reverse slope, escaped injury.

There were very few hits in the neighbouring trenches in the intervals; the trenches were not damaged, but they contained many corpses of Turks who had been killed by shrapnel. There were quantities of empty cartridge cases in the trenches and on the glacis of the forts which were

used as rifle positions. Most of the Turkish corpses lay in the ditches of the forts, where they had fallen from the covered ways, and in rear of the forts; the greater number of them had been killed by shrapnel.

In the batteries of the East Front only three or four guns had been damaged. A few of the light splinter- and shrapnel-proof shelters had been demolished, but the majority of them had escaped.

The wire entanglements had suffered very little from high-explosive shells. This is also evident from the table given above, in which only three passages are shown as having been made by artillery fire.

In the advanced positions on the East Front the damage done to the trenches by high-explosive shells was very small, although these trenches were sited on the "military crests" and very badly concealed, but the whole area was strewn with shrapnel bullets and splinters of shells. The quantity of blood-stained Turkish clothing bore witness that the losses from fire in these trenches had been very great. The trenches were of "full" profile (with a firing step), with traverses at 10-metre intervals, but, as elsewhere, without any form of overhead cover. Some of the Bulgarian shields of French design were lying about.

An inspection of the approaches to the forts of the North-East Front disclosed that on the north side (the attack of the 56th Regiment) the first pause had occurred on the bank of the Provadiisca Stream. The bank was adapted to form a rifle position, and recesses had been cut in it as a protection against the enfilade fire from the direction of Tash-Tabiya. The right flank section, which lay in the valley with its flank towards the machine guns, and apparently unsuccessfully entrenched, had been killed to a man, one by one. In the other parts the losses had been insignificant. At 200 metres from the stream (and 300 metres from Aivas-Baba), at the foot of the ridge, was the second and last position of the attack, in the form of separate rifle pits for firing lying. On the approaches to Fort Aivas-Baba from the east (the attacks of the 23rd and 10th Regiments), there were at the foot of the ridge some sections of trenches for firing lying, excavated in complete irregularity. No other works made by the attack were noticed in this section. In Fort Aidji-Yolu the efforts of the attack to adapt the fort, after its capture, to their own use were noticed.

On the South Front the trenches had suffered little from artillery fire, but the concrete battery No. 62, for six 15-c.m. guns, had suffered very badly. On one traverse there were three hits from the Servian 15-c.m. howitzer shells. All the area occupied by the battery was cut up by craters of shells, and on the guns there were many scratches and grazes from splinters and shrapnel bullets. In one case a roof of ferro-concrete, 17·7 in. in thickness, had been wrecked by a single shell.

The neighbouring concrete batteries, *the flashes of discharge of whose guns had not been seen*, had suffered little. There were no craters of high-explosive shells within 230 yards of them, but many traces of shrapnel fire.

The entrenchments on the South Front showed the resolution of the attack and the strength of the fire of the defence. In the section of the 30th Regiment, to which fell the heaviest fighting before Pamuk-Sirti, the first trenches of the attack lay at the distance of about a kilometre from the Turkish trench. The next position, trenches for riflemen standing made during the attack, was at 300 to 400 paces from the first. After this the attackers descended into a ravine, and entrenched them-

selves on the ridge 400 paces from the Turkish trench. This trench, capable of holding a battalion, was of the profile "firing standing on the bottom of the trench." Beyond this, there were only short lengths of trench, for a section, a squad, or file, with profiles for firing lying. Still further, at 100 paces from the trench, there were more attack trenches of the same nature, with quantities of expended cartridges. Some Bulgarian corpses lay here. Individuals had crept even 30 to 40 paces nearer and had entrenched. The attack could approach no nearer. The "unapproachable" Turkish trench was like a fissure in the ground, completely merged in the landscape.

In the central section of the South Front, in the course of the two days' fighting and at a distance of 900 to 1,000 paces, the attackers had made seven lines of trenches, of various profiles.

On the left flank, at Doudjaros, the 12th Tunja Regiment had made two lines of trenches, the nearer of which was 300 paces from the Turkish trench, and in which, lightly covered with earth and brushwood, lay the bodies of the Turks slain in the hand-to-hand fighting.

On the West and North-West Sectors there were no demolitions caused by artillery fire, as here there were very few guns of large calibre, but all the Turkish advanced positions were so strewn with shrapnel bullets, that in every 12 square feet there lay from two to three bullets.

On these sectors there were no traces of the close attack. The Servians opposite Papas-Tepe had trenches for firing standing, not nearer than 600 to 700 metres to the Turkish front trenches, but in the Maritza Valley their trenches were nearer. On the North-West Front the advanced positions Kadik-Keui and Yekmekchi-Keui Farm had been adapted to defence by the attack. On the approaches to Uch-Tepeler craters of 21-c.m. high-explosive shells were to be seen, which had evidently been fired by the Turks against the attacking troops of the Allies.

Before the surrender the Turks had begun to destroy and demolish whatever they could. On the East Sector, which had been taken by assault, they had done nothing in this way. On the West Sector, where the Papas-Tepe Group was of field character, there was nothing to destroy except the guns, and they were uninjured. In the South Sector the gorge barracks in Fort Marash had been blown up, and the whole interior of the fort had the appearance of an enormous crater.

