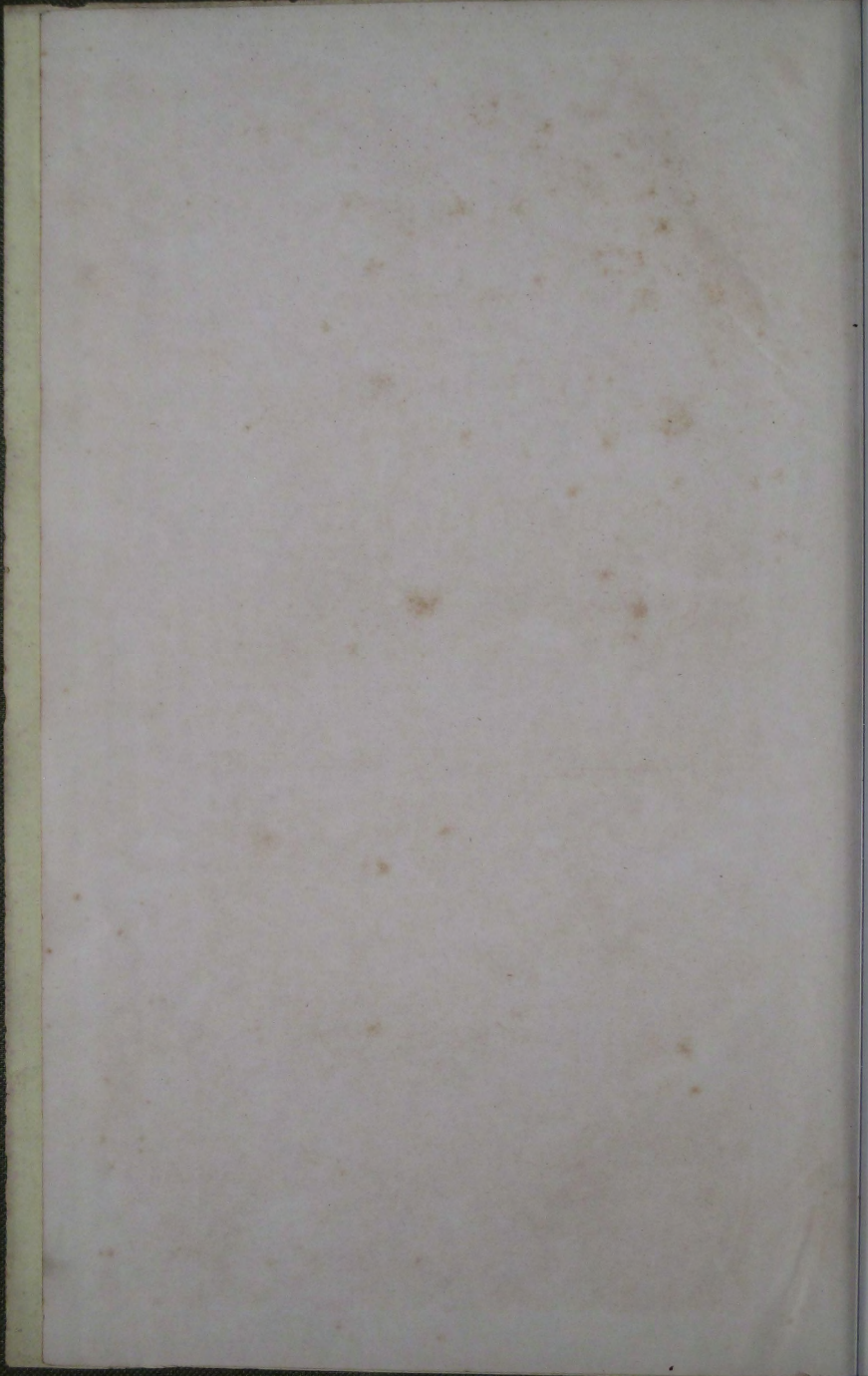


R. E



PAPERS
ON SUBJECTS CONNECTED WITH
THE DUTIES
OF THE
CORPS OF ROYAL ENGINEERS,
CONTRIBUTED BY
OFFICERS OF THE ROYAL ENGINEERS.

NEW SERIES.

VOL. XX.

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1872.

PARTS

OF THE

THE DUTY

CORPS OF ROYAL ENGINEERS

OFFICERS OF THE ROYAL ENGINEERS

NEW EDITION

1864

BY THE EDITOR OF THE

1864

P R E F A C E .

The issue of the present Volume has been delayed far beyond the time at which the Editor expected it would have been ready, by the difficulty of procuring papers bearing upon the professional subjects connected with the late war; owing to various circumstances, the Officers from whom it had been hoped much valuable information would have been obtained, have hitherto been prevented from furnishing it.

For those War Papers which the present Volume contains, the Corps is principally indebted to Lieut. Fraser, R.E.

Since the issue of the last Volume the Corps have had to deplore the loss of their venerated Chief, Sir John F. Burgoyne, who was an earnest supporter of the Corps Papers as a means for promoting the scientific advancement of the Corps, and the diffusion of professional knowledge among its members. His numerous contributions—the result of high scientific attainments, backed by experience of the most varied character in the largest spheres of action—have added much to the value of this publication. A Memoir of the late Field Marshal, written at the request of his family by the Right Hon. Sir Francis Head, Bart., has been inserted at the commencement of this Volume.

Immediately following this Memoir will be found one of the life of the late Lieut. General Sir W. Denison, one of the original founders and first Editor of the Corps Papers, written by Major General Harness, C.B.

Accompanying the present Volume, but bound separately from it, is issued an Index of the Subjects and Authors of all Papers published from the commencement of the Corps Papers (Quarto Series) up to, and inclusive of, the present Volume of the New Series.

No Occasional Meetings have been held during the past year, no papers suitable for discussion having been received.

C. S. HUTCHINSON,
Lieut.-Colonel, Royal Engineers,
Editor.

Railway Department,
Board of Trade, Whitehall,
March, 1872.

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NOTE.—ERRATUM IN VOL. XIX., PAPER VIII.

The invention of the Cylindrical Stone Lewis should have been attributed to Sapper *James* Hughes, and not to Sapper *William* Hughes.

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MEMOIR
OF
FIELD MARSHAL
SIR JOHN FOX BURGOYNE, BART.,
G.C.B., &c., &c., &c.

BY THE RIGHT HON. SIR FRANCIS B. HEAD, BART.

Not many months ago, at a dinner party in London, an old officer said aloud and emphatically to a much older one,

"*You* have done more under fire, than any soldier in Europe!"

"Well," replied the accused, in a tone of mild apology, "but remember, I have been *a long time about it*."

The truth of his defence will be demonstrated in the following very brief outline of his life and services.

FIELD MARSHAL SIR JOHN FOX BURGOYNE, Bart., G.C.B., K.C.T.S., F.R.S., D.C.L., Grand Officer of the French Legion of Honour, First Class of the Turkish Order of Nishid Medjidie, Constable of the Tower of London, Lord Lieutenant and Custos Rotulorum of the Tower Hamlets, and Colonel Commandant of the Corps of Royal Engineers—born in London on the 24th of July, 1782—was the son of General the Right Hon. John Burgoyne, and

godson of the statesman Charles James Fox, who stood sponsor to him at his baptism.

"One man in his time plays many parts,
His acts being seven ages."—SHAKSPEARE.

Fortune divided *his* "ages" into four, as follows:—

SCENE I.

On the death of young Burgoyne's father, his old friend, Edward Lord Derby, the twelfth Earl, nobly undertook the entire charge of his maintenance and education; and, accordingly, at the age of ten he was removed to "The Oaks," which had been purchased from General Burgoyne by Lord Derby, who sent him to Eton, where he was the cotemporary and fag of Hallam the historian.

After imbibing at Eton school, in about equal parts, its ordinary doses of bitter and sweet, denominated in its pharmacopœa, Latin Greek and Arithmetic—boating football and cricket—he was sent by Lord Derby to reside for a short time with a private tutor at Cambridge; and in compliance with his lordship's application, on the 19th of October, 1796—as a recruit, aged 14—he was denuded of civil attire, and in lieu thereof clad in the tight ready-made military uniform and stiff black leather stock of Woolwich Cadet No. 734. The ancient volumes of the Academy record, that on the 20th of February, 1797, he was promoted into the 2nd Academy; on the following 9th of August, into the upper one, where he rose to be the uppermost; and on the 14th July, 1798, to the rank of Assistant Engineer.

In what was then termed "the black book" of the Royal Military Academy, the following solitary sin remains recorded against him:—

"OVERSTAYD THE VACATION ONE DAY.—EXCUSED.—*See Orders 9th January, 1797.*"

"The Accusing Spirit which flew up to Heaven's Chancery with the oath, blushed as he gave it in; and the Recording Angel, as he wrote it down, dropped a tear on the word, and blotted it out for ever."—STERNE.

On the 29th August, 1798, he was gazetted a Second Lieutenant in the Corps of Royal Engineers, and thus at the age of sixteen years and one month, the beardless boy grasped the lowest round of a ladder, which, hand over hand, and step above step, regardless of climates—of extreme heat—of intense cold—of the fire of musketry, cannon, and mortars—wounds and sickness—during a period of 73 years' service, he slowly but steadily ascended, until at an age far beyond the scriptural limit of the life of man, he reached that summit of his professional career, which, in a published letter, dated Wilhelmshöhe, October 29th, 1870, earned for him from the French Emperor, Napoleon III, the designation of

"LE MOLTKE DE L'ANGLETERRE."

During this period of service, so devoted was his heart to his country, to the British Army in general, and to his commanders in particular; moreover, so engrossed was his mind with the never ending still beginning difficult and dangerous duties he was successively selected to perform, that it may truly be affirmed he never desired to be what is termed 'A great man,' or ever *knew*, what everybody around him *saw*, that he was a good one; and although it would have been impossible for him to deny, that either from a perfection or imperfection in his composition, he had been created utterly destitute of that instinctive precautionary sensation, commonly called fear, yet nothing would have been more uncongenial to him than to be decorated with the gaudy appellation of 'a brave man;' and thus, as in a Canadian winter, the atmosphere providentially becomes still, inversely as the intensity of the cold increases, so did his judgment strengthen, and his plain honest countenance become more and more serene, in proportion to the increasing fury of those desperate contests,

"Where mingled War's rattle,
With the groans of the dying."—WALTER SCOTT.

After the foregoing lines had been written and despatched, the following note from a distinguished Engineer General Officer, K.C.B., was received:—

Woolwich, November 13th, 1871.

Some years ago the late Sir Howard Douglas, speaking of Sir John Burgoyne's cool courage, said to me—that whenever, for the benefit of the Service, there was an object to be attained, requiring the greatest personal exposure, absorbed in what he was doing, and totally regardless of consequences to himself, he had apparently no preception of danger, and Sir Howard illustrated this by saying he should never forget on one occasion in Spain, in a battery in which they were suffering very severely from a gun that was concealed from their view, on its being observed that if any one could but get on the parapet, its whereabouts might be discovered and it might perhaps then be silenced; to their great dismay, at once Burgoyne climbed up on the parapet, where, in spite of their entreaties to come down, he coolly watched for the gun, until, from its fire, of which he himself was the target, having ascertained its exact position, he quietly descended from the parapet, and gave the information all had been so desirous to obtain.

J. L. A. SIMMONS.

Before the eyes of the British Army and its allies he daily appeared a lithe but sturdy labourer, always hard at work, never above his work.

In his "Military Opinions," (p. 286), in advocating that siege engineering duties should be assisted by *eclât*, he wrote—

"Works are not executed by the British in the time they should be, nor with the alacrity with which they are in other services. I have known our men (the Line) refuse to take out their gabions and set to work. . . . I have myself placed, at different times, hundreds of gabions with my own hands, and then *entreated* the men to go and fill them, but to no purpose."

Many people are gifted with talents—many with application. The few inheritors of both are justly termed “great men,” and yet, it is painful to reflect, that of the three categories, how large a proportion, simply from the want of opportunities to develop their respective merits,

“Go down to the vile dust from whence they sprung,
Unwept, unhonoured, and unsung.”

And such would have been the fortune and misfortune of BURGOYNE, had not, as will now be shewn, that great Master of War, Napoleon I., and other personages of less distinction, created a succession of convulsions in the world, which, without the slightest merit on his part, forced him into a series of wars wherein he was always found—from intrinsic value alone—to be the right man in the right place.

The meagre outline of his extraordinary career is as follows :—

As a lad of 18, he embarked on the 5th of April, 1800, with the expedition to Egypt, under Sir Ralph Abercromby, but was detached at Malta, to be employed under Major General Pigot, in the blockade of La Valetta, situated on a narrow spit or tongue of barren rock (separating two great harbours), scarpd so as to render it inaccessible by sea, and on the isthmus or only side on which by land it could be approached, fortified by demi-lunes, ravelins, counterguards, bastions, and cavaliers, towering one above another, on so gigantic a scale that the wall of the escarp, from 130 ft. to 150 ft. high, was, and is, nearly five times the height of that of an ordinary fortress.

On every projecting point of the various bays contained in each of the two great harbours, were forts flanking each other, yet all offering a concentrated fire upon any and every part of the fort; and, accordingly, when a vessel, labouring, pitching, heaving, and tossing, suddenly entered the great harbour of Valetta, the unexpected calm, the sudden lull, the peaceful stillness which prevailed on its deep unruffled surface, formed an appalling contrast with the innumerable guns which, bristling in every direction from batteries one above another, fearfully announced to any invading enemy that he was in the chamber of Death—in a slaughter-house from which there was no rescue—and that, although he had just escaped from the raging of the elements, the silence around him was that of the grave.

For two years the French garrison maintained, with their accustomed bravery, their impregnable position; steadily and cheerfully did they submit to every possible privation; their stock of spirits, wine, meat, bread, &c., doled out in the smallest possible allowances, gradually diminished, until all came to an end. Sooner than strike, they then subsisted upon the flesh of their horses, mules, and asses, and when these also were consumed, and when they had eaten

not only their cats, but the rats, which in great numbers infested the houses, drains, &c., and when from long protracted famine the lamp of life was absolutely expiring in the socket, in short, when having—as one of their Kings once nobly exclaimed—“lost all but their Honour,” these brave men, with nerves unshaken, with reputation unsullied, and with hunger deeply furrowed in their lean emaciated countenances, on the 5th of September, 1800, surrendered the city and the island to that Nation, which Napoleon, on board H.M.S. *Bellerophon*, in the last dying words and confession of his guilty career, designated, “*The most powerful, the most constant, and the most generous of his enemies.*”

After the surrender, First Lieutenant Burgoyne, who, attached to the garrison, for some time had the honour of serving as aide-de-camp to its commander, General Fox, who had succeeded General Pigot, obtaining two months leave of absence, visited Constantinople and Egypt.

On the 4th of October, 1806, Captain Burgoyne, (aged 24), joined the army in Sicily, from whence, on the 28th February, 1807, he embarked, as Commanding Engineer, with the expedition to Egypt, under Major General Mackenzie Frazer, and, on the 20th March, took part in the assault of the lines of Alexandria, and siege of Rosetta, in both of which services his conduct was favourably mentioned in all General Frazer's despatches.

Whilst in Egypt, he corresponded with his most intimate friend, Captain Squire, of the Royal Engineers, then in Sicily, with Sir John Moore. His letters were shewn to that great commander, who was so struck by their ability, and their acute criticism of military proceedings, that—unheard unseen—he applied for Captain Burgoyne to be attached to his command, and, accordingly, as Commanding Engineer, (aged 25), he accompanied that General in his expedition from Messina, destined for Portugal, from 26th October, to 30th December, 1807.

Returning to England with Sir John Moore, he rested in garrison at Chatham, under Lieut.-Colonel D'Arcy, R.E., for nearly four months, when,

On the 30th of April, 1808, he was ordered to hold himself in readiness for foreign service, and by the expressed desire of Sir John Moore, again under his command, (aged 26), he was appointed Commanding Engineer in the expedition to Sweden, from 30th April to 20th July, 1808.

Returning to England, for ten days only, with Sir John Moore, in the same year, and under the same General, he sailed with an expedition to Portugal, on the 31st July, 1808.

During the Corunna retreat, in the presence of the enemy, he blew up the bridge of Benevente, of which the French advanced cavalry occupied the further end, and thus *checked the pursuit*. At that moment, on a ridge in the distance, were

plainly discernible a large body of French horsemen, and some Generals, among whom was supposed to be the Emperor Napoleon, who, continuing the pursuit of Sir John Moore no further than Benevente, returned to France, leaving the further pursuit to Marshal Soult. In fact, the snare which by a rapid movement he had prepared to cut off, at Benevente, the English General in his retreat, had, as already described, been frustrated.

On the death of his illustrious Commander, Captain Burgoyne did *not*, as has been repeatedly published, form one of the few, who, faithful to the last, stood—"O'er the grave where that hero was buried."

"We buried him darkly—at dead of night,
The sods with our bayonets turning;
By the struggling moonbeam's misty light,
And the lantern dimly burning.

Few and short were the prayers we said
And we spoke not a word of sorrow;
But we steadfastly gazed on the face that was dead,
And we bitterly thought of the morrow."

and it was *expressly* to provide against 'the morrow,' that Captain Burgoyne, instead of standing a mourner at the grave of his late patron and commander, remained with the rear division—the post of honour in a retreat—to assist in arresting, as desperately as possible, the farther advance of the enemy.

In consequence of Captain Burgoyne having been detached with the light division of the army that embarked at Vigo, he missed the battle of Corunna. On his return to England he was granted a short leave until the 21st of February, 1809, when he was again ordered to prepare for foreign service, and on the 16th of the following month, under the command of Major Fletcher, he embarked on board the *Trident*, at Woolwich, and on joining Sir Arthur Wellesley's army in Portugal, on the 2nd of April, he (aged 27) received from him the significant honour of being attached to the 3rd (nick-named by the soldiers the "Fighting") Division, commanded by Sir Thomas Picton (This division subsequently, as if to demonstrate that in its attack it had legs as well as arms, marched for 34 days, through muddy roads, without a halt to the battle of Vittoria.)

Ten days after he had joined Sir Thomas Picton, Captain Burgoyne was present at the passage of the Douro, on the 12th, and in the affair of Salamonde, on the 16th of the same month (April).

In the campaign of 1810, he was charged by Lord Wellington, not only with the destruction of Fort Conception, but, in order to conceal the British retreat to the Lines of Torres Vedras, he was directed not to blow it up till the enemy had advanced in force, with strict injunctions not to be deceived by any feints.

Orders more congenial to the cool temperament of Captain Burgoyne could not have been conceived, and accordingly, exactly at the critical moment, in the immediate presence of the enemy, by successfully, on the 21st of July, blowing up the Fort, he thereby suddenly arrested his progress.

On the 27th of the following September, he was present at the battle of Busaco, (at which 1,200 of Lord Wellington's army were killed and wounded,) and subsequently retreated with Picton's division into the lines of Lisbon.

In the following year, 1811, on the advance of our army into Spain, the Corps of Royal Engineers in general, and, as will appear, BURGOYNE in particular, were required to undertake a series of sieges, under circumstances which, aggravating to an enormous extent the dangers and difficulties they had to contend against, it becomes necessary, in common justice to them, very briefly to explain.

Considering it has long been an axiom among engineers, that while a well-conducted siege is certain in its results, the hurried application of labour and force *without science* is invariably punished by an enormous unnecessary expenditure of life and money,

"La précipitation," wrote Vauban, "dans les sièges, ne hâte point la prise des Places, la retarde souvent, et ensanglante toujours la scène."

it will scarcely be credited that the trenches, saps, mines, batteries, and other important works necessary for the recapture of Olivença in April 1811; the attack of Fort Christoval in May 1811; the siege of Badajoz in May and June 1811; the siege of Ciudad Rodrigo in 1812; the siege of Badajoz in March and April 1812; the escalade and capture of the French works at Almaraz in May 1812; the reduction of the French posts at Salamanca in June 1812; the capture of the Retiro at Madrid in August and the siege of Burgos in September and October 1812; were undertaken and conducted by a British army UNATTENDED BY A SINGLE SAPPER OR MINER (at Olivença there were present only two military artificers, namely, one carpenter and one mason); that, under an inadequate number of officers of engineers, the above works were accordingly directed by *infantry* officers "appointed to act as assistant engineers, and to be obeyed as such;" and that in lieu of a corps of sappers and miners, a selected body of from 100 to 200 infantry private soldiers, who literally had never seen a military sap, mine, fascine, or gabion, were collected to superintend, by night as well as by day, in sunshine, darkness, and in all weathers, the construction of trenches, parapets, banquettes, and batteries, by working parties of their fellow-soldiers, amounting from 1000 to 2000 men, all equally ignorant of the duties they respectively were required to perform; and yet when the French besieged Badajoz, in 1811, although *they* had, as assistants, 100 miners, 483 sappers, 60 artificers, it required 41 days of open trenches to take the place.

The sacrifice of money, to say nothing of men, from the inadequate means above described, having proved, as might have been anticipated, enormous (at

the second siege of Badajoz, in 1812, the number of casualties were—officers and men killed 1035; wounded, 3787; missing, 63; total 4885), the Duke of Wellington, on the 11th of February, 1812, wrote to Lord Liverpool as follows:—

“While on the subject of the artillery, I would beg to suggest to your lordship the expediency of adding to the Engineers' establishment a corps of Sappers and Miners. It is inconceivable with what disadvantage we undertake anything like a siege, for want of assistance of that description. There is no French *corps d'armée* which has not a battalion of sappers and a company of miners; but we are obliged to depend for assistance of this description upon *the regiments of the line*; and although the men are brave and willing, they want the knowledge and training which are necessary. Many casualties among them consequently occur, and much valuable time is lost at the most critical period of the siege.”

Although by the above recommendation the Duke caused to be originated our present highly educated corps of Sappers and Miners, yet it was not until 1813, *when most of the sieges were concluded*, that a single company of sappers was despatched to Spain. In the meanwhile, the engineer department of the army, notwithstanding its exertions, was so inadequate to the important services to be performed, that although the utmost amount of engineer officers ever present at any one time in the Peninsula was 48, the number killed and wounded in the various sieges amounted to 49.

Under the difficulties above explained, the siege services imposed upon BURGOWNE will now be merely enumerated as they occurred.

At the short siege of Badajoz from the 2nd to the 13th June, 1811, at which 18 Engineer officers were present, of whom 3 were killed and wounded, he (aged 29) was appointed “*Director*” of the attack of the Castle, against which were fired 8,419 24-pdr. shots, 441 24-pdr. grape shots, 640 10-in. shells, 1,090 8-in. ditto; total quantity of powder expended, 1,545 barrels.

On the 26th of the following September, he was present at the action of Elbodon, during which he was verbally thanked by Lord Wellington for the assistance he had rendered to a Portuguese Brigade.

Two days afterwards, he was present in the action of Aldea de Ponte.

Four months afterwards, in 1812, at the short siege of Ciudad Rodrigo, from 8th to 19th January, at the storming of which, after dark, under Generals Picton Crawford McKinnon Vandeleur and Pack, were killed, 9 officers, including General McKinnon, and 217 men; with 60 officers and 500 men wounded, (total loss at the siege, 84 officers, and 1,000 men killed and wounded), Captain Burgoyne, with his habitual coolness, led the 3rd Division to the assault, for which, and for his conduct during the siege, he earned a Brevet Majority. At this siege, of 16 Engineer Officers, one, Captain Burgoyne's “co-director” Captain Ross, was killed, and five wounded.

Two months afterwards, at the second siege of Badajoz, which lasted from 16th of March, to 6th April, (at which were present 24 Engineer Officers, of whom four were killed, and eight, including the Commanding Royal Engineer, Lieut. Colonel Fletcher, wounded), Major Burgoyne not only again led Pieton's division to the point of attack, in which desperate duty two Engineer Officers were killed and two wounded, but also accompanied it in the escalade of the Castle, for which conduct he was again mentioned in Lord Wellington's despatches, and earned his Brevet Lieutenant Colonelcy.

A descriptive "memorandum," by Lieut. Colonel Burgoyne, entitled "THE ASSAULT OF BADAJOZ," ends as follows:—

"The Governor and second in command had taken refuge in St. Christoval, and there gave themselves up. Our loss was 3,000 killed and wounded; among the latter, Generals Colville, Bowes, Walker, and Kempt. Our previous loss in the siege 1,500 (total 4,500). The garrison at the commencement consisted of 4,800 men, of whom about 3,000 were marched away prisoners."

"In the assault, of the Engineers, Lieutenants Lascelles and de Saluberry were killed, and Captains Nicholas and Williams wounded."

During the remainder of the campaign of 1812, Lieut. Colonel Burgoyne, (aged 30,) continued Commanding Royal Engineer with the Field Force under Lord Wellington, (Colonel Fletcher and Captain Squire having been left behind with Sir Rowland Hill's corps to repair the ruined works of Badajoz). In this capacity, from the 17th to the 27th June, he acted at the siege and successful storming of the forts of Salamanca, defended by Marshal Marmont, (during which five British officers and 94 men were killed, 29 officers and 302 men wounded) for which he was again mentioned in Lord Wellington's despatches.

On the 18th of the following month, July, 1812, he was present in the action of Canizal, in which 500 officers and men were killed and wounded; four days afterwards in the battle of Salamanca, at which 5,000 officers and men were killed and wounded, among the latter five Generals; and after an interval of three weeks (on the 14th August) at the capture of the post of the Retiro, at Madrid, wherein were taken 76 officers, 2,211 rank and file, 180 pieces of ordnance, 26,000 stand of arms, with a great quantity of ammunition, artillery, and other carriages, clothing and stores of all kinds.

From the 19th of the following month (September) to the 21st of October, Lieut. Colonel Burgoyne (aged 30), acted as Commanding Engineer at the desperate siege of Burgos, at which one Royal Engineer officer was killed, himself slightly and seven others severely wounded (total British loss in killed and wounded, 92 officers, 1,972 rank and file); for his services during this sanguinary siege, which were eminently conspicuous, he was again favourably mentioned in Lord Wellington's despatch (dated 26th October.)

In 1813, he accompanied the army in its advance to the Ebro, in May and June; and on the 21st of the latter month, was present in the battle of Vittoria (our loss, 5,000 killed and wounded). In this desperate action, his horse was shot under him.

From the 15th of the following month to the 31st of August, he assisted, and on the death of his superior officer, from the 1st to the 9th of September, acted as Commanding Royal Engineer, at the second siege of the castle and citadel of St. Sebastian, at which Lieut. Colonel Sir Richard Fletcher, the Commanding Royal Engineer (who had been previously severely wounded at the first siege) was shot through the heart, two Engineer Captains killed in the breaches, and Lieut. Colonel Burgoyne (present at both assaults) was shot through the neck, and two other Engineer officers wounded. Of eighteen Royal Engineer officers present at both sieges, eleven were killed or wounded. (Total British loss, 3,500 officers and men killed and wounded.)

Lieut. Colonel Burgoyne's detailed "mem." of the assault of St. Sebastian, characteristically ends as follows:—

"Our loss was very considerable, probably 2,000 or 3,000. The enemy's also must have been great. Sir Richard Fletcher, Commanding Engineer, was killed by a musket shot, and Captains Rhodes and Collyer killed in the breach. The former headed the first party that made a push for the curtain, and fell on its summit, covered with (11) wounds. Besides myself, slightly wounded, were Lieutenants Baring and Marshall, severely wounded. About 20 sappers were killed and wounded."

At the commencement of the following month (October), while still suffering from his "slight" wound by a ball which, grazing an artery, very nearly caused his death—but which after two or three days had not prevented him continuing to superintend the operations against the castle of St. Sebastian—he rejoined Sir Thomas Picton's Division; on the 7th, he was present in the action of Bidassoa, in which our loss was 6,000 killed and wounded; on the 10th of the next month at the battle of Nivelle, at which 2,500 were killed and wounded. During the 10th, 11th, and 12th of December, at the battle of the Nive, at which, 3,200 were killed and wounded. On the 23rd February, under the command of Lieut. Colonel Elphinstone, C.R.E., at the passage of the Adour, at which the casualties were 2,300; and on the 14th of April, at the sortie from Bayonne, on which occasion he was mentioned in General Howard's despatch.

At this moment, however, intelligence of the capture of Paris, and the abdication of that "Wholesale Dealer in War," NAPOLEON, flashed upon the British army!

When, in the trenches at the siege of Frederickshall, a $\frac{1}{2}$ -lb. ball went through the forehead of Charles XII, Voltaire, in his history, writes:—

"A ce spectacle, l'Ingénieur Megret, homme singulier et indifférent ne dit autre chose, sinon, 'Voilà la pièce finie, allons souper !' "

In plain English, our protracted sanguinary Peninsular War suddenly came to a glorious end.

"Huntsman, rest, thy chase is done,
Think not of the rising sun,
For at dawning, to assail ye,
Here no bugles sound reveillie."

In the military annals of England, the following anecdote will, it is believed, appear almost incredible.

After the peace of 1815, the Prince Regent magnificently directed that all officers of every branch of the service wearing five gold medals, should receive the grade, star, and decoration, of Knight Commander of the Bath, but the recipients numbering many more than he expected, he subsequently enacted that only upon General Officers should the distinction hereafter be conferred.

Lieut. Colonel Burgoyne, came out of the Peninsular War the senior officer of Engineers who had been engaged in the sieges of Spain. Their seniority was as follows :—

Lieut. Colonel Fletcher Killed.

Lieut. Colonel Squire Killed.

Lieut. Colonel Burgoyne Twice wounded, (and horse shot under him at Vittoria.)

Lieut. Colonel John T. Jones Wounded.

And yet, while his distinguished cotemporaries throughout the army in general, and the Royal Artillery in particular, six of whom junior officers to himself, received the Star and Knighthood of K.C.B.—Lieut. Colonel Jones, R.E., created a Baronet and Queen's Aide-de-Camp—upon Lieut. Colonel Burgoyne, whose services had earned for him five gold medals, and who, moreover, in complimentary terms had eight times been mentioned in public despatches, was simultaneously conferred the *lower* grade only of C.B., the reason assigned being, that his name, by a clerical error, acknowledged by Lord Fitzroy Somerset and Colonel Torrens, having unintentionally been omitted, could not be recommended. In atonement, the Government of his country offered to dub him a Civil Knight, which title, added to his C.B., would in grammar, form not the high-bred, but the hybrid distinction of k.C.B. BURGOYNE, then aged 32, whose devotion to duty never forsook him, without a word of remonstrance or complaint, declined to accept this mongrel distinction, but from wounded feelings—not so much on his own behalf as on account of the slur cast upon his

Corps, of which 49 officers had fallen in the sieges—he never wore the decoration of C.B.

Twenty-four years afterwards, while in his quiet unassuming way he was (aged 56) acting as Chairman of the Board of Works in Dublin, by the Brevet of 1838, he acceded to the rank of General Officer, and it being *then* resolved that the long withheld distinction of K.C.B., should be conferred upon him, it became necessary for him to return the badge of C.B. before he could receive it. After a hard search, it was discovered fast asleep in a drawer, exactly in the state in which it had reached him. *He had not even opened the case.* But as the hey-day of his life had passed—

“The lovely toy, so keenly sought,
Had lost its charms on being caught.”

Under Lieut. General Lord Hill Lieut. Colonel Burgoyne was employed, or rather reposed, in the south of France until June, 1814, when he was suddenly appointed Commanding Engineer in a secret expedition, under the command of Lieut. General Sir Rowland Hill, and on its being countermanded, under Major General Sir Edward Pakenham, as Commanding Royal Engineer he embarked on the 1st of November, 1814, (aged 32) to engage in a winter's war in North America. On the 25th of December he landed in Louisiana, was present at the attack of the American Lines before New Orleans on the 8th of January, 1815, and from that day to the 11th of the following month at the capture of Fort Bowyer, for which he was favourably mentioned in Major General Sir John Lambert's despatches (dated 28th January and 14th of February).

After Napoleon's escape from Elba, General Sir Thomas Picton, serving in the allied army under Lord Wellington, made an urgent application for the services of his old subordinate, Lieut. Colonel Burgoyne, but the command of the Engineers having been entrusted to Lieut. Colonel Carmichael-Smyth, who, although senior to Burgoyne in the corps, was his junior in the army, the application was very properly refused, and accordingly, on the 5th of June, 1815, he was ordered to Hull to take command of the Yorkshire District. These orders, however, after the battle of Waterloo had virtually terminated the war, were countermanded on the 27th, and on the 29th he was ordered to proceed to Ostend by the packet, join the army under the Duke of Wellington, and, without loss of time, place himself under the orders of Colonel Carmichael-Smyth. Accordingly, on the 6th of July, 1815, he landed at Ostend, from which time he remained with the army of occupation until November, 1818, when he was ordered to proceed from Cambrai to England.

From 1821, for four years as Commanding Engineer at Chatham, he was enabled, by strict example as well as by earnest precept, to stimulate and im-

prove the military education of his corps, both officers and men, until, in 1826, he was ordered to embark again as Commanding Royal Engineer, (aged 44) with the expedition to Portugal, under Sir William Clinton, with whom he sailed on the 27th of December. On the 2nd of February, 1828, receiving orders to assume the command of the Engineer Department at Portsmouth, he arrived in England on the 11th of April.

SCENE II.

On the completion of the foregoing series of military services, consisting of battle after battle, siege after siege, stormings, escaladings, retreats, advances, finally culminating in victory, and ending in important home engineering duties, Scene 1st of BURGOYNE's eventful life suddenly changes, and the sound of the bugle—as it were—proclaiming to him, by High Authority, the drill-sergeant's favourite words of command, "*As you were!*" the resolute soldier, whose self-possession and cool courage under fire had proverbially, for so many years, been conspicuous on all occasions, obediently laid aside the glittering uniform in which he had lived since the age of boyhood, and accordingly, he now appears upon the stage a citizen, in plain clothes, upright in person, nimble in step, his countenance beaming with brightness good sense and benevolence, his manners modest and diffident, as, in spite of his unceasing efforts to conceal these virtues, they continued to adorn him to the last hour of his life.

In 1831, (aged 49) he was appointed Chairman of Public Works in Ireland, and, moreover, to superintend an expenditure of the Imperial Loan of £500,000, he became a member of four other Irish Boards, namely :—

- 1.—Inland Navigation and Fisheries.
- 2.—Loans from Consolidated Fund.
- 3.—Dunmore Harbour.
- 4.—Kingston Harbour.

On the 5th of August, 1835, on being appointed the first president of the Institute of Civil Engineers of Ireland, he delivered the inaugural address.

In 1837, he was appointed Chairman of a Commission for the improvement of the navigation of the Shannon, which presented the following year to both Houses of Parliament four elaborate reports, and on their approval, their proposed works of great extent were executed by the Commission.

In 1837, by a Royal Warrant, he was appointed to a Commission on Railways (Under-Secretary Thomas Drummond, president), which, after having entered into numerous investigations, drew up and presented to both Houses of Parlia-

ment, in 1838, reports, a large portion of which were compiled by Colonel Burgoyne, and, by those best acquainted with the subject, it is believed, that if the recommendations contained therein had been adopted, the difficulties and embarrassments which have since attended the railway undertakings in Ireland would have been saved. (For an interesting account of this Commission, see page 35-39 in Mr. McLennan's Memoir of Thomas Drummond).

In 1838, he was appointed Chairman of Commissioners of Drainage, also a member of the Board of Wide-street Commissioners for Dublin.

While Chairman of the Board of Public Works in Ireland, he was requested by the Master General of the Ordnance to prescribe for a little pimple of discussion, which had been festering for some years, relative to the giving up of an old-fashioned battery at Liverpool standing doggedly in the way of the construction of new docks.