On the North-West Sector the concrete magazine in the area of the Shaitan-Tarla Group had been demolished, and some of the guns had been cut off near the muzzle by dynamite charges. The big searchlight in Shaitan Tarla had been burnt. In Fort Hedirlik the wireless telegraph station was damaged and burnt. In the centre of this fort was an enormous heap of burnt cartridges, rifles and other articles. Some rifles had been thrown into the wet ditch of the fort but were recovered by the Servians. Near this fort more than 300 artillery horses had been slaughtered. A motor lorry had been burnt, and also the Yanlik-Kashli Barracks, some provision stores, etc.

But the most serious damage was the demolition of the railway bridge over the Arda, which delayed for more than two weeks the passage of the Bulgarian trains to the south, during which time loads had to be transferred through Adrianople.

F. E. G. SKEY.

(To be concluded).

HISTORY OF UNDERGROUND WARFARE.

Being a Review of the book by A. GENEZ, Captain of Engineers, French Army.—(Librarie Militaire Berger Levrault, Paris, Rue Des Beaux-Arts 5–7, 1914. Price 5 francs).

THE small importance of the sieges undertaken during the Franco-German War, with the exception of that of Belfort, has had the effect of diverting attention from the use of military mines as an aid in siege warfare. Other causes, such as the advent of heavy shells with large charges, the addition of pontoon bridging to the duties of the Engineers, and the introduction of short service also tended to the neglect of the art of mining. The Siege of Port Arthur, however, has shown that this art is not out of date, and the time seems opportune for reviewing the past in order to recall the glories of underground warfare, to follow its evolution, and to compare the successive characteristics of mining in attack and defence.

This history is divided into four principal periods :—

First period—up to the year 1487 when gunpowder was first employed in mines at the Siege of Serezzanella, near Florence.

Second period—that of breaching by means of mines, from 1487 to the Siege of Candia (1667 to 1669) during which the miner determined to meet his adversary under the glacis, and employ explosives against him.

Third period—from the Siege of Candia to that of Schweidnitz in 1762 where the *globe of compression* of Belidor was first made use of.

Fourth period—from the Siege of Schweidnitz to the present day.

FIRST PERIOD.

The use of mines in the attack is of great antiquity. The Siege of Fidenæ by the Romans in 430 B.C. furnishes a typical example. At this time the only object was to gain a footing unobserved within the defended locality. The employment of mines in defence was probably subsequent to their use in attack, and an old Greek author, writing on the subject of countermines, recommended that when it had been observed that the enemy was driving a mine, a deep ditch should be dug outside the ramparts, having its sides supported by masonry. This was to be filled with dry wood, and when the assailants broke into it, the wood was to be set on fire and covered over with earth to force the smoke into the enemy's gallery. Another suggestion was that the introduction of swarms of bees into the mine would cause no little inconvenience to the assailants.

Again, he mentions the Siege of Barca by Amaris, King of Egypt. The defenders were convinced that a mine was being driven under the fortifications, but could not discover on which side. A tinsmith conceived the idea of using a bronze shield as a stethoscope. Applying it methodically to the ground in various places, he soon discovered where

the miners were at work. A countermine was then sunk above the besiegers' gallery, and the defenders, having the advantage of the command, soon drove out their assailants.

Polybius gives an account of a breaching mine at the Siege of Pale. Philip III. of Macedonia caused galleries to be excavated up to the walls, with branches under the foundations. The walls were then supported on wooden staging for a length of two arpents (480 ft.). When all was ready the staging was set on fire, with the result that the walls collapsed, forming a practicable breach through which the besiegers rushed and captured the town. It is probable that holes from the galleries were made at intervals outside the walls to allow the smoke to escape and improve the draught.

Philip successfully employed the same system at the Siege of Thebes, but at Apollonia the defenders outwitted him. From inside the walls they drove galleries towards the front, and hung bronze vases in them. The vibration of one of the vases denoted the blows of a pick in a neighbouring mine, the position of which was carefully estimated. Above the supposed position of the mine, a countermine was excavated, in which were collected cauldrons of boiling water and pitch, night soil, and hot sand. During the night shafts were sunk to the mine and the materials thrown into it, killing all the workmen.

During the Mithridatic Wars at the Siege of Thermiscyra countermines were dug over the assailants' mines, and bears, and other wild beasts, also hives of bees, were lowered into them.

Many other instances occur in ancient times, and in the Middle Ages, of the use of mines both in attack and defence. One of the most striking of these is the Siege of Chateau Gaillard by Philip Augustus in 1204. The defenders excavated their countermines too close to the foundations of their wall, with the consequence that it soon fell under the blows of stones hurled from a ballista.

At the Siege of Acre, which fell in 1291, Greek fire was used to set fire to the works. The wooden towers on wheels which the Crusaders had constructed, were set on fire by this substance. Philip Augustus, who was present at that siege, succeeded later in destroying by Greek fire the English fleet which was blockading Dieppe. About the same time Gaubert of Mantes set fire under water to a double stockade which protected the Island of Andelys, after having had fireworks, enclosed in pots of earth, fixed to it by divers.

Cæsar (De Bello Gallico. Vol. VII.) relates that the Gauls at Bourges destroyed his works by mining under them, a labour to which they were accustomed owing to the number of iron mines in the country! When the Romans excavated mines the Gauls broke into them, filled them with beams, sharpened, and hardened by fire, with pitch and heavy stones, and thus prevented the miners from approaching the walls.

SECOND PERIOD.

Gunpowder produced a great improvement in weapons of war, but was not used in mines until two and a-half centuries after its invention. The first attempt at modern mining was made in 1487 when the Genoese were attacking the Florentine town of Serazzano. One of their engineers

filled his mine with powder instead of with staging and faggots, but as he did not tamp the charge the explosion took effect outwards, and the fortifications were not damaged. A Spanish soldier in the Genoese service, Peter of Navarre, who was at Serazzano and afterwards rejoined the Army of his own country, tried in 1500 to blow down the walls of the Castle of St. George on the Island of Cephalonia. The attempt was not altogether a success, but the breaches which were made led to the surrender of the castle.

About this period, during the quarrels of Louis XII. and Ferdinand II. over the partition of the Kingdom of Naples, the French in the forts surrounding the city of Naples were besieged by the Spaniards. Here Navarre determined to repeat his experiment and blow up the Chateau Neuf. On this occasion he was successful in effecting a practicable breach. The Chateau de L'Œuf was next attacked. Situated on a rocky peninsula almost cut off by the sea and defended on the land side by a deep ditch, the castle could only be approached by sea. Navarre roofed over some boats, and from them opened a gallery which he drove straight under the castle. In this he fired a mine by slow match, the rock was split, and a large portion of the wall of the castle fell. Many of the defenders were killed, the remainder were easily overpowered.

Navarre continued his brilliant career at the Siege of Bologna in 1512, and prepared a mine under the walls. The wall was blown vertically into the air for several feet, but fell again on to its foundations, hardly cracked. So high was it raised that the assailants actually saw beneath it the defending troops drawn up ready to repel their assault. From this failure Navarre learnt not to place his charge exactly under the centre of gravity of the mass to be shattered. That such an event is possible was exemplified in 1795 when the same phenomenon was repeated in blowing up a solidly constructed curtain during the demolition of Fontarabia.

Navarre had by this time achieved such a reputation that the Castle of Milan, which had already withstood several sieges and was considered impregnable, was surrendered with a strong garrison well supplied with food and munitions of war, by Duke Maximilian Sforza, as soon as it was known that Navarre was to conduct the siege.

Countermines were successfully employed at Marseilles in 1524, and at Naples in 1528, and the sieges were abandoned. In 1529 the Turks employed mines against Vienna. These were interrupted for the greater part by the countermines of the besieged, only a few could be fired and the assault was repulsed. The expedient of countermining therefore seems to have followed very quickly on Navarre's invention of powder mines.

Probably the earliest instance of countermines prepared deliberately in advance occurred at Padua, which was besieged in 1509 by the Emperor Maximilian I. with a mixed army of Germans, Italians, Spaniards and French. This town then belonged to the Republic of Venice, and was exceedingly well organized to resist a siege. The garrison was large, provisions plentiful, and there were two lines of defence, in the interval between which countermines had been prepared. A few exterior works of small importance had been captured when a strong effort was

made against one of the bastions. A breach was made by the artillery sufficiently wide for the advance of 1,000 men. Two assaults failed, the third was successful, but scarcely had the last Venetian left the bastion when the mines beneath it were fired. Many distinguished generals were killed, and the Imperial troops were so dismayed that they were rapidly driven from all the works they had already captured.

The moral effect of this event was so great that Maximilian found it impossible to induce any of his troops to hazard a further assault, although he proposed that it should be led by the cream of his troops, the gendarmery of France. Never was such a demand for priests to hear the confessions of those who might be detailed for the assault. The Chevalier Bayard expressed great indignation that noblemen should be expected to risk their lives fighting with bakers, shoemakers, and such riff-raff, and advised that, as there were plenty of German counts, seigneurs, and gentlemen, they should be directed to support the gendarmery, who would willingly show them the way. It is well known how the Chevalier, "sans peur et sans reproche," shuddered at the idea of a bullet, the only weapons worthy of him were spear and sword wielded by gentlemen.

In 1601 an army composed of Spaniards, Germans, Italians and Belgians, under Marquis Spinola, laid siege to Ostend, which was held by a mixed garrison of Dutch, English and French. This city had been fortified by William of Orange, who protected it by a girdle of bastions. The attack was directed almost entirely against the front facing Nieuport; on the attackers' left, near the sea, was the Sandhill Bastion, separated by a canal from the Hellemond Bastion, then the West Gate, South-West and Polder Bastions, and on the extreme right the South Bastion. Communication with the sea could not be interrupted, so that the defenders could by this means obtain supplies of all kinds. The Commandant was Colonel Vandernoot, an experienced and clever man.

Every attempt at a general assault failed, and in 1604 recourse was made to a step-by-step advance. To the Germans was entrusted the attack on the Sandhill, to the Spaniards that on the Hellemond, to the Belgians the West Bastion, and to the Italians the Polder and South Bastions.

A lunette called the Green Ravelin covering the Hellemond was first attacked in March, 1604. The earthwork of the salient was demolished by small mines, then called petards, and the salient captured. The work was cut in half by a palisade, to capture which mines had again to be employed. The besieged countermined, and combats took place in the galleries, but the besiegers managed to explode their mines, and the place was captured.