In accordance with his report, not only was the case in dispute immediately adjusted, but his submitted plans for an improved battery elsewhere, were simultaneously adopted. For this service, he received from the Master General and Board of Ordnance, a complimentary letter.

On the 2nd of February, 1839, he was appointed Honorary Member of the Institution of Civil Engineers of Great Britain.

During the period of thirteen years he was employed on the above arduous duties in Ireland, he received repeated approbation of his services from the Lord Lieutenants, Marquis of Anglesea, Marquis Wellesley, and others. Also from Chief Secretaries Lord Stanley and Mr. Littleton, Under-Secretary Sir William Gossett, Secretary of the Treasury Mr. Spring Rice, Sir Charles Trevelyan, and others.

SCENE III.

The shrill blast of the bugle now suddenly repeated to the indefatigable day labourer its former order of "*As you were*," and in obedience thereto, on the recommendation of the Duke of Wellington, Colonel Sir John Burgoyne, in 1845 (aged 63), denuding himself of his innumerable civil duties in Ireland, appeared in London, in his natural scarlet garb, as "Inspector General of Fortifications"—an ignorant and inadequate appellation of the multifarious duties of not only maintaining, increasing, and, above all, improving, the fortifications and barracks of the British Empire, but of commanding, educating, and stimulating throughout the United Kingdom and its Colonies, that intellectual Corps of Officers named Royal Engineers, and their intelligent highly disciplined subordinates, the Corps of Royal Sappers and Miners.

At the latter end of 1846, Major General Sir John Burgoyne addressed to the Master General of the Ordnance that important memorandum, entitled "Observations on the possible results of a War with France under our present system of Military Preparation," the facts and reasoning in which were reflected in the Duke of Wellington's "celebrated" reply to him, dated Strathfieldsay, January 9th, 1847.

This memorandum, as also another, entitled "Remarks on the Military Condition of Great Britain (both since published in his "Military Opinions), were deemed so valuable that they were privately printed by the Treasury, and circulated amongst the members of the Government, and as a further proof that BURGOYNE's mind was always, say twenty years, ahead of that of the age in which he lived, it may be cited that in 1850, he published a plan of short enlistment, in order to obtain an army of reserve, which, in 1870, *has just been carried into effect.*

During his tenure of this office, for 22 years, and especially after the death of the Duke of Wellington, as the foremost adviser of the Cabinet, he was in constant and confidential communication with the administrations of the day, upon most military questions; and it is very much owing to the influence exerted by him in this capacity, that the country has been placed, at last, in a respectable state of defence.

The value which successive administrations entertained of his experienced judgements, enhanced by the unusual modesty with which they were delivered, is but too clearly demonstrated by the alacrity with which they loaded, or rather mercilessly overloaded him with the following extra duties.

On the 10th of February, 1847, as Major General Sir John Burgoyne, K.C.B., he was appointed President of the Irish Famine Relief Commission, whose reports were presented to both Houses of Parliament. On the completion of this service he received from the Treasury a complimentary letter, with a special grant of money for his laborious exertions.

On the 7th of April, 1848, by a Royal Commission, Earl de Grey, he, and another were appointed to superintend the completion of the new Palace of Westminster.

On the 25th of September, 1848, by letters patent, he formed one of a consolidated Commission of Sewers for the whole Metropolis.

On the 24th March, 1849, he was ordered to inquire and report to the Treasury on damage done to Inverness Bridge, by floods, assumed to have been occasioned by the Caledonian Canal.

In 1849, to inquire and report to Government on the state of Westminster Bridge, as regarded the necessity for *immediate* re-construction.

On the 30th of August, 1850, with Lord Granville and three others, he was employed in a Treasury Commission on the proposal for an Irish Transatlantic Packet Station. (Their reports were presented to both Houses of Parliament in 1851.)

On the 1st of May, 1851, he was appointed Juror, Class VIII., in the Exhibition of that year.

On the following 6th of October, with ten associates, a member of the Metropolitan Commission of Sewers.

In June, 1852, he, Lord Rosse, and a naval officer, were appointed members of a very confidential committee, to investigate Captain Warner's inventions, the Invisible Shell, Long Range, &c.

On the 24th of the following month he was appointed, with thirteen associates, a member of the re-constituted Metropolitan Commission of Sewers.

In the same year, in connection with Lord Ashburton, Sir Roderick Murchison, Dr. Playfair, Sir Stafford Northcote, and others, a member of an association for promoting a cheap and uniform system of International Postage.

In January, 1854, Major General Sir John Burgoyne, detached and despatched from his important military duties in England to proceed on a mission to Turkey, of a very important character, was placed in confidential communication with Napoleon III, the Sultan, and other authorities. (Lords Stratford and Cowley have each acknowledged the importance of the service rendered by him on this occasion.)

Before entering into the Crimean war, it must very briefly be observed, that although, at great public dinners Sir John Burgoyne, in presence of ministers, members of both Houses of Parliament, merchants, and all sorts and conditions of men, had been required over and over again, to "rise to return thanks" for what is still vulgarly called "The Army," for more than a quarter of a century, he had not only inwardly known, but respectfully appealing to the Duke of Wellington and to the country, had endeavoured privately and publicly to demonstrate, that a congregation of British regiments, without the appurtenances thereof, namely, professional education, intelligence, the knowledge and means of self-protection by field-works, &c., the power of readily transporting ammunition, food, forage, baggage, &c., across plains, mountains, morasses, rivers, and ravines, of removing and attending wounded and sick, burying dead, &c., can with no more justice be called "*An Army*," than 100,000 gallant sailors, trained and domesticated in barracks, constructed in mimic representation of a fleet, could, without ships, be called "*A Navy*;" and thus, the enormous attractive wealth of the British Empire in general, and of London in particular, has re-

remained, and almost to the present hour continues to remain, internally defended by "incomparable artillery, splendid cavalry, and highly disciplined infantry," which, on being suddenly congregated, would, from the deficiencies detailed, prove utterly unable, for more than a few days, either offensively, or defensively, to act as, "AN ARMY."

And, accordingly, the Crimean campaign—in which were exemplified the most brilliant military enterprises, and in consequence of the total break down as predicted by Sir John Burgoyne of every Department of the English War Office, the severest military sufferings on record—terminated, in the words of Voltaire's summary of the career of Charles XII:—

"Après avoir éprouvé ce que la prospérité a de plus grand, et ce que l'adversité a de plus cruel, sans avoir été amolli par l'une, ni ébranlé par l'autre."

To enter, in the present paper, into the details of this extraordinary campaign—in which a British army, after having been conveyed nearly 3,000 miles by sea, was to be disembarked in a country totally destitute of resources, with no base but the open sea—is simply impracticable.

The Historian and the Painter, in due time, will delineate, in a series of pictures, the veteran BURGOWNE in the desperate battles of Alma and Inkermann, and in the frozen trenches, as he appeared the calm Mentor and respected adviser of the British army.

It will, therefore, only be stated that a reconnaissance having been made of the coast of the Crimea by order of the Home Governments, by a joint Commission of English and French officers, it was recommended that a landing should be effected at the mouth of the Katcha river. On the receipt in England of the report of this Commission, it was shown to Sir John Burgoyne, who expressed his opinion in writing to the English Cabinet, that the proposed operation of attempting to force a landing at such a point, in the face of an enemy, would certainly result in failure; and he laid down as a principle, that the first landing of the troops must be effected by surprise, and at such a distance from the Russian army, as to ensure a superior force being thrown on shore before they could be attacked. This opinion having alarmed the English Cabinet, he was requested by the Duke of Newcastle to proceed himself to the scene of operation. Sir John was at this time 72 years of age—he had large insurances on his life, which would be forfeited by the step he was asked to take—he was offered no definite position—but he never hesitated for a moment, and within twenty-four hours he was on his road to the Black Sea.

His first active interference with the measures of the Allied Armies took place at the period of the second reconnaissance of the coast on board the *Caradoc*; there were present, besides himself and the French and English Commanders,

General Canrobert, Colone. Trochu, Sir George Brown, Sir E. Lyons, and the French Admiral. The French officers, supported by Lord Lyons, were in favour of forcing a landing at the Katcha, according to their original report, and this, notwithstanding that a Russian Corps was actually encamped on the spot at the period of the second reconnaissance. Sir George Brown, who had recommended the same at the period of the first reconnaissance, having, however, begun to distrust the success of it, supported Sir John Burgoyne in his reasoning. Although forming a small minority at the commencement of the discussion, the views of the English Generals ultimately prevailed, and accordingly it was determined to select a spot further removed from the Russian head-quarters. (It is worth mentioning that Lord Raglan, Sir E. Lyons, and Sir J. Burgoyne, in riding over this ground on the advance of the army after the battle of the Alma, observed that the river Katcha, pent up by a rise in the beach before it reached the sea, spread into a wide piece of water, so that the army on landing, finding nothing but water in their front, and thereby having to debouch by a narrow causeway right and left of them, must have been cut to pieces, and Lord Lyons very honestly acknowledged the fact to Sir John Burgoyne at the time.)

Throughout the battle of the Alma, Lieut. General Sir John Burgoyne accompanied Lord Raglan. As they crossed the river, on Sir John's hat falling off, he reined up his horse, and while Maguire, his groom, under a very heavy fire, dismounted to pick it up, he continued all the time humming a tune, as he was always in the habit of doing when in particularly high spirits. At this moment his horse was struck by a shot, which, grazing its hind leg, made it very restive for the remainder of the day. Nevertheless he remained on his saddle between eight and nine hours.

His next interference was at the period of the flank march. The position of the allied armies would have been altogether a false one on the north side of the harbour, 1st, because operations at this point could have led to no decisive results; and 2ndly because the position contained the radical defect that it did not cover their base of operations, so that their communication with the fleet would be always liable to be cut off by works thrown up by the enemy. Although, at this period, the position was only defective, a few weeks later it would have been positively dangerous; for the Russians developed such an unexpected force at the period of the battle of Inkermann, that, by throwing up entrenchments and blocking up the Allied Army on the narrow promontory between the Belbec and Sebastopol, the safety of the whole force would have been seriously compromised. From this danger the army was saved by the flank march to the south of the place, in explanation of which Sir John Burgoyne, in an important letter, stated—

"I fully believe that if my views on the propriety of making the south the point of attack had not been adopted by the Allied Commanders, winter would have surprised us on the heights of the Belbec without a harbour and with a difficult line of operations to defend, and that the safety of the whole allied force would have been compromised."

On the day of this flank march Sir John Burgoyne, for thirteen hours riding in advance with Lord Raglan, was one of the first who came in contact with the baggage and rear guard of Menschikoff's Army defiling across their path towards Sympheropol.

During the night, his baggage not having come up, the veteran lay down on the ground, his saddle serving as his pillow. After a time his Aide-de-camp, procuring him the old door of a house, prevailed upon him to sleep upon that.

The correctness of Sir J. Burgoyne's reasoning in favour of the flank march was shewn by the fruitless efforts afterwards made by the enemy to force the positions at Balaklava and at Inkermann. The last of these actions was called by the newspapers the "Soldiers' battle," because 8,000 men, with unexampled bravery, resisted the attack of 60,000 Russians. But as it was called so, avowedly as a slur upon the English Generals, it must be asked, who but these Generals placed the men where 8,000 could resist 60,000? The truth of the matter is, that the ground selected was impregnable strong, and the Russians, forced to attack in a narrow position and consequently unable to deploy their force, suffered enormous losses.

In the important letter by Sir John Burgoyne (already quoted) with reference to this subject, he observed—

"It was not until the result of the battle of Inkermann had given us possession of the ground south of the Great Harbour, that an attack against the Malakoff Front became possible. This battle was a heavy blow and discouragement to the Russians. It was a great and decisive victory, and, in its consequences, even more important than the battle of the Alma. It cleared our way to an attack against the Malakoff Tower, which was decidedly the proper point of attack, where success was both more easy of accomplishment and more decisive when accomplished. It was these considerations which led me, in the memoranda of the 25th November and 21st December, 1854, (published in the official account of the siege) to recommend to Lord Raglan that the French should relieve us of the charge of our left attack, so as to enable us to take ground farther to the right, and prosecute the attack against the Malakoff Front."

Sir John Burgoyne's family have no records of what are commonly called "*personal adventures*." In his letters he never mentioned them. Indeed, occupied by events passing before him, he really did not notice them.

From the private letters of one of his staff, the following trifling extracts may be deemed worthy of perusal:—

"Balaklava, 8th Sept. Sir John is very well. The first night we had no tents, but

Captain Gordon happened to come up and gave him a blanket. He holds a regular levee every day. General Straungways, R.A., the Adjutant General, and, in fact, all heads of departments come to him for advice when in want of it, which is pretty often."

"Camp opposite Sebastopol, 10th Oct. Only fancy Sir John going out at 10 p.m., when we were all asleep, and riding with Nasmyth up to the trenches. He only returned at 3 a.m."

"Thursday. Last night — and I were alarmed at one o'clock by musketry firing, which is a sign that close work is going on. We went to Sir John, who, being more experienced in these matters, recommended us to return to our beds and put by our revolvers."

"Camp before Sebastopol, 26th October. Sir John, attended by — and myself was with the Staff, and, from a hill above, overlooked the cavalry charge at Balaklava."

"6th November. In the battle of Inkermann (on the preceding day) Sir John, —, and I, accompanying the staff, were, for about a quarter of an hour, under a heavy fire of shell and round shot. We could hear the pieces pinging all about us. The head-quarter staff suffered severely."

"10th November. Sir John, —, and myself started off for Inkermann Heights to have a look at the site for a new advanced work to command the harbour and shipping, for the construction of which the French have promised men. I requested the Officers of Engineers who were with us to stay behind, as their making a crowd round Sir John would attract notice from the Russian riflemen in batteries of which we were within range. Sir John made his reconnaissance without being hurt, though, not without being seen and fired at, for, just as he had finished, a shell burst; in a few minutes more we had a solid shot wide, and a few more nearer as we retired. Sir John's coolness is wonderful. He halts on the report, says, "Now look out," or hums a tune, watching the course of the ball."

"26th January. Yesterday Lord Raglan and Sir John, accompanied by staff, &c., paid a visit to the trenches, and, after proceeding through Gordon's, walked through Chapman's, and finished with our three gun battery at the head of the Harbour."

"*The Times*," in an able summary, from which an extract has already been made, thus continued to estimate the value of the services rendered by Sir John Burgoyne:—

"Again, when the army (after Balaklava and Inkermann) had advanced thus far, the proper work of the Engineer officers commenced, for they had to determine which was the most vulnerable portion of the fortress, and against which, therefore, the chief efforts of the Allies should be directed. Here, again, the superior genius of British engineering was vindicated by Sir John Burgoyne; for, while our Allies desired to attack the town itself, he pointed from the first to the Malakoff as when taken involving the fall of the city. We are all aware that the plan of the French was adopted at first, and we are also well aware with how little success, and how great a loss of lives and of money it cost England; but at length, though not until the gallant old General had returned home, both the English and the French commanders came round to his view, and concentrating their whole strength on the Malakoff, took it by assault. With the Malakoff the key of Sebastopol passed into the hands of the Allies, and Sebastopol fell, thus justifying Burgoyne's prediction to

the very letter, for the fall of that tower rendered the other fortifications untenable. Indeed, from first to last, whatever amount of success attended the expedition to the Crimea would appear to have been due, to say the least, as largely to Sir John Burgoyne as to any other single individual. By the landing at Eupatoria, not only was the disembarkation of our troops effected in security, but a lodgment was made in the rear of the enemy. Lord Raglan acknowledged in the noblest manner how much he was indebted to the advice and assistance of Sir John Burgoyne at the battle of the Alma; and it has been stated that he addressed a despatch to the Horse Guards requesting that he might be promoted to the rank of General, and that his promotion should date from the date of the battle itself. At the battle of Inkermann Burgoyne was again in action and Lord Raglan, in his despatch on that occasion, once more acknowledged the great assistance which he received from his experience and counsel."

But popular clamour now began to attack the old Peninsular Generals who had directed the strategy of a winter campaign and siege which, up to this date, had been unsuccessful, and the Government yielding to the storm, Sir James Graham, in defence of his colleagues, with the fervour of an accomplished orator, exclaimed in the House of Commons—

"Done nothing!" "WE HAVE RECALLED SIR JOHN BURGOWNE!"

to whom, at the same moment, he might have apostrophized the lines,

"Dum Fortuna ridet, multos numerabis amicos,

"Tempora si fuerint nubila, solus eris."

It is obvious that in the immediate presence of the Allied Armies of France, England, Turkey, and Sardinia, this recall, at such a juncture, was a heavy slur upon a Veteran Officer, who, for more than a quarter of a century, had, in vain, endeavoured to prevail upon Parliament to incur the expense of averting the very calamities for which *he* was now to be punished. But the devoted soldier appreciating the difficulties of H. M. Government, and faithful to his principle of loyalty to his employers, never allowed a syllable of complaint to escape from him, either in public or private. And thus the wound from the Governors of his beloved mother country—although severer than any one he had previously received in her defence—bleeding inwardly only—passed unnoticed by the community.

Before leaving the Crimea, he compiled for Lord Raglan memoranda, strongly recommending that the main attack should be made on the Malakoff Front, and when the French decided to erect the new works against this point, his latest advice to Lord Raglan was, to arrange, if possible, that at the final assault, a column of English troops, which he gladly would have conducted, should be thrown against it.

It will be seen from the foregoing narrative of facts that Lieut. General Sir John Burgoyne occupied, during the Crimean campaign, a position resembling

that which Count Moltke occupied with the Prussian Head-quarters during the late war; both campaigns were eventually successful,—yet the contrast between the way in which the two men have been treated is very remarkable. Services of this nature, which are purely consultative, can only be known to the Heads of the Governments which employ the officers in question, and, consequently, it is to their superiors entirely, and not to the public, that such officers are entitled to look for appreciation of their services. Ministers should not forget Napoleon's maxim,

“Les services les plus utiles ne sont pas toujours les plus éclatants.”

On his return from the din of battle (that is after he had been recalled from the Crimea) he resumed, at the War Office, the tranquil duties of Inspector General of Fortifications.

Shortly after the fall of Sebastopol, he was promoted to the rank of full General; was created a Baronet (the fees for which Lord Palmerston, with his accustomed liberality, remitted); on the 15th of December, 1854, with sixteen other Generals, he received the thanks of both Houses of Parliament “for their services in the Crimea;” and again, on the 4th of January, 1855, “for their distinguished services in the Crimea;” Oxford conferred upon him the honorary degree of Doctor of Civil Laws; the Council of the Royal Society elected him one of their fellows; the Emperor of the French nominated him a Grand Knight of the Legion of Honour; the Sultan conferred upon him the order of the Medjidie of the 1st Class; subsequently, Her Majesty presented to him the Baton of a Field Marshal; the Lord Mayor, Aldermen, and Common Council of London conferred upon him the freedom of the City in a casket of gold; finally, on the death of Lord Combermere, he was appointed Constable of the Tower of London, and Lord Lieutenant and Custos Rotulorum of the Tower Hamlets; the duties, however, attached to these fine English and Latin titles, it was resolved by H.M. Government, were to be performed by *him*, weaned from the nourishing salary of £950, with which all his wealthy predecessors had been regularly fed, from morning till night, to the last moment of their existence. Against this hard decision he never expressed a syllable of complaint, and thus the constellation of glittering honours above enumerated, did not deposit in the terrestrial soldier's empty pocket, one shilling.

Nevertheless, *per contra*, the substantial value of his cool judgment and amassed experience on civil as well as military subjects was so accurately appreciated by the Administrations of the day, that, in addition to his arduous military avocations, the following extra services were dexterously extracted from the recalled veteran :—

1.—During the latter part of the Russian campaign, besides attending, in London, most of the sittings of the Committee of the Cabinet, in which was centred the administration of the war, he formed one of the Council of War, held at Windsor, at the period of the visit of Napoleon III. to this country; and, on one occasion, he drew up for the Cabinet a memorandum, detailing their reasons for disagreeing in a project of operations proposed by the French Emperor.

2.—He was appointed, in 1854, member of a very confidential committee of inquiry into Lord Dundonald's secret plan for accelerated attacks of batteries and forts.

3.—Member of a subsequent committee on the same, with Admiral Sir Byam Martin, Admiral Berkeley, &c.

4.—Member of Royal Commission on Army Promotion.

5.—Member of a committee of the Society of Arts, to consider the improvements of the City of Paris.

6.—1855. Member of Royal Commission of the Patriotic Fund.

7.—Juror at the great Paris Exhibition.

8.—Member of the Defence Committee from its first formation in 1855 to his death in 1871.

(6th June, 1856. Elected a Fellow of the Royal Society.)

9.—In 1858, he was despatched on a complimentary mission to France, to present to the Emperor of the French the funeral car used at the burial of the great Emperor at St. Helena. The short address he made on this occasion was much admired for the tact shewn in executing this somewhat delicate mission, and our ambassador, Lord Cowley, was much pleased with it.

10.—In 1859, appointed member of a very confidential committee, (of which His Royal Highness the Duke of Cambridge was president,) on the state of the defence of the country.

(5th March, 1861. Received commission as honorary colonel of the 1st Middlesex Engineer Volunteer Corps.)

(29th October, 1861. Commission as Honorary Colonel of the 1st Lancashire Engineer Volunteer Corps.)

(December, 1862. Member of the Society of Arts.)

11.—1865. Appointed President of the Magazine Committee, with six colleagues.

(Their able report, drawn up by Sir John Burgoyne—considered an extraordinary production for a man of 83 years of age—has become the text-book by which the storage of gunpowder is regulated in the public service, all its recommendations having been adopted by the Secretary of State for War.)

12.—1868. Commission of the Patriotic Fund renewed.

13.—1868. Member of Treasury Committee on Concentration of Public Offices.

On other subjects Her Majesty's Government maintained with him constant and confidential communication.

While he was zealously performing, in addition to his military duties, the above *extra* civil services, he received, in August, 1867, a letter from the Secretary of State for War, complimenting him on the ability he had shown in the office of Inspector General of Fortifications, and, in acknowledgement thereof, acquainting him that he was re-appointed to that post for another term of five years. Affectionately attached to his duties at the War Office and to his own corps, of which he had risen to be the revered Chief, the receipt of this letter made him thoroughly happy, and, accordingly, in his reply, he warmly expressed to the Government his gratification and gratitude. Three months afterwards, he received from the War Minister a *counter-communication*, informing him that as it was contemplated to make some change in the office he held, it would be conducive to the good of the public service that he should resign his post. This blow, totally unexpected, was deeply felt. In the words of Wolsey he might have exclaimed—

Farewell, a long farewell, to all my greatness !
This is the state of man ; to-day he puts forth
The tender leaves of hope, to-morrow blossoms,
And bears his blushing honours thick upon him ;
The third day, comes a frost, a killing frost ;
And—when he thinks, good easy man, full surely
His greatness is a ripening—nips his root,
And then he falls, as I do.

but, with his indomitable loyalty, bearing it with dutiful submission, without a word of remonstrance or stipulation for a recognition of his services, he wrote in reply to resign his appointment.

At a full dress parade of the whole of the officers, non-commissioned, and sappers, amounting with the Royal Engineer Staff to about 1,000, held at Brompton Barracks on the 24th January, 1868, Colonel J. L. A. Simmons, C.B., Director of the Royal Engineer Establishment, read a long "special memorandum," which commenced and ended, as follows :—

Field-Marshal Sir John Burgoyne cannot relinquish the post he now holds without thanking the officers and men of the corps of Royal Engineers for the cordial and efficient co-operation and support which he has always received from them during the 22 years that he has held his present office ; and, at the same time, expressing the great regret with which he bids farewell to the active superintendence of a corps in which he will never cease to feel the deepest pride and interest. . .

. . . After an association extending over 70 years, and comprising many periods of difficulties and hardships, Sir John Burgoyne takes leave of his comrades of all ranks with the strongest sentiments of esteem and regard, and with the fullest confidence in their future prosperity and distinction.

On leaving the Office in January, 1868, after 70 years' continued service, a retiring pension of nearly the amount of his salary at the War Office was granted to him.

With three other Officers he was promoted to the rank of Field Marshal, but no special distinction marked the close of a career of military and civil services which, without exaggeration, may be termed unparalleled for their number, variety, and value. And it may here be observed,

1st.—That at the close of the Peninsular War (the last European one in which England had been engaged) it was decided that all the General Officers who had held the position of second in command, such as Hill, Hope, and Graham, should receive, *as they did receive*, Peerages and pensions for three lives.

2nd.—That after Sir John Burgoyne, in October, 1854, was appointed General on the Staff of the Eastern Army, he not only became, by his rank and seniority, second in command of that army, but Lord Hardinge (then Secretary at War) wrote privately to direct that he was to assume command of it, in the event of the illness or absence of Lord Raglan.

LAST SCENE.

Seven months after Field Marshal Sir John Burgoyne's resignation had been accepted, there appeared in *The Times* of the 7th August, 1868 (occupying in small type, two columns) a letter from him, which from its marvellous clearness and ability, created a great sensation, in which, in reprobation of "the depreciating view taken by the British public of the military operations of their own countrymen," he (aged 86) stated,

In the Crimean War the duties were severe and responsible, our means totally inadequate to the task. Many circumstances tended to make the attack a service of a peculiarly arduous character.

Among these circumstances he briefly enumerated,

1.—That no time was available for procuring any accurate information as to the state of preparation of the enemy to resist the attack.

2.—The peculiar disadvantage which always attends such enterprises, when attempted by a landing from a fleet.

3.—The want of a stable base of operations from which to draw supplies, and on which to effect a retreat, if necessary; while, on the other hand, all the resources were in possession of the enemy.

4.—The climate and the prevalence of an epidemic cholera in the Army at the time.

5.—The enormous evil of an army consisting of a combination of forces, of which no one was in a decided predominance.

Sir John proceeded to state,

The history of the defence of Sebastopol, published by the Russian General Todleben, shews that, at the period of the expedition, General Menschikoff possessed at his disposal, in the Crimea, 51,000 men, to which were added, after the destruction of the fleet, 18,500 seamen. They had, in addition, within Sebastopol, 2,822 mounted pieces of artillery—of which upwards of 200 were mounted on the works—large stores of intrenching tools, with all the resources of a dismantled fleet and a great naval Arsenal. It will thus be seen that, even in the number of men, the Russians were superior in strength to the whole of the Allied force, which barely exceeded 60,000 men at the period of disembarcation, and consisted of a mixed army of French, English, and Turks.

The invasion of a country possessing such military means, by an army inferior to their enemy, disembarked on an open beach, without transport, stores, or reserves, and in a country destitute of resources, must be admitted to have been a most daring and perilous undertaking. So far from the Russians proving themselves to be our masters in the art of war, as attempted to be shown by contemporary writers, the reverse was the case. During the greater part of the period over which the operations extended, the Russians were superior to us in absolute force, and the extraordinary spectacle was witnessed of the besieged being actually stronger than the besiegers. Our enemy beat us in numbers, but in nothing else. They produced no novelties in the art of war; all the science and modern appliances of warfare which date from the Crimea, were introduced by the Allies. The battles of Alma and Inkermann have raised the reputation of the British Infantry higher than ever, and our Cavalry at Balaklava extorted the admiration of the world.

The English people have no reason to be ashamed of the part played by their countrymen in the Crimea.

J. F. BURGOYNE.

To provide subsistence and employment for the soldiers who had served, and especially for those who had been wounded in this war, in compliance with the request of Captain Walter, the commanding officer and founder of the Corps of Commissionaires, on the 4th September, 1868, he again addressed to *The Times* an energetic letter, the result of which was that the sum of £5,000 required for the "endowment of the corps" was subscribed, as advertised, "*in answer to the appeal made by Field Marshal Sir John Burgoyne.*"

Moreover, urged by his generous desire to befriend soldiers of all nations, during the late war of France against Prussia, he was one of the active members of the Committee of the National Red Cross Society for aiding the sick and wounded.

At public dinners, when required to "rise," he never failed, in the brief words of a soldier, to urge the country to complete its defences.

The intellectual improvement of the Army, and of his own Corps in particular, were constantly in his mind.

Although retired—wrote a General Officer of Engineers, K.C.B.—he keeps us all together; his influence is always felt as a *point d'appui* upon which we rest.

In his home, his boyish simplicity, his happy bright countenance his warm affection, and the eager vitality of his mind, rendered him proverbially almost the youngest of its inmates,* and adored by his children, who were ever congregated in his heart—the sunshine of his existence, apparently without a cloud “to dim its glory and check its bright course to the Occident,” was approaching the horizon, when, all of a sudden, not only to the British people, but to mankind, was flashed by electric telegraph, the appalling intelligence, that the most costly and carefully constructed armour-plated experimental turret-ship in the world, commanded by a selected officer, manned by 500 picked seamen, and, containing within itself, its projector, Captain Cowper Coles, by the common law of gravitation, turning slowly bottom upwards, had, in utter darkness, on the 7th September, 1870, sunk to the bottom of the Bay of Biscay, leaving,

“*Rari nantes in gurgite vasto,*”

18 sailors and Captain Hugh Burgoyne, V.C., who, refusing their loyal calls to him to survive his vessel by entering the boat in which, subsequently, they were all saved, was left by them to perish, as he did perish, at his post—the keel of a capsized boat—upon which, in the gale that had foundered his ship he remained, at midnight, until the concluding storm of his own existence having subsided into the calm of Death, his corpse, shrouded in British Naval Uniform, slowly descended towards those of his noble crew, catacombed in their huge iron SEPULCHRE beneath!

We have heard of men who, although extricated from a railway accident without a scratch or bruise, afterwards died from the shock to their system. In the catastrophe of the “Captain,” the same was the effect upon Field Marshal Sir John Burgoyne, Bart. Proud of the name and hereditary title he had made for himself, which he hoped to see further illustrated by his only son, he was enjoying a just gratification in that son's early career, when the overwhelming news of his sudden death, with all its harrowing details, appeared in every daily newspaper. For a few days he bore the blow with the composure, and quiet uncomplaining fortitude which had always characterised him; but his strength, his energy, his vitality, were so shattered by the stroke—altogether too severe for the nervous system of an old man with such strong affections—that his medical attendants feared a paralytic seizure.

*“When I was young,” he very lately laughingly observed, “I was always spoken of as ‘old Burgoyne;’ my friends now call me ‘young Burgoyne.’”

A short time before, hale, hearty, and erect, he had been present at public meetings—at civic dinners—at all kinds of social gatherings—he had joined in every description of amusement with that keen sense of enjoyment so seldom experienced after early youth, but which *he* always possessed in so eminent a degree.

From the moment that the fatal news of the foundering of the “Captain” arrived, with the exception of an occasional hour’s drive in a close carriage, he never, during the year, left his house again to the day of his death.

From that moment, his life was that of an infirm invalid, suffering from a severe irritation of his skin, called eczema, caused by the over-excitement of his nerves.

His intellect remained clear and strong, but the wonderful energy which had caused his brain for so many years to work so actively on such an endless variety of subjects, was gone for ever!

Rest, from which his active disposition had always seemed to shrink, was now the only thing he appeared to desire.

He was much soothed, consoled, and affected by the marks of sympathy and esteem he received in all directions.

Within a fortnight of the day of his bereavement—when public clamour, with its utmost violence, was raging against “The Admiralty” for having caused it—in a black-edged private note, his warm feelings, uncomplaining submission, and generous noble sentiments were thus simply, but beautifully expressed:—

20, Brunswick Terrace,

Brighton, 20th Sept., 1870.

My Dear Head,

The sight of your handwriting always does me good,—the reading of it does me more! and no comfort can be better bestowed on me than at the present moment of trouble.

The sympathy of my friends,—and from none does it come warmer to my feelings than from you;—and the very high character given universally to my poor son, of which testimony bursts out on all sides on this melancholy catastrophe, afford me much consolation.

I cannot find in my heart to blame any body for the awful event—“*The best General is the one who commits the fewest errors,*” and so it may be said of the

best inventor of a new model of a ship ;—many foretold that the Captain would be found to have certain disadvantages, which would prove themselves on trial by degrees, and be more or less improved upon in future constructions, but no one predicted that circumstances might render the first blow so terrific ! With best regards to —— and many thanks for your very kind action in writing to me,

Ever my dear Head,

Yours most sincerely,

J. F. BURGOYNE.

Although confined to his house and almost to his room in Pembridge Square, he continued to take interest in military subjects, particularly in those relating to his own corps, for which he always felt a father's affection ; and, even in the spring of 1871, in the portal of his 90th year, he wrote a letter to *The Times* on *Army Promotion*, to which reference was often made in the House of Commons during the debate on the New Army Bill.

On a visit from one, who, almost longer than any, had enjoyed the happiness and the honour of his acquaintance, he welcomed him with his usual joyous countenance, asked eagerly for information, and, when it came to be his turn to listen—just as a tea-kettle when its contents get thoroughly warm and comfortable begins to sing, and just as a cat lying before a genial fire begins to purr—his well-known “hum of happiness” was distinctly heard.

But these glimmerings or flickerings were of very short duration. In the words of the Psalmist, CLOUDS AND DARKNESS WERE ROUND ABOUT HIM.

Had he no son ?
Ay, once he had—but he was dead !
Upon the harp he stooped his head,
And busied himself the strings withal,
To hide the tear, that fain would fall.

Broken down by affliction, his strength and constitution gradually sank. His appetite—which had hitherto faithfully befriended him—departed. His last and sole remaining pleasure in this world consisted in gathering his wife and children all around him, and although their features and figures gradually became more and more dim, yet, so long as he was able to count them, and find none missing from the group, he was calm and happy.

At last he sank quickly, and shortly after noon on the 7th day of October, 1871, without the slightest pain, he expired so quietly, that those disconsolate around his remains were left unable to record the precise moment, when his gentle spirit returned to its GREAT CREATOR.

(Before two months had elapsed, his Widow also expired—broken-hearted.)

HIS FUNERAL.

*Man goeth to his long home, and the mourners go about the streets.—
Ecclesiastes, 12th chap., 5th verse.*

When people in different positions of life, with minds as dissimilar as their incomes, desire to effect one common object, they generally discover, that to do so, each must be left—in common parlance—to go his or her own way.

In the funeral of BURGOYNE this principle was beautifully illustrated.

The unassuming modesty of his character—its perfect purity—that gentleness and sweetness of disposition which throughout his life had shrunk from pomp, vanity, or affectation of any description, were exemplified by his family, as follows:—

On the morning of the 17th of October, 1871, precisely as the church clock struck ten, a procession, less ostentatious than many of those daily to be seen proceeding towards the cemetery of Kensal Green, drove up, and for a few busy minutes paused, before the door of No. 5, Pembridge Square, to proceed from thence, by express permission of Her Majesty, to the Tower of London.

The procession consisted simply of a hearse, drawn by four horses,—followed by four mourning coaches, drawn each by two—conveying:

1. Ensign Gretton, and Master John Stopford, grandsons; Lieut.-Colonel Hon. G. Wrottesley, and Rev. James Spurgeon, sons-in-law.
2. Edward Woodhouse, Esq., son-in-law; Lieutenant William Denison, Rev. Dr. Hornby, and Admiral R. Stopford, relations, or connected by marriage.
3. Sir John Montagu Burgoyne, Bart., the Lord Wrottesley, relations; Dr. Lee, F.R.S., late medical attendant; the Right Hon. Sir Francis Head, Bart.
4. Thomas Burgoyne, Esq., family solicitor; Hugh Cameron, Esq., late medical attendant; Captain Drummond Stewart, Clerk to the Lieutenancy of the Tower; W. W. Baynes, Esq.

To the above cortege—all that was provided by the family—there spontaneously appeared, as its Rear Guard of Honour, three Royal carriages, sent by command of Her Majesty the Queen, H.R.H. the Prince of Wales, and H.R.H. the Duke of Cambridge.