Meanwhile the Belgians mined the glacis of the West Bastion, and the explosion of "9 tons of powder" (about 900 lbs.) enabled them to obtain possession of a ravelin which protected the front of the bastion, and to capture its garrison on 18th April. The descent of the ditch was then undertaken, and by 27th May it was possible to reach the escarp. The ditch was fordable, and a hard bottom was made with fascines and hurdles. To save time it was decided not to mine under the ditch, and though a deserter said that the parapet was countermined, six officers

and soldiers volunteered to cross the ditch, and make an opening in the escarp. They advanced under a fierce fire from both flanks, but in half an hour the survivors had dug themselves in. A covered way was then made across the ditch, and in eight days' time 40 ft. of mine gallery had been excavated under the parapet. The mine chamber was loaded with 30 tons (3,000 lbs.) of powder.

Troops were drawn up for the assault, and a few men sent on to the parapet to draw the garrison out over the mine. The result of the discharge was to open a wide breach, but a great deal of the effect acted outwards, and killed or wounded numbers of the assailants. It also opened out the approach to the defenders' fire, and the assaulting troops lost heavily. A counter-attack by 400 men repulsed them to 60 paces from the ditch, their works in the crater were destroyed and their fascines burnt. A parapet 12 ft. high was then constructed to close the breach.

Several days were required by the assailants to regain the escarp, when the besieged themselves fired a mine, thereby disclosing a masked battery constructed behind the parapet, and which commanded the besiegers' approach. However a fresh mine was dug, and was about to be charged when the movements of the defenders seemed to indicate the preparation of a countermine. To make sure if this was the case or not the besiegers sent out a reconnaissance. The defenders thought this the prelude to an explosion, and themselves retired. The besiegers then waited for the discharge of the supposed countermine, and did not dare to return to their works until a spy had ascertained that no countermine existed. Eventually the mine was charged and fired at the end of June. Again the greater effect was produced outwards, and the assailants lost heavily. However the assault was delivered and half the bastion was taken, but another mine was necessary to capture the remainder.

On the besiegers' extreme right the Italians effected the passage of the ditch of the S.W. Bastion, and after several small explosions, each followed by a slight advance, managed to charge and fire a larger mine. The defenders countermined unsuccessfully, and the Italian mine formed a good crater from which they were able to make a further advance. At length the explosion of 2,000 lbs. of powder cleared the way for the final successful assault. But before this occurred the combatants often met below ground, where sanguinary encounters took place in the dark. Occasionally barrels of powder were accidentally fired, burying dead and living, or blowing up indiscriminately any combatants who might happen to be overhead.

The Spaniards advanced steadily towards the Hellemond, one of their mines uncovering a countermine which was just ready for firing. Another countermine was broken into, but a moment later a second close by was fired, and suffocated more than twenty of their workmen. An hour later the attack fired a mine which killed a number of the defenders, who had been enticed over it by the false alarm of an immediate assault. The capture of the Hellemond, which commanded and flanked the Sandhill, rendered possible the capture of the latter which it was almost impossible to mine as the sand fell in as quickly as it could be removed. It was taken on 13th September.

The besiegers now found themselves confronted by a second enciente. The defenders compared Ostend to ancient Troy, and called their first line New Troy, the second Little Troy. However batteries erected on the outer line soon reduced to silence the guns of the inner lines, which were on a low parapet, commanded by the former. The defenders were not yet discouraged, they fired mines in the space between the two lines and compelled the besiegers to advance with circumspection. When the second line had been captured yet a third appeared. The Germans from the Sandhill were able to penetrate a work defending the old town, which they carried after exploding a mine, and on their right the Spaniards captured a large demilune. The defenders had now lost the key of their position, their communications with the sea were threatened. They capitulated on 20th September, 1604, after three years of siege, and seven months of underground warfare.

Subterranean works thus had an important bearing on the results of this siege, but it is noteworthy that the defenders only used countermines to enable them to reach the attackers' galleries, to fight them there, and do what damage they could by hand. They do not appear to have made any systematic use of gunpowder to destroy at a distance the galleries and mines of their opponents. The explosions of the defence had as object to check the assaulting columns, and to spread panic in their ranks. The way in which they utilized mines to suddenly clear the foreground and unmask batteries trained on the attackers' approaches is also worthy of notice.

In 1654 Arras was besieged by the Spaniards, and affords a good example of the employment of a grand parallel covering the artillery. Approaches from it by zigzag or double sap brought the besiegers to the counterscarp. Fresh batteries were erected on the glacis, and mines carried from them towards the most advanced work, which was not revetted, but had steep slopes with palisades in front. The defence was stubborn, and the attack could only advance step by step. On 1st August two shafts were sunk, whence galleries were driven towards the salient. Efforts to reach these by countermining were unsuccessful, and on the night 7th August the mines were fired with good effect, and the craters occupied after a three hours' fight. No further advance could be made, and mining had again to be resorted to. This time the defenders were successful in countermining, and hindered the work considerably, only giving way on 18th August. On 24th the palisades of the covered way of the place itself were blown up, but attacks made on that and the following day failed, and Turenne's Army arrived in time to raise the siege. In this case the defenders advanced underground to meet the attackers as the ancients had done, and were undeterred by fear of explosions.