In Pembridge Square, in which the windows of several houses, and especially of ONE, presented closely-drawn blinds, had assembled a small crowd, which—as the funeral passed along Bayswater Road, Oxford Street, Holborn Viaduct, East Cheap, King William Street, Tower Street, to Tower Hill—sometimes expanded into a mass of people, pressing each other, and sometimes dwindled into a fringe to the foot pavement of 4, 3, 2, and in rare instances, of one person deep.

At windows along the line, and even on house-tops, were seated groups, which for more or less time had been waiting for a national ceremony, they did not precisely know what. Of many doors, the entrances and front steps were tessellated with human feet; from the iron railings of Kensington Gardens, persons of all ranks were to be seen clinging. From Regent Circus the mass gradually thickened, and, as the distance from Pembridge Square to Tower Hill, by the route traversed, is exactly six miles, and as by very attentive observers it was estimated that, including those at windows, door-ways, and at the cross-ways of great thoroughfares, the sum total of those congregated fully amounted to a line of spectators four deep on each side of the roadway, it follows, that the spectators assembled to witness the passing funeral of one of their fellow-countrymen, would, if ranged in a single line, shoulder to shoulder, have extended exactly 48 miles. On this fact, let every one be left to draw his own conclusion.

As soon as the line of five black specks forming the procession emerged from narrow Tower Street, the important duty of the day commenced.

In rear of the ramparts of the once venerated, but now-a-days only venerable, fortress of London, there appeared on the summit of its White Tower—in mournful Honour of the approaching ceremonial—half-mast high, England's Union Jack, in obedience to its fickle-minded master the wind, now flying—now fluttering—now drooping from its lofty flag-staff.

In front of it, on the esplanade named Tower Green, were congregated a dense dark mass of people, through which was carved a passage, bounded and guarded on each side by a detachment from the Scots Fusilier Guards, in garrison at the Tower. They were there, in out-post position, to be the first military recipients of the body of a British Field-Marshal, come to take possession of its grave in the Tower of London, of which it was still the recorded Governor. And as the black nodding plumes of the black horses of the black hearse proceeded between these two bright scarlet lines, each detachment, in succession, by the word of command of its Officer, presented arms, until, when the coffin had passed, reversing them,—soldiers, whose sorrowful hearts were externally glittering with the medals of Alma and Inkermann, resting their bear-skins on the butts of their rifles, mutely stood, appropriate mourners of their revered associate.

On passing over the drawbridge of the fortress, its guns instantly commenced firing the salute accorded by regulation to a Field-Marshal, during which, at minute intervals was heard to toll, the big bell of the little church of St. Peter ad Vincula.

At the Stockade Gate, occupied by a detachment of the halbert-armed Warders of the Tower—old soldiers with old medals on their breasts, wearing the ancient beef-eaters' uniform of velvet hats bedizened with red and white roses, starched neck ruffs, red hose, terminating in parti-coloured rosetted shoes,—the body was received by the 1st Battalion of Scots Fusilier Guards, its band reverberating the Dead March in Saul, successively taken up by the band of each of the two other corps forming the line.

From the inner ward, the duty of lining the road was performed by about 500 Royal Sappers and Miners, extending to within about 50 yards of the Chapel, their centre and band in front of the Guards' Mess House. Up to the gable of the Chapel of St. Peter, the double alignment was continued by the Corps of Commissionaires—most of them wearing medals—many mutilated.

Beyond the Commissionaires, in front of the Chapel, was drawn up—as the special Guard of Honour—a company of Royal Engineers, the pavement being lined with Tower Warders.

Most people, and especially Foreign Officers, would have expected that these simple preliminary arrangements were merely the outworks of a grand imposing internal military spectacle; but, from the same feeling that had marked all the previous movements, it had been decided, that veneration, respect, and affection, instead of being drilled into stiff martial array, should be left totally uncontrolled.

And accordingly, without the slightest attempt at artificial effect, the rigid rules of military precedence appeared, for the moment, to be forgotten.

To receive the coffin of FIELD-MARSHAL SIR JOHN BURGOYNE with due honour, were assembled, in the great Court in front of the White Tower, first and foremost, the Right Hon. Edward Cardwell, Secretary of State for War. By Officers of high name, were adequately represented, Her Majesty the Queen, H.R.H. the Prince of Wales, H.R.H. the Duke of Edinburgh, H.R.H. Prince Arthur, His Majesty the King of the Belgians. There were also present H.R.H. Field-Marshal Commanding-in-Chief, accompanied by his staff; Representatives of the British Navy, the Army and Navy of the United States, the Corps of Civil Engineers; Members of Parliament, a Deputation from Trinity House, Deputy Lieutenants of the Tower Hamlets, with a large body of Militia and Volunteer Officers in uniform, &c., &c. The assemblage forming altogether a brilliant mass of gold, scarlet, blue, waving plumes, and of military decorations of all Europe.

Among the British Officers assembled, were two Field Marshals, ten full Generals, of whom seven wore the insignia of Grand Cross of the Bath, three Lieut. Generals, fifteen Major Generals, including Prince Edward of Saxe Weimar.

Of the deceased's own Corps, there had voluntarily congregated from all parts of the United Kingdom, two Generals, nine Major Generals, eleven Colonels, seventeen Lieut. Colonels, four Majors, thirty-eight Captains, and eighty-three Lieutenants; total, 164.

Of all the Lieut. Colonels, Majors, Captains, and Lieutenants who had served with or under the deceased in any one of the sieges in Spain, not an individual appeared. All dead, save four subalterns, worn into octogenarian Lieut. Generals, too infirm to attend.

It may be added, that the non-commissioned officers and privates of Royal Engineers at Chatham had asked leave—1st, to purchase and wear black crape round their left arms; 2nd, to join with the whole Corps in its subscription for a monument; all, of every rank, fervently uniting in one common prayer, that the revered banner or Latin motto of their Corps, "*Quo fas et gloria ducunt, Ubique*," might ever, in their hearts, be concentrated into the one English word,

BURGOYNE.

As soon as the coffin—(preceded by Colonel Milman, Major of the Tower, carrying the Field Marshal's baton of the deceased), bearing loosely on its lid the crimson robes of the order of Knight Grand Cross of the Bath, attended by four Royal Engineer non-commissioned officers on each side as pall-bearers, by an official, carrying on a cushion the cocked hat, sword, medals, and orders of the deceased, followed by the few family mourners had emerged from the last of the dark low narrow passages it had been necessary to traverse, the chaplain of the Tower solemnly repeating, "*I am the Resurrection and the Life, &c.*,"—the brilliant assemblage of officers and civilians, each of his own accord, uncovered; and Mr. Secretary Cardwell having previously assumed his place in the church, His Royal Highness the Field Marshal Commanding-in-Chief, taking the lead, the whole of the remainder, utterly regardless of their respective ranks, merged in procession, forming altogether a grand imposing national picture of the *Last Honour*, paid not only by the Royal Family, army, and people of England, but by the highest authorities of Europe, and of the United States of America, to a veteran British soldier.

While the coffin, attended by its eight pall bearers, was being transferred from men's living shoulders to two wooden trestles immediately in rear of the grave, which, excavated at right angles to the altar, was partly beneath it, a loud clanking of sabres and spurs, a rustling of plumes, and a confused heavy, and in

some parts—especially on the staircase leading to the gallery—a hurried tread of feet, seemed entirely to engross attention, until every person, either in the aisle or above, having taken their places in worm-eaten pews, the ordinary funeral service commenced.

Consistently with the previous details of the day, every arrangement approaching to affectation, or to that other *defect*, commonly called *effect*, had apparently been forgotten.

Throughout the service the organ was dumb. Not a sigh, not a sob, not a sound of any sort was heard, save the clear gentle voice of the Tower Chaplain.

From the pew adjoining the altar, from which the whole aisle could be scanned, the scene presented only one feature. There was no exhibition of hysterical grief, but in lieu thereof, every countenance—whatever might be its shape or colour, round or angular, ruddy or pale—appeared absorbed in deep thought, shrouded by solemn gloom.

In short, in every sense of the word, it was a soldier's funeral, and had it been on the long Plateau of Sebastopol, instead of within the little Tower of London, it could not have been more serious, more impressive, more deeply felt, and above all, more simple.

On lowering the coffin to its final resting place, the Tower guns, by a Field Marshal's salute, officially proclaimed the precise moment when the curtain fell upon the

“Last scene of all,
That ends this strange eventful history.”

On Mr. Cardwell and H.R.H. the Duke of Cambridge rising from their seats, every one, following in the wake of their example, proceeded slowly, not towards the Altar, but towards and out of the door; and when, on the conclusion of the solemn ceremony, the military bands, according to their usual habit, struck up a lively tune, the late immense congregation slowly moved away, leaving behind them, in his narrow solitary grave, all that remains in this world of ONE who, without adulation or exaggeration, may be designated the most experienced Engineer, one of the ablest chiefs, and the most estimable military character that England has ever produced; and while His Name will illuminate Her History, warmly will it be remembered by the British Army in general, and most affectionately by the officers, non-commissioned officers, and men of his own corps in particular, all uniting in the one emphatic sentiment, that

He lived “WITHOUT FEAR,” *and died* “WITHOUT REPROACH.”

Croydon.

F. B. H.

MEMOIR

OF

LIEUT. GENERAL SIR WILLIAM T. DENISON, K.C.B., &c., &c.

In the preface to the last volume of the Professional Papers, the Editor alluded to the general regret of the Corps on the recent death of their distinguished brother officer, Sir William Denison; and in the March number of the "Royal Engineer Journal," his character and career are briefly sketched by Major General Nelson, a friend who had known him for more than fifty years.

In 1837, while a subaltern in the Corps, the officer to whom these passing tributes of respect and affection were paid, succeeded in establishing the Professional Papers, and in so doing has, with the single exception of the founder of our School at Chatham, done more to increase the interest of his brother officers in their profession, and to diffuse through the Corps the experience of its individual members, than any of his predecessors or contemporaries; and the interest he then manifested in our professional pursuits was never diminished by the responsible duties of the high offices he held. That the benefits we have thus received may not be forgotten, that the honour we derive from his career may be preserved to us, and that his firm, just, and unselfish character may be remembered as an example, it is fitting that these volumes should contain a brief memoir of his life.

William Thomas Denison was the third of the nine * sons of John Denison, M.P., of Ossington Hall, in the county of Nottingham. He was born on the 3rd May, 1804, and after passing a short time at a private school, was sent when ten years of age to Eton, where he remained till he was fourteen, and had attained to the upper fifth form. As he was intended for the Royal Military Academy, he was then placed at a school on Blackheath, well known at that period as one of the preparatory schools for Woolwich. In the first week of February, 1819, having passed the qualifying examination, he joined as a cadet

* The eldest of these nine sons has been chosen Speaker of the House of Commons for the three last parliaments. The second died Bishop of Salisbury in 1854. Three of the remainder were distinguished by first-class honours at Oxford.

at the lower barracks in the Arsenal, and about six months later was passed on to the upper barracks on the Common. He rose through the different academies as quickly as possible, taking many places and losing none, and passed for his commission in December, 1823. He remained a year longer for the practical courses of the Repository and Arsenal, and finally left to wait for a commission in December, 1824, there being many others at that time similarly situated.

The small number now living of his brother officers who were with him at Woolwich will remember how thoroughly the earnest and determined character of the boy was in accordance with the character he has shown in his manhood. He was earnest in everything, in every game and in every study, even in the work which was most irksome—the copying of innumerable plates of fortification. The few that are exactly of his own standing will remember the determination with which, while a “neux,” he resisted, and afterwards vanquished in a fair fight in the racquet-court, an old cadet, about four years older and six inches taller than himself, who attempted to bully him one evening at football; but only those who were at Woolwich in those days can fully appreciate the courage evinced by that resistance.

In the summer of 1825, he was directed to join the survey as a “Candidate for the Royal Engineers,” the survey course of instruction being at that time under the superintendence of the Director of the Ordnance Survey, and the cadets considered only as candidates for the Corps until they had completed it. In March, 1826, he was “gazetted” as a Second Lieutenant, and after passing through the course of instruction at Chatham, was ordered in the spring of 1827, to proceed to Canada to join a company of Sappers then on its way to the Ottawa for employment in the construction of the Rideau Canal. He went out by way of New York, and having joined the company, remained with it at By-Town (now the capital Ottawa) during the whole of his service in Canada, about four and a half years, except when employed to examine and report upon localities in the interior, then hardly known; the part in which he was constantly employed included the junction of the canal with the river Ottawa, and the country was at that time a mere wilderness, but his professional life was well commenced there. The nature of the work was admirably suited to afford him that kind of experience which is derived from contending with great natural difficulties in newly settled districts. Experience of this kind peculiarly qualifies the mind to receive at once all the knowledge that can be gained by seeing other works at any future period; for no subject is ever studied with so much facility or with so much advantage, as one on which the mind has been for some time earnestly exercising itself without external assistance. It was of advantage also that the work was one of navigation partly obtained by canals,

and partly by controlling rivers of considerable magnitude, and deepening or altering the levels of the natural lakes; for almost every description of engineering operation came under his observation, if not included in his own division of the work. In the first volume of the Professional Papers there is an account of the Rideau Canal, by Lieutenant (now Lieut. General) Frome, who was also employed upon it, and in subsequent volumes descriptions of particular portions written by Lieutenant Denison. In addition to his duties on the canal and with his company, he made careful experiments upon Canadian timber, the results of which he presented to the Institution of Civil Engineers. That Institution recognized their value by presenting him with the Telford Medal, and by publishing them in 1838, in the second volume of its Transactions.

But at this period his opinions were conclusively formed on another subject, in a manner which affected all his future life. Among his most intimate friends at that time, was one who denied the authority and truth of the Scriptures, and was well able to maintain his conclusions by argument. The subject was frequently discussed between them, and Denison was induced to think and read much in consequence of their discussions. The result of this thought and reading was so thorough a conviction of the authority of the Scriptures, that a firm belief in, and reliance upon them became a characteristic of his mind, and their daily study a habit during the remainder of his life.

In December, 1831, he returned to England, and was stationed at Woolwich until February, 1833. In the autumn of 1832, it had been decided that the survey course of the Candidates for the Royal Engineers should be removed from the superintendence of the Director of the Ordnance Survey to that of the Director of the Royal Engineer Establishment at Chatham; and in February, 1833, that decision was acted upon by Lieut. Denison being ordered to Chatham to take charge of that branch of instruction. Those cadets who were appointed to the Engineers were still to continue as cadets, under his immediate command, until their survey course was completed; and those officers of the Corps still living, who were "gazetted" as Second Lieutenants between February, 1833 and the autumn of 1835, when Lieutenant Denison had been relieved in this duty by Lieutenant (now Lieut. General) Frome, must have been his pupils. The earnestness with which he took up the subject is shown by the fact that the transit instrument and the altitude-and-azimuth instrument, now in the Observatory, at Chatham, were purchased by himself, for use in his instruction, and were left by him, while still his property, for the use of his successor, on whose recommendation they were subsequently purchased by the Government. While he was there they were placed under two very small wooden huts, which

after a few years were removed to make way for the present permanent building. He must, however, be regarded as the founder of the Observatory, a necessary adjunct to the English School of Military Engineering; but which, without the comprehensive view of his subject, taken by Lieutenant Denison in 1833, would most probably never have been given to it.

Towards the end of 1834, Captain Macaulay, Royal Engineers, the first officer of the Corps who had undertaken to teach Fortification at Woolwich, and who had greatly improved the method of teaching that subject, announced his intention to retire as soon as his successor was appointed, and Lieutenant Denison became a candidate for that professorship. The only other candidate was the officer of Artillery who had been the Instructor of Fortification, and who was in the spring of 1835, appointed as Professor. But the failure to obtain the professorship had a permanent influence on Denison. He resolved never again to seek for any duty; and although, perhaps, the first determination may have been occasioned, as he sometimes appeared to think, by pique, its maintenance through life was due to the higher feeling of a desire to leave himself in the hands of his Creator, and to do with all his heart and strength the duties of every position in which he might be placed. In the summer of 1835, he was taken from Chatham for employment on the Municipal Boundary Commission, and on the completion of that duty, in May, 1836, was placed at the disposal of the Director of the Ordnance Survey, and employed at Greenwich in examining the arc of Ramsden's zenith-sector, and comparing the observations made with it with those made with the mural circles of the Royal Observatory. Having completed this duty, he was in the autumn of 1837, placed in charge of the works in progress at Woolwich Dockyard, Captain Brandreth, Royal Engineers, being then the Director of Admiralty Works. In November, 1838, he married Miss Caroline Lucy Hornby, a daughter of Admiral Hornby, at that time the Superintendent of Woolwich Dockyard. In November, 1841, he became a Second Captain. Between July and October, 1842, he was sent to inspect the Admiralty works at Bermuda; in June, 1845, he was transferred from the Woolwich to the Portsmouth Dockyard; and in June, 1846, was appointed Lieut.-Governor of Van Dieman's Land. On leaving his employment on the Admiralty Works, Captain Denison was knighted in recognition of his services, at the request of Lord Auckland, who was then the First Lord.

During the period between 1838 and 1846, we find him taking a strong interest in many subjects connected with his Corps. He had never forgotten the defective state of the instruction at Woolwich, when he was a cadet, and he urged so strongly the necessity for improvement that a committee was appointed

in 1835 to enquire into it, and several changes were introduced in consequence. He took great interest in Humbolt's proposition for the establishment of magnetic observatories at various points upon the globe, and suggested that advantage might be taken of several British military stations for the purpose, where English officers might be found to make the observations. But the subject which has proved of most interest to us is the successful commencement in 1837, of our Professional Papers. Having obtained the concurrence of General Mulcaster, the Inspector General of Fortifications, and the promised support of many officers of the Corps, he undertook the editorship, and continued to conduct their publication until he went to Van Dieman's Land. The first eight volumes emanated from him, the ninth was brought out in March, 1847, by Captain (now Major General Sir Henry) James, who mentions in the preface, that the greater part of the papers for the volume had been collected by Captain Sir W. Denison.

The objects in view when the publication of these papers was decided upon, and the peculiarities in the service of the corps for whom they were intended, cannot be more clearly expressed than in the preface by their first editor to their first volume; and the sense of the advantage already derived from them in 1846, may be inferred from the terms of the inscription on the piece of plate presented to him by the corps on his resignation of the editorship, "as a token of grateful remembrance that to him alone they are indebted for having originated the diffusion of individual experience by means of professional papers."

In those volumes will be found numerous papers by their first editor, from which the engineering works on which he had been employed, and the engineering subjects which had interested him may be seen. Many of the works that had been under his own immediate charge were of great importance, and presented engineering difficulties that required much professional knowledge and skill to be successfully contended with; in fact, when he was selected to be Governor of Van Dieman's Land, he had served as an Engineer officer for twenty years in various places; and during four years in Canada, and eight years in connection with the Admiralty, had been applying his professional knowledge to difficult works, and acquiring professional experience of the most valuable description.

The next twenty years of his life were passed as a Colonial Governor, and some of the very interesting questions which in that capacity he had to consider and to form an opinion upon, are mentioned in the two volumes, "Varieties of Vice-regal Life," compiled by him during his leisure hours after returning to England, and published at the beginning of 1870. Many of those questions related more particularly to the legislation and to the social progress of the

colony, but some were connected with the engineering works, both civil and military, that it became desirable to promote, and some were purely military.

He landed at Hobart Town, in Van Dieman's Land, in January, 1847, and, soon after his arrival, gave his attention to the general survey of the island, causing a trigonometrical survey to be commenced as a proper basis for it, and, after two years, he was able to write to Admiral Beaufort, the Hydrographer of the Admiralty, about the assistance he could afford to the Marine Surveyors by the triangulation of the survey, and its connection with the Observatory at Hobart Town. He had also, at that time, given his attention to education, and had started a scientific society, perceiving that one great want in the colony was scientific men. He had informed himself with respect to the mineral resources of the island, and especially as to its coal fields; he made the people of England acquainted with the magnificent timber obtainable from it, both by letters and by sending specimens to the exhibition of 1851; and in 1854, on the proclamation of war with Russia, we find him constructing batteries for the defence of the harbour, and training the police to act as gunners, which precautions he evidently considered quite sufficient for the occasion.

Every man in a public situation who is capable of strong convictions and honest enough to express them, must experience alternations of popular regard; but an upright and straightforward character is sure to obtain general respect and esteem at last. Sir William Denison's public life in Van Dieman's Land is a proof of the truth of this assertion. Several events during the first period of his government could not be honestly dealt with by him without creating adverse feelings. Soon after his arrival he found that the position of one of the judges who was in debt, and the conduct which his judicial office enabled him to adopt with respect to his debts, affected the public confidence in his court—of course that judge was removed. But before another could arrive the revenue of the colony was seriously impaired by a decision of the remaining judge as to the legality of one of the Colonial Acts, which decision affected many other Acts which had been approved by the same judge as a member of the Legislative Council. Of the integrity of this judge there was no doubt, and Sir W. Denison, throughout this difficult period, always evinced his sense of it; but the mere fact that the Revenue and the Courts of Justice were in difficulties, was enough to enable party papers to attack the executive of the day. A little later we find the opinion Sir W. Denison had formed on the great value of the convict establishment to the colony, disliked by a large party; and the publication in a blue book at home of a "confidential" despatch to the Secretary of State for the Colonies, produced strong expressions of feeling against him.

In October, 1849, when this unpopularity was at its height, an incident oc-

curred, which, as it most probably had much effect in commencing the subsequent change of feeling, and is also highly characteristic of the man, is worthy to be recorded, as described by a brother officer, who was acting as his private secretary.* An agricultural meeting was held at a town in the central district of the island, where Sir W. Denison was so unpopular, for the reasons above given, that, on his arrival in the town, the District Magistrate called on his private secretary to tell him that some of the people threatened to insult the Governor if he attended either the agricultural show, or the dinner in the evening, and to advise that he should leave the town. On this being mentioned to Sir William Denison, the result was, that, instead of waiting for the large following of police, &c., that had been arranged to accompany him, he started at once with Lady Denison and his private secretary only, and was soon in the midst of his most rabid opponents (most of whom only knew him through the press) discussing long and short horned cattle, and the points of the horses exhibited; and when the leaders of the party arrived and recognised him, he was the centre of a group of farmers. The game was won, hats were taken off, and the only signs of unpopularity were the sulky looks of a few. He also went to the dinner, spoke well, alluding, in manly terms, to the causes of his unpopularity, was then enthusiastically applauded, and, when the dinner ended, was accompanied by the whole party to his hotel.†

After this his unpopularity was of short duration, and rapidly changed to the opposite feeling; even those who differed most from him could not but acknowledge the earnest and genial nature of the man, and his transparent straightforwardness. In less than two years after the time of his greatest unpopularity, we find those most opposed to him on colonial politics uniting to take advantage of his return to the seat of Government after an expedition into the interior, to show their admiration of his character by a reception which was most enthusiastic in its progress.

In September, 1854, having administered the Government of Van Dieman's Land for seven years and a-half, he was informed in very flattering terms that he had been appointed to the more important Government of New South Wales; and after receiving his successor, Sir H. Young, replying to numerous addresses, and going through a hearty leave-taking at Hobart Town, he landed at Sydney on the 17th January, 1855, to enter on his new duties.

We find him directly attending to the schools and local charities, and taking steps for the re-establishment of the observatory, which had been closed, and

* Lieutenant (now Lieutenant Colonel) A. Clarke.

† This incident will be found, as related by Lady Denison in her letters to England, at page 127, of Vol. I, of *Varieties of Viceregal Life*.

for procuring a competent astronomer for its direction. He found the maps of the colony worthless, and at once looked for means to commence a proper survey, and to connect with it the labours of a geologist then in the colony. He took up the question of the defence of Sydney, the access to its harbour being very easy even at night. Immediately on his arrival he had to consider questions connected with the establishment of a mint at Sydney, and he gave his support to Captain (now Colonel) Ward, R.E., who had been sent from England for that purpose, and had met with much opposition. He also considered the means of communication within the colony, and after observing its peculiar features, the absence of navigable rivers, the scarcity of water for canals, the high price of labour, and looking also to its great extent, came rapidly to the conclusion that railroads must be resorted to, and the question he proposed to himself was, what is the proper form for them? He began experiments on friction as one of the steps towards a solution of that problem; and in 1856 we find him asking the Home Government for an officer of Engineers to assist him in working out a system of railways, and Captain (now Colonel) Martindale was sent out in consequence in 1857. In 1856, also, he succeeded in establishing a philosophical society, and opened it by reading a paper of his own on Railways. And he appears to have given consideration to the proper organization for a Board of Works for the colony; and to have become convinced that the education of the population was a pressing necessity. In 1857, we find that the introduction of "responsible government" had relieved him of much official labour, and that he was giving more of his attention to the advancement of knowledge by writing both for the philosophical society already mentioned, and for an agricultural society subsequently founded, and in many other ways.

In July, 1856, his services were acknowledged by a Knight Commandership of the Bath; and in September, 1860, on the death of Sir H. Ward, he was selected by the Secretary of State for India as the best person to succeed to the Government of Madras. At page 510 of the 1st volume of the "Varieties of Vice-regal Life," there is an account, written by Lady Denison, of his last levee at Sydney, and of the scene at his embarkation, which events were sufficient to show the respect and esteem he had earned in administering the Government of New South Wales.

Sir William Denison landed at Madras in the middle of February, 1861, and we find him entering at once into the important military questions which had been brought under consideration by the recent mutiny; and also into the subjects connected with the public works of the Presidency. Three weeks after his arrival he described in a letter to the Governor General the process by which he proposed to arrive at a sound opinion as to the requisite strength, constitution,

and distribution of the military force for the Madras Presidency; and in the following month we find he had considered the course that had been adopted in introducing railways, and had formed the opinion, which has most probably by this time been found to be just, that the Indian Government had acted unwisely in guaranteeing an interest of 5 per cent. to the holders of Indian Railway Stock.

The military question became very complicated, and for its more thorough discussion he went at the end of April, 1861, to Calcutta, and remained on a visit to Lord Canning, the Governor General, for nearly a fortnight. The minute he then wrote on the subject, with the marginal notes of Lord Canning, and his observations in reply thereto, is printed at length in the second volume of the "Varieties of Vice-regal Life," where his brother officers may read his opinions on military organization and the introduction of changes therein, which are not without interest at the present time, as they are in some points applicable to the changes now under discussion at home.

By the middle of 1861 he had, by much reading and inquiry, made himself acquainted with the constitution of the Public Works Department; and we also find him considering the steps to be taken for improving the quality and increasing the supply of Indian cotton, and in connection therewith, for making the river Godavery navigable; also for forming a harbour on the west coast at Sedashegur, and connecting it by a road with the cotton district of Dharwar. Before the middle of July he had visited the mouth of, and ascended many miles up the Godavery, in order to form his own judgment on the first of these projects, and had also examined the plans and estimates; and in October we find him visiting Sedashegur, and in November shooting at tigers and other large game.

Independently of his personal interest in our Corps, the organization of the Public Works Department, and the employment, under that organization, of the Engineers in India, forced the subject of the amalgamation of the Royal and Indian Engineers upon his notice; and in August, 1863, he sent to the Inspector General of Fortifications a copy of a minute he had written on the organization of the Engineers in India. When at Sydney, after the mutiny, he had thought upon the question, he, like most others, considered amalgamation desirable; but now, after becoming acquainted with the peculiarity of the Engineer service in Madras, he observed that in that Presidency "the officers of Engineers are practically officers of the Department of Public Works; they have but little of the military organization but the name," and expressed an opinion that this state of things, after the amalgamation, could not be long maintained. He suggested that the simplest mode "of avoiding the inconveniences which must necessarily arise out of a system which requires that the officers of the same Corps shall be paid and employed according to two different rules, would be that of

restoring to the Corps of Engineers in India its military organization, and of making the arrangements here" (*in India*) "harmonize with those which regulate the service in England, and in all the Colonies." In his minute, he entered into all the details necessary to justify this opinion, which was supported by the concurring observations of the Commander-in-Chief at Madras. From the opinion thus expressed in 1863, he did not deviate; in 1867, after his return to England, he again urged it on the attention of the authorities at home, as an officer of Engineers interested in the well-being of his Corps, and thoroughly acquainted with the nature of its employment in India. The last 8 pages of his book "*Varieties of Vice-regal Life*" are devoted to remarks on this subject. Time will probably show, if it have not already done so, the wisdom of his views.

On the 21st November, 1863, Sir William Denison received telegraphic information of the death of Lord Elgin, the Governor General, and under the provisions of the India Council Act, became responsible for the government of India until the vacancy could be filled by the arrival of a successor. His presence at Calcutta was instantly called for as urgently required; many important subjects requiring prompt decision were pending; and a war had been commenced on the north-west frontier, which was not progressing satisfactorily. Before he reached Calcutta the Council had passed a resolution ordering the withdrawal of the troops, and the very first step taken by Sir W. Denison was to induce the Council, on the 4th of December, the second day after his arrival, to rescind this resolution; and he appears to have succeeded by his arguments, which he recorded by a minute, in convincing all but one member of its impolicy. He wrote to a friend thus on the 15th of December, 1863, "So we have kept them up, and they are to act on the offensive in a day or two, which there is every reason to believe will bring these people to their senses;" adding on the 17th, "We got good news from the frontier yesterday, the troops had commenced acting on the offensive, have attacked a post of the hill people, driven them out of it, and killed upwards of three hundred, with but little loss on our side." A postscript added on the 20th says, "We have finished our business in the hills, having beaten the mountaineers on two occasions; they came in as suppliants." A very interesting account of this short mountain campaign has been published, which was written by Colonel Adye, C.B., of the Royal Artillery, in which he remarks, "Sir W. Denison remained but a few weeks as Viceroy, but he had the satisfaction of feeling that a most dangerous state of affairs was brought to a speedy conclusion by his good sense and determination, backed up by the vigour of Sir Hugh Rose and the valour of the troops engaged."

He was relieved at Calcutta on the 12th of January, 1864, by Sir J. Lawrence, and he left on the 14th, and was soon after fully occupied by drainage, water

supply, irrigation, and railway questions connected with his presidency, all of which he entered into, not merely as an administrator, but as an educated and experienced engineer, competent to form a sound opinion as to the designs and estimates placed before him.

In December, 1853, while in Van Dieman's Land, he had been "seconded," and in March, 1865, he received, through his military secretary, a copy of a letter addressed to the Commander-in-Chief in India by the Military Secretary at the Horse Guards, enquiring whether Sir W. Denison intended to return to the duties of his Corps, or to retire permanently and remain in civil employment. His minute on that letter directed a reply, stating that it was his intention "to return to the duties of his Corps, the Royal Engineers, when ordered to do so." He also wrote to the Horse Guards himself to the effect that he held himself in readiness to obey any orders he might receive from His Royal Highness the Commander-in-Chief, at the same time pointing out that the usual period of tenure of the Government of Madras would soon expire in his case, and that he should like to be permitted to complete it. He was accordingly left to complete that period, and returned to England in the spring of 1866.

It is not necessary to recall the pleasure with which his brother officers received him on his return, and anticipated his being again employed among them; nor their gratification when they heard that His Royal Highness the Commander-in-Chief had offered him the Royal Engineer Command at Portsmouth, and that he had gladly accepted it. The appointment, however, did not take place, and his letter in reply to the communication from the Inspector-General of Fortifications, which informed him that it was not considered right to send him to that duty after the high positions he had held, is so characteristic, that his friends and brother officers must wish it to be recorded in these pages.

"United Service Club, 1st July, 1867.

"My dear Sir John,

"I am much obliged to you for allowing me to see His Royal Highness's letter on the subject of my appointment as Commanding Royal Engineer at Portsmouth. I feel grateful to His Royal Highness for the testimony borne by him to the mode in which I have performed the duties incidental to the various positions in which I have been placed. I cannot but think, however, that the motives which have actuated me throughout my career have been misunderstood, and feelings alluded to, as likely to arise out of the inferiority of my present position, or of my possible future one, to those which I have held, which neither have found, nor will find a place in my mind.

"I have always had a strong Corps feeling, and have ever considered my position as an officer of Engineers an honourable distinction. I have done my best to qualify myself for the various duties which, as an officer of Engineers,

I might be called upon to perform; and I have striven to induce my brother officers to take the same view as myself of the very varied character of their duties. How varied these have been in my case you know very well, but the variety was not the result of any application on my part. The offer of employment, other than that of the ordinary duties of the Corps, in every case came spontaneously from persons in authority, and I accepted the offer feeling myself competent to execute the works entrusted to me, and with a conviction that in so doing I was but acting up to my duty as an officer. I never looked upon the appointments I held as permanent; indeed they were essentially of a temporary character, and though I have been moved from one government to another, I have always looked forward to the time when I could rejoin my Corps, and as a matter of course re-assume my military position. His Royal Highness is aware that in 1865, when the question was put to me whether I intended to resign my commission, I distinctly stated that such was not my intention, and that I held myself in readiness to obey any orders I might receive from His Royal Highness. I did not then, neither do I now, think, that in re-assuming my position as a Colonel of Engineers, after having acted as a governor or governor-general, I have in any way lost caste; or that in performing the duties incidental to an officer of my rank and standing, I can be considered to be doing anything derogatory to myself—on the contrary, I feel that a refusal on my part to accept the realities of my position, and to perform my duties as an officer, would be equivalent to an admission that I was incapable or unfit to do so; and this most certainly I am not in any way disposed to allow. My opinion is that in returning as a matter of course to my ordinary duties in the Corps, I have but acted in accordance to a sense of duty, and as I should wish to see my brother officers do: that they appreciate my motives and are glad to see me back amongst them I have every reason to believe. Such being my feelings, and those of my brother officers, I, when asked by the Deputy Adjutant General whether I would accept the command at Portsmouth, replied at once in the affirmative; indeed I could not act otherwise, and I trust that His Royal Highness will admit that, under the circumstances, no option was left to me, and will appreciate my wish to resume my military duties.

“ Believe me,

“ Yours very truly,

(Signed) W. DENISON.”

He was not, however, left without occupation. He was chosen to be the chairman of a Royal Commission, appointed to inquire into the means of preventing the pollution of rivers, and the duties of that commission employed him officially during the remainder of his life. He also found questions of interest for himself, taking up, among others, very warmly, the subjects of colonization

and emigration, on which his acquaintance with Canada, in his early life, and his intimate acquaintance latterly with Australia, made his opinions very valuable. But a few weeks before his death he gave two lectures on these questions at Edinburgh, which have been published.

In this brief sketch of the career of Sir William Denison, it has been endeavoured to convey a correct idea of the character of the brother-officer we have lost; it must, however, be impossible, without having known him, to understand how exceptionally noble it was. Capable of deep thought and long continued study, he could also arrive promptly at a vigorous decision, and carry it out with energy and dauntless determination. It was impossible that his disinterestedness or his impartiality could ever be doubted; there was not the slightest stain of diplomatic art in his nature. The opinions he formed, he expressed as he formed them, and as strongly as he conceived them; but he was always open to arguments, and his opinions were never obstinately held.

And no man is known to us really, unless we can see clearly the religious views by which he is practically influenced. The tastes, as shown both in serious and lighter pursuits, are in some degree indications of the character of a man, but in no sense to be compared with the indication afforded by the nature, and by the greater or less earnestness, of his religious opinions. The effect upon him of his early intercourse with an intimate friend in Canada, has been mentioned, and to the end of his life that effect was shown. In later years he recognised most thoroughly the relationship of earthly parentage, as typical of that between man and his Creator, and among other pamphlets printed by him at different times bearing on religious questions, is a short one written about eight months before his death, and addressed to his children, in which he exhorts them to the daily study of the scriptures, and tells them that their parents, from the time of their marriage have carefully studied the New Testament together, to ascertain what its teaching really was, and he leaves them copies of the notes they made as the results of that study. He tells them to have faith in God's care and guidance; to accept what God sends them; commencing their career in the world on this principle, "Trust in God as a kind and loving Father and Saviour, so will your lives be happy and your death full of hope."