Military mines had now reached such importance that much controversy took place in regard to their construction and destruction. The ancients attacked the bases of the walls, but the advent of artillery led to the use of thick parapets of earth, which was obtained from a ditch, and galleries had to be inclined, or shafts sunk, to obtain the necessary depth. Wider and deeper ditches made the labour of driving galleries excessive. The failure of the first powder mines demonstrated

the necessity of tamping the charge, and this led to placing the charge in returns, and not at the actual end of the gallery. Long vertical or stepped shafts with horizontal galleries from them were easier to construct than inclined galleries, but communication was more difficult.

Chevalier Antoine de Ville, an engineer born in Toulouse, now suggested sinking shafts in steps each the height of a man, from which it was more easy to remove the earth than from deep shafts. These shafts were sunk chequer-wise to facilitate tamping. Occasionally shafts were sunk in the ditch itself, or the ditch was crossed by blinded galleries. De Ville also indicated a method of defence by countermines; a shaft was sunk in the terreplein of the fortress whence a gallery was driven to beyond the counterscarp. At its extremity a transverse gallery was made embracing all ground likely to be threatened by the enemy's mines. From the transverse gallery shallow shafts were sunk, and branch galleries from these, which were in turn joined up by a second transverse gallery. De Ville unequivocally condemned the counterscarp galleries of the first French and Italian bastion systems, and to him therefore belongs the honour of having invented the system of modern countermining.

Candia, held by the Venetians, was besieged by the Turks from May, 1667, to September, 1669. The Turks could not isolate it from the sea, so that supplies were constantly pouring in. On the land side it was defended by a good seven-faced bastioned front, covered by exterior works which were countermined with a view to their destruction when they could no longer be held. Captain-General Morosini was in command, and this siege has made his name famous. The Turks opened parallels, and tried to make use of mines, but the defenders listening in their galleries always detected them, blew them up, or penetrating the galleries, damaged or carried off the powder. One of the outer works was captured by the Turks at the end of the fifth month of the siege, and after being recaptured, was finally abandoned and blown up with its Turkish occupants by a charge of 7,000 lbs. of powder. During the first six months 618 mines were fired, and the Turks acknowledged losing 12,000 men by that agency. A mine containing 18,000 lbs. powder is recorded, and during the year 1668 the defenders expended 3,000,000 lbs. of powder.

De Morosini had more faith in mines than in sorties, and the disastrous result of one sortie confirmed him in this opinion. In 1669 he determined to blow up the salient, which the Turks had captured, of one of his bastions. The explosion was of terrible effect, but the Turks returned to the attack, and on their part, succeeded in destroying the remainder of the bastion by a mine. This opened the place, and the end of its defence was at hand when a French division arrived as reinforcement. Morosini was unable to deter them from making a sortie, and they succeeded in driving the Turks from their trenches. Unfortunately at this moment a few barrels of powder left in a battery exploded. The French, who for the last two years had heard of nothing but the fatalities caused at Candia by mines, mistook this explosion for the bursting of a mine. Consternation seized commander and soldiers; the ranks broke and fled. The Turks pursued, but were checked by the fire of the garrison.

It was, however, impossible to restore confidence, the remainder of the French troops departed by sea, the Germans followed, and Morosini, left to his own resources, was obliged to capitulate.

This deplorable event again draws attention to the moral effect of mines. Napier records that at the assault of Badajoz half a British regiment, which had escaladed the wall, fled in disorder at the sight of a lighted match on the ground, which had just been used to fire a gun. Prior to the assault of the Malakoff at Sebastopol, the Engineers fired several large mines on the glacis, which would certainly have destroyed any of the enemy's mines which had happened to be near, but were, in fact, only fired to inspire confidence in the attacking troops by showing them that their own troops were masters of the ground. Chevalier de Ville pointed out a means of locating the enemy's mines by the use of a boring tool. At Candia borers were used, and the miners placed small charges at the bottoms of the holes and fired them when they heard the enemy at work near by. This siege was therefore the first at which bored mines were used.

The French engineer Castellan, who was at Candia, returned to France after the siege, and was employed by Vauban to direct the mining operations at the Siege of Maestricht. He doubtless told Vauban how the Turks, against whom every inch of ground had been disputed, had multiplied their trenches and places of arms. Vauban had already published his *Première Instruction sur les Sièges*. At that time it was usual to open only one parallel, and in it, under the name of the Royal Battery, to place all the guns destined for the bombardment of the fortress. At Maestricht Vauban applied a new method of attack which he had deduced from the Siege of Candia, and opened several parallels.

A.R.R.

(To be continued).

THE UNIVERSAL IMPROVISED TRESTLE.

From an article in the February number of the *Mitteilungen über Gegenstände des Artillerie-und Genicwesens.*

THE importance of improvised bridges in war is incontestable. It varies according to the difficulty of getting the normal bridging equipment to the site—or even the impossibility of doing so—when, for example, the equipment would have to be replaced by improvised material in order that it might be available for use elsewhere.

Several kinds of trestles, transoms, etc., are used as a "permanent foundation" for improvised bridges. None of these, however, owing to their particular characteristics (quite apart from the question of strength) can be used on every occasion; a very careful selection must be made according to the nature of the obstacle to be bridged. One type, for example, can be quickly and easily constructed but cannot be used in a strong current, while another type demands skilled labour, and therefore much time, in building.

Experience shows that, when time is short and there are no floating piers, rivers with rocky, stony or holding, muddy bottoms form very serious obstacles to any who are restricted to the "permanent foundations" which have been used hitherto.

The particular qualities that should be combined in a "permanent foundation" for improvised bridges, if such is to be suitable for use on service and fit for every emergency, are the following:—

1. The possibility of rapid construction under any circumstances;
2. Simplicity in construction, to avoid the use of skilled labour;
3. The maintenance of the same principle of construction, both for the lightest and the heaviest types of bridges;
4. The greatest possible economy in material by means of a technically sound design;
5. Adaptability to the most difficult conditions—unfavourable bottom, strong current, great depth of water, lack of floating material, etc.
6. The essential qualities of a hoist; and
7. The possibility of use as a foundation for trestle bridges in tiers.

None of the "permanent foundations" hitherto in general use can claim all these qualities.

The universal trestle (Austrian patent No. 52050—1911) of Major Raimund Hamböck, commanding the 15th Pioneer Battalion, merits all the more attention, as it fulfils completely the conditions already mentioned and seems peculiarly fitted, by reason of its simplicity and easy method of construction combined with exceptional stability and adaptability, to be the model for improvised bridges.

The trestle (*Plate* I., *Fig.* 1) consists of:—

(*a*). Double legs, which combine the bearing legs, BL, and the auxiliary legs, AL.

(*b*). Shoes, S, which prevent the bearing legs from sinking into the ground (not required on rock).

(*c*). Diagonal bracing, D, for the legs.

(*d*). Bearing spars, BS, which transfer the weight to the bearing legs.

(*e*). Transom, T.

(*f*). Transverse baulk, TB, which transfers the weight through the road-bearers, RB, to the transoms.

(*g*). Hoisting spars, HS, and wedges, W, for fixing the baulk, TB; the hoisting spars are also for raising and lowering the roadway.

The way to build the trestle is as follows:—

Before any bridging is attempted the section of the obstacle is rapidly taken. There is no need to take an accurate section, since the bearing legs—as explained later—are not cut to their exact length till they have been placed in position.

There is no trimmed timber in the trestle; the spars are cut to length in the same state as that in which they are found or felled, in the latter case with the bark on.

The various members of the trestle are assembled at the spot where the timber is obtained. Each pair of double legs is joined together and, by means of lashings, trenails, dogs or bolts, the movable diagonals are fastened near the bottom of the legs; shoes are lashed on too, should the nature of the bottom render them necessary.

All the other single members which have been detailed above are also prepared.

The trestle is constructed in separate parts. This is a particularly valuable feature, especially with heavy types of bridge, and is of even greater importance when surprise bridges are to be built, if wagons can be requisitioned to take the material to the site so that the detachment can build "direct from the wagon," as is done with normal bridging equipment.

A further great advantage of this method of construction is the fact that the bearing legs are not cut to their final length until they have been put in position.

The trestle accommodates itself, therefore, to the various inequalities of the ground caused by stones, rocks or holes, and the delays which are inevitable (should serious inequalities that the section has missed be encountered) in placing trestles which have been made up into one whole on the bank, are thereby avoided.

The construction in the water is carried out from a construction vessel (barge, boat or raft), which is provided, when conditions are difficult, with a construction scaffold, G, (*Plate* I., *Figs.* 2 and 3); from this scaffold the various members of the trestle are placed in position by means of guys.

The order of construction of the trestle is as follows:—

1. Shipping the various parts of the trestle on to the construction vessel.

2. Booming out and fixing the construction vessel, by means of baulks of a measured length, from the last trestle that has been built in bridge.

3. Simultaneous placing in position, that is to say, lowering the legs together with the diagonals (upright) up stream from the guide baulks, GB, which project from the shore side of the boat.

4. Simultaneous crossing of the diagonals and lashing them on opposite sides of the legs (*Plate* I., *Fig.* 3).

5. Cutting the bearing legs to the right length.

HAMBÖCK'S UNIVERSAL TRESTLE.

Fig 1. Heavy Type.

Fig 2. Construction Scaffold. G.

Outrigger and Guys are for the construction of high trestles in deep water and strong current.

Guys A are for launching the legs, together with diagonals, from the deck of the construction vessel.

Guys B are intended to prevent the legs dragging. They run through dogs at the lower ends of the legs. × is the point about which the diagonals revolve.

Fig 3.

D- Movable diagonal, connected to the legs by lashings or bolts.

Fig 4. Light Type.

SR = Shoe rib and fixed in 10 minutes.

Fig 5. A Trestle on piles used as a hoist

6. Fixing the bearing spars, BS, the transoms, T; the road-bearers, RB; the baulk, TB; the hoisting spars, HS, and the wedges, W.

7. Placing in position and lashing the roadway, and

8. Casting off the construction vessel.

When there is no water, the trestles are made up into a whole first, in the normal way. But with particularly heavy timbers the trestle can be built in separate parts; the diagonal bracing is first lashed to the legs; these are then erected, and the comparatively heavy transoms and the rest of the structure are put in position afterwards.

Plate I., *Fig.* 4, shows a universal trestle of a light type, such as would be built for footbridges, etc. The principles of construction inherent in the universal trestle for heavy bridges are very clearly seen in this type. The difference consists, apart from the smaller dimensions, in the absence of the transverse baulk and in the use of lashings instead of dogs and bolts.