It seems almost superfluous to add that the domestic life of Sir William Denison made his home bright and happy to all belonging to him.

His life then is an example to us, and to those who are coming after us. In every passage of that life we have reason to be gratified with our brother-officer, and when we regard the whole of it, we cannot but desire to preserve the memory of his career as that of one of the most excellent among us.

H. D. H.

PROFESSIONAL PAPERS.

PAPER I.

MEMORANDUM ON A PROPOSAL FOR A SYSTEM OF RAILS AND TURNABLES TO FACILITATE THE ARMAMENT OF LAND WORKS.

BY MAJOR HARRISON, R.E.

It is assumed that Moncrieff's system of mounting guns will be largely adopted when the land works, which are already constructed for the defence of the dockyards and arsenals of England are being armed and rendered fit for service.

The Moncrieff carriages will, it is supposed, be placed in recesses cut in the parapet, the parapet itself being strengthened in front by masonry or concrete, should its thickness be not otherwise sufficient.

The traverses between the gun emplacements can be made into bomb-proofs, and access to them by the gun detachment rendered short and easy. The carriages will thus be in nearly the same position as they would be if placed in the kind of pit that Captain Moncrieff himself recommends.

It is argued that it would be most advantageous for an armament of the above description, if the guns could be moved with facility and comparative speed from one emplacement to another. *First*, because it is not probable that a fort will ever be fully armed, and it is impossible to know on which side the attack may come. *Secondly*, because it would be invaluable to be able to remove a disabled gun and bring up another in its place.

The desired result can be obtained by a system of rails and turntables, the nature of which it is the object of this memorandum briefly to describe.

It is understood that experiment as well as theory has established the fact that by Moncrieff's system of mounting heavy guns, there is little or no strain on the platform consequent on the discharge of the piece. Hence a simple slide laid down upon rails fixed upon a turntable would create sufficient friction to

check recoil; but if not, some small additional stop, such as a cable, would render all secure.

It is proposed then, that in each pit or emplacement for a gun, there shall be a turntable crossed in one direction by a line of rails, on which the gun platform or slide should rest. (See fig. 1.) The turntable would be traversed as will be described hereafter.

That in rear of each pit there shall be another smaller turntable of the ordinary description, viz., with two lines of rails crossing each other at right angles, and sufficiently large just to admit the platform. Between these two turntables, as well as all round the fort in rear of the gun-pits, there would be a line of railway.

The process of getting the guns into position would be as follows:—The slide and such part of the carriage as was necessarily fixed to it would be first lifted on to the line of rails, then the carriage itself, and lastly the gun. The whole could then be moved into any emplacement in the fort where it was required, either by a small steam-engine, or by a system of capstans, ring-bolts, and tackle, or possibly by a combination of both. No doubt the weight which counterbalances the gun in Moncrieff's system will be made moveable. In this case the difficulty of shifting guns from one place to another will be lessened.

The peculiarities of the proposed system are as follows:—

First, in making the gun slide able to be moved readily from place to place.

Second, in the method adopted for traversing the large turntable on which the gun works.

The gun slide or platform (see fig. 2), is simply an iron railway carriage (A) running on four strong wheels (*a, a,*) which are fitted with eccentric axles. The levers, when applied, give the slide a bearing on its wheels, and they are then fixed down in the position shewn in the figure; when the slide is brought to its place on the large turntable, the levers are removed. The slide then sinks down on to its four feet (*b, b,*), which are grooved to fit over the rails, and becomes a practical part of the turntable.

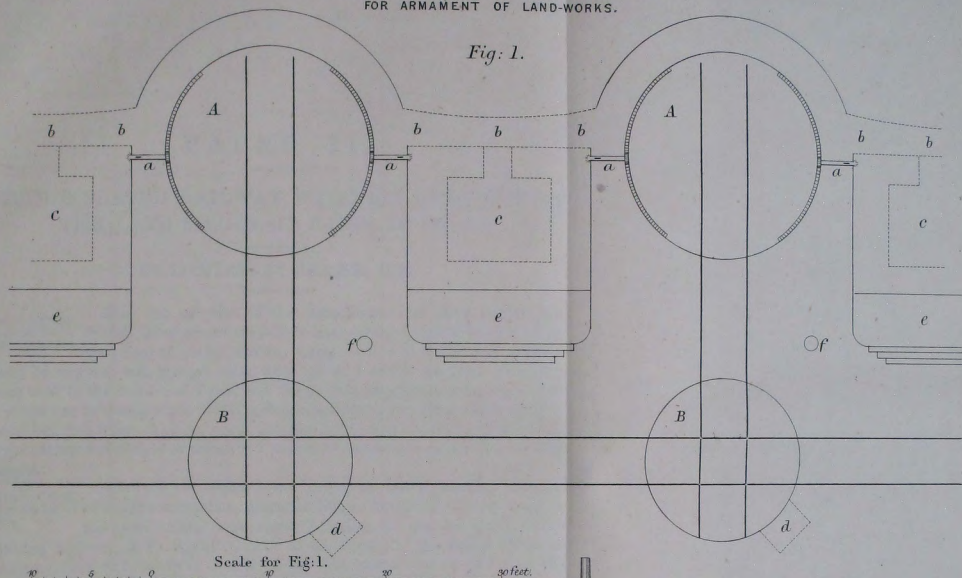
The turntable (see figs. 3 and 4), is traversed by means of an iron bar on either side. One end of the bar is fitted into a socket let into the wall of the traverse; the other is confined by an iron collar to the ground, and ends in a pinion working on a rack. Thus by a simple rack and pinion motion the desired end is effected. The iron bar is pierced with holes, into which the ends of pointed levers would fit (see fig. 3). Two or four men could work, if required, at each bar, and thus it is believed that the gun could be smoothly and easily traversed.

It may be added that the line of rails would be usefully employed, in addition to the work above described, in the transport of shot, shell, and stores, required for the service of the guns.

R. H.

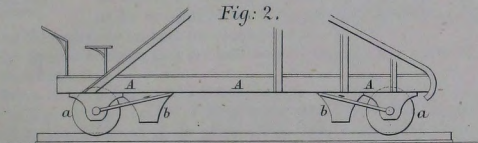
RAILS & TURNTABLES, FOR ARMAMENT OF LAND-WORKS.

Fig: 1.



Scale for Fig: 1.

Fig: 2.



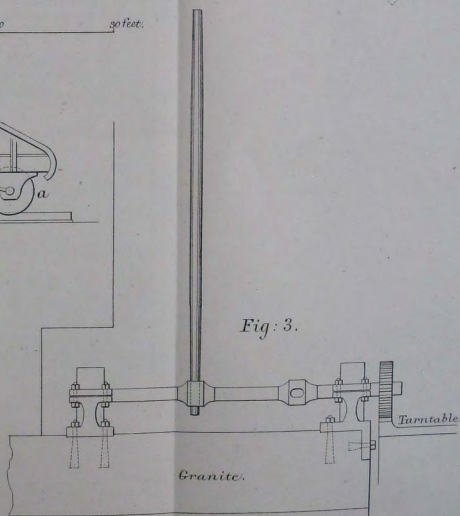
Note to Fig: 1.

- A. Turntables on which to work the Guns.
- B. Small Turntables on line of Rails.
- a. Method of traversing large Turntables, (see other plan.)
- b, c. Passages and Shell or Powder Rooms.
- d. Pits for traversing apparatus.
- e. Musketry Platforms.
- f. Capstans.

Note to Fig: 2.

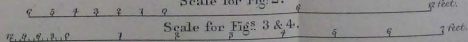
- A. Slide on which Mowbray's Gun Carriage would rest.
- a, a. Tracks fitted with eccentric axles.
- b, b. Feet to rest on Rails, when the bearing is taken off the trucks.

Fig: 3.



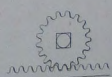
METHOD OF TRAVERSING LARGE TURNTABLE.

Scale for Fig: 2.



Scale for Fig: 3 & 4.

Fig: 4.



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PAPER II.

ARMOUR PLATED RAILWAY WAGGONS USED DURING THE LATE SIEGES OF PARIS IN 1870-71.

BY LIEUTENANT FRASER, R.E.

Plated railway
waggons for
mitrailleuses.

After the adoption of the mitrailleuse into their service, the French Government are said to have directed their attention to the designing of plated railway waggons in which the new weapon could be worked, but, though some were made, I could not learn that they were used in the defence of Paris, and the general impression seems to be that it would not be worth while to use such arrangements for mitrailleuses or light guns, but that when they are used, the fire from them should have a decided preponderance of weight of metal, and should be as accurate as possible for long ranges.

Plated railway
waggons for
guns.

After the war began, Mons. Dupuy de Lorme, Engineer-in-chief of naval construction, prepared designs for plated railway waggons for guns. They were made, I believe, in the workshops of the Orleans Railway, in Paris, and, thanks to the energy of the engineers of the company, they were ready in time to be brought into action on the following important occasions, viz. :—

Occasions on
which they
were used.

Near Brie sur Marne, to support the Champigny sortie.

At Choisy Le Roi, for the sortie which preceded the above.

At Le Bourjet, for one of the attempts to recapture that position.

At Malmaison to support the Montretout sortie.

On the last occasion they are said to have caused great inconvenience to the Prussian artillery.

Some of the waggons which went into action were struck in several places by field gun shells; on one of them there were five or six hits, some of which were at the junctions of the plates; but, though the latter were a good deal dented, none were penetrated.

The motors or engines escaped all damage, and no wheels were struck where exposed below the armour plating.

The only man killed was struck in the head by a shell which passed through the bullet-proof screen above the plating of one of the waggons (fig. 5.)

There were altogether four blinded waggons for guns and two blinded "motors." It was intended that one of the latter should draw two of the former, but the speed they could manage was so little, that ordinary engines were pre-

pared, by being screened with an iron envelope (without wood backing) about two-fifths of an inch thick, and were used to draw two gun waggons each. A speed of about five miles an hour was thus obtained, and the engines happened to escape injury on each occasion.

Method of transporting the batteries. It appears that, in some instances, the two carriages were on different pairs of rails, though drawn or pushed by the same motor or engine; a rope from the engine to the carriage on the other line allowed this to be done.

It will be seen by the figures that the armour plating ended nearly a foot (30 c.) above the tops of the rails; there was, therefore, a great risk of the wheels being struck; for this reason the batteries were followed by a special train, with bullet-proof engine, which carried a party of workmen with sand-bags and in-trenching tools so as to cover the unprotected space with a small parapet as soon as the machines stopped.

The party also carried tools and materials to repair any damage to the line which might prevent the retreat of the batteries. On one of the occasions referred to, the Germans succeeded in slightly damaging the line in rear of the batteries by their artillery fire; the working party, however, repaired it, it is said, in a quarter of an hour, and thus enabled the train to retreat.

The crew of each carriage consisted of seven marines and a naval lieutenant.

During the civil war, the communists brought out these carriages to several points. They appeared, I believe, on the railway viaduct across the Seine, near the Point du Jour; but in this case they were opposed by such heavy artillery from the batteries at Sévres, Meudon and Montretout, that they were quite silenced.

The equipment at the workshops of the Orleans Railway Station, consisted of two motors, two revolving railway waggons and two solid waggons.

Motors. The motors each consisted of a 25-horse-power engine, with vertical boiler, mounted on a heavy frame supported on three very strong locomotive tender axles. The power was applied to a central axle with two cogged wheels on it. An endless chain, like that for a traction engine, passed round each of these cogged wheels, one chain passing round cogs on a rear wheel-axle, while the other chain connected the central axle with a similar wheel-axle in front. The distance between the cogs on the central axle was rather less than the gauge.

There were no springs used for the motors or waggons, so that, in going round curves, the load was found to be badly distributed, nor had the coupling hooks the usual springs; it was found, in consequence, they were very apt to break; for this reason, spare ones were provided, as well as spare coupling chains.

Armour plating of motors. Each motor weighed about 33 tons (33,000 kilos), they were plated in front and on the sides, but not in rear, as they were there supposed to be protected by the plating of the waggon next to them.

The armour consisted of 5 plates of wrought iron, each about $\frac{3}{4}$ in. thick, making a total of 2 ins.; such plates as were available were used, they were, therefore, smaller than was desirable.

The same was the case with the plating of the gun waggons.

The iron work was supported on 10-inch oak timbers, (See Figs. 2 and 3.) Iron wood-screw bolts, with eyes, connected the plating with the woodwork; the roofs of the motors alone, were plated with $5\frac{1}{2}$ ins. of oak, and about $\frac{3}{4}$ ins. of wrought iron plates. Those of the gun waggons were all open.

The two first waggons that were made were without the revolving arrangements. The gun (the carriage of which was placed on a sort of traversing platform) fired, in this case, *en barbette* over the end of the waggon, which was armour plated there as well as on the sides, but not in front, where it was thought unnecessary to use plating.

The armour extended about 4 feet 6 inches above the floor on which the platform traversed, and the axis of the gun was, when horizontal, about 18 inches higher. Above the plating, a bullet proof screen of iron $\frac{3}{4}$ of an inch thick, and 18 inches high, extended round the sides, and the end where the gun fired; in the latter case it was divided into three portions, any one of which turned down, when required, on hinges, (Fig. 5) according to the traversing of the gun. This arrangement allowed a total lateral range of about 30 degrees.

The guns used for these waggons were cast iron B. L. rifled Naval ones, with steel cores. The diameter of bore was 5.5 inches (14 centimetres), while those for the revolving waggons were $6\frac{1}{2}$ inches (16 centimetres) in diameter, and of the same construction. The length of the guns was about 7 feet (2.1 metres). In one case, owing to one of these guns having burst, a rifled bronze field gun was put in its place.

A strong rectangular frame formed the bed of the waggon; each of the side pieces was supported on four large oak blocks, which rested on plummer blocks on the ends of the axles outside the wheels. Four of the strongest locomotive tender axles were used for each frame. Vertical oak timbers were secured to the frame, and to these the armour plating was bolted with ironwood-screws. The plating of all the waggons was of five thicknesses of iron, each $\frac{3}{4}$ of an inch thick. It ended 11½ in. (30 centimetres) above the top of the rails, as in the case of the motors.

The weight of each gun waggon, of both kinds, was about 43 tons (43,000 kilos) the four axles that carried this were each 4.7 inches (12 centimetres) in diameter, and the plummer blocks had a bearing of about 7½ inches (20 centimetres.)

The upper portions of the two last made waggons (Figs. 1 to 4), were arranged to pivot on a large central pin (Fig. 4). They were supported on rollers which ran on a circular iron racer (of about 4 feet 8 inches radius) bolted down to the lower frame; the latter was strengthened, where the pivot passed through it, by a strong iron plate, extending right across the frame.

The turret portion was made to revolve by means of a winch and pinion, worked by hand, inside the waggon. The gun was fired through an embrasure (1 foot 11 inches wide) in the end of the waggon, and direction was given to it by the revolution of the turret, which carried the carriage on its floor. It will be seen (Fig. 1) that it had also a considerable range of elevation and depression.

The carriage of the gun worked on a platform (Fig. 6), something like "Clarke's," only that it was fixed, and that the guiding flanges were outside the sides of the carriage.

Preventer ropes were used to check the recoil. In some of these waggons small bunks were formed in the corners, to the right and left of the muzzle of the gun, to hold ammunition; they were, for safety, armour plated with the same thickness of metal as the waggons. The space between the upper and lower portions of the waggon was about 1·4 inches (3·5 c.), and this interval was found in practice to be insufficient, after the carriage had been strained by firing. It is admitted that at Malmaison the arrangement jammed, though an attempt was made to relieve the strain by putting wedges in at the rear of the waggon between the turret and the lower platform. Additional stiffness had been given by cross-ties of railway bars between the wheels (figs. 1 & 2.)

The height of these waggons was about 7 feet 2 inches above the level of the rails. In plan they were 16 ft. 6 in. long, and 10 ft. 2 in. broad over all.

T. F.

PAPER III.

NOTES ON SOME OF THE HUTS AND OTHER FORMS OF TEMPORARY SHELTER USED IN THE LATE WAR OF 1870-71.

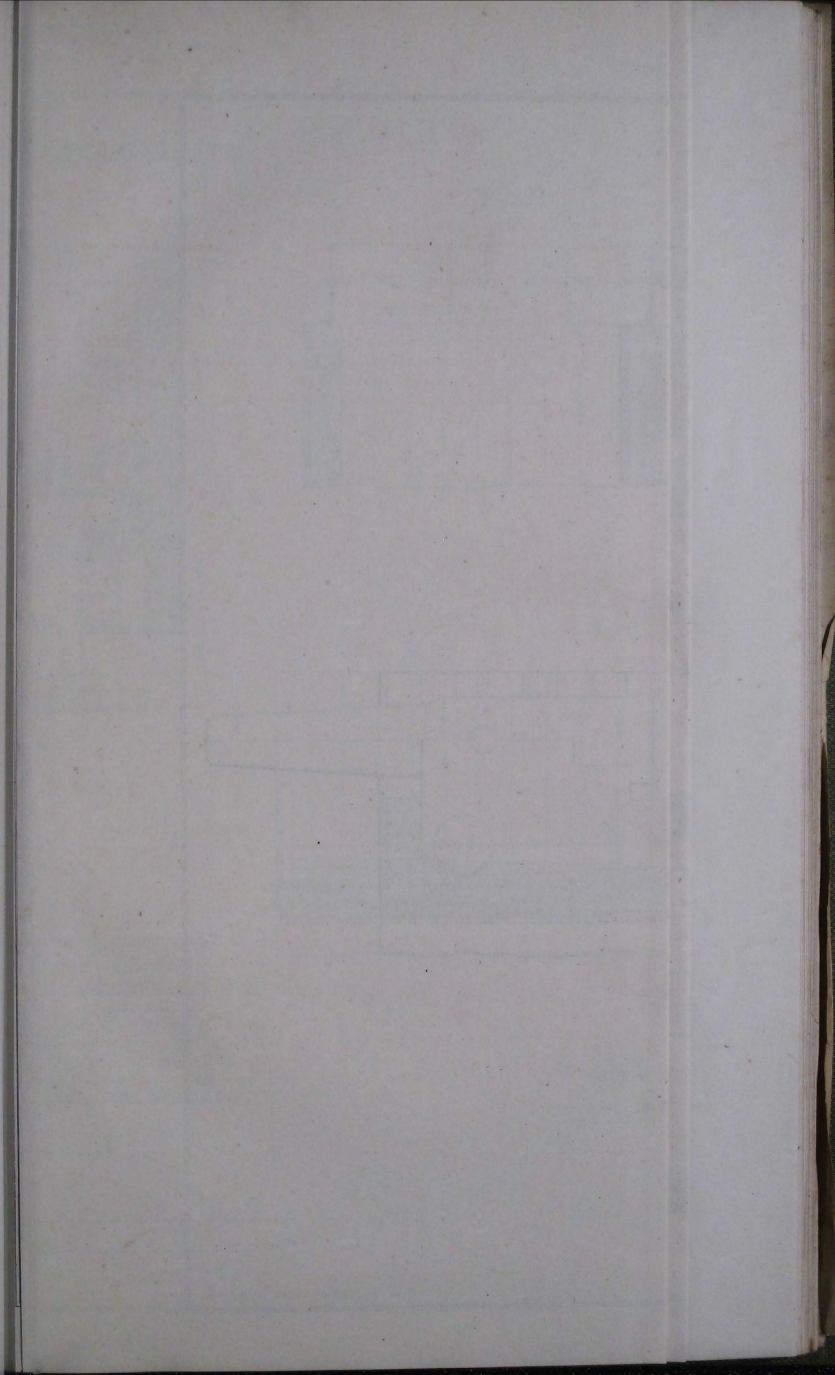
By LIEUTENANT FRASER, R.E.

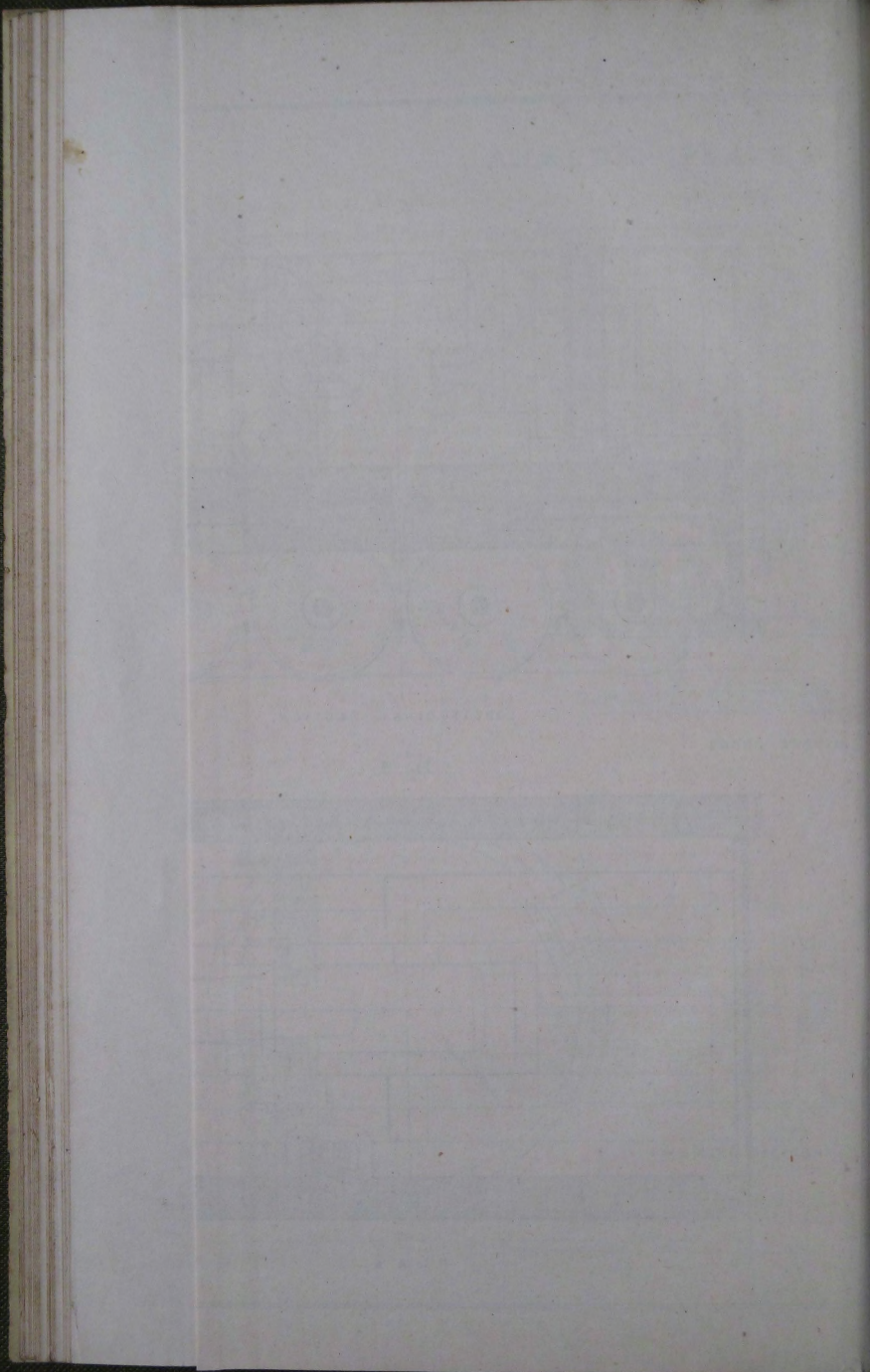
As it is not unlikely that all armies may, in some cases, follow the example of the Germans in doing without tents, it becomes more than ever necessary that all troops should be acquainted with simple and quick methods of making shelter out of such materials as are generally to be found.

Several causes combined to make hutting a necessity during the war of 1870-71.

In the first place, the Germans, though they admit they were most fortunate in the opportunities they had for housing their troops, were still obliged, for want of tents, to provide cover where houses failed; and this was the more necessary in the latter part of the campaign, owing to its having extended into a very severe winter, which made bivouacing almost impossible.

The French, while chiefly using tents in the field, also made large use of huts for their troops in garrison; this was particularly the case in the advanced redoubts before the forts of Paris, which, having been hastily constructed, were





without barrack accommodation; and also in Paris itself, during the siege, where many of the boulevards and open spaces were filled with long rows of huts, mostly for infantry.

The figures on Pls. I. and II. show some examples of huts, &c., which have been actually used; and though not, perhaps, the best that could be made, they, at all events, give an idea of what troops can be expected to do.

The rudest attempts that were noticed seemed to be intended only for shelter from the wind.

Bivouacs near
Joinville-le-
Pont.

On the bivouacs of Ducrot's troops, after the sortie of the 30th November, 1870, many small pits were to be seen by the side of the road from Joinville-le-Pont to Brie-sur-Marne, like the sketch Fig.

1 Pl. I. A circular hole had been scratched out 9 inches to 12 inches deep, and a little bank formed round it, in which leafy branches were stuck as a screen. The men lay within this circle. This arrangement could only be used when not liable to be flooded.

Huts of French
near Vitry le
Francais.

Fig. 2 represents an improvement on the above. Numbers of such huts were formed behind the walls in rear of the trenches, which extended from the Plateau of Villejuif, in front of Vitry, to the Seine. A hole was dug from 8 to 10 feet long, and about 6 feet wide. Stiff branches, about 1 inch thick, were stuck round the edges; their heads drawn together and interwoven; leafy branches twisted among these gave a certain amount of protection from the weather.

Shelter booths
near German
Engineer Park,
south of the
wood of Meu-
don, near Paris.

In rear of the wood of Meudon, and near the Prussian Engineer Park, on the Versailles Road, there were a large number of booths, ranged in regular rows. They consisted merely of large leafy branches, laid together as in Fig. 3.

Huts of hurdle
work near Ver-
sailles.

Fig. 4 shows the end of a small hut, the walls of which were entirely made of hurdle work, the roof being formed of branches with leaves. The right hand side was open.

Fig. 5 is one, the sides of which were of hurdle work, and the roof, of canvas, stretched across the upper framework. The inner end was closed by being placed against a wall.

Huts with
hurdle floors,
used by the
Germans south
of Paris.

The huts shewn in section in Pl. II. Fig. 23, consisted of a circular hole, about 2 feet deep, and 17 or 18 feet wide. The bottom of the hole was further deepened 18 inches in the centre (so as to be saucer-shaped), where a well was dug out about 2 feet wide and deep. This was filled with stones, and larger stones were set on edge, in a circle, round the circumference of the well. This arrangement acted as a fire-place. The floor was formed of sectors of hurdle work (Fig. 25), which were laid all round the centre, touching each other, and tied together with withes. A man lay on each of these, feet to the fire. The earth was thrown out to form a sloping bank, highest where the door was required. The bank supported a lean-to of poles, covered with branches, leaves, and earth. The entrance was by steps, and a hole in the roof let out the smoke. The hurdle work kept the men dry, any water draining into the well from under the hurdles. In some

cases the holes were only sunk 18 inches at the centre; the outer rim of the hurdle work being flush with the surface of the ground. This floor could then be sheltered with booths of branches. These hurdles would make convenient tent bottoms, being very light and portable.

Fig. 6 shows the framework of a branch hut, used by Prussian foreposts in a wood, in rear of Les Planchettes, before Metz. The framework was of round poles, and was roofed with leafy branches.

The hut was, perhaps, 30 to 40 feet long, and was well drained.

Although immense numbers of huts were used in and about Paris during the siege, those for infantry were, with hardly any exceptions, made, as shewn in Figs. 7 and 9.

Fig. 7 shews a section of hut, the frames of which were formed of round poles, and were placed at about 8 or 10 feet apart. The sides and ends consisted of weather boarding, and the roof of light planking. The whole was covered with paper, prepared with tar, such as is used for covering packages. The joints of the planks forming the roof, were closed by small ribbons of wood, nailed down outside the junctions. A double row of low guard-beds ran along the sides of the hut, leaving room for a convenient passage up the centre. The men laid their mattresses on these beds. The doors were generally at both ends; but in very long huts there was sometimes a central one also. A few small glass windows were occasionally put into the sides, which were necessary when the huts were partitioned off into compartments. In some of the open spaces, such as the "Place des Invalides," regular camps were formed of these huts, and special ones, as shewn in Fig. 8, were provided as latrines. The length of one of the latter was from about 20 to 30 feet, and they appear to have been cleared nightly by means of carts. The floor and sides of the platform were sheeted with zinc or sheet iron. Portable urinals were also placed in the corners of the platform. The receivers were of sheet iron.

The other form of hut, fig. 9, was entirely formed of planking. The roof consisted of arches of plank, the ends of which were shod with small pieces of sheet iron through which a tie rod passed, one end of this tie had a thread and nut to lengthen or shorten it as required.

These arches were placed about 10 feet apart and were carried on vertical supports (see detailed sketch) of thick plank. Small battens were laid from arch to arch, and the light roofing planks were nailed down to these.

The sides were the same as in the other huts and tarred paper was used as before, over all, with wooden ribbons over the joints of the roofing boards.

The interior arrangements of these huts were the same as the others. There were great numbers of them in Paris, but, on the whole, the other form was most used, and was that which was put up in the advanced redoubts.

Fig. 10 is a form of hut, made of planks, used in the Fortress of Valerian.

They were made to suit a narrow site, the backs of the huts being close to the steep bank of the great central mamelon. Only one row of

Prussian fore-
post hut before
Metz.

Huts used in
Paris.

Huts with
arched roofs.

Type of hut
used in
Valerian.

beds was used. The roof and sides were covered in the same way as those already described.

Figs. 11 and 12 show two forms of framework used in the large huts in the boulevards intended for some of the garrison of Versailles during the civil war.

The roofing boards were supported in the centre by a plank prop resting on the tie beam. They were covered with tarred felt or canvass. The sides were boarded with vertical boards, nailed to longitudinal pieces on the tops of the side posts.

Central props supported the roof ridge, and light planking nailed to these formed a central partition along the length of the huts, which were also divided by cross partitions forming rooms. There were generally two side and two end doors to a hut and a few small windows about 16 in. by 30 in.

The German huts at Lagny differed from the French, in having more steeply pitched roofs and lower sides; boards only, without any additional covering, were used for the roofs and sides.

Fig. 13 shows the section of a temporary railway shed, made entirely of planks, which was used at the Sedan station. The ventilating arrangements seemed simple and convenient. The frames required to be placed tolerably close together,

Fig. 14 shows a quick way of making a shed against a wall, the roof being formed of fascines. One end of each cross-piece was let into the wall and the other was secured to an upright.

In addition to those huts, the only object of which was to give shelter from the weather, others had sometimes to be constructed to give more or less protection from musketry or shell fire to foreposts, guards of the trenches, &c.

A common form is that shown in Fig. 15, Pl. II., which is a sketch of a field casemate, used behind a line of parallel, connecting batteries XXVII. and XXVIII. on the heights of Fancelle facing St. Denis.

A trench had been dug out 5 or 6 feet deep, about 9 feet wide at top, and, in this case, from 30 to 40 feet long. The diggers were probably arranged in two rows. Vertical posts were then let into the ground on both sides of the trench and longitudinal pieces laid along their head, so that the tops of the longitudinals were about on a level with the ground; across these a row of logs was laid touching each other, and the dug out earth was heaped on the top of these roofing logs. The entrance was by three sets of steps in rear of the excavation, two at the ends and one in the centre.

Casemates of this kind were a good deal used by the Germans; for instance, there was one on the high ground outside Metz, between Servigny and Noiseville, and close to the latter.

Another instance of this kind of cover was to be seen in the Cemetery of the village of Thais, facing the redoubt of the "Hautes Bruyères," by Villejuif. This Cemetery formed a strong advanced post, but was much exposed to the fire of the above named redoubt. In addition to the field casemate, some of the vaults of the Cemetery had been opened and had no doubt been used for shelter.

The great objection to this form of hut is that it is apt to collect water, unless it is in soil that drains itself, or in such a position that a trench can be cut so as to drain it.

The section of a somewhat similar field casemate, which was used at the Montretout Gate of the park of St. Cloud is given in Fig. 16. In this case the timber roofing was very strong, and part of the earth was got from the front. Like Fig. 15, it was liable to be wet.

Another form of shelter less liable to be flooded is that shown in Fig. 17, which is a section of a long line of sheds used for the German supports on the Plateau of Chatillon. A bank was taken advantage of near the edge of the Plateau to save the necessity for a deep excavation. Any accumulation of water thus drained away to the reverse of the trench.

Fig. 18 is an instance of the use of a wall for a similar purpose. It is the section of a splinter proof shed at the same gateway as Fig. 16. Large timbers leaned at short intervals against the wall and were roofed with a double row of smaller logs and with earth. The floor was sunk to give head room; the entrance was at one end.

Fig. 19 shows how a wall was used to make a tolerably secure stable for horses. The roof was formed of logs, thatched with branches, with some earth on top.

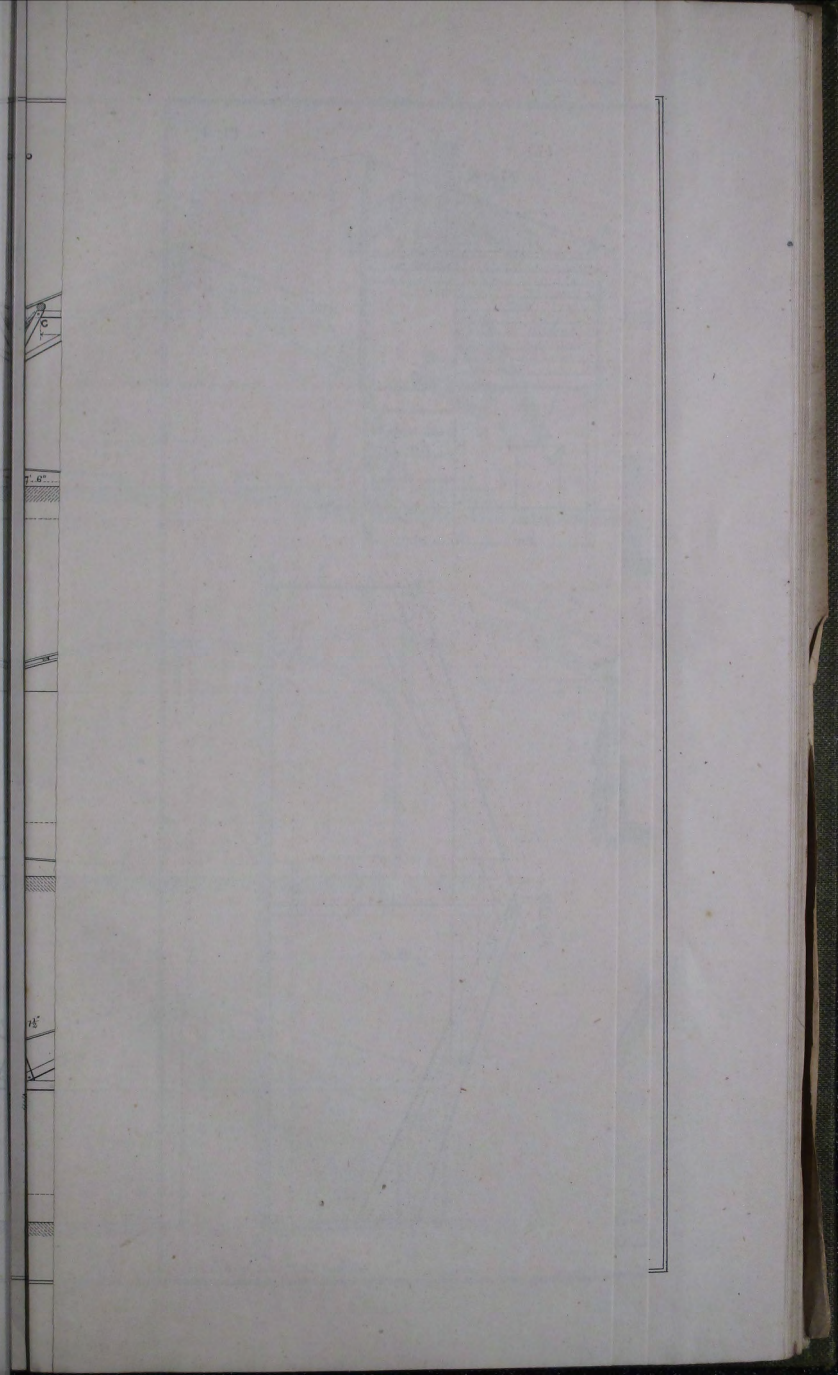
Fig. 20 gives a section and plan of the type of company kitchen used at the French camp of Sartory. A trench was dug out with steps at the ends; in front of this the twelve small fire-places were made and the earth from the trench formed into a bank beyond them. A row of round posts supported a ridge-pole, on which rested a lean-to of planks, fastened together by cleats in sets of three. The spaces between the posts in front of the fire-places were left open, as well as the ends of the shed.

The tents of this camp were arranged for each regiment in a column of companies (5 to each company), and the cooking huts were placed on one flank. All the large French tents appear to have had their doors closed by a flap of canvass about 6 feet long and 3 feet wide, which, in the day time, was propped up and formed a convenient porch. The top of the canvass of these tents had a ring which was slung from a boss on the top of the tent pole, leaving air space for ventilation. These details are shown in Fig. 22.

Fig. 21 shows the latrine arrangement for this camp.

The shelter shed shewn in section in Fig. 26, is one used by the Germans in an infantry breastwork of the northern line of defences. Pits were dug behind the breastwork, so that sentries standing in them should have more cover. Some of these pits were put partly under the shelter sheds. A still simpler form is shewn in Fig. 27, where no earth is used; in both cases the roofing logs were touching each other. The distance between the uprights varied with the strength of the sills. This arrangement was sometimes used on a larger scale in the siege batteries.

T. F.



PAPER IV.

NOTES ON THE POSITION OF SOME OF THE SIEGE AND OTHER BATTERIES USED IN THE WAR OF 1870-71, AND ON THE EFFECTS OF THEIR FIRE, &c.

BY LIEUTENANT FRASER, R.E.

It is reasonable to expect that the operations of the war of 1870-71 should throw some light on the question of how far the attack of fortresses has been modified by the improvements in artillery and small arms, and the main question is of course the ranges at which these arms are effective.

The following rough tables have therefore been made out from the imperfect information as yet collected without waiting for the accurate details which we may hope will hereafter be published.

The number and nature of the guns have not in every case been ascertained. The ranges are given roughly from the battery to the parapet of the work fired at.

The advantages of command are referred to by giving as far as possible the relative levels of the sites of the battery and the work engaged; the positive sign implying that the battery was on higher ground.

It appears that circumstances of ground more generally decided the position of each battery than the question whether it was most favourably placed for enfilade or for counter-battering as the case might be.

With reference to the nature of the guns, &c., it is said that the

Prussian 4 prs.	throw a shell of about	10lbs.
" 6	" "	15
" 12	" "	30
" 24	" "	60

The short 24 pr. had, I think, rather heavier shells, and was fired with reduced charges.

German Attack on the Southern Forts of Paris.

The details of the batteries for this attack are given in Table I. It will be seen that they were chiefly grouped on the high ground behind St. Cloud; by Bellevue; the terrace of Meudon and the Plateau of Chatillon; on the latter, in addition to the guns mentioned in the table, there were epaulments for about 16 field guns. There was no regular parallel in connection with these batteries. The features of the ground, banks, woods, walls, villages, &c., were used as far as possible for covered communication. When necessary, narrow trenches sometimes from 2ft. to 4ft. wide and deep were thrown up to cross an open space.

It will be seen from the plan that, in most cases, the guns could be brought up almost into battery, by good roads; the importance of this was very great when it is remembered at what season the siege took place.

The focus of the attack was the Fort of Issy against which were directed about 46 guns and mortars bringing a converging fire to bear on it. The southern front of the fort mounted eight guns on the curtain, four on each face and two on each flank. The bastions were well traversed, but the embrasures were soon obliterated, all fire silenced and a small breach formed towards the western end of the curtain. This was chiefly formed by the fire of the cast iron short 24 prs. in No. XIX, throwing long shells with reduced charges; but, no doubt, the other batteries were directed on the breach as far as possible. The scarp of the curtain forms a screen to the end of the casemates; it is about 4 ft. thick in front of the springing of the arches and thicker below. The casemates are 20 ft. wide in the clear, divided by 4 ft. partition walls. Two adjacent casemates were broken into in front, the gap extending from the crown of the arches to below the springing. The debris formed a practicable ramp about 40 ft. wide up to the opening into the casemates, but an assault could not have passed over the parapet by means of it. The defenders had barricaded the breach with sand bags backed with earth, a difficult matter, as the ground was frozen at the time. There were also several grooves cut in the curtain near the left bastion, one or two of which had extended into the casemates in rear.

The counterscarps were of course quite uninjured. The rear ends of the casemates, the floors of which were on the level of the parade, were protected by parados, in section like a trench cavalier, but with four rows of gabions; these were also not much injured.*

All the buildings on the parade of the fort were destroyed, but the expense powder magazines on the parapets, which were blinded by lean-tos of rails and earth, escaped much damage.

The two guns in the left flank of the south front seemed workable, owing to the large traverse on their left. Issy had been prepared for defence with more care than any of the other southern forts.†

* It may be worth while to mention that the casemates of Issy were arranged for hammocks as follows:—Strong iron rods, say 2 in. diameter, ran through and through the partition walls between the casemates at 6 ft. above the floor; these rods had hooks at their ends for hooking the hammocks. The other ends of the hammocks were hooked to a central iron bar, slung below the crown of the arch, at the same level above the floor as the through rods, by tie rods from each side, the upper ends of which were bedded in the springing of the arches. The garrison of Mobile Guards, it is said, did not like hammocks, but our Marines probably would, and it allows the casemates to be aired and cleaned quickly, or to be re-appropriated at a moment's notice.

† The heaviest guns used by the defence were 6½ in. cast iron M.L.R. ones, with three grooves and with shrunk coils of wrought iron at the breach; some of the latter had sprung. The Germans had blown off the muzzles of these guns with dynamite before evacuating the fort. Five German pounds of dynamite were used, put in a lump on the outside of the muzzle, surrounded with a little kneaded clay and covered with a little loose earth. A Bickford detonator was employed to fire the charges. Dynamite, or litho-fracteur, was also used by the Germans to destroy the Chateau Grange-aux-bois, before Metz, while fighting was going on at hand. About 1,000 German lbs. is said to have been used. The French used it to breach the walls of Buzanval Park in the sortie of the 19th Jan., 1871. It was also employed in the street fighting in Paris, in groups of very small charges put into auger-holes in the partition walls, in breaking from house to house.

Fort de
Vanves.

Vanves appears to have been bombarded by about thirty pieces; its scarps were less damaged than Issy, none of them were breached, but the embrasures and parapets seemed, if any thing, more demolished than at the former fort.

The north flank and curtain of the west front and the left face of the south-west bastion had suffered much; there was also an unimportant breach in the gorge wall. The six gun battery in the open, to the right of Vanves, was but little injured. The battery on the left is said to have suffered rather more. The buildings inside the fort were of course destroyed.

Fort Mont-
rouge.

About 40 pieces appear to have been brought to bear on Fort Montrouge. It seemed to have suffered more than Vanves; the west and south fronts were most injured. On the west front the curtain and right flank were most damaged. The right faces of both the south bastions and the curtain and left flank of the south front, were also much knocked about; but no breach had been made.

The forts of Bicêtre and Ivry seemed to have escaped injury, and the redoubt of Les Hautes Bruyères was but little damaged.

Nature of the
masonry of the
southern forts.

The stone of the revetments of the forts is Parisian limestone, quarried in the neighbourhood, of inferior quality, honey-combed, and in small blocks 12 in. to 18 in. cube and smaller; the mortar appeared soft and the joints thick; still it stood fairly well and did not split up much under the blows of single shot; the exact form of the conical heads being often left in the stone. On the whole the penetrations were surprisingly small.

Enceinte of
Paris.

About 34 guns seem to have been employed from time to time against the southern enceinte at ranges of from 3160 to 3600 metres. The damage done was chiefly confined to the neighbourhood of the Point du Jour, and the bastions near the river on the Vaugirard side. On this side the curtain which touched the river and the bastion to its left had suffered most. The guns here had apparently been dismounted and the embrasures had been much injured. Just by the Seine there was a gate in the enceinte and the object seemed to have been to destroy it. The curtain was covered with shot marks, but not breached. Many shells had fallen in the water of the ditch (about 2 ft. deep) and had exploded in the mud beneath.

The salient at the Point du Jour, though well traversed, was reduced to a nearly shapeless heap of earth. The damage diminished towards the Porte St. Cloud. The large hollow-traverses on the terrepleins were in nearly every case intact, and the excellent temporary cover under them was in every case quite so.

The damage to buildings in rear was comparatively slight, and was greatest near the Point du Jour; the great embankment on the Vaugirard side had given much protection.

As a rule there were no guns in the curtains of the enceinte. Those in the bastions were generally about 6 in. M. L. bronze ones with some M. L. cast iron ones of about the same diameter.

Everywhere between the guns was a continuous row of sand bag loopholes.

German Bombardment of the Northern Forts of Paris.

It will be seen from Table II that the "Double Couronne" was bombarded from three directions by the fire of from 60 to 80 siege guns (besides about 30 field guns before Pierrefitte and Stains) at ranges of from under 2000 to over 4000 metres; while Fort La Briche was attacked by from 52 to 70 pieces, many of them firing at even greater ranges than the above. For the attack of the "Double Couronne" the Germans had found suitable positions on the West at Epinay, on the North at the Butte Pison and the heights of Faucelle, and on the East about Stains. While the high ground above Montmerency gave a fine position for the distant bombardment of Fort La Briche, the position of the batteries had of course to fall in, more or less, with the great defensive line which barred a sortie in the direction of the North. Heavy guns were used by the attack in many of the batteries, and the armament of the Forts must also have been very heavy as splinters of large French shells were to be seen on the Butte Pison; the German batteries, however, had not suffered.

All these batteries were more or less sunken, the thickness of the parapets generally seeming to decrease as the distance from the Forts increased; thus the parapets of the batteries near Montmerency appeared to be only 10 or 12 feet thick and were very low. The same was the case with the batteries on the Butte Pison. The gabions used, were generally made of fine willow twigs twisted into bands before being made up.

No shells appear to have reached the Pavillon Rouge from the French guns. The eastern bastion had not suffered much. The woodwork of the drawbridge was smashed, the curtain was pitted with shell holes which had not penetrated deep into the masonry, but there was no concentration of fire on any one point, and the penetrations generally in the masonry were very small. An immense number of shells had fallen short and burst in the Glacis. The western bastion had suffered even less. The parapets of both fronts did not seem much knocked about. The portions of the town in rear were ruined; there were 17 shell holes in the roof of the new church, and the cathedral had suffered a good deal. Fort La Briche was not visited but was said not to have received much injury.

With regard to the eastern attack less information has been obtained.

The French batteries and works on this Plateau were shelled by the Germans at ranges of about 2700 metres from the direction of Rancy, where there were four batteries at from 3200 to 5600 metres from the heights between Chelles and Mont-firmeil, and at from 4500 to 5000 metres from the position in the neighbourhood of Brie-Sur-Marne.

The centre of the Plateau of Avron (which the Germans afterwards occupied) is about 1700 metres from Fort Rosny.

Siege of Paris during the Civil War of 1871.

Some of the most important batteries employed in the siege are given in Table III., but in addition to these, most of the German ones at Meudon, Clamart, and Chatillon, were occupied and armed.

The details of the latter, except as regards guns, are given in Table I.

There were also batteries opposite Chevilly and Thais, making a total of about 54.

As the attack advanced, additional works were thrown up. Thus, a 4-gun elevated battery was formed across the great street of Neuilly, near the bridge. There were other batteries also in the smaller streets that converged on the Porte Maillot. Two or three 2-gun batteries were formed close to the water's edge on the right bank of the Seine, near the enceinte, and opposite the railway viaduct over the river, to breach the screen walls which filled up the arches. Others were made on the slopes of Les Moulineaux below Issy; others again in rear of Issy and Vanves.

The great command of the Plateau of Valerien made the fire from it, on the enceinte more efficient than that from the guns in its bastions. Some guns however from the bastions did fire on Paris, in addition to the 16 mentioned in the table. The latter were mounted on platforms of rails. Only one shell from the enceinte reached the Plateau.

The seven batteries of Montretout were sunken ones with countersloping embrasures. They had traverses to every two guns and gabion revetments. No. V. Battery, which was the largest, had 26 guns.

These works had been thrown up behind trees, which were afterwards cut down as low as was necessary.

The batteries in these places were small and much hidden among the trees; they were generally sunken. In order to get elevation, the platforms were frequently made in two parts, one part for the wheels and behind this another part, 12 ins. to 15 ins. lower, for the trail. The Bellevue batteries appeared to be firing with about 15 deg. of elevation.

In the batteries formed in Fort Issy, the platforms were horizontal and the wheels were scotched with sand bags; cleets nailed on the platforms for the wheels and trail gave direction for night firing; the elevation being got by measurement from the platform at the breech.

It was mentioned with reference to these batteries of Issy that the effect of their own firing on the cheeks of the embrasures was so injurious as to make it necessary to revet them afresh every night with new gabions, though the guns were very long and entered well into the embrasures.

The right battery was a sunken one for two mortars and for several guns firing through countersloping embrasures with reduced charges. It was nearly opposite to the Porte d'Auteuil. In rear of it was a parallel about 2 ft. deep and 10 ft. wide in the excavation.

Most of the trench work was very much less in section than this; the line of it that connected the batteries was often only 3 or 4 feet wide, and 2 or 3 feet deep. Most of these batteries were situated in rear of the "Lakes;" they were generally elevated, and had, in some instances, been thrown up behind a parapet of the refuse brushwood, which remained from the woods cut down before the first siege, to clear the ground in the Bois de Bologne, between the enceinte and the "Lakes." The parapets were generally about 20 ft. thick, with 14 ft. traverses, having blinded passages in front. The epaulments had expense magazines in them. The main magazines were rectangular, and in the rear.

Park of St.
Cloud, and
Bellevue.

Batteries in
the Bois de
Bologne.

There was a trench about 4 ft. by 4 ft. in rear of some of the terrepleins; this drained them and acted as a communication to the magazines. The embrasures were generally closed by rope mantlets about 3 ft. square, and of four thicknesses of $3\frac{1}{2}$ in. rope. They were hung from a horizontal pole supported on two forked props, one on each side of the embrasure.

Some of the batteries in the streets leading to Porte Maillot had their embrasures blinded with timbers laid across the top of the gabions and covered with earth.

Before the German Siege, the large gaps in the enceinte, for the main roads into the country, were either built up completely with masonry (about 4 feet thick) or else so as only to leave an opening to correspond with the width of the draw-bridges put up; under these, small drop ditches were cut in the causeways that crossed the main ditches. These were the points which the attack wished to breach.

From Porte Maillot to the Seine all the gate walls, except the Porte Dauphine, were breached. At Port Maillot all the covering wall, 60 to 90 feet in length, was swept away. The revetment below the ground level, however, was but little injured.

The underground railway in rear had its roof broken in; perhaps by the defence to form a retrenchment.

Here also the covering wall, 50 to 60 feet long, was all cut away. There was a fascine causeway made across the drop ditch after the entry. Inside there were strong earthen retrenchments with ditches 6 or 7 feet deep and 15 feet to 18 feet wide.

The covering wall of this gate was only partially destroyed, a great deal of it was standing.

The closing wall, here 60 to 80 feet long, was swept away to the level of the roadway; below this the injury was slight and the drop ditch (14 feet wide) not filled up.

The wrought iron railway girders of the viaduct in rear of the gate had been pierced through the webs with many shells; one girder was bent but still hung in the air.

The state of this gate was much the same as the others, little was left of the covering wall, and the guard house at the side was much injured.

All these gates had couvrepottes in front.

Part of the enceinte near the Viaduct over the Seine comes right down to the water's edge. At the south angle there had been a gate, which had been built up. A practicable breach was here made in the covering wall, the debris from which partly filled up the ditch outside. This breach had been formed from Fort Issy and batteries near it, probably helped by those at Bellevue.

On this side a small breach had been made in the covering wall of a gate near the first railway station from the bridge. This had been done by batteries in the village of Issy. Gaps had also been formed in the walls closing the arches of the Viaduct, by batteries along the river's edge.

Effects on para- Entering by the Porte St. Cloud, it was seen that the embrasures
pets of enceinte, near the gates were generally nearly obliterated, and the guns dis-
mounted. The latter were mostly about 6 in. rifled M.L. bronze ones.

As a general rule the splinterproof traverses were serviceable, and none of the temporary casemates under the terrepleins had suffered. There seemed no want of ammunition, as many magazines on the parapet were full of powder and loaded shells, and cases for the Gatling guns were to be seen on the ground.

At the Point-du-Jour the damage was much more considerable than after the German siege. The shell fire on the space in rear of the parapets must have been very severe, as many as forty shells a minute having (it is said) been sometimes counted in the neighbourhood of the Porte d'Auteuil. Every lamp post, or tree, was cut down, and an extraordinary amount of damage done to the buildings. The percussion fuzes, particularly of the naval guns, appeared to be very efficient. The shells from Valerien and Montretout could be followed by eye nearly into the town, and were almost always seen to burst.

Any damage to the parapets left undone by the German attack was effectually done by the French, though the fire from the fort had at first caused the French in the German batteries greater loss than the Germans had suffered, owing, no doubt, to the embrasures the French had to cut.

The breach in the scarp had been increased. Three casemates were fully opened and two others damaged, and there was now a practicable ramp from the ditch over the parapet.

The parados on the parade in front of the casemate doors were much injured, showing how searching the fire had been, and some of the expense magazines had been penetrated by the Communist fire from Paris after Issy had been lost by them.

Siege of Strasburg.

This siege appears to have been conducted with the most regularity of any during the war.

The details of the batteries are given in Table IV.

The artillery consisted of twelve different natures, and numbered about 240 pieces, (44 of which were Baden), viz. :—

Against Citadel.	Against Town.	Nature.	No. of Rounds said to have been fired.
16	30	Long B.L.R. 24-prs.	28000 Shells } 5000 of them
	12	Short B.L.R. 24-prs.	45000 do. } Shrapnell Shells.
16	64	B.L.R. 12-pdrs.	11000 Shrapnell.
	20	Ditto 6-pdrs.	8000 Shells and 4000 Shrapnell.
	2	Rifle Mortars of 8·3 in.	600 Shells.
	19	Mortars, 50-prs.	15000 Ditto.
4	20	Mortars, 25-prs.	20000 Ditto.
	30	Hand Ditto, 7-prs.	23000 Ditto.
8		Mortars, 60-prs.	3000 Ditto.

Making a total of over 193,000 rounds, which spread over 31 days, gives an average of above 6,000 rounds a day.

The 44 pieces used against the citadel were in Baden batteries at Kehl, across the Rhine, about 3,000 metres distant. These pieces fired at the rate of about four rounds an hour, and an officer on the church tower of Kehl signalled by telegraph the effects of each round, so as to regulate the laying of the guns. Under this fire the citadel suffered very considerably, and appeared to be much ruined.

The parapets, &c., of the enceinte seemed slight and weak, and the traverses small and with hardly any splinter-proof accommodation.

The bombardment of the town, which began about the 24th of August, having failed to cause it to surrender, the first parallel was traced at about 800 paces from the enceinte, the covering parties having been thrown forward during the night to within 400 paces. The parallel was completed on the 27th—28th. Two days later, batteries for 46 guns were finished.

The second parallel was commenced on the 1st, and was finished on the 5th—6th of September.

The third parallel was begun about the 11th—12th, in front of it. Dismounting batteries were afterwards thrown up.

In this siege the close attack was almost entirely carried on by flying sap.

Rifled mortars. These were used for the first time. They threw a shell of about 160 lbs., with 10-lb. bursting charge. The wrong shells were at first sent for them, which upset when fired and did not burst, but this was probably soon corrected, as their fire, with that of the short B.L.R. 24-prs., rendered lunette 44 untenable. They were afterwards used against bastions 11 and 12. After the 9th of September the fire of the place, except from mortars, was very much got under.

Wall-pieces. A wall-piece detachment was formed from the best shots of the Infantry. The Baden men so employed used the grey linings of their caps outside, so that their heads could not be distinguished against the parapets.

The artillery speak of their batteries as having been regularly carried forward from position to position by means of the fire of these wall-pieces and of light field guns, which were very accurate.

As bastions 11 and 12 were those it was proposed to attack, lunettes 52 and 53 had to be taken. The scarp of 53 was breached partially by curved fire from No. 8 battery. An Engineer officer, who got down by a rope into the ditch, discovered some countermines from the counterscarp; these were mined into, and after they had been unloaded, were used to observe the effects of the breaching fire, which was thus regulated.

The passage of the ditch of 53 was effected by a causeway of fascines, made in two nights; that of 52 was described in the last volume of these Papers.

Curved fire (see Table IV.) was also employed against the left face of bastion 12 and the right face of bastion 11, where breaches were commenced. They were talked of as being practicable for an assault, but judging by their appearance,

they would have required some additional shelling to have made an assault even moderately easy, particularly with their wet ditches.

At bastion *Porte de Pierre* also, a breach had been partly made; the approach to it, however, would have been difficult on account of the wet ditch, which was very broad here.

With a view to emptying the ditches, the Germans directed a heavy and continuous fire on some of the sluices and dams; but the defence, who always kept large working parties ready with filled sand bags, managed to repair all damages at night. They had also some additional dams made to provide for the possible demolition of the regular ones. The diverting of the *Ill* had, however, interfered with the usual supply of water for the inundations.

Siege of Toul.

Table V gives some information relative to the artillery fire on Toul. There does not appear to have been much regularity about the attack, but it will be a standing reminder both to attack and defence that the weakest places *can* resist an assault when unsubdued by the artillery fire of the attack. The command of the position of *St. Michael* (over 700 feet) rendered any resistance to a regularly conducted attack hopeless.

Bombardment of New Breisach.

Table VI. gives some details about the fire on this place. The batteries near *Alt Breisach* were first used against an outwork (*Fort Mortier*) and were afterwards turned against the town; besides this, five other batteries were constructed for the bombardment, which ended in the capitulation of the town.

Bombardment of Schelestadt.

Table VII. gives the particulars of the batteries thrown up against *Schelestadt*.

No. 1 was simply to distract attention from the others which were thrown up beyond the railway in low lying vineyards.

The damage done to the enceinte did not appear to be considerable, though 26 guns, it is said, were dismounted; even the buildings in rear of the parapets had suffered slightly compared with many places, but the effect on the crowded houses was, no doubt, the cause of the surrender. Though the German batteries were so near and the parapets had a command of several metres, the French fire appears to have done but little harm.

Siege of Belfort, 1870-71.

No table of batteries can, in this case, be published, but a few facts of interest may be mentioned.

The French garrison, under command of Colonel *Denfert-Rochereau*, of the Engineers, consisted of between 16,000 and 17,000 men, but only a small portion were line troops. The 43rd Regi-

Strength and
composition of
garrison.

ment, I believe, distinguished itself very much and carried with it to Paris the morale of a good defence. On the 18th March it was one of the few regiments that marched out to Versailles intact, and even brought away some field artillery.

Attacking force.

The German attacking force is said to have been only 10,000 or 11,000 men, supported, of course, by General Von Werder's Army, but harrassed by constantly threatened attacks and by the movements of Bourbaki.

Its composition.

A large portion of this force consisted of Landwehr men, and the German Engineers say they found them the best workmen at the siege.

Attempt at bombardment.

At first it was hoped that a bombardment might, in this, as in other cases, be followed by capitulation; batteries were made accordingly in the direction of Bavilliers and Essert, which are about 3,000 metres from Belfort. Near Besancourt also (over 5,000 metres off) guns seem to have been put in position against Fort La Justice. (The batteries were made by the roadside). When, however, no great effects were produced, the regular siege was commenced.

Reasons for selection of front attacked.

The attack on the side of La Miotte, to the north, which at first seemed most easy, was rejected because it would have involved a second siege of the citadel after getting into the entrenched camp. This objection did not apply to the attack on the Chateau from the side of the "Perches"; besides, it was calculated that, from the heights of Les Perches, Fort des Barres and the redoubt of Bellevue could be made untenable.

It was necessary, for this attack, to capture the village of Danjoutin, and Perouse. These were carried by night attacks; in the case of the former, two companies took the village in reverse, by passing along the railway embankment; this seems to have caused a panic which enabled the main body to carry the place easily. The first batteries against the Perches were screened in the Wood of Bosmont, and the first parallel was opened about 1000 yards from the redoubts, which each held a garrison of 400 men.

Though these redoubts were only field works, their ditches had scarps and counterscarps which stood quite steep, owing to the rocky nature of the soil.

The ditches seemed about 9 or 10 feet deep, 18 or 20 feet wide, and the parapets had a command of about 12 feet, and a thickness of 10 to 12 feet. In the gorge of the Basse Perche there was a length of about 160 metres of temporary casemate accommodation.

The first assault, made by four companies, from the first parallel, advanced on a moonlight night over the snow and was soon discovered and fired upon; when it reached the ditches, there were no means of getting up the scarps, on the steepness of which the assault had not calculated. A large number of men were made prisoners in the ditches, and the assault failed. The attack had to work up a hill with a slope of about one-ninth (more in places) and so rocky, that the places where most earth could be found, often decided the direc-

tion of the approaches. The ground, too, was covered with snow and frozen hard, which increased the difficulty. The second parallel was made, when practicable, 4 ft. deep, and was generally narrow. The flying sap was done by bringing up one gabion at a time by each man; the engineer officer in charge frequently placing the gabion himself. Flying sap was used entirely for the close attack. When the works approached the redoubts, the latter were found to be abandoned, and were at once entered by the Engineers in the trenches. A line of batteries was then constructed along the ridge, on which the two redoubts stood, which is about 1,100 metres from the Chateau, and very little lower than the latter. These were mostly sunken batteries; many of them of very slight profile. The guns for them were brought up by hand, sometimes as many as 100 men being required to draw each gun up the steep slope. It is said, that, in six hours after this line of batteries had opened fire, that of the place was silenced. Some of the batteries on the left flank of the ridge looked down on Fort Des Barres. In addition to these counterbattering works, some of the old bombarding batteries were used to partly enfilade some of the faces of the enceinte. Inside the fortress the different tiers of fortifications at the Chateau had all, more or less suffered. The haxo casemates at the top, which had been blinded with rails, were fairly serviceable; all the guns, traverses, &c., on the open parapets below, had suffered severely. The same was the case in Fort la Justice, where lean-to blindages of timber had been put up against the casemated barracks, which were taken in reverse. With regard to the distance at which siege batteries should be placed, the German officers who had been at the siege, seemed to think that, for dismounting guns, &c., they should not be farther than 1,500 schritt (1,128 metres) from the place. Their experience about wall pieces for the attack, was, that they could not compete successfully with chassepots; a very different result to that arrived at at Strasburg.

Many attempts were made by the Germans, to fire on the troops encamped in the intrenched camp, but they failed almost entirely, though they tried to get information from the deserters, &c.

The capitulation prevented the siege being pushed further than the ridge of the Perches.

T. F.

TABLE No. I.

GERMAN ATTACK ON THE SOUTHERN FORTS OF PARIS.

POSITION OF BATTERY.	Number of Battery	No. of pieces.	NATURE.	Range Metres.	Relative level of battery and object in metres.	No. of Rounds said to have been fired.	OBJECT.
Behind Pavillon De Bréteuil in Park of St. Cloud	I.	6.	{ At first 24-prs. } { afterwards 12-prs. }	3160	+ 72	1250 2570	{ Point du Jour and Billancourt. Bologne and the Seine.
Left flank of Terrace of Meudon	II.	8.	{ 4 12-prs. } { 4 24-pr. }	3520	+ 80	1840 1460	{ Point du Jour and the North branch of the Seine.
Terrace of Meudon	III.	6.	{ 2 12-prs. } { 4 24-prs. }	2500	+ 80	1310 from 12-prs. 1890 from 24-prs.	Fort Issy.
Ditto	IV.	6.	Do. do.	2500	+ 80	About the same.	Ditto.
Southern part of Wood of Meudon	V.	6.	{ 2 12-prs. } { 2 6-prs. } { 2 24-prs. }	2500	about +60	{ 220 from 12-prs. } { 2260 " 24 " } { 610 " 6 " }	Ditto.
South-east of No. V at southern edge of Wood	VI.	6.	24-prs.	2800 to 3000	+ 73	1060	Vanves.
Left battery on Heights of Chatillon ..	VII.	6.	{ 2 12-prs. } { 4 24-prs. }	2200	+ 60	{ 480 from 12-prs. } { 2600 " 24 " }	Issy.
Plateau of Chatillon to right front of VII. Ditto right flank of VII. on } Chevreuse Road	VIII.	6.	24-prs.	1780	+ 75	3360	Vanves.
To east of IX. and S. of Chevreuse Road	IX.	8.	12-prs.	{ 1840 } { 3320 }	+ 75	4000	For enfilading Vanves & Montrouge
Due south of village of Chatillon a } little north-east of Pontenay-aux- Roses one on each side of the road }	X.	6.	24-prs.	2600	+ 60	1000	Probably Montrouge.
	XI.	6.	12-prs.	2800	+ 16	1840	{ Probably Montrouge.
	XII.	6.	24-prs.	3000	+ 20	3760	
Plateau of Chatillon west of No. VII.	XIII.	2.	{ 8-26 in. rifled mortars' ele- } { vation up to 80 degrees. }	2000 & 2080	+ 60 & 70	800 about	Issy and Vanves.
Ditto west of No. IX.	XIV.	2.	Ditto.	1860 & 2180	ditto	800 about	Ditto.
West of Bagneux	XV.	2.	Ditto.	2240	+ 4	800 about	Montrouge.
Terrace of Meudon between II. and III.	XVI.	6.	12-prs.	2400	+ 80	1790	Ground in front of Fort Issy.
Plateau of Chatillon to left front of VIII.	XVII.	6.	12-prs.	{ 1300 } { 2430 }	+ 75	2430	{ French earth-works between Issy & Vanves.
S. of road from Bagneux to Chatillon ..	XVIII.	6.	Bronze 24-prs.	2300 3600	+ 16	2600	Montrouge and Paris.
The Swiss Chalet N. of Wood of Meudon	XIX.	6 to 8	{ 6 short 24-prs. } { 2 to 4 long 24-prs. }	{ 1600 } { 3400 }	+ 30	{ 2000 } { 1100 }	{ Breaching Curtain of south front of Issy, also against Paris.
Wood of Meudon by porte de Clamart.	XX.	6.	Long 24-prs.	2500	+ 45	2050	{ South front of Vanves, and left face of north-west bastion.
To west of Village of Chatillon	XXI.	6.	Short 24-prs.	1300	+ 22	1880	South front of Vanves.
Close to left of No. XVIII.	XXII.	6.	24-prs.	{ 2303 } { 3600 }	+ 16	1700	Montrouge and Paris.
Right rear of the Moulin Pierre	XXIII.	4	50-pr. mortars.	1100	+ 20	350	Fort of Issy and advanced works.

TABLE No. II.
BOMBARDMENT OF NORTHERN DEFENCES OF PARIS 1870—71.

POSITION OF BATTERY.	No. of Battery.	No. of Pieces.	Range Metres.	Command of battery over object in Metres.	OBJECT.
By road to Garges, N.W. of Stains.....	XXII.....	} 14	3200.....	+ 6.....	E Face Double Couronne.
N. of Stains	XXIII.....		3280.....	+ 11.....	ditto.
Do.	XXIV.....		2940.....	+ 16.....	ditto.
Do.	XXV.....		3070.....	+ 14.....	ditto.
E. of Pierrefitte near Railway	XXVI.....	3	1952.....	+ 12.....	N Face of ditto.
Heights of Fauceille E. Slope	XXVII.....	6	2360.....	+ 32.....	ditto.
Do. in rear of Quarry, W. Slope.....	XXVIII.....	8 to 10	2460.....	+ 40.....	ditto.
On the Pavilion Rouge before Mont-mercy	XXIX.....	10	4600.....	+ considerable	Fort La Briche.
Do.	3 others.....	18	do.....	do.....	ditto.
Before Deull	1 other.....	3	3400.....	do.....	Against Epinay.
Do.	XXX.....	18	3700.....	+ slight ..	Against N.W. Face of Double Couronne
Do.	others.....	18	do.....	do.....	or perhaps La Briche.
South of Railway near La Barre	XXXI.....	6	3000.....	do.....	La Briche.
Before Enghein.....	XXXII.....	6	3000.....	do.....	ditto.
Before Ormessen at level crossing.....	one	6	2600.....	+ 3	ditto.
Before St. Gratien	one	6	4400.....	do.....	ditto.
Near Epinay by roadside	one	5	2500.....	+ 6	Double Couronne.
The Butte Pison	2 or 3	24	4270.....	+ over 50	ditto.
Between Pierrefitte and Stains	several	24	do.....	+ slight ..	ditto.
Before Stains.....	1 or 2	6	do.....	+ slight ..	ditto.

TABLE NO. III.
SECOND SIEGE OF PARIS, 1871.

POSITION OF BATTERY.	No. of Pieces.	NATURE.	Range Metres.	No. of Rounds Fired.	Relative level of battery and object in metres.	OBJECT.
Terrace of Valerien .....	..16...	..... B. L. Naval .....	.....5160.....	.....	+120...	Porte Maillot.
Batteries (Seven) at Montretout ..	..76...	..... ditto .....	.....3145.....	{ 40 rounds per } gun per day }	+ 60...	Porte d' Auteuil and Port St. Cloud.
Ditto at Bellevue	8 to 10	M.L. Bronze Rifle, about 50 prs.	.....2850.....	.....	+ 54...	Port St. Cloud and Point du jour, also the Seine.
Batteries in N. Front of Issy to E. of Gate.....	... 3 .....	..... ditto ditto .....	..... 2140 .....	..... 1500	+ 52...	To form breach at Point du jour, and enceinte near Grenelle.
Ditto to W. of Gate .....	... 5 .....	..... ditto ditto .....	..... 2140 .....	.....	+ 52...	To counter-batter enceinte and keep down fire of defence.
Batteries in Bois de Boulogne most of them in rear of the " Lakes "	..62...	Chiefly Bronze Rifle M.L. about 50 prs. and about 10 mortars.	800 about	.....	0	
Park of St. Cloud at La Lanterne	not known	.....	} about 3100	.....	+ 56...	On enceinte towards Point du jour and Boulogne.
Ditto at Bréteuil.....		.....		.....	+ 72...	
Ditto Port Du Mail.....		.....		.....	+ 4...	

TABLE IV.—SIEGE OF STRASBURG.

No. of Battery.	No. of Guns.	No. of Mortars.	Calibre.	Nature.	Range Yards.	OBJECT.
1	..	4	50 prs.	S. B.	1560	Bombarding batteries.
2	..	4	"	ditto	1370	Ditto.
3	..	4	"	ditto	1300	Ditto.
4	..	4	"	ditto	1430	Ditto.
5	..	4	"	ditto	2000	Ditto.
5a	..	4	"	ditto	450	To shell XLIV.
6	..	4	"	ditto	..	Bombarding batteries.
7	..	4	"	ditto	900	Ditto.
8	..	4	"	ditto	900	Ditto, afterwards with curved fire of 24-prs. to breach scarp of lunette LIII.
9	4	..	24 prs.	B. L. Rifled	2400	Ditto.
10	4	..	"	ditto	..	Ditto.
11	4	..	"	ditto	..	Ditto.
12	4	..	"	ditto	..	Ditto.
13	4	..	"	ditto	..	Ditto.
14	4	..	12 prs.	ditto	..	Counter-batter right face bastion IX.
15	4	..	"	ditto	1600	Counter-batter left face.
16	4	..	"	ditto	1500	Enfilade flank XLVII. of hornwork.
16a	4	..	"	ditto	1300	Ditto.
17	4	..	"	ditto	1300	Counter-batter left face of lunette LIV.
17a	4	..	"	ditto	950	Enfilade flank.
17b	4	..	"	ditto	1050	Counter-batter IX.
18	4	..	"	ditto	1800	Counter-batter right face of bastion XI.
19	4	..	"	ditto	1200	Enfilade flank of hornwork.
19a	4	..	"	ditto	1200	Ditto.
19b	4	..	"	ditto	600	Ditto.
20	4	..	"	ditto	2000	Counter-batter face XLVII. of hornwork.
20a	4	..	"	ditto	1200	Ditto.
21	4	..	"	ditto	2000	Counter-batter bastion X.
21a	4	..	"	ditto	900	To attack XLIV.
21b	4	..	"	ditto	600	Against XLVII.
22	4	..	"	ditto	950	Counter-batter face XLIX. of hornwork.
23	4	..	"	ditto	1200	Counter-batter right face of bastion XI.
24	4	..	"	ditto	..	..
25	4	..	"	ditto	1200	Counter-batter left face of bastion XI.
26	4	..	"	ditto	..	..
27	4	..	"	ditto	1000	Counter-batter bastion XII.
28	4	..	"	ditto	1200	Ditto and outworks.
29	4	..	24 prs.	ditto	1500	Ditto lunette LIII. and bastion XI. right face.
30	4	..	12 prs.	ditto	1200	Ditto XII.
31	..	4	25 prs.	S. B.	1100	Shell XI. (dismounting battery.)
32	..	4	"	ditto	950	Shell XII.
33	8	..	24 prs.	B. L. R. (short)	1700	Counter-batter lunette XLIV.
34	..	4	25 prs.	S. B.	500	Shell LIII.
35	..	2	8-3 in.	Rifled of 150 cwt.	1000	Shell lunette XLIV.
36	..	4	25 prs.	S. B.	900	Shell collateral face, &c., to left of XII.
37	..	4	"	ditto	400	Shell XLIV.
38	4	..	24 prs.	B. L. R.	700	Shell XLIV.
39	..	4	50 prs.	S. B.	800	Shell XII.
40	..	6	"	ditto	900	Shell XII.
41	4	..	12 prs.	B. L. Rifled	1000	Keep down fire of collateral works.
42	6	..	24 prs.	Ditto (short)	900	Breach right face of XI. with curved fire.
43	8	..	"	ditto	2000	Attack collateral works.
44	6	..	"	ditto	750	Breach right face of XII.
45	..	4	25 prs.	S. B.	300	Shell LIII.
46	..	6	7 prs.	ditto	800	Attack bastion XII.
47	..	6	"	ditto	900	Attack XI. and hornwork.
48	1 (6pr)	6	"	ditto	500	Attack hornwork.
49	..	6	"	ditto	500	Shell hornwork.
50	..	5	"	ditto	700	Counter-batter XLIX.
51	4	..	6 prs.	B. L. Rifled	100	Breach right face LII. lunette.
52	2	..	"	ditto	400	Enfilade right face XLVIII. lunette.
53	2	..	"	ditto	60	Breach left face LII. lunette.
54	2	..	"	ditto	90	Ditto.
55	6	..	"	ditto	400	Counter-batter right face XII.
56	4	..	"	ditto	400	Breach XI.
57	..	4	25 prs.	S. B.	320	Shell XII.
58	4	..	24 prs.	B. L. Rifled	600	Breach right face XII.
59	..	2	7 prs.	S. B.	..	..
60	..	3	"	ditto	300	Shell XI.
61	..	6	"	ditto	330	Shell XII.

TABLE V.—SIEGE OF TOUL.

Position of Batteries.	No. of Guns.	Calibre.	Nature.	Range, Metres.	OBJECT.
Mount St. Michael	4	6 prs.	Heavy Field Battery, 14-lb. Shell.	1400	Counter-batter left face of bastion 50.
Ditto	4	12 prs.	Prussian Rifled, 20-lb. Shell.	1570	Enfilade left face of bastion 41.
Ditto	4	6 prs.	Heavy Field Battery.	1270	Counter-batter left face of bastion 43.
S.W. of Dommartin	6	4 prs.	Light Field Battery.	1700	Enfilade curtain between 38 and 39 bastions.
Between the Orleans and Nancy and the Neuchâteau Road, near St. George's.....	2	24 prs.	Prussian Rifled, 71-lb. Shell.	1200	} Left face of 40 bastion and the town.
	3	25 prs.	French Howitzers, 60-lb. Shell.	1200	
West of St. Eve	6	12 prs.	Prussian Rifled.	780	Enfilade right face of No. 40 and counter-batter left face of 39.
Ditto	6	12 prs.	Prussian Rifled.	900	Batter Porte de France.
South of Moulin Haut ..	6	12 prs.	Prussian Rifled.	800	Counter-batter left face of 41.
West of Railway Station.	6	12 prs.	Prussian Rifled.	700	" Right face of 40.
Ditto	10	12 prs.	Howitzers.	1400	" Bastion 40 and 41.
			Prussian Rifled.	1400	" Right face of 40. Left face of 41.
Ditto	6	..	Heavy Field Battery, Mortar 7-prs.	1400	" Right face of 40.
North of Railway Station	4	..		1060	" Bastion 40 to 42 and town.

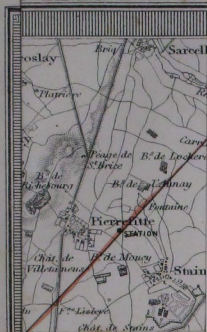
TABLE VI.—BOMBARDMENT OF NEW BREISACH.

POSITION OF BATTERY.	No. of Battery.	No. of Pieces.	Nature.	Range Metres.	OBJECT.
No. Ia.)	..	4	24-prs., afterwards 60 pr. mortars.	900 to 1120	At first into Fort Mortier, afterwards the town at long Ranges.
" IIa.) By Alt.	..	4	24-prs.		
" IIIa.) Breisch	..	4	60-pr. mortars.	1875 to 2100	Bombarbed the town.
" IVa.)	..	4	12-prs.		
By Wolfsgantzen	I.	4	24-prs.	1875 to 2100	Bombarbed the town.
Ditto	II.	4	24-prs. French		
By Beisheim	III.	4	24-prs. afterwards 12 prs.	1875 to 2100	Bombarbed the town.
By Wolfsgantzen	IV.	4	27 centimetre French mortars.		
Beisheim	V.	3	Ditto.		

TABLE VII.—BOMBARDMENT OF SCHELESTADT.

Position of Battery.	No. of Battery.	No. of Pieces.	Calibre.	Nature.	Range Metres.	OBJECT.
In rear of Forest of Ilwald	I.	3	12 prs.	Rifled Guns.	2700	Against reverse of work No. 30.
	II.	4 or 5	50 prs.	11 in. Mortars.	780	To batter " 29.
Parallel to and beyond the railway from Strasburg & Mulhouse..)	III.	6	12 prs.	Rifled Guns.	800	ditto " 29 & 17.
	IV.	4	24 prs.	.....	850	ditto " 30.
	V.	3 or 4	24 prs.	Rifled Guns.	780	ditto " 29.
	VI.	4	50 prs.	11 in. Mortars.	860	ditto " 31 & 19.
	VII.	4	50 prs.	11 in. Mortars.	800	ditto " 30.
	VIII.	2	4 prs.	Field Guns.	750	ditto " 18.

PARIS.



PAPER V.

NOTES ON SOME EXAMPLES OF COVER OBSERVED TO HAVE BEEN USED IN FIELD AND SIEGE WORKS OR IMPROVISED IN PERMANENT WORKS DURING THE WAR OF 1870-71.

By LIEUTENANT FRASER, R.E.

The figures in Plates I., II. and III. have, in most instances, been selected to illustrate the large use that was made of iron in providing cover. So many railways converged on Paris that railway bars were easily obtained, both by the attack and defence. The large use also of small rolled I girders for building purposes in Paris caused a supply of this form of iron to be there available.

At Belfort large quantities of railway bars were obtained from the railway station and were made good use of for the defence of the place.

At Strasburg, too, the terminus line into the town and the railway station were included in the attack; rails were, therefore, available without having to be carried far. They were also to be had at Metz; and most of the minor places that were besieged had railways passing by or through them, thus portions of lines were often stopped for traffic and broken up, so that the only use the rails could be put to was for cover. Pls. III. and IV., Paper VI., give some additional instances of the use of iron in the French redoubts in front of the southern line of forts at Paris.

As a general rule the quantity of earth used on the roofs of splinter-proofs and bomb-proofs appeared very small according to our ideas, in many cases so small as to be almost useless, unless the sense of security it may have given to troops who were so fortunate as not to discover its worthlessness, may be thought to have been useful.

Cover in German batteries. Fig. 1, Pl. I., gives two very common forms of shelter used in German batteries; the right hand shed is a hollow epaulment, and the left hand one is a hollow traverse used in No. XX. battery according to the German siege plan of the southern attack on Paris. This battery was placed behind the park wall of the Wood of Meudon, near Clamart, the position on plan of the sheds is shown in Fig. 35, Pl. III., which is a sketch of

the work. The inner side of the epaulment shed was closed by two tiers of gabions except where the entrance came.

The sides of the central traverse were made up of two rows each of two tiers of gabions. The supports of the roofs were vertical timbers (cut from the wood) with ground and cap sills, the latter supported a row of logs, laid touching, on which came the earth.

As a general rule in sunken batteries, the base of the traverse was not, as in this case, dug out, except where the shed itself was to come.

It was usually the case in these batteries that the magazines were placed to one side or other of the gun portions; here they were on the left, and communicated by a narrow deep trench with the battery, and as the latter had no embrasures the men were not exposed in passing from the magazines in rear of the guns. In the French batteries, in the Bois de Boulogne for instance, the magazines seemed, generally, to be placed in rear, and were commonly small rectangular ones.

Prussian maga- A magazine and shelter shed had been constructed in each of zine and shelter the two epaulments of battery No. VII. on the edge of the plateau of shed. Plateau of Chatillon, Paris. Chatillon. Fig. 23, Pl. II, shows the plan of one shed and magazine; Fig. 22 is a longitudinal section through them, and Fig. 23a is a cross-section of the shed.

The magazine consisted of an excavation about 4 ft. 6 in. deep, in which two braced frames were set up, nearly parallel to the crest line, and the first one nearly in line with it. Baulks, 8 in. to 10 in. square, were laid across these frames, and double-headed rails laid flat were placed on the baulks. The rails touched each other and were parallel to the frames. The magazine must have been very wet in the winter, as even in dry weather there was a good deal of water in it.

The shed had an excavation of about 4 ft.; it consisted of three frames (Fig. 22), on which about 50 double-headed rails were placed, webs vertical and flanges touching. The side of the shed next the epaulment was revetted with gabions; that towards the battery was open when examined, but may have been closed with gabions. Some of the hollow epaulments had their inner sides quite open, so that the whole gun detachment could at once get under cover.

Shelter shed in Figs. 33 and 34 are the elevation and plan of a somewhat similar a German bat- shelter-shed used in the flank battery on the left of the terrace of Meudon. Meudon. The roof was formed of rails laid touching; their ends were supported on rails laid flat on the tops of the gabions, and their bearings were shortened by cross-pieces supported on vertical props. The shed was revetted below ground with fascines, and above ground and outside chiefly with gabions. The depth of the floor of the shed appeared to be about 3 ft., rather deeper than the terreplein of the battery.

French maga- Fig. 2, Pl. I. is a section through a powder-magazine in this field- zine. Redoubt work. It consisted of timber frames with sheeted sides, and with of Bellevue, near Belfort. a roof formed of rails on edge touching each other, the whole being well covered with earth.

German magazine. Terrace of Meudon.

Figs. 3 and 4, Pl. I. are respectively a section and plan of a magazine which was placed between two of the batteries on the terrace.

It communicated with these batteries by means of a deep narrow trench. Timbers, 8 in. to 10 in. square, formed the framework, and similar splinter-proofs formed the roof. The floor and sides were sheeted with doors, &c., from the houses. The earth on top was thicker than usual.

Magazine in the mortar battery at Moulin Pierre, before Fort Issy.

Figs. 20 and 21 give a section and plan of a magazine used in this battery, which was the nearest German battery to the southern forts of Paris, being about 1,200 metres from Issy. The magazine

was roofed with rails on edge and touching; and the sides were closed by two rows of gabions, three tiers high. It was in this battery that a rail-covered magazine, probably of the same pattern, was blown up by the French fire.

Blinded gun portion. Fort La Justice, Belfort.

Fig. 7, Pl. I. is a longitudinal section, and Fig. 8 a cross-section, of a blinded gun portion in a salient of Fort La Justice, Belfort, where

other guns had been similarly protected. The interior revetment, so to speak, above the level of the sole of the embrasure, was of rails laid flat one above the other. The framework of the chamber, which was planked at the sides, had sets of two cross rails on edge, extending from cap sill to cap sill, and these sets again supported a row of rails on edge and touching. The whole was covered with earth. The gun appeared to have escaped injury, though the interior of the fort had been very much wrecked by the German fire.

Rail-covered casemates. Enceinte of Paris.

The Communists in their defence of Paris constructed somewhat similar casemates on the enceinte, but their roofs were completely broken into by the heavy plunging fire from Montretout, &c., and at the time of the assault they appeared to be useless.

Communist gun-pit. Barricade of Neuilly.

Fig. 15, Pl. I. is a longitudinal section, and Fig. 16 a cross-section, of a blinded embrasure in the barricade across the main street of Neuilly, just outside the Porte Maillot. The barricade was of paving stones and earth, but the parapet at the embrasure was almost entirely of sandbags. A large timber lay above the embrasure and supported the upper ends of two other timbers, the lower ends of which rested on the ground; these latter timbers supported a layer of rails, the flange of each lower one resting against the web of the one above it. These rails were covered with a mass of sandbags. The gun in this pit had not been dismounted, though in an extremely exposed position, and the roof was intact.

Blinded embrasures of haxo casemates, citadel of Belfort.

The citadel of Belfort formed a tier of works surrounded by two others at lower levels, towards the German attack, which was directed on the redoubts of "Les Perches." The citadel had ten

haxo casemates for guns; these were protected by being plated outside with a double row of rails laid horizontally, as in Fig. 14, and the outer embrasure was further blinded by a layer of rails from gabion to gabion, extending about 8 ft. out from the masonry, Figs. 11 and 12, Pl. I. In order to reserve the fire of these guns to oppose the close attack, the Commandant of Belfort filled up the embrasures with earth, (not shown in figs.) but their posi-

tion was sufficiently well known to the attack to allow of their being fired into, and in one or two instances they were slightly damaged by shells.

Gun platform Another use of rails at Belfort was for gun platforms. Fig. 39, of rails.

Pl. III. shows one arrangement; the rails in the centre which carried the trail were given a much more rapid fall to the front than those for the wheels.

At Fort Valerien also rails were used, Fig. 38, Pl. III. for the platforms of some of the heavy naval guns on the top of the Mamelon.

At Belfort, again, flat bottomed rails were used as ribands for strengthening a stockade, to which they were spiked with dog-spikes, Fig. 6, Pl. I.

Rails used as blindages. Fig. 5, Pl. I. shows a form of rail blindage used at the Chateau of St. Cloud. The rails were simply laid flat, one above the other, against a terrace railing. Fig. 18 shows another blindage close to the same place in which two layers of rails were supported between pairs of vertical rails with struts of the same.

Fig. 41, Pl. III. is a similar blindage used on some of the terminus lines in Paris by way of deflading buildings, &c., from shell fire. The posts required to be tied together at their heads; rails used for verticals could be connected at the bolt holes with fish plates or with telegraph wire.

Covered caponier flanking north wall of the Garen de Garches. Fig. 17, Pl. I. shows the front of one of the caponiers which flanked the long northern wall of the Garen de Garches, a large open space among the woods of La Celle St. Cloud, south west of La Bergerie. Much labour had been spent in strengthening this open space with large field-redoubts constructed along the southern edge, and the wall, with its caponiers, formed a strong advanced line in their front. The wall itself was loopholed, and the caponiers consisted of vertical stockade-work, projecting about 10 ft. from the masonry; a row of logs, touching, with a cross row of fascines, covered with earth, formed the roof; two saw-cuts, in each of two adjacent logs, made a loop-hole. This form of caponier was also used to flank the gorges of some of the small redoubts which had been thrown up further to the westward along the roadside. And a somewhat similar one was used in the village of Montretout to flank the street.

The remaining figures refer chiefly to cover for troops.

Blindage in a Field Redoubt near Metz. Fig. 36, Pl. III, is a simple form of cover seen in a German field work by Ars Laquenexy; the floor was a foot below the ground level, and was very wet, nor was very much cover obtained; the lean-to timbers were about 5 in. thick, and the revetments of sticks 2 in. or 3 in. thick.

Railway platform blindage at Belfort. Fig. 13, Pl. I. shows a simple blindage of rails touching each other, against the edge of the railway platform. The railway station, and the neighbouring houses, were, more or less, in a state of defence, and these blindages provided safe cover for the defenders.

Rail cover in the trenches at Strasburg. A somewhat similar use of rails was made (Fig. 37, Pl. III.) in the trenches before Strasburg, where they were laid with one end in the parapet of the parallel, and the other on the reverse of the trench; the

rails were, of course, touching, and were sometimes covered with timber and a little earth; the sides of this blindage were closed with gabion parapets. One of them, used as a magazine for the rifled mortars, was blown up by a shell from the place which fell on the rails. I did not see this blindage, but the sketch is as described to me.

In spite of the enormous length of the enceinte, great labour appeared to have been expended on almost every part of it in preparing for the defence. Nearly every bastion was provided with hollow traverses, and with casemates under the terreplein. Parados were thrown up on the parades inside the terreplein, and in some instances on the terreplein in rear of the guns in the flanks.

The Figs. 9 and 10, Pl. I are sections of a large casemate over 100 feet long, made just inside and to the left of the eastern gate of the

Double Couronne; flat bottomed rails rested on the head of the uprights, and supported a layer of horizontal splinterproofs, which again supported 5 or 6 feet of earth. The sides were sheeted and had planked loopholes in them, the length of the casemate was perpendicular to the enceinte, the entrance being in rear. The casemates had been struck near the rear end, but had not been penetrated.

Fig. 27, Pl. II, shews the common form of hollow traverse, made up of casks. When gabions were used, the roof logs were supported

by vertical props between them, resting on horizontal pieces, as in Fig. 28, Pl. II. Other traverses had been made as in Figs. 29 and 30, which are respectively section and plan of a traverse, consisting of a back wall, with partition walls at intervals, on which rested rows of rails or logs; the whole well covered with earth. Wall plates of wood were put along the tops of the partition walls, to take the rails or logs.

Fig. 31 gives the common arrangements of these casemates. They consisted simply of vertical props with cap and ground sills, the roof being of plank covered with rails, or I girders, on edge and touching. Fig. 32 shews the plan of the entrance and of two bays of casemates. Some of the casemates were not so deep as this one, the central space being left out. The casemates were ventilated by means of 3 in. iron gas pipes running up through the surface of the terreplein.

Another common form of casemate, is that shown in Fig. 26; it consisted of two parallel walls; a rail bedded into the inner edge of the top one, acted as a wall plate to support the leaning rails or I girders. These were sometimes put close together, but at other times wide apart, and were then kept upright by cross stays of bent iron rod; boards were then laid on the lower flanges, and cement, or plaster of Paris, was filled in over them, so as to form a water tight roof; the whole was then covered with earth.

Many of the flanks had bonnettes at their shoulders, under which were sheds with board-loopholes to enable riflemen to flank the ditch under cover. Fig. 24 shows a longitudinal, and Fig. 25 a cross sec-

Improvised
cover, enceinte
of Paris.

Casemates, Dou-
ble Couronne,
St. Denis.

Hollow tra-
verse, enceinte
of Paris.

Casemates
under the ter-
replein, en-
ceinte of Paris.

Lean-to case-
mates.

Flanking sheds,
enceinte of
Paris.

tion of such a shed; the roof consisted of two layers of large logs, with an intermediate layer of fascines, the whole covered with earth.

Another arrangement at the shoulders of the flanks (Fig. 40, Pl. III) was to have a deep revetted cut, about 6 ft. by 2 ft., through the

parapet out to the exterior slope; the revetment was of planking, fixed to small posts, about 4 in. by 4 in., firmly driven into the ground. The object seemed to be to enable men to get out under cover, either to see into the ditch of the curtain, or, perhaps, to fire along it.

Railway irons were made use of at this fort to blind the end walls of some of the expense magazines on the terreplein. The rails were not generally touching, but tolerably close together and covered with fascines and earth. They answered the purpose so far as fire from the front was concerned, but two of them had been penetrated by shells from the enceinte in the second siege. In this direction it was not expected they would be exposed to fire. In one case the rail that was struck was almost cut through.

T. F.

PAPER VI.

NOTES ON THE EARTH WORKS, &c, CONSTRUCTED IN ADVANCE OF THE SOUTHERN FORTS FOR THE DEFENCE OF PARIS, BEFORE AND DURING THE SIEGE OF 1870-71.*

BY LIEUTENANT FRASER, R.E.

It has been stated that 100,000 men worked at preparing Paris for the siege of 1870; and while most of the labour was expended on the enceinte and the forts, a good deal of work was done in occupying the ground in front of the latter, more particularly along the southern line of the defences, and on Mount Avron.

Commencing near the Seine, by Vitry le Français, a line of parallel extended nearly from the river to the Orleans railway, which it reached at about 5,200 metres from the enceinte.

* These notes were made at the time of the evacuation of the southern forts by the troops of the French Government, after which they were at once occupied by those of the Commune. At this moment every one was suspected; the examination of the works therefore was necessarily imperfect, and the measurements only rough.

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Redoubt of Vitry. On the western side of the railway, and just behind the parallel, a large redoubt had been constructed, with its left flank almost touching the line, which is here very slightly raised above the country. Its plan is shewn in Fig. 1, Pl. I. It had a front of about 430 feet, measured along the crest; and the crest of the right flank was about 300 feet long. The front alone was intended for guns, and had altogether eleven embrasures, revetted with gabions and provided in some instances with circular rope mantlets. Six of the guns were 9-in. S.B.M.L. guns. They had been dismounted by the Germans, and their high wooden carriages had been sawn in two.

The villages of Vitry and Choisy le Roi lie in the low ground which extends from the foot of the plateau of Villejuif to the Seine, and this redoubt had evidently been intended to interfere with the occupation of the latter place by the attack, and to supplement the fire of Fort Ivry.

Skillful use had been made of a high wall before the redoubt, behind which its excavation had been concealed. The wall had afterwards been cut down in parts to unmask the guns. Another wall, parallel to the railway, formed the left flank of the work. The front was well traversed, and there was a large hollow mound of earth in rear of the parapet at M, which served as a casemate. In addition, there were two blockhouses with thick earth roofs (Figs. 5 and 6), placed at A and B, near the gorge. There was no earth against the sides, which seemed exposed to dropping fire from the front, but shewed no marks of having been struck. All the sides of these blockhouses were loop-holed (Fig. 7), the guard-beds forming banquettes. A small redan was formed in the gorge to flank the entrance, opposite which the ditch had not been dug out; the barrier consisted of a strong gate.

Under the shelter of the right flank, a long hut, of the pattern shown in Paper III., Pl. I., Fig. 7, had been formed for the garrison.

The ground between the front ditch and the wall was flanked by a parapet of earth extending from the left shoulder of the work to the wall itself, which was loop-holed in places. The soil is a soft sandy loam, easy to work, and standing well at the escarps and counterscarps. Figs. 2, 3, and 4 give approximately the sections of the parapets and ditches. The continuation of the parallel in front of the redoubt was indented, the short branches looking towards the river; from this, the earth-works ran westward across the ends of several rectangular walled enclosures which extended from Vitry to the south. The end walls of these enclosures were in places prepared for defence, and behind them were the remains of many bivouacs.

From Vitry the earth-works ran up the slope of the plateau of Villejuif. To sweep this slope, a small redoubt had been constructed in the line of parallel, in advance of the road from Vitry to Villejuif. The most advanced parallel extended considerably in front of the town of Villejuif and in front of the redoubt of Les Hautes Bruyères to the western ridge of the plateau. Guns appear to have been used in converted portions of this parallel, and the sapping out of embrasures had been commenced in several places. The guard of the trenches had also in many places cut recesses into the reverse of the trench, which they had roofed with logs for cover.

Redoubt of
Moulin Saquet. In rear of the advanced trenches a strong line of defences extended right across the plateau. On the left flank of this line the large redoubt known as the Moulin Saquet, had been thrown up across the main road from Villejuif to Vitry, and at the point where it begins to descend towards Vitry. The distance from Fort Ivry is here about 1,600 metres, and about 2,100 metres from Bicêtre. This work had been commenced early in the war, and had been patched and added to continually during the siege. It got its name from the mill in rear of the left of the gorge.

Owing to its position, sweeping the plateau and also looking down into the Vitry plain, it was of much importance during the German siege, and it was one of the first works occupied by the Communists on the 20th of March, and held by them till it was taken by surprise on the 4th of May, 1871, by General Lacerrière. The trace is shown in fig. 8, Pl. II., where it will be seen that the portion to the south of the road had a front of nearly 1,000 feet. This portion only was regularly prepared for guns, of which 11 or 12 were mounted on the front faces, and fired through embrasures; these faces, as well as the flanks, were very fairly traversed by ordinary traverses with hollow timbered recesses, giving splinter-proof accommodation. Two or three guns may have been used at H, and one or two at K, but the rest of the work north of the road appeared to have been for musketry only, the parapets being slight (from 4 to 8 feet thick). A retrenchment had been made round the buildings at the mill, consisting of a parapet and V shaped ditch.

The gorge of the redoubt, was partly closed by a breastwork of casks, and a small road passed between it and the mill.

The ditches of the fronts and flanks, Figs. 9 and 10, had steep scarps and counterscarps, which stood well, the soil being stiff sandy loam; those of the flank were apparently 6 or 8 feet narrower than the others. The front ditches were flanked by two caponiers, a single one at the left shoulder (Fig. 11) and a double one at the salient (Fig. 9) both communicating by galleries with the interior of the work. These caponiers consisted of stockade work of round logs, roofed with timber and covered with earth. They did not appear to be injured, but none of the work seemed to have suffered much from artillery fire. To prevent the caponiers firing into each other, a line of palisading ran obliquely along the bottom of the ditch between them. Starting from the foot of the escarp at the single caponier, it crossed nearly to that of the counterscarp half way along the ditch, whence it ran again to the foot of the escarp at the double caponier. The other ditches to the south of the great road were also furnished with palisades. The ditches at the caponiers were made wider than elsewhere.

By way of obstacles four rows of deep military pits had been dug along the glacis round the whole of the ditches, except those of the retrenchment. Outside these pits and extending nearly all round was a slight ha-ha, which gave the pits a little cover.

Beside the main road at B, there was a long line of splinter-proof sheds, (Figs. 12 and 13) roofed with timber, fascines, and earth, and rows of huts of the

pattern shewn in Paper III., Pl. I, Fig. 7, had been constructed (at C, C) for the use of the garrison.

The interior space to the north of the main road was much cut up by traverses, and portions of intrenchments. The entrances by the great road were probably closed by barriers. From the left of the redoubt, a line of parallel ran right into the town of Villejuif; its section was rather narrower and shallower than an ordinary first parallel. It passed straight through houses and walls into the main street of Villejuif, across which a high barricade had been constructed. The houses of this town, more particularly in front, had been loop-holed, and good loop-holes had been formed in the western fronts of the line of houses which runs north and south along the great road to Paris, and in the long lines of garden walls below them. From this, the town runs westward, the southern front being similarly prepared for defence.

The cemetery at the extreme west had been prepared by digging a ditch, about 8 feet wide and 3 feet deep, outside its wall, and heaping the earth against the wall, as a protection from artillery; large stones, &c., were placed on the top of the wall to cover riflemen.

From this point a portion of parallel extended up to the left flank of the redoubt of les Hautes-Bruyères, near which there were emplacements in the parallel for about 10 guns.

This redoubt was placed a little to the south of Villejuif, and with its right flank on the western ridge of the plateau, so as to look down into the steep valley in which Cachan lies. Nothing could be finer than the position of this work, on the highest portion of the plateau. Looking westward it commanded the low ground between Bagneux and Fort Montrouge, and was even visible from below Chatillon. It also partly looked up the valley between Bourg la Reine and Fontenay aux Roses, and that between Bourg la Reine and l'Hay. Southward it commanded the whole plateau before the German positions in l'Hay, Chevilly and Thais, and its left flank swept the ground in front of Villejuif. The redoubt (Fig. 14, Pl. III.) had been designed and commenced as a permanent fort, but for want of time, it had to be completed for defence more in the style of a field-work.

It consisted of two faces, two flanks, and a bastioned gorge. The crest along the front was nearly 600 feet long, and that of each flank was about two-thirds as much.

The work was placed about 1,500 metres from the southern salient of Fort Bicêtre and 2,500 from the south-eastern salient of Fort Montrouge. Its position was such, that the highest part of the ground was in the centre of the interior space; from this it fell towards the front and right flank, and also, though more gradually, to the rear. It was, therefore, necessary to make up the glacis and parapet of the front and right flank much more than would have been required with a horizontal plane of site.

The glacis had an interior slope of about 4 ft. 6 in. in height. There was a covered way about 8 or 10 ft. wide, along the front, and rather narrower opposite the flanks.

Redoubt of Les
Hautes-Bru-
yères.

Ditches. The ditches had no revetments. The counterscarps appeared about $\frac{3}{4}$, and the scarps which were in the prolongation of the exterior slopes stood at about $\frac{1}{4}$, the soil being stiff sandy loam.

A line of stockade-work, about 9 ft. high, and of 8 in. timbers, ran along the bottom of the front ditches. Loop-holes were formed in the stockade at intervals of about 6 feet. The defenders could leave the ditches by doors in the central caponier.

The gorge had a similar stockade which extended to the flanks. Near the eastern flank there was a 4-in. oak door in the stockade, for getting out into the outer parts of the ditch.

The ditches of the flanks had detached walls in them of rubble masonry, loop-holed for musketry (Fig. 18, Pl. III.)

Flanking defence. The fort had been designed with the intention of having permanent masonry caponiers, with masonry passages into the area behind the casemates (the passage to the central caponier had been almost completed), but for want of time, temporary timber caponiers had been constructed, the central one being a double, and the two side ones, single caponiers. The passages into the latter had been formed with timber shoring, which had partly failed. The flank defence of the gorge depended on its bastioned trace.

Central caponier. The details of the central caponier are given in Figs. 19, 20, and 21, Pl. III. It consisted of walls of very large squared timbers, with cap and ground sills, and with large cross timbers which were also supported by two rows of props inside the caponier, and which carried the earth roof. About 11 loop-holes were formed in each wall, about 4 ft. 6 in. above the ground, and in each side there was a gun or mitrailleuse embrasure, the sill 2 ft. 6 in. above ground and the opening 3 ft. wide by 4 ft. high (Fig. 26), closed by a 4 in. oak door.

The front row of timbers had been loop-holed with a double row of loop holes; but it was noticed that the upper ones were seen into from the covered way, and they had to be closed up. The form of loop-hole is shewn in Fig. 25.

Parapets. The parapets of the fronts were from 25 ft. to 27 ft. thick. About 10 guns were mounted on them; but more might have been placed on the fronts, in addition to those which the flanks could mount.

Traverses. There were generally two guns between the traverses. The latter were solidly made, with splinter-proof chambers inside. In the case of the flank traverses (Fig. 24) the entrance was in the rear side.

Casemates. There were two sets of casemates in the redoubt, one under the terreplein of the faces, and another below the parapet of the gorge. It had been intended to connect them with an arched tunnel, which was not finished. (See Plan.) The details of the casemates in the front are shewn in Figs. 15, 22, and 23, where it will be seen that they consisted of masonry partition walls and front walls with brick arches over the doors. The roofs consisted of railway bars, extending from wall to wall; the bars were on edge and touching. Boarding was probably laid on top of the rails, and then came the earth from 5 ft. to 6 ft. thick. The bearings of the rails were diminished by their being supported by

two rows of posts in the casemates. Figs. 22 and 23 show the details of the wood-work of the casemates. The men could sleep on the upper berths and on the floors. The casemates in the gorge, Figs. 16 and 17, were simply boarded off from each other.

Along the length of each casemate there were four rows of uprights, (about 8 in. by 8 in.) three in each row, with capsills on them, on which lay the timbers that formed the support for the earth. Each had a central passage, and on each side there were two tiers of berths.

The earthen slopes at the entrances were revetted with boarding.

The parapets of the gorge were in an unfinished state, and the ditch was not all excavated.

The entrance to the work was a temporary ramp at the extreme right of the gorge.

An *unfinished* cask parapet extended along the parade. It was probably intended to have acted as a *parados* to the gorge when completed.

The redoubt had been very little injured by the German fire. The prolongations of its faces could not have been taken up, though the flanks might easily have been enfiladed. They were, however, well traversed. The redoubt had one weak point, namely, that there was a large pit on the glacis, just in front of the salient, from which earth for the work had been obtained, and which could not be seen into from the parapets. The artillery fire of the work was supplemented by a battery for three or four guns outside the glacis of the right flank, and on somewhat lower ground. From the battery a parallel of rather small section ran to the rear, keeping about the same level below the crest of the hill, and extending to the north of the viaduct of Arcueil, and between forts Bicêtre and Montrouge.

The arrangement of placing batteries on the flanks of works was used elsewhere. Thus there was a six-gun siege battery outside the left flank of Montrouge, and near the military road. There was another for several guns in the same position with respect to Fort Vanves, and a third outside the right flank of that fort. From the latter ran a branch of the trench-work between Issy and Vanves. The other branch formed a salient with it to the front of the forts; the salient itself being turned into a small lunette with a barbette for one gun.

After leaving the Plateau of Villejuif, the next earthwork of importance is the redoubt on the Plateau of Chatillon, its trace is shown in Fig. 30, Pl. IV. It was in a very unfinished state at the time of the advance of the Germans, and was occupied, at the commencement of the siege, by the Bavarians. The work lay across the "route de Chevreuse," with its front looking south-west.

The parapets were unformed, and wide spaces (sometimes 20 to 30 feet) remained between the foot of the exterior slopes and the top of the scarps. It would have been much better if the different reliefs of the work had been arranged so that the redoubt might have been defensible at each stage. The ditches were from 25 ft. to 36 ft. wide, and 8 ft. or 9 ft. deep. They were intended to be flanked by double caponiers of timber-work at the shoulders (Figs.