It is obvious, too, that a transverse baulk, if it were a question of inserting a movable transom, could easily be added.

The construction is carried out exactly in the way which has been already described, with the simplifications which the lighter type entails.

By means of auxiliary trestles in tiers, the highest and strongest and therefore the heaviest foundations can be made for bridges over valleys and gorges. The principle of the universal trestle can also be applied with great advantage to piles (see *Plate* I., *Fig.* 5).

As this description is only intended to make known the principle of the universal trestle, a detailed description of the procedure of building a high arched bridge with several storeys would be out of place.

To close, a few data may be given, the results of actual work done; they prove how eminently suitable is the Hamböck trestle for use on active service:—

(*a*). During training, Sappers built a heavy trestle bridge of improvised material to take the heaviest military vehicles.

Among others was a universal trestle, 17 ft. high, to take a load of 18 tons, in 14 ft. 6 in. of water with a current of 5 knots. The trestle was built within 15 minutes by a trained detachment. This is a convincing proof that, wherever a pile can be driven, this type of trestle can be set up.

(*b*). Trained infantry pioneers finished 58 yards of light bridge (*Plate* I., *Fig.* 4) in an hour.

(*c*). A light improvised bridge with lashed trestles (*Plate* I., *Fig.* 4), which was built over a creek, was, during 30 days' training, crossed by 100,000 fully equipped soldiers on the march, and by 100,000 men at the double, without any effect on its stability.

(*d*). In order to test the stability of a tier bridge 65 ft. high, guys were attached to both the outer, upper ends.

A party of 10 men was detailed to pull on each guy alternately in order to disturb the equilibrium of the structure.

The deviation, which could only be detected while the men were actually pulling, amounted to 3·9 in. on each side.

E.W.C.

REVIEW.

THE EVERY-DAY USES OF PORTLAND CEMENT.

THIRD EDITION, 1913.

THE above work is published by the Associated Portland Cement Manufacturers, Ltd., Portland House, Lloyds Avenue, E.C. It is divided into Parts which deal with the subject under many headings, such as Portland Cement; Sand and Coarse Material; Concrete; Workmanship; Concrete-blocks and Moulded Concrete; Reinforced Concrete; Foundations; Walls, Piers and Posts; Interior Steps and Stairs; Paths and Pavements; Concrete for Roads; Joints in Drains; Manholes and Cesspools; Pipes, Mains, Conduits and Sewers; Houses; Various Buildings; Stables; Sheds; Silos; Bridges and Piers; Dams; Docks; Harbours and Canals; Rifle Ranges; Floating Docks and Pontoons; etc., etc., etc. The above will give an idea how comprehensive the work is and the facts are set forth in a clear and simple manner, the adaptability of concrete naturally finding great merit in the pages of a trade publication. There are numerous illustrations of work actually carried out and at the end of the book there is a useful set of "Memoranda for Concrete Users," which gives various valuable statistics and a handy Glossary. The work is certainly one which those engaged in the use of Portland Cement should read. Its popularity is proved by the fact that it has reached three editions in four years.

NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

June, 1914.

THE BATTLE OF SEMPACH.

Conclusion of article. Only historical.

FOLDING DISCS FOR VISUAL SIGNALLING.

The disc is made of aluminium in two halves, united by two hinges. When required for use it is opened and clipped on to the bayonet, which forms a handle for it; when not in use it is folded and strapped to the pack. It is claimed to be more easily seen than a flag of the same area, to be instantaneously fixed, and to be very strong and light. It can be used at night to veil or disclose a light.

REMARKS ON THE GREEK ARMY DURING THE CAMPAIGN IN EPIRUS.

These observations only apply to the mental and physical qualities of the soldier. The writer was not allowed in the front line, so can offer no remarks on the military operations or on the tactics employed. Commencing with an appreciation of the influence of modern Greek history on the national character, the progress of the army from its foundation in 1831 by King Otho I. to the present day is shortly sketched. The characteristics, dress, and equipment of each arm are then described in greater detail.

THE TRICOUMI NAIL.

This nail, intended for mountaineering, is described and illustrated. It is stated to be lighter than those in vogue hitherto, can be fixed closer to the edge of the sole of the boot, which gives a good grip on any small projection in the rock. It wears splendidly, does not tear the leather and get loose, and does not bruise the feet.

A.R.R.

CORRESPONDENCE.

EAVES GUTTERS.

DEAR SIR,

With reference to Major G. Walker's letter of 4th May on the subject of eaves gutters.

In Mauritius in 1908, the following method of preventing water from lodging in dips in gutters was adopted :—

Holes were punched, or bored (according as the gutters were wrought or cast), at about 3-ft. intervals, of a size such that a galvanized iron nail used for fixing the shingles on the roofs would drop in.

The nails were dropped in, and during actual rain very little water came through the holes. After the rain had ceased the water ran down the nails and dripped off wherever there was a collection of water that was held up.

I do not know whether time has brought out any disadvantages, but while I was there the scheme worked very well and saved the cost of the labour of cleaning out the water which, as there were a number of unoccupied buildings in my Division, was considerable.

Yours faithfully,

A. R. A. IREMONGER,

Lieut., R.E.

Glen Hewen, Devonshire, Bermuda,
24th June, 1914.