Effects of German Artillery fire on the work.

Redoubt of Chatillon.

35 and 36), which communicated with the interior of the work by galleries, supported with frames and sheeted with 3-in. poles.

The sides of the caponiers appear to have been formed of thick horizontal sheeting, fixed to the uprights.

Inside the work a large block of buildings had been commenced. It consisted of front and side walls; parallel to the side ones, were a number of partition walls about 20 ft. apart in the clear, forming rooms which were entered by openings in the front walls.

I shaped iron floor girders (Figs. 31 and 32), at intervals of about 6 ft., rested on these walls, and were supported by wooden props. Double headed railway bars were laid on the top of the girders, about 6 in. apart, their ends overlapping, as shewn in Fig. 32. Two-inch planking was placed on the top of the rails, and above the planking came about two feet of earth. The Germans closed the rear of the casemates by a lean-to of railway bars covered with earth. The floor girders in this arrangement appeared over-loaded, and were inclined to bend. Their flanges looked less than a quarter of an inch thick.

A smaller casemate of the same kind existed at C.

At B a powder-magazine had been partly built, but not covered with earth.

The Germans, after their occupation, had constructed two splinter-proof sheds of the usual pattern, with roofs formed of railway bars (on edge and touching) supported on vertical frames across the length of the shed. The one at E was only open to the south-west; that at D, which was more square in plan, was open both to the south-west and south-east.

A very low casemated hut had also been made just outside the right flank at D.

It is, I believe, intended to construct a permanent work on the plateau, in place of the present one.

Redoubt of Braborion. The next large French work we meet with is the redoubt of Braborion, situated on a plateau on top of a high mound overlooking Sèvres. Like the last work, it was abandoned by the French, and was unfinished when occupied by the Germans. Fig. 33, Pl. IV, gives an eye-sketch of the form of the work, which is an irregular pentagon, with a diameter of, perhaps, 250 to 300 yards.

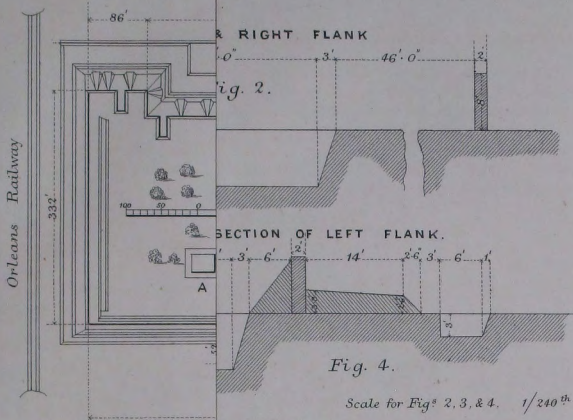
The eastern front which looks down on Paris is irregular; that on the south is a bastioned front; and the remainder are straight.

The centre of the plateau is about 400 metres from the main road through Sèvres, and about the same distance back from the river.

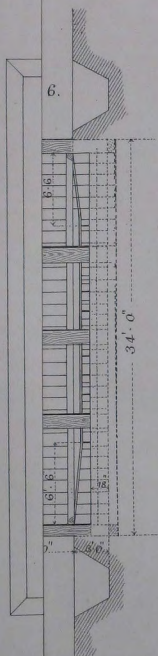
The chief peculiarity of the work is that all the faces except the bastioned one, were protected by scarping the sandstone of which the mound is composed, so as to form a steep wall about 9 ft. high (Fig. 37). For this reason, there was, in places, a scarcity of earth for the parapets, which were partly made up of masses of fascines or logs.

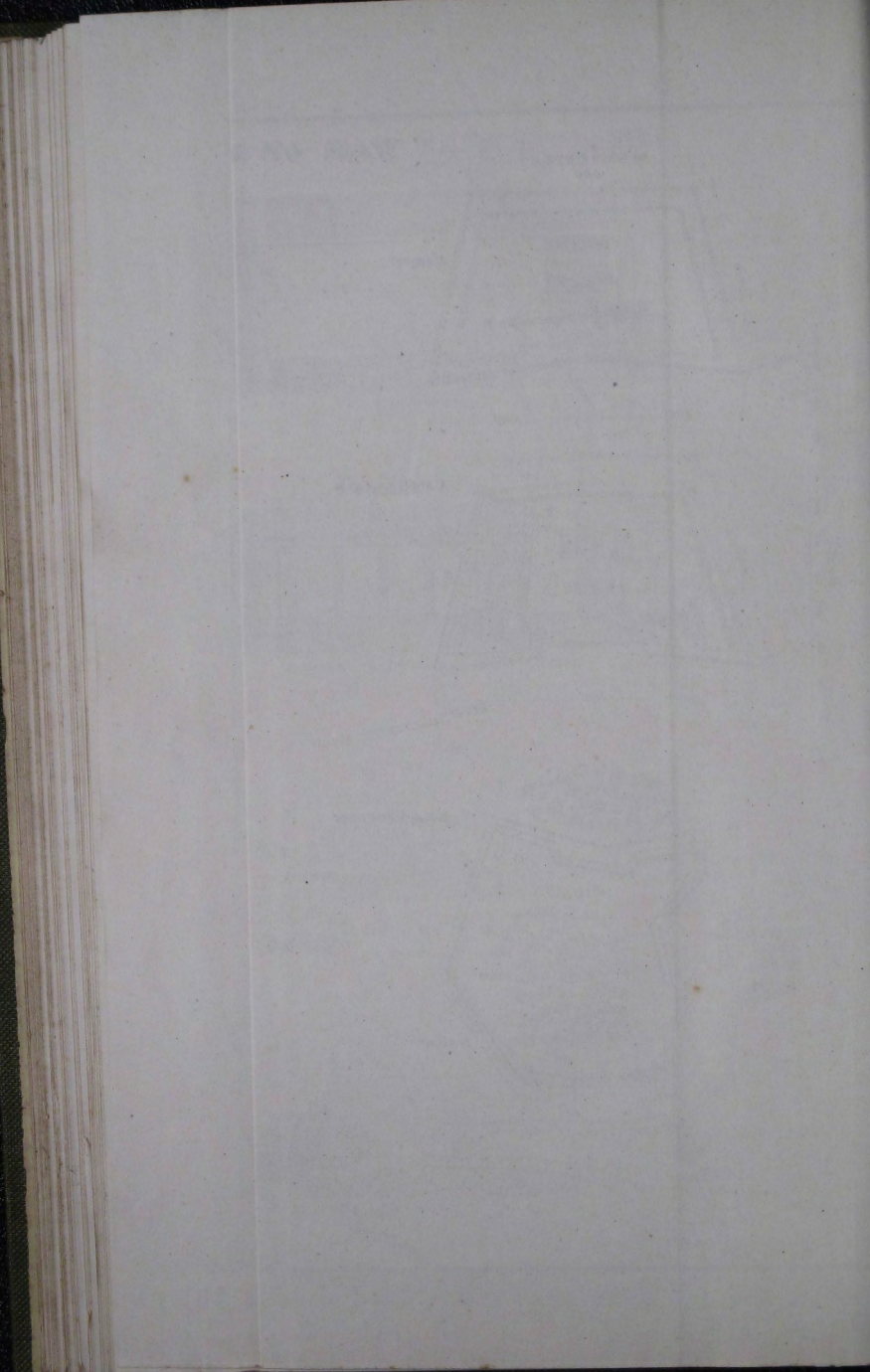
The face BC had a *fausse braie* of short round logs about 3 ft. long, which were here and there supported by using the stumps of trees (Fig. 37).

The general position of this redoubt for the defence of Paris appears to be bad. It is commanded from the south-east corner of the Park of St. Cloud, and



BLOCKHOUSE





also by the high ground above Bellevue and Meudon. The ground, too, in front of the south-east front is so wooded that an attack might have approached, under cover, almost up to the counterscarp. These objections, however, did not apply to the Prussian occupation of it, and it gave them a strong point to resist any attempt at an advance on Versailles through Sèvres.

The Redoubt of Montretout. The last of the large earth-works in this direction is the redoubt of Montretout, distant about 3,000 yards from Valerien. It stands on the top of the plateau above St. Cloud, to the west of the Versailles Railway and the main road to Valerien. The plateau is here as high, or rather higher, than the level of the enceinte of that fort. The ground runs westward in the form of a ridge between Garches and Busanval. The whole of it is commanded by the redoubt right up to the woods.

This work, like the others, was unfinished at the beginning of the siege, and soon fell into the hands of the Germans, who, however, only used it as a forepost, because it was much exposed to the fire of Valerien. On the 19th of January, 1871, it was recaptured for a short time by the French, who advanced up the steep ground below the plateau and easily entered the gorge, the ditch and parapet of which were so unfinished as to be almost useless.

The trace of the work is given roughly in Fig. 27, Pl. IV. The ditches, which were from 35 ft. to 50 ft wide, had been dug out in parts to a depth of 10 or 12 ft.

It had been intended to construct caponiers at the shoulders, and the masonry passages in the right shoulder had been commenced, but the caponiers themselves had not been begun.

The casemates (Figs. 28 and 29) were nearly as unfinished as at Chatillon. They consisted of walls about 5 ft. thick, 10 ft. high, and 25 ft. long, perpendicular to the common back wall. Long rails, 6 in. apart were laid from wall to wall, the spaces between them filled in with plaster, and on the top of this came the earth, of which there was but a small thickness. Outside the front, a line of abattis had been placed along the top of the counterscarp.

In rear, the curtain of the gorge was protected by a masonry redan with loopholes. The masonry was in parts about 9 or 10 ft. high.

It was in rear of the gorge of this redoubt, and a little down the slope, that 76 guns were placed during the civil war, in a line of batteries (six or seven in number) known as the Montretout Battery, for the bombardment of the enceinte before the Bois de Bologne. These batteries played a most important part in destroying the covering walls at the gates of the enceinte and in silencing its fire, while the railway and the road in their rear made the transport of ammunition to them much easier than could otherwise have been the case.

The importance of the position is therefore so fully recognised that it is intended to occupy the plateau with a permanent fort of a large size.

T. F.

P A P E R V I I .

NOTES ON THE DEMOLITION OF BRIDGES IN FRANCE DURING THE LATE WAR; AND ON THE RESTORATION OF ONE AT DANNMARIE, NEAR BELFORT.

BY LIEUTENANT FRASER, R.E.

It is said that no less than 120 bridges of more or less importance were destroyed during the late war in France. The railway bridges being most important, generally suffered most, but north of Paris a large number of the fine road bridges across the Seine had been destroyed, and gaps had been made in nearly all the bridges immediately outside Paris.

Pont de l'Arche. A little south of Rouen, an arch of the road bridge at Pont de l'Arche was broken down.

Vernon. At Vernon, a stone bridge across the Seine had the whole of its arches destroyed by charges lodged in the haunches; and an iron girder railway bridge was also quite destroyed, the girders lying in the river. In this case the abutment piers had been blown down.

Mautes. All the three arches of the stone bridge across the Seine were here blown down, no sign of an arch being left on the piers. The effect on one of these was very curious, the pier seeming to be thrown quite out of the vertical by the explosion.

Trielle suspension bridge. At Trielle, a wire suspension bridge crosses the river consisting of a central span and two half spans; in this case the whole of the roadway of the western of the half spans was removed.

Sartrouville. The stone bridge connecting Sartrouville with Maisons-sur-Seine had four arches blown down, the piers being destroyed nearly to the water's edge; in this case the piers seem to have been attacked instead of the haunches.

Carrière, St. Denis. Here a small bridge on the Rouen-Paris line had been blown up, but had easily been restored by vertical trestles resting on the road below.

Bézon Railway. Cast-iron arched bridge. The above railway crosses two channels of the Seine at this point. The first was passed by a cast-iron bridge of four arches, each arch having three ribs. The French blew down the pier

nearest to Paris, destroying two arches. The north-west arch had also been rendered almost useless by the demolition of the north-west abutment, which was blown up (by the Germans, it is said). In the latter demolition the comparative weakness of the wing walls had not been allowed for, and consequently, the charges blew out sideways, and the centre of the abutment was left standing with the central rib. More than half of each of the outer ribs hung on to this, though their ends at the abutment had come down. Infantry might, I think, have passed over the remains. The debris of the iron-work made it impossible to form a hasty bridge in the gap. The temporary railway bridge was therefore put up beside the other, and a loop line formed on it to connect with one of the old lines (Fig. 2.) Sets of vertical trestles were used three metres apart; each was supported on six piles driven into the blue clay of the river bottom. The trestles consisted of four vertical, and two inclined, legs of squared timbers, about 10 in. square, with a cap and ground sill; ordinary diagonal bracing was used for the frames. The connections were made with bolts and nuts. The base of the frame was very wide, as the current was very strong. The rails, which were about 30 ft. above the water, were spiked direct on to the road bearers, which consisted of three thicknesses of timber, one above the other, each about 13 in. wide and 11 in. deep. These road bearers were strapped down to the vertical legs, so that, if settlements occurred, they could be packed up as required. The bridge was steady enough under trains moving slowly.

Bézon stone bridge. The stone bridge at Bézon had also been destroyed, four arches being blown down.

Asnière composite bridge. The ribs only of this bridge were of cast-iron, the rest of the structure was of wood. It had been fired, and six of the arches were more or less destroyed. Beyond this again was a cast-iron arched bridge which had only one arch standing.

Conflans. The Seine was here crossed by a suspension bridge of a whole and two half spans. It was destroyed by blowing down the piers to about the level of the roadway; and the wire cables on one side were also partly cut through just above the anchorages.

The river was here crossed by an ordinary raft drawn from side to side by horse-power, and kept from going down stream by being fastened to a pulley which travelled on a light wire rope suspended above the river by posts on each bank.

Sèvres. The stone bridge at Sèvres had an arch on the Paris side of it blown down, and near it a wrought-iron girder bridge lay in the river.

Joinville sur Marne. Here a gap of 70 paces had been formed in the stone bridge, the piers of which had been blown down within 5 ft. to 10 ft. of the water. Two vertical trestles were put up on each of these, on which the road-bearers rested, as well as on sets of struts which abutted on the piers.

Champigny. The Marne was here crossed, at an island, by a bridge of five wooden arched arches, each consisting of six wooden ribs. To destroy it, a pier and an abutment were blown down, and the wood-work was set on fire. The demolition succeeded perfectly.

Railway bridges on the Marne. The railway from Epernay to Lagny was perhaps the most important portion, for its length, held by the Germans.

Between Château Thierry and Lagny, it bridges the Marne six or eight times. Several of these bridges were destroyed.

Lagny. Here, a road bridge, which had been destroyed, was replaced by the Germans with a trestle bridge.

Meaux. Near Meaux, a pier of the railway bridge had been blown up, the restoration was by means of vertical trestles.

Trilport. Here, both road and railway bridges, had been broken; three arches of the latter had fallen, and the gap had been restored as at Meaux. Further on, and just outside the west end of the Nanteuil tunnel, an abutment of a bridge had been blown up, destroying the arch; a portion of the latter, however, hung on to its pier, and was turned to account as a support to the road-bearers, by being shored up with timbers, the feet of which rested on the masonry of the broken abutment. Two vertical trestles provided the other supports for the road-bearers.

Mezières. Near this, a railway bridge had been partly cut through by the French, in a way that was not observed; the result was that a train with a convoy of wounded or prisoners, broke down the bridge in passing over it.

Sédan. The railway bridge between Doncherry and Sedan was blown up by the Germans, and restored almost immediately afterwards by them. As the arches were small struts were used from each pier or abutment to shorten the bearings of the road-bearers.

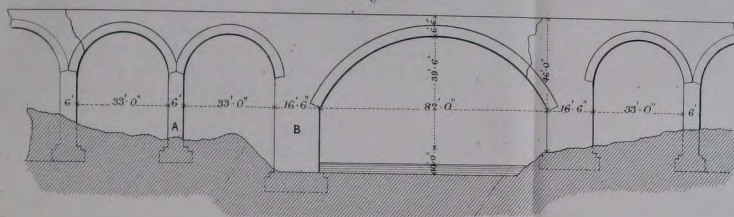
The demolition of a railway viaduct at Dannmarie. This was a most judicious demolition, as after the fall of Schelesadt, on the 24th of October, 1870, and Neu Breisach on the 10th of November, the whole line as far as Belfort fell without any hindrance into the hands of the Germans, and the material for the siege of the latter could, but for this gap in the line, have been brought without break of bulk by train, from Strasburg to that fortress.

Dannmarie is a small village between Mulhausen and Belfort, and 15 miles from the latter. Fig. 1 gives a sketch of the bridge, which was of brick, and consisted of one large arch (spanning a watercourse liable to be flooded), and of a number of small ones. Charges were lodged in two of the piers, marked *a* and *b*; their demolition brought down three arches, forming a gap of 160 to 170 feet.

The repair of this bridge was commenced on the 13th of February, 1871, and it was completed on the 16th of March. In order to leave the gap open and clear for permanent repairs without stopping traffic, the single temporary line was taken in a curve to one side of the viaduct. It was supported on timber trestles; those of them that were alongside the standing portion of the viaduct were tied to the brickwork with iron ties. The portion over the water course where the bottom was rocky and unfit for piles, was spanned by a pair of wooden lattice girders from 50 ft. to 60 ft. long, carried at each end by a group of three sets of trestles close together. These trestles were in two tiers, while those which did not support the girders were in three. The trestles had cap

WAR OF 1870 - 71. RESTORATION OF A RAILWAY BRIDGE NEAR BELFORT.

Fig. 1.



Scale of Feet.
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 Feet

Fig. 3.

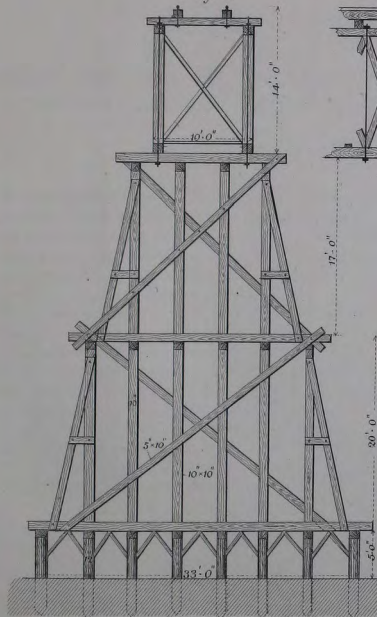
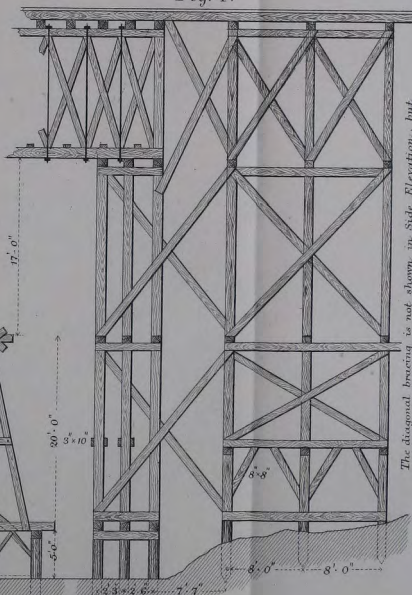


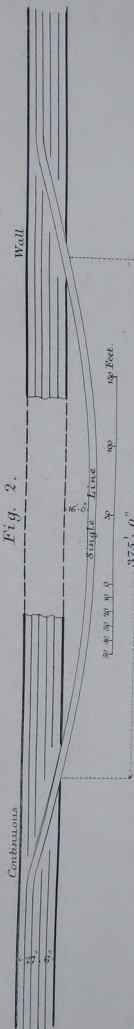
Fig. 4.



The diagonal bracing is not shown in Side Elevation, but each frame was so braced.

Scale of Feet.
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 Feet

Fig. 2.



NOTE: The dimensions are only approximate, the drawings having been made from a hasty sketch.



and ground sills, the latter resting on rows of piles of round timber. They were strongly braced with half timbers and a good deal of longitudinal bracing was also used. The rails were carried on top of the lattice girders, as shown in Fig. 3; the lower booms of these were connected by diagonal plank bracing, while the planking of the roadway connected the upper booms. The timber appears to have been brought from Mulhausen, where similar logs were to be seen in the canal. The wood was fir, roughly squared, and about 10 in. by 10 in. in section. Iron bolts, nuts, and straps were chiefly used to connect the different parts, a few dogs were also to be seen. The total length of the timber work was about 375 ft. Figs. 1, 2, and 3 have been drawn from a very hasty sketch, and are merely intended to give a general idea of the arrangement.

T. F.

PAPER VIII.

NOTES ON THE RESTORATION OF A RAILWAY TUNNEL BETWEEN RHEIMS AND EPERNAY.

By LIEUTENANT FRASER, R.E.

The demolitions of the bridges were not the only difficulties the Germans had to contend with in order to use the railway lines as communications from their base to the front of their operations. The French in retreating made at least two very successful demolitions of railway tunnels. The most important was the well known one at Nanteuil. The northern line of communication by Sarreguemines, Metz, Mezières, and Rheims, was interfered with, up to the 14th of December, by the successful resistance of Montmédy, where also the railway tunnel at the eastern end, close by the fortress, appeared to have been injured to a certain extent with a view to stopping it up. This line runs to Paris through Soisson, but in order to use it in connection with the great dépôt of Lagny and the artillery park at Esbly, it is necessary to branch off at Rheims and join the more direct line from Strasburg and Nancy, which was cleared by the capitulation of Toul on the 24th of September. Thus Nanteuil, lying to the west of Epernay, stood in the way of the combined traffic of both lines towards Paris on the south-east, while the southern line of railway from Mulhausen, through Vésoul, Chaumont, and Troyes, which was never so completely grasped

by the invaders, was cut at Dannmarie, and was further closed to a certain extent by the defence of Belfort. Attempts were made to repair the tunnel at Nanteuil, but owing to the nature of the strata, which appears to be nearly horizontal and to consist of a sandy shale, it was not found possible to do so, and a piece of connecting line had to be constructed round the foot of the hill which the tunnel had pierced.

The other demolition was on the line between Epernay and Rheims.

Just north of the small station of St. Germain there is a tunnel of over 1,000 metres in length, lined with masonry. Near the St. Germain end, the line had at first run in an open cutting, but owing to the treacherous nature of the soil which, it was found, could not be kept from slipping, an arch was built in the cutting, and the latter partly filled in over the arch. The banks seem to have springs in them, which made the earth in parts very unstable. A small stream of water was also carried above the tunnel (near the damaged part) in a wooden trough, from which there was probably some leakage. At the point of demolition the earth was from 25 ft. to 30 ft. thick above the crown of the arch. The work was done with about 2,640 lbs. of powder, lodged in six charges (three on each side, nearly opposite each other) behind the masonry lining and a little above the floor level. The charges seemed to have been fired by electricity, and their explosion destroyed about 36 yards of tunnel at the southern end.

The Germans, it is said, after occupying Rheims and the neighbourhood, contracted with a Jew at Rheims to open the tunnel, but as the work did not progress, and it was suspected he purposely delayed it, it was handed over to the military engineers, who set to work with the troops, and in from 24 to 28 days drove a framed and sheeted gallery through the destroyed part, large enough to take an engine and train.

About 14 metres of the old tunnel was formed into an open cutting, the earth being carried back and spread along the sides of the line; the remaining 22 metres were timbered, generally with rough unhewn trees. Fig. 2 gives a cross-section through the restored tunnel near the mouth. Fig. 1 is a section along the length of the tunnel, and Fig. 3 shows the arrangement of the work looked at from the inner end.

The process of repair appears to have been somewhat as follows.

The driving of the tunnel was commenced from both ends, the height of the framework decreasing from both ends towards the centre (where it was lowest), at the rate of about 1 foot in 20. An excavation was made inwards for a short distance (about 20 centimetres) to allow of a large vertical frame being set up, and the longitudinal timbers over the capsill being inserted and driven forward, so as to support the roof; sheeting planks, about two or three inches thick, were driven or slipped in over the latter, and also behind the sides, where the thickness used was about four inches. The excavation was then further advanced till another frame could be set up, and the top timbers again driven forward and sheeted. The process was continued till the two galleries met in the centre. Additional sheeting was introduced at the back of the frames, and used so as to relieve the pressure on them, and the uprights were connected

R RHEIMS.

CROSS SECTION THROUGH TUNNEL SHEWING PART OF
INNER END ELEVATION OF THE TIMBERING.

Arch. 28 Feet Span.

9 Feet

SECTION OF TUNNEL.

Scale of Feet.

0

5

10



together with long iron dogs, and with iron straps or railway bars spiked diagonally across them, as shown in Fig. 2. The whole had a very irregular appearance, as timber had to be used anyhow, wherever there was a difficulty with the earth. Horizontal timbers extended across the floor of the gallery and acted as a counter-arch to keep out the feet of the frames. These timbers carried the rails. It was found when the first engine ran in that its chimney struck the wood-work, so that the level of the road had to be lowered in the gallery in order to get headway enough.

Owing to the loose nature of the soil, and also to the small depth of earth over-head, the whole operation was one of extreme difficulty, and is spoken of even by the French railway engineers as remarkably successful; at the same time it is difficult to believe that an open cutting could not have been made in less time and with more certainty. Had Toul and Soisson held out and continued to bar the Strasbourg-Nancy line and that between Rheims and Paris, the importance of the restoration of this tunnel would have been very great; as it was, it greatly relieved the strain on the other line, at least, as far as Epernay.

T. F.

PAPER IX.

ACCOUNT OF A TORPEDO USED FOR THE DESTRUCTION OF A RAILWAY TRAIN ON THE 26TH OF OCTOBER, 1870.

By LIEUTENANT FRASER, R.E.

The following account of the demolition of a railway train was obtained at Lannois, from a sub-officer of a company of Franc Tireurs, known as the Franc Tireurs of the Meuse, who were engaged in the work.

They had ascertained that a Prussian military train was to pass near Lannois (on the line between Rheims and Mons), on the 26th of October, and they determined to destroy it. As any obstacle on the line would probably have been discovered, it was decided to use gunpowder lodged in the permanent way, to be exploded by the passage of the engine. A spot was selected where a well wooded slope ran down to a cutting on one side of the railway, while on the other side (that along which the train was to pass), was an embankment of perhaps 12 ft. in height. The woods on the upper slope communicated with large woods which provided a safe retreat for the Franc Tireurs.

A pair of rails were taken up, the sleepers removed, and a deep trench cut across the ballast of the outer line. Some pieces of iron were laid on the bottom of the trench, and on them a box was placed, containing 30 kilos. of powder. A percussion fuze from a French field shell was fixed into the lid of the box, so that when one rail was replaced, the head of the fuze was just below its lower flange.

In replacing the sleepers and rails, one sleeper was left out, so that the rails were unsupported for a length of about two metres over the powder-box; the ballast was then replaced, and nothing was left to attract attention.

The Franc Tireurs, about 75 strong, were then posted in the wood beside the line.

In due time the train came up at the ordinary speed; it is said to have consisted of about 40 carriages with a number of German soldiers in them. As the engine passed over the rail, it forced it down with a blow on to the fuze head; the iron under the box prevented any yielding, and the fuze exploded and fired the powder.

The explosion tore up a connected mass of rails and sleepers, and at the same time threw the engine down the embankment, where it was followed by some of the carriages. The whole train became a wreck, and the confusion was increased by an explosion of steam in the engine. Those soldiers who were able to clear themselves from the wreck, were shot down by the Franc Tireurs from their cover. In this way they claim to have destroyed about 400 men. They believe that a few escaped by passing back along the line.

The remains of some of the carriages were still lying at the foot of the embankment as I passed by the spot.

T. F.

PAPER X.

IRON SHIELD EXPERIMENTS.

By LIEUT. COLONEL INGLIS, R.E.

RESISTANCE OF SHIPS' DECKS.

In Table I. will be found the results of some further practice against the Ship's Deck Target, described at page 107, Vol. XIX, as being 20 ft. long by 10 ft. wide, and consisting of six deck beams 10 in. deep, spaced 2 ft. apart, and covered, as regards one half of the target, with two thicknesses of $\frac{1}{2}$ -in. plate with 5 in. fir planking over them; and, on the other half of the target, with two thicknesses of $\frac{3}{4}$ -in. plate and $4\frac{1}{2}$ in. of fir.

The following conclusions were drawn from the previous practice, namely :—

1st. That a shell fired with 20 lbs. of powder from the 13-in. sea service mortar, at an elevation of 45 degrees, and ranging about 4,200 yards, would go very easily through a ship's deck equal in strength to the stronger portion of this target; but that a similar shell, fired with a charge to give a range of about 2800 yards, would not quite go through the same deck, although it would go through a deck covered with plating only 1 in. thick.

2nd. That a blind Palliser shell (or shot) fired from the service 9-in. 12-ton gun with full battering charge (43 lbs. R.L.G.), at a range of 100 yards, would fail to pass quite through a deck, such as the stronger portion of this target, with an angle of incidence of 8 degrees, but that it would injure it very severely.

The object in continuing this experiment in the present year was to ascertain at what angle of incidence a live Palliser 9-in. shell at short range would get through the stronger part of this deck.

After the former practice the target was thoroughly repaired, and it may be also mentioned that both on the former and present occasion the target was so placed that the deck beams were in the direction of the line of fire of the gun.

From the table of the present practice it will be seen that when the angle of impact was 15 degrees, a shell (Round 1796, striking between the beams on the stronger portion of the deck, passed through and burst on the underside, making an extensive rent.

At the angle of 8 degrees, the shells (Rounds 1797 and 1798) striking on the stronger portion, made long rents 1 ft. and 1 ft. 11 in. wide, respectively, in the plating between the deck beams, but both were deflected upwards without exploding.

At the angle of 10 degrees, the shell (Round 1807) striking between two deck beams, on the 1½-in. plate portion, passed through the deck, bursting on its way, and making a hole some 4 ft. long by 2 ft. 6 in. wide.

The general conclusion to be drawn from this second experiment is that a ship's deck composed of rolled iron beams, 10 in. deep and 2 ft. apart, covered with two thicknesses of $\frac{3}{4}$ -in. plating, and 4½ in. of fir planking, is not proof against a live shell fired at a short range from the 9-in. 12-ton gun and striking at an angle of 8 degrees, although it may just resist it, if fired without the bursting charge; or which is nearly the same thing, it may just turn a 9-in. shot fired under similar circumstances.

As the decks of some of our most recent ships are covered with as much as 3 in. of iron in the more important parts, it is understood that a further experiment is to be made with a target representing one of these stronger decks.

TABLE I.

SHIP'S DECK TARGET (No. 32.)

Report of Practice on the 3rd and 5th of May, 1871.—Range, 100 yards.

Photographic No. of round.	Gun.	Charge and brand of Powder.	PROJECTILE. — Nature, length, total weight, and diameter.	Striking Velocity. feet.	$\frac{Wv^2}{2g}$ in foot tons on impact.	Foot tons per inch of shot's circumference	Observed Effects.
1796	9-inch M. L. R., No. 145.	lbs. 43 R. L. G. 5-7-70 Lot 1620	Palliser shell, filled. 21-45 inches. 250 lbs. 8-92 inches. Head 1-5 D. Bursting charge, 5 lbs.	1328	3060	109	<i>Angle of impact, 15 deg.</i> —Shell struck the deck 8 ft. from end, and 4 ft. from left, between two beams; length of graze in wood-work 7 ft. 6 in. Shell passed through deck, making a hole in the iron 4 ft. 6 in. long by 1 ft. 5 in. wide; of this, 2 ft. was on the $1\frac{1}{2}$ in., and 2 ft. 6 in. on the 1 in. portion. Shell exploded against a beam under the deck.
1797	"	"	"	"	"	"	<i>Angle of impact, 8 deg.</i> —Impinged 2 ft. from lower end of target, penetrated the $1\frac{1}{2}$ in. plate 6 ft. from the end, making a rent in the iron between two deck beams 6 ft. long by 1 ft. wide; of this, 4 ft. was in the $1\frac{1}{2}$ in., and 2 ft. in the 1 in. portion; the shell then deflected without exploding.
1798	"	"	"	"	"	"	Impinged on wood 3 ft. from lower end, making a graze on the wood 11 ft. 6 in. long, and a rent in the iron between two beams 6 ft. long by 1 ft. 11 in. wide; of this, 3 ft. 3 in. was in the $1\frac{1}{2}$ in., and 2 ft. 9 in. in the 1 in. portion; the shell then deflected without exploding.
1805	"	"	"	"	"	"	<i>Angle of impact, 10 deg.</i> —Struck on lower edge of target 5 ft. from right, cutting a scoop 8 in. wide and 7 in. deep, out of end; shell passed on, making a hole in the $1\frac{1}{2}$ in. iron skin 20 in. long by 9 $\frac{1}{2}$ in. wide, and fair between two beams; the beam on right of hole bulged a good deal by fragment of shell just beyond the end of hole; shell burst in going through the iron; wood planking ripped off for a length of about 4 ft. 6 in. by 1 in.
1806	"	"	"	"	"	"	Struck 1 ft. 11 in. from proper right, on edge, similar to last round, and burst on striking, cutting a scoop 11 in. wide, 8 in. deep, and 2 ft. 3 in. long, in the iron ($1\frac{1}{2}$ in.), ripping off the wood for a length of 3 ft.
1807	"	"	"	"	"	"	Impinged close to lower end of target, making a scoop 2 ft. 6 in. long; penetrated the $1\frac{1}{2}$ in. iron, making a hole 4 ft. long by 2 ft. 6 in. wide; shell burst in passing through the iron, and blew the deck beams on each side out. The whole of the ground below the deck was covered with fragments of shell and target.

ARMOUR-PLATING FOR TURRETS.

The attention of the designers of turrets for the Navy having been directed to the principle of armour-plating in two or more thicknesses, adopted by the War Office for fortification purposes, as distinguished from that of using the armour in one solid thickness hitherto employed in the protection of all our plated ships, it was determined to ascertain by actual experiment the relative advantages of the two methods, as regards the special purpose of plating a ship's turret.

With this object in view, two targets were made by the Admiralty for trial at Shoeburyness. The one (No. 34) represented the Admiralty principle, and had all its armour in one solid thickness of 14 in. The other (No. 35) was supposed to represent the other principle, as its armour was disposed in two thicknesses of 8 in. and 6 in. respectively, but for the following reasons it cannot be accepted as a fair representative of the War Office plan.

One of the chief advantages in the plate-upon-plate system is that the number of joints in any given surface to be protected may be diminished, and through joints may be dispensed with altogether; for as the thickness of an armour plate is diminished, in the same proportion may its superficial area be increased within certain limits; and it is also obvious that the joints of the plates in the two thicknesses of a plate-upon-plate structure may be laid out so that they shall break with each other. Now, the two targets made for this trial were both 14 ft. long, and 7 ft. 4 in. high, that being the least height of plating necessary for a large gun turret. As it is not possible to make a 14 in. armour plate of so great a width as 7 ft. 4 in., it was unavoidable that there should be either two vertical through joints in the armour of No. 34 target, or one horizontal through joint for the entire length of it. As there would be great difficulty in constructing the parts of an actual turret about its ports with narrow plates arranged vertically, No. 34 target, in order that it should represent one of our existing ship's turrets, was covered with two horizontal 14-in. plates, the longitudinal through-joint giving a central belt of weakness from end to end. Now, as already shown, there was no necessity whatever for this source of weakness in No. 35 target; for there would have been no difficulty in rolling an 8-in. plate, 7 ft. 4 in. wide and 14 ft. long, and even if there had been any doubt about that, two 7-in. plates of those dimensions could certainly have been made, and two 7-in. plates would stop a shot quite as well as an 8-in. and a 6-in. plate. Therefore, had No. 35 target been made to represent the War Office system, it would not have had any joint at all in either thickness, whereas it was actually made with a horizontal joint from end to end of each thickness, and to make matters worse, these joints were laid out precisely opposite to each other, so that there was a through-joint in the armour of this target corresponding exactly with that in No. 34.

Again, in No. 35 target the principle of holding on both thicknesses of armour by one set of through bolts was employed, contrary to the experience

gained in former experiments at Shoeburyness, which proved the advantage of bolting each armour plate separately to the armour next behind it, and the innermost plate to the skin, or supporting structure in rear.

However, notwithstanding these disadvantages, No. 35 actually compared favourably with the other in this trial, as the following account and the tables of practice will show.

The following detailed description of the targets is taken partly from the report of the special committee of officers under whom the trials were conducted.

The two targets were of the same outside form and dimensions, each being 14 ft. long by 7 ft. 4 in. high, $30\frac{1}{2}$ in. in thickness over all, and they were both curved to a radius of 15 ft. $7\frac{1}{2}$ in. on plan.

Their inner skins were also alike, each consisting of two $\frac{5}{8}$ -in. plates, breaking joint with each other, backed by vertical ribs, 10 in. by $3\frac{1}{2}$ in. by $\frac{1}{2}$ in., spaced at intervals of 1 ft. 7 in., and secured to the skin plates by two angle irons, $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by $\frac{1}{2}$ in. On the front side of the skin were two horizontal stringers, each consisting of an angle iron, 6 in. by $3\frac{1}{2}$ in. by $\frac{7}{16}$ in., riveted to the skin plates, and projecting into the wood backing.

In each target the total thickness of armour was 14 in., and of timber backing 15 in.

In No. 34 target, the armour was in one solid thickness of 14 in., disposed in two front plates, each 14 ft. long by 3 ft. 8 in. high, placed horizontally with the joint running right across the centre of the target. The upper armour plate was rolled by Messrs. J. Brown & Co., of Sheffield, and was curved in the process of rolling by being caught by "dogs" suspended from above. The lower plate was rolled by Messrs. Cammell, of Sheffield, and was curved whilst hot by hydraulic pressure. The oak backing was in two layers; the front layer 9 in. thick, set vertically, the other 6 in. thick, placed horizontally. There were 20 armour bolts, $4\frac{1}{4}$ in. in diameter, with conical heads, set in countersunk holes in the face of the armour plates, and secured on the rear of the skin by means of large hexagonal nuts on india-rubber washers in hexagonal cups. The shanks of the bolts were not reduced. The bolts securing the timber backing to the skin were $\frac{3}{4}$ in. in diameter.

In No. 35 target, the armour was in two thicknesses, of 8 in. and 6 in. respectively, separated by a 9-in. layer of oak timbers, placed vertically. The armour plates were all 14 ft. long by 3 ft. 8 in. high, and ran horizontally with a joint across the centre of each thickness. The upper plate in each thickness was made by Messrs. J. Brown, the lower by Messrs. Cammell & Co. The 6-in. layer of horizontal oak timbers was placed between the second thickness of armour and the skin. In addition to the 20 armour bolts of exactly the same pattern as those in the other target, there were 8 of $2\frac{3}{4}$ in. diameter, of similar construction, securing the second thickness of armour to the skin.

In each target there was a base plate and a top covering plate, each 1 in. thick, which were attached to the vertical ribs by means of triangular web pieces and angle iron. Through these plates were tapped a set of $1\frac{1}{2}$ in. screws, passing into the top and bottom edges of the armour plates. Holes were slotted near the ends of the base and top plates to receive rolled beams of I section,

which were set vertically against the end edges of the armour plates; keys were passed through these rolled beams at points just above the base plate and below the top plate. An angle iron was riveted on the top side of each top and base plate, close to its rear edge and for its entire length.

The targets were secured to the usual timber supports in rear by means of bolts passing through the angle irons on the top plates.

The method of holding these targets for the trial should be particularly noticed, because of its complete failure, as described hereafter.

The following guns were placed in battery at a distance of 200 yards:—

Nature.	Battering Charge, Pebble Powder.	Weight of Palliser Projectile.
12-in. M.L.R. of 25 tons	85 lbs. ..	600 lbs.
11-in. " "	85 lbs. ..	530 lbs.
10-in. " 18 tons	70 lbs. ..	400 lbs.

The experiments took place on the 4th, 5th, and 8th May, and 6th July, 1871.

No. 34 was struck altogether by nine projectiles, of which one was a 12-in. shot, two were 12-in. shell, and six were 11-in. large cored shot, of which one was used as a shell, with a bursting charge of 6 lbs., and one did not give a fair hit. The total effective energy represented by these rounds was about 53,000 foot tons, or 517 foot tons per square foot of target surface.

No. 35 received eleven blows, of which, however, three were not fair hits. These were made up of five 12-in. shell, three of which struck only the edge of the target; three 12-in. shot, of which one was a mere graze; two 11-in. large cored shot, of which one was used as a shell; and one 10-in. shot. The total effective energy of these rounds was about 52,000 foot tons, or 506 foot tons per square foot of surface.

The tables of practice will show that neither of these targets was pierced by any of the projectiles used, but it was considered that they afforded but little margin of protection against the 25-ton guns.

For the relative effects of each nature of projectile upon the two targets, the following rounds should be compared.

As regards the 12-in. shot, round 1792 compares with 1800, the depth of penetration on No. 34 target being 14.3 in., and on No. 35, 27 in. Of course, in these comparisons, allowance must be made for the 9 in. of wood between the armour plates in No. 35 target. On No. 35 target being taken to pieces, the indent on the inner armour plate, due to this round, was found to be 8 in. deep.

The 12-in. shell in Round 1794 on No. 34 target, compares with that in round 1820 on No. 35, the depths of penetration being respectively $10\frac{3}{4}$ in. and 23.5 in. On a subsequent examination of No. 35 target, the indent due to this round in the 6-in. plate was found to be $5\frac{1}{2}$ in. deep.

The 11-in. shot in round 1822 on No. 34, penetration 13.5 in., compares with that in round 1802 on No. 35, penetration 24 in. The depth of indent on the 6-in. plate by this round was found to be 7 in.

The 11-in. shell in round 1823, penetration $16\frac{1}{2}$ in., compares with round 1810, penetration 28 in., 7 in. of which formed the indent on the 6-in. plate.

There was no comparison obtained with the 10-in. gun.

As regards the effect of shot striking upon the joints of the armour, round 1803, from the 11-in. gun on No. 34 target, and round 1793, from the 12-in. gun on No. 35 target, may be used for comparison.

In most of these cases an apparent discrepancy occurs in regard to the total recorded penetrations in No. 35 target, as compared with the depth of indent in the second thickness of armour, added to the thickness of the front armour and wood backing between them. Thus in round 1800 the total penetration measured 27 in., while the indent in the second plate was 8 in., which added to the 8 in. of front plate and 9 in. of wood, gives a total of only 25 in. The difference is still greater in round No. 1820.

These and other similar differences are, no doubt, to be accounted for by the 9-in. interval between the armour having become locally increased, partly by the buckle of the inner plates, and partly by the front plates starting forward to some extent.

Also it will be noticed that the depth of penetration in the armour alone was generally greater in No. 35 target than in No. 34, and yet when the two targets came to be taken to pieces, the effect of the practice was unmistakably less on the inner skin of No. 35, than on that of No. 34. The separation of the moulds of one of the 14 in. plates, in No. 34 target, by which towards the end of the trial it was virtually split into two plates of 8-in. and 6-in. thicknesses, is also to be observed, and the performance of the armour bolts was far from satisfactory; see particularly "observed effects" in Tables II. and III., after rounds 1804, 1809, 1802, and 1812. Also most of the cup washers were burst.

It will be seen that at round 1809, No. 34 target was thrown down on its face; also that the same target which had been again set up, fell once more at round 1826, and that both targets had broken loose from their fastenings very early in the trial, see "observed effects" after rounds 1794 and 1802 in tables II. and III. This was entirely due to the very defective means employed to attach the targets to their supports, which depended, as before described, almost entirely upon some $1\frac{1}{2}$ inch. screws, tapped into the edges of the armour plates.

With regard to the relative efficiency of the different natures of projectiles used in this trial, the committee reported that the 11 in. cored shot when used as a shell, penetrated somewhat deeper than when used as a simple shot, and also deeper than either the 12 in. shot or the 12 in. shell, but the 12 in. cored shot gave a slightly deeper indent than the 11 in. cored projectile used as a shot. On the whole, the powers of these two guns may be considered as very nearly equal both as regards simple perforation and the general effects of battering.

As regards the comparative merits of the two systems of armour plating, the committee reported that, "Taking into consideration that the double plate system admits of the employment in turrets of armour plates of a breadth equal to the height of the turret, that thus through joints can be dispensed with, that the bolting and securing of the structure is facilitated, that the absolute cost is less, and that the total resistance does not appear to be practically affected, they preferred this (the double plate) construction to that in which the armour is disposed in one thickness."

TABLE II.

ARMOUR PLATING FOR TURRETS, TARGET No. 34.

Report of Practice on 4th, 5th, and 8th May, and 6th July, 1871.

Range 200 Yards.

Photographic No. of Round.	Gun.	Charge and brand of Powder. lbs.	PROJECTILE. Nature, length, total weight and diameter.	Striking Velocity. feet.	Total Energy in foot tons on Impact.	Energy per in. of shot's circum- ference. ft. tons.	Observed Effects.
1792	12-inch M. L. R., Expl. No. 372.	85 Pebble. 9.14. and 31. 5. 70.	Palliser shot. Head 1.5 D. 26.2 ins. 593 lbs. 11.92 ins.	1269	6622	176.8	Struck 6 ft. from right of top plate, 2 ft. 2 in. from top to centre of indent; diameter of indent 13 in. by 12.7 in., depth 14.3 in., crack across face of indent. The top plate set back 1.1 in. below centre of indent in a length of 9 ft., and canted out 0.5 in. at top and 0.4 in. at bottom. <i>In rear.</i> —13 washers started, and 8 rivets sheared from web piece at top of rib C*. Two rivet heads broken from flange of rib E; two of the wood bolts in wake of shot driven in about 1 in.; 34 countersunk rivets sheared from outside of top plate. The whole target started 0.5 in. forward at the right foot; ribs D and E buckled 0.3 in. The fragments picked up were: 4 pieces of iron washers. 10 rivets from inside. 34 rivets from outside of top covering plate. Struck on edge of a bolt 2 ft. 6 in. from left of lower plate, 1 ft. 5 in. from bottom; diameter of indent 12.5 in. by 13.3 in., depth 10.75 in. Front mould of armour plate broken away over an area of 16 in. by 5.4 in. at lower side of indent, and split completely through at bottom. Plate driven back below indent 1.5 in. as far as left edge; upper edge driven back 6 in. Shell burst and broke upon striking, indenting the face of the target. <i>In rear.</i> —4 iron washers started. The whole target started forward 0.7 in. at right bottom, and 3 in. at top (this moving of the target was due to the shearing of all the countersunk rivets, tapped into upper edge of top armour plate, and which were supposed to be sufficient to secure it to the top covering plate). The fragments picked up inside were:— 14 rivets from inside. 10 pieces of iron washers. 2 wood bolts. 1 rivet from top.
1794	"	"	Palliser shell. Head 1.5 D 29.2 ins. 601 lbs. Bursting charge, 11.14 lbs. 11.92 ins.	1258	6595	176.1	

* Ribs lettered from right to left. A, B, C, &c.

Photographic No. of Round.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, total weight and diameter.	Striking Velocity. feet.	Total Energy in foot tons on impact.	Energy per in. of shot's circum- ference, ft. tons.	Observed Effects.
1803	11-inch M. L. R. Expl. No. 394.	85 Pebble. 9.14, and 31. 5. 70.	Palliser shot. Head 1.5 D. 28.5 ins. 534 lbs. 10.92 ins.	1292	6181	180.2	<p>Struck 2 ft. 5 in. from proper right, 4 in. from top edge of lower plate, and penetrated to a depth of 24 ins., opened the joint by forcing the top plate up and the lower one down, the opening being 8 in. wide at right, diminishing to nothing at 12 in. from left end. Scoop made in top plate 12 in. by 2.5 in. on face and 1 ft. 1 in. deep; plate bulged out 2 in. round lip of scoop.</p> <p>The welding of the moulds at 6 in. from face of lower plate separated by a split .5 in. wide. The plate separated into five moulds at indent.</p> <p>Shot broke up on impact and was driven into wood backing, the vertical timbers of which were cut through along top edge of lower plate, for a length of 2 ft. 6 in.</p> <p>The iron struts on right side blown out 1 ft. 9 in. at top, and the adjoining vertical timber of backing driven violently out sideways.</p> <p>The armour bolt between indent and end of target forced about 0.75 in. to the front.</p> <p>In rear.—Rib A buckled 0.3 in.; rib B buckled 1 in. and bent 0.8 in. sideways; rib C buckled 0.5 in.</p> <p>The whole target broken loose from base and top covering plates; one armour bolt broken between ribs A and B (this is the one forced to the front).</p> <p>The fragments picked up inside were:—</p> <ul style="list-style-type: none"> 1 armour bolt head and nut. 6 wood bolt heads and nuts. 10 pieces of iron washers. 5 pieces of india-rubber washers. 2 iron washers from wood bolts. 13 inside rivets.
1804	"	"	"	1289	6152	179.3	<p>Struck upper plate 3 ft. 6 in. from proper left, and 2 ft. 8 in. from top; the centre of an armour bolt falling just on the outer lower margin of the indent.</p> <p>The shot plucked off the conical head of the bolt at 10 in. from face, driving it 38 yards to the front, and forcing the remainder of the bolt through the target so as to leave a clear opening to the interior. Diameter of indent 13 in., depth 19 in. Head of shot rebounded 6 yards to front, the body breaking up into long fragments. The visible penetration in wood backing about 3.5 in. The plate within indent separated into five moulds. There</p>

Photographic No. of Round.	Gun.	Charge and brand of powder, lbs.	PROJECTILE. — Nature, length, total weight, and diameter.	Striking velocity, feet.	Total energy in foot tons on impact. ft. tons.	Energy per in. of shot's circum- ference. ft. tons.	Observed Effects.
1804 contd.							<p>were two cracks from lower margin of indent to edge of plate, extending back through the plate; the three rear moulds appeared badly cracked through, the broken ends being forced down and showing between the plates.</p> <p>The armour bolt, above the one struck, now projected about 0.2 in.</p> <p><i>In rear.</i>—Rib G buckled 0.6 in., and bent sideways 0.5 in.; rib F buckled 1.7 inch, and bent sideways 0.8 in.</p> <p>A portion of armour bolt 2 ft. 9 in. long, with nuts and washers driven violently through the target, nearly cutting a timber strut in halves.</p> <p>The fragments picked up inside were:—</p> <ul style="list-style-type: none"> 1 armour bolt with nut and washer attached. 5 pieces of iron washers. 7 pieces of india-rubber washers. 1 wood bolt head and washer. 4 rivets. <p>GENERAL EFFECT. Back.—All washers of armour bolts more or less started; the cups of two bolts only remain unburst, and in both of these the flat iron washers are broken. One armour bolt is broken off at screw thread, and one has been driven bodily through the target.</p> <p>10 wood bolts broken off at screw thread, and 4 started back from 0.5 in. to 2 in. The whole of the rivets connecting target with top covering and base plates sheared; those connecting ribs and skin intact. 5 ribs slightly bulged.</p> <p><i>Front.</i>—6 armour bolts out of 20 remain unstarted. The vertical backing timbers driven up 2.75 inches in wake of round No. 1792, and also in wake of other rounds.</p> <p>The plates separated so as to expose the wood backing across the whole face of target about 8 in. on right, and 1.8 in. on left.</p> <p>Struck on top edge of target breaking away a piece of plate 20.5 in. by 11 in.; centre of indent 5 ft. 4 in. from proper left, and 3 ft. 2 in. from bottom of plate; the plate in interior of indent separated into 5 moulds; a piece of the top covering plate 1 ft. 10 in. by 2 ft. 6 in. carried away.</p> <p>One armour bolt, second from bottom on proper right of target, started out 2.5 in. to front (had evidently been broken at some</p>
1608	11-inch M. L. R. Expl. No. 394.	85 Pebble. 9, 14. and 31. 5. 70.	Palliser shot, Head 1.5 D. 28.5 ins. 530 lbs. 10.92 ins.	1305	6259	182.4	

Photographic No. of Round.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, Length, total weight and diameter.	Striking Velocity. feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference. ft. tons.	Observed Effects.
1808 contd.							previous round, the nut still on inside). <i>In rear.</i> —1 wood bolt broken off at screw thread. The fragments picked up were : 1 wood bolt with nut. 1 piece of armour plate. 1 piece of top covering plate. Target thrown down on its face. Struck top plate 5 ft. 11 in. from left, and 1 ft. 6 in. from top to centre of indent ; diameter of indent 16 in. by 12 in. Shot passed through plate and backing, broke up, and passed in fragments over skin, breaking in latter.
1809	11-inch M. L. R., Expl. No. 394.	85 Pebble. 9. 14. and 31. 5. 70.	Palliser shot. Head 1.5 D. 28.5 ins. 533 lbs. 10.92 ins.	1303	6275	182.9	The damage done by this shot joined that of round No. 1808, and completely broke up the portion of plate between indent and edge, the whole substance of the armour plate being removed for a width 3 ft. 6 in. (measured on top edge), excepting one fragment 18 in. by 9 in. on face, on right top, left attached by one corner. The wood backing destroyed over a triangular space of 2 ft. each way in plan,—roughly measured. <i>In rear.</i> —2 armour bolts, second and fourth from bottom, between ribs D and E, broken off, one at screw thread, the other 4 in. inside skin. A third armour bolt (top one) between ribs F and G, broken off at screw thread. 7 wood bolts broken off at screw thread. GENERAL EFFECT.—5 out of the 10 bolts holding upper plate broken, the plate having received 3 fair hits and two edge blows ; and 2 bolts broken in bottom plate after 2 hits.
1822	11-inch, M. L. R. Expl. No. 394.	85 Pebble. 21. 29. 8. 70. Lot 1642.	Palliser shot, large core. 28.5 ins. 537 lbs. 10.92 ins.	1263	5940	173.1	Struck lower plate 5 ft. 10 in. from proper left, and 19 in. (to centre of hole) from bottom ; diameter of hole 11 in. by 12 in. ; head of shot remained in hole 6 in. to inside of head ; total penetration 13.5 in. The plate cracked in two places below shot hole, the cracks being 8 in. apart and 4 in. long, up from bottom edge. On top edge the separation of moulds, caused by a previous round at 6 in. from face, increased to 0.5 in. in width ; a second separation of a 2-in. mould was found, the opening between it and 1st mould being 1 in., and between this and last rear mould (6-in.) a separation of 1 in. ; the rear mould cracked through 4 in. from rear in line of shot.

Photographic Record Round.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, total weight, and diameter.	Striking velocity. feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference, ft. tons.	Observed Effects.
1822 contd.							<i>In Rear.</i> —One wood bolt broken through head between ribs G and H, one rivet securing rib D to skin 2ft. 11 in. from bottom broken; skin and ribs considerably bulged in line of shot, could not be accurately measured, the surface being winding.
1823	11-inch M. L. R. Expl. No. 394.	85 Pebble. 21. 29.8. 70. Lot 1642.	Palliser shell* 28.5 ins. 5.42 lbs. 10.92 ins. Bursting charge, 6 lbs.	1265	6014	175.8	Struck lower plate 5 ft. from right, edge of hole 7 in. from bottom; diameter 11 in. by 12 in.; portion of shell up to front stud remained in plate; total penetration 16.75 in. The plate broken through below indent to edge; the gape at edge 1.5 in.; plate driven in 1 and 2 in. at side of crack. The 2nd bolt from proper right in bottom row now stood out 0.5 in. (broken). The separation of moulds previously noted on top edge now increased in width to 1.25 in. above indent. The target driven back bodily 2 ft. 5 in. at proper right. <i>In Rear.</i> —One armour bolt, 2nd from proper right in lowest row, broken at screw thread. One of the temporary horizontal struts (14 in. by 14 in. by 8 ft. 6 in.) against the foot of the target in line of shot was split up from end to end. The fragments picked up were: 1 armour bolt head and nut. The shot first cut off the stump of a pile and grazed an old armour plate laid in front of the foot of the target, it then struck the lower plate 12 in. from bottom, and 4 ft. 7 in. from right. The point of the shot penetrated to wood backing, the plate being broken through from hole to bottom edge, and opened 6 in. at back of bottom edge. Target thrown on its face. <i>In Rear.</i> —Third armour bolt from right of bottom row started in 1 in., probably broken, but the fact could not be ascertained for certain, owing to the position of the target. GENERAL REMARKS. —After the practice of 8.5.71, it was found that, both targets had entirely broken loose from their supports, and one had fallen on its face. Owing to the shearing of the connections between the thin top and base plates, and the body of the targets, it was not possible to refix them to strutting of the construction usually employed, and they could only be shored up in a temporary manner by timbers placed against the shot holes, which had to be replaced and altered every round.
1826	12-inch M. L. R. Expl. No. 372.	"	29.2 ins. 599.5 lbs. 11.92 ins. Bursting charge, 13.5 lbs.	1222	6208	165.8	

* This was a large cored shot used as a shell.

TABLE III.

ARMOUR PLATING FOR TURRETS, TARGET NO. 35.

Report of Practice on the 4th, 5th, and 8th of May, and 6th July, 1871.

Range 200 Yards.

Photographic No. of Round.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, total weight and diameter.	Striking velocity. feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference. ft. tons.	Observed Effects.
1793	12 inch M. L. R. Expl. No. 372	85 Pebble. 9. 14. 31. 5. 70.	Palliser shot, Head 1.5 D. 23.2 ins. 595 lbs. 11.92 ins.	1268	6529	174.4	Struck 5 ft. 9 in. from proper left on junction of plates, 3.5 in. of indent on lower plate, dia- meter of indent 13 in. by 14 in. Plates opened out 1.6 in. at left, and 0.3 in. at right end of target, the supporting frame at left end being driven back 0.6 in. and forced up 1 in. Head of shot re- mained in indent, the body having broken up; penetration found to be 27 in.; point of shot just through junction of rear plates, the rear wood backing being visible. <i>In rear.</i> —9 washers started; 1 small armour bolt and 6 rivets broken; ribs E and F buckled, the former 1.5 in. and the latter 0.5 in. Horizontal joint of skin in wake of shot opened, and up- per half driven in 1.2 in. upon lower half, between D and E ribs. The bottom or sill plate started 0.5 in. from framing. The fragments picked up were: 1 armour bolt head and nut. 6 inside rivets. 12 pieces of iron washers. 26 rivets from outside of top covering plate.
1795	"	"	Palliser shell, Head 1.5 D. 29.2 ins. 603.8 lbs. Bursting charge, 12.8 lbs. 11.92 ins.	1254	6584	175.8	Struck 4 ft. 4 in. from proper right, and 9 in. from bottom of lower plate; depth of indent in armour 10.5 in. Shell cut a scoop out of plate and passed down- wards through base plate, making a hole 4 ft. deep in ground; burst. The edge of lower plate buckled 4.5 in. in a length of 6 ft. <i>In rear.</i> —11 iron washers start- ed; 1 timber strut broken and 1 badly sprung; top covering plate started up 2.2 in. The fragments picked up in- side were:— 4 pieces of iron washers. 9 rivet heads from inside. 2 wood bolts. 2 rivets off top covering plate. Struck top of target and glanc- ed off, breaking up on striking roof of the Plymouth Breakwater Fort target. No result on No. 35 target.
1799	"	"	Palliser shot, Head 1.5 D. 26.2 ins. 592 lbs.	—	—	—	

Photographic No. of Round.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, total weight, and diameter.	Striking velocity. feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference. ft. tons.	Observed Effects.
1800	12-inch M. L. R. Expl. No. 372.	85. Pebble. 9.-14.- 31. 5. 70.	Palliser shot. Head 1.5 D. 26.2 inches. 594 lbs.	1262	6560	175.2	<p>Struck top plate 2 ft. 3 in. from top, 5 ft. from proper right. Shot penetrated its whole length into target and there remained, the base being 0.6 in. inside face, and cracked in 4 radial fissures. Outer plate cracked through, from bottom of hole to edge 0.4 in. Plate bent in below shot hole, 0.7 in., which extends to 1793 on one side, and for a length of 1 ft. 2 in. on the other.</p> <p><i>In rear.</i>—Ribs C and D buckled, the former 4 in. and the latter 3.8 in. 2 large and 1 small armour bolts broken off at screw thread (the small one in wake of shot, and the others on either side). Skin buckled in 5 in. between ribs C and D, and cracked horizontally at maximum of buckle, 5 ft. above base plate; foot of rib O driven 4 in. upon base plate, and the latter started forward 0.5 in. at left corner.</p> <p>The fragments picked up inside were:—</p> <ul style="list-style-type: none"> 14 pieces of iron washers. 4 pieces of india-rubber packing. 2 large } armour bolt heads 1 small } and nuts. 1 wood bolt head and nut. 6 rivets (inside). 1 rivet from outside of top covering plate.
1802	11-inch M. L. R. Expl. No. 394.	"	Palliser shot. Head 1.5 D. 28.5 inches. 536 lbs. 10.92 inches.	1291	6194	180.6	<p>Struck on lower plate 1 ft. 10.5 in. from proper left, 2 ft. 3 in. from bottom; head remained in plate; diameter of indent 12 in. by 12.8 in., depth 14.65 in. to inside of core of shot; total penetration 24 in. Plate cracked through from top of indent to edge 0.9 in. Shot struck between 4 armour bolts, all of which are drawn through the plate, No. 1-0.3 inch., No. 2-0.4 in., Nos. 3 and 4-0.1 in. Plate driven back bodily about 3 in. in line of indent; upper plate projecting 0.6 in. above lower, at indent. Left front strut jumped out of base plate by the lifting up of the 1 in. top covering plate, and buckled by cracked off piece of armour plate; one timber of wood backing between armour plates driven out sideways.</p> <p><i>In rear.</i>—Rib G buckled 0.8 in. and bent sideways 0.5 in.; rib H bent sideways 0.9 in. (point of impact being nearly midway between them); foot of rib H driven in 0.6 in. on base plate; 1 small</p>

Photographic No. of Round.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, total weight, and diameter.	Striking Velocity, feet.	Total energy in foot tons on impact.	Energy per in. of shot's circum- ference, ft. tons.	Observed Effects.
1809 contd.							<p>armour bolt broken off at screw thread in wake of shot. The fragments picked up inside were:—</p> <p>1 small armour bolt head and nut.</p> <p>4 pieces of iron washers.</p> <p>12 inside rivets.</p> <p>3 wood bolt heads.</p> <p>GENERAL EFFECT. Back.—All the washers (except three small ones) of the armour bolts, more or less started, and the cups burst excepting the 3 above-mentioned and 2 large ones. 2 large and 3 small armour bolts broken at screw thread; 4 wood bolts broken and 1 started. The whole of the rivets connecting the target with top covering and base plates sheared, thus allowing the target to move; 3 connecting ribs with skin intact; 6 ribs bulged, and skin torn and bulged, between C and D ribs; one angle iron of D cracked through a rivet hole.</p> <p>Front.—Only 5 armour bolts unstarted out of 20. 2 vertical timbers from between armour plates in wake of 1793, 2 in wake of 1800, and 1 in wake of 1804, driven up 3 in.</p> <p>Struck 3 ft. 6 in. from proper left, and 1 ft. 6 in. from top of upper plate; diameter of indent 12 in. by 11 in., edge of indent 3 in. from a bolt; crack 7 in. long from bottom of plate to bolt in lower row; the bolt started out 0.3 in. Penetration 28 in., the point of shell showing just through inner plate, which is starred. The bolt alongside of indent visible at back. (This round started out No. 1800, 3.3 in. from face of target.)</p> <p>In rear.—1 small armour bolt (2 ft. from top) broken at screw thread, between ribs C and H. 1 large armour bolt (2nd from top) broken between ribs F and G; the skin between these ribs bulged 2.5 in., 1 ft. 8 in. from top, and driven in at the horizontal joints, 1 and 4 ft. below the top, 1 and 5 in. respectively. One rivet (the first) broken from the skin, between F and G ribs at lower horizontal joint. A quantity of teak from the outer layer of backing driven in between top covering 1 in. plate, and top of target. The inner layer of back-</p>
1810	11-inch M. L. R., Expl. No. 394.	85 Pebble, 9. 14. 31. 5. 70.	Palliser shell* Head 1.5 D. 538 lbs. Bursting charge 4 lbs. in bag.	1306	6363	185.5	

* This was a large cored shot used as a shell.

Photographic No. of Round.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, total weight, and diameter.	Striking velocity. feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference. ft. tons	Observed Effects.
1810 contd.							ing now projected 5 in. above top of skin. The fragments picked up were : 11 pieces of iron washers. 7 pieces of india-rubber washers. 7 pieces of armour. 7 pieces of shell. 14 pieces of wood. 4 rivet heads (one of these from skin).
1812	10 inch M. L. R. Expl. No. 381	70, Pebble. 9. - 14. - 31. 5. 70.	Palliser shot, Head 1-6 D. 24-5 ins. 398 lbs. 9-92 ins.	1325	4845	155-5	Target strutted up in front before firing. Struck 7 ft. 6 in. from proper right, 1 ft. 10 in. from bottom of lower plate ; diameter of indent 10 in. by 10-6 in. ; depth of penetration 22-5 in., at an angle of 4 degs. from line of fire. <i>In rear.</i> —2 wood bolts broken off at screw thread. The fragments picked up were : 4 pieces of iron washers. 1 piece of india-rubber washer. 2 splinters of teak backing. 2 wood bolt heads and nuts. GENERAL EFFECT. 4 of the through armour bolts broken in top plate, being 2nd, 3rd, 4th, and 5th from proper right in 2nd row, the plate having received 3 fair and 1 glancing hits ; none broken in bottom plate, after 3 fair and 1 "scooping" hits. Of the small bolts 3 out of 4 in upper plate broken, and 1 out of 4 in lower plate.
1819	12-inch M. L. R. Expl. No. 372.	85 Pebble 21.-29.8.70. Lot 1642.	Palliser shell, 29-2 ins. 601-5 lbs. 11-92 ins. Bursting charge, 13-5 lbs.	—	—	—	Struck 14 in. from bottom of lower armour plate on proper right edge of target, made a slight scoop and glanced off, carrying away side stay. <i>In Rear.</i> —No result, except the shaking off of a fragment of a damaged iron washer.
1820	"	"	" 599-25 lbs. Bursting charge, 13-25 lbs.	1218	6164	164-6	Struck lower plate, edge of hole 3 ft. from proper right, and 10 in. from top ; diameter of hole 14-5 in. by 14 in., edge of hole 9 in. from edge of round 1795, a wide crack joining both holes ; upper edge of hole 1 in. from a bolt. Head of shot remained in target ; penetration to inside of head 16 in. ; total penetration 23-5 in. The plate on left of indent driven in 2-5 in. half round it for a space of 8 in. Two bolts at top of plate broken, the one below hole driven in 0-5 in. An old crack from round 1792 extended into round 1812, and a new one from 1812 to bolt hole below it. The dis-

Photographic No. of Round.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, total weight, and diameter.	Striking velocity, feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference, ft. tons.	Observed Effects.
1824	12-inch M. L. R. Expl. No. 372.	85 Pebble, 21-29.3.70. Lot 1642.	Palliser shell, 29.2 ins. 593 lbs. Bursting charge, 13 lbs.	1227	6191	165.3	<p>tance between rounds 1820 and 1812 was 4 ft. The plate driven in so as to alter the curve above the hole; the plates now 2 in. apart above the hole, and 0.75 in. at right edge.</p> <p><i>In Rear.</i>—Two large armour bolts, 1st and 2nd from right in 2nd row from bottom, broken at screw thread, head of one thrown 5 yards to rear.</p> <p>The fragments picked up inside were:—</p> <p>6 pieces of iron washers. 3 pieces of india-rubber washers. 2 large bolt heads and nuts.</p> <p>Struck top edge of target close to round 1799, and burst on top covering plate.</p>
1825	"	"	592.4 lbs. Bursting charge, 13.4 lbs.	1235	6265	167.3	<p>Struck lower edge of upper plate 2 ft. 9 in. from right, cutting a piece out 2 ft. long on edge, 10 in. high; a bolt on the upper edge of the hole driven in 5 in.; a slight scoop only on lower plate. No mark of the shot on the rear 6 in. plate, the whole of the fragments having passed out at side between the two armour plates. The proper right of upper plate now 5.5 in. behind lower plate, the opening between them being 6 in. at right, and 3 in. below round 1800. The whole target was driven back 2 ft. by this round.</p> <p><i>In Rear.</i>—Large armour bolt, 2nd from right in 3rd row from bottom, driven in 5 in. The shell exploded between the two armour plates, the effects passing out to proper right. The conical head of 1st large armour bolt on top row broken off inside front plate, by the rising of the latter; one wood bolt strut broken.</p>

PROOF TARGET No. 33.

The only other practice against armour plates to be noticed here is that which has been carried on, from time to time during the past summer and autumn, for the proof of service projectiles made in the Royal Laboratory Department, and also to test the qualities of shot and shell of different make and metal.

The target used for this purpose was one made in the course of last year, and was of the following construction.

It was 48 ft. long and 9 ft. high. For 18 ft. of its length it was an exact

repetition of the targets described in Vol. XVI., page 131, and Vol. XVIII., page 266, and which answered so well the purpose for which they were designed—namely, that of affording throughout an uniform resistance sufficient to stop 9-in. Palliser projectiles of average quality, fired direct with battering charges at 200 yards. This part of the present target, called in Table IV. the “8-in. portion,” was therefore made up of 8-in. armour backed by 18 in. of teak in two layers, one vertical and the other horizontal, supported in rear by a skin of $\frac{3}{4}$ -in. plate, in three tiers running horizontally, the joints in the skin being covered on the front side by strips 12 in. wide by $\frac{3}{4}$ in. thick.

On the back of the skin were vertical ribs, 7 in. deep, spaced $12\frac{3}{4}$ in. apart, made up of angle irons, 7 in. by $3\frac{1}{2}$ in. by $\frac{1}{2}$ in., each being attached to the skin by two angle irons, 3 in. by $2\frac{1}{2}$ in. by $\frac{1}{2}$ in.

The armour plates were 4 ft. 6 in. wide, and ran horizontally. On this part they were held on by 36 conical headed 3-in. bolts, with plus threads and plain hexagon nuts and washers. Ten of these armour bolts were 7 ft. long, and were nutted at the back of the timber frames supporting the target in rear. The remaining 16 bolts were nutted with similar nuts and washers on the back of the skin.

The timber was held on to the skin by a separate set of 1-in. bolts.

The front armour plates of the remaining 30 ft. of this target, called in the tables the “13-in. portion,” were the same as before—namely, 8 in. thick and 4 ft. 6 in. wide; but in the 18 in. space behind them, filled in the other portion with teak, there was placed a 5-in. thickness of armour between two layers of $6\frac{1}{2}$ in. of teak. These were arranged as follows. The front layer of teak between the 8-in. and 5-in. armour stood vertically. The 5-in. armour was made up of two plates, each 15 ft. long and 9 ft. broad, so that there was no horizontal joint in this thickness. The teak in the layer behind the 5-in. plates was placed horizontally.

The skin of this portion was made up of two thicknesses of $\frac{3}{4}$ -