The Editor, *R.E. Journal.*

SOME WAR MEDALS OF THE BENGAL SAPPERS & MINERS.

SIR,

The medals depicted in the illustrations accompanying Lieut. Hobart's article in the August number of the *Journal* are of great interest, and the 1st Sappers & Miners are to be congratulated on their acquisition.

There are, however, one or two points on which I hope that Lieut. Hobart can give additional information.

(1). From an inspection of the photographs forwarded it would appear that neither the Nepaul nor Burmese War Medals of Subadar-Major Ganga Singh, are *original* issues of 1816 and 1826 respectively. The suspender of the Burmese War Medal is of a type not introduced until 1846, the original mounting being an iron clip and ring like the Waterloo

Medal. From a technical point of view great value attaches to a medal being an original issue, and not a re-issue or a late issue.

(2). It would be of very great interest to know the details of Ganga Singh's services in the Nepaul War. The War lasted from October, 1814, until the middle of March, 1816, and the medal was authorized by the Governor-General by G.G.O. dated 20*th* March, 1816. It was restricted "to every Native officer who actually served within the hills, and to as many of the Non-Commissioned Officers and Privates as shall be recommended by the Commanders of their respective Battalions for distinguished zeal or gallantry in the course of that duty."

The medal was not given for operations unconnected with Nepaul, *e.g.* the Capture of Hathras in 1817; but the Native survivors of the Nepaul War, who had not received the Company's medal, received the Army of India Medal with clasp "Nepaul" in 1851.

(3). The Jellalabad Medal of Ganga Singh's is the "Flying Victory" or second medal. The date on which he exchanged his first medal for this one would be of great interest and value to the "scientific" collector.

(4). Information as to the column with which Basawan Singh served in the 2nd Afghan War would be interesting as completing the details of this veteran's services.

I trust that Lieut. Hobart will be able to supplement his valuable contribution by giving information on these points, and I hope that his example will be followed by other Messes, which own relics of a similarly interesting nature.

Yours faithfully,

H. BIDDULPH,

Major, R.E.

The Editor, *R.E. Journal*.

PROFESSIONAL PAPERS OF THE CORPS OF ROYAL ENGINEERS.

FOURTH SERIES. VOL. I., 1905-07.

PAPER I. **Simple Tunnel Work on the Mari-Attock Railway, Panjab,** by Capt. H. E. C. Cowie, D.S.O., R.E. ..... 1s.

,, III. **Recent Works in the N.W. Frontier Province, India,** by Bt. Colonel G. K. Scott-Moncrieff, C.I.E., R.E. ..... 3s. 6d.

,, IV. **Armoured Trains,** by Capt. H. O. Mance, D.S.O., R.E. ..... 3s. 6d.

,, V. **Reinforced Concrete,** by Lieut.-Colonel J. Winn, late R.E. ..... 2s. 6d.

,, VI. **Fortress Warfare,** by Capt. Moritz Ritter von Brunner, Austrian Engineers. Translated by Capt. C. Otley Place, D.S.O., R.E. ... 3s. 6d.

,, VII. **Fortresses and Military Engineering in Recent Literature. Heft 63, "Mittellungen des Ingenieur-Komitees."** Translated by Capt. F. A. Buzzard, R.F.A. ..... 5s.

VOL. II., 1908-11.

PAPER II. **Report on Mechanical Road Transport for India,** by Capt. E. N. Manley, R.E. ..... 2s.

,, III. **The Khushalgarh Bridge,** by Capt. H. E. C. Cowie, D.S.O., R.E. 2s. 6d.

,, IV. **The Engineer Troops in the Campaign of Melilla,** by General Don José Marvá. Translated by Lieut.-Colonel G. M. W. Macdonogh, p.s.c., R.E. ..... 3s. 6d.

,, V. **Works Economics,** by Brig.-General G. K. Scott-Moncrieff, C.B., C.I.E., R.E. ..... 2s.

,, VI. **Moving Loads on Military Bridges. With some Notes on the Graphical Representation of Formulæ,** by Capt. C. E. P. Sankey, R.E. ..... 1s. 6d.

FROM 1912 THE PROFESSIONAL PAPERS WILL BE PUBLISHED IN PAMPHLET FORM ONLY.

PAPER I. **Six Lectures delivered at the Senior Officers' Course, 16-21 Oct., 1911, School of Military Engineering,** by Col. J. E. Capper, C.B., Commandant, S.M.E.; Lt.-Col. J. A. Gibbon, R.E.; Major G. C. Kemp, R.E.; Major J. C. Matheson, R.E.; Capt. C. E. P. Sankey, R.E.; Capt. H. Clementi Smith, R.E. ..... 9d.

,, II. **Notes on Roofs. With numerous Diagrams and Plates,** by Major E. N. Stockley, R.E. ..... 3s.

,, III. **The Growth of the Offensive in Fortification. With 18 Plates,** by Major J. C. Matheson, R.E. ..... 2s. 6d.

,, IV. **Telephone Transmission. With Diagrams,** by Capt. A. D. St. G. Brenner, R.E. ..... 1s. 6d.

,, V. **Stiffened Suspension Bridges. With Diagrams,** by Major H. Biddulph, R.E. ..... 2s.

They may be obtained from Messrs. W. & J. MACKAY & Co., LTD., Chatham, or from any Bookseller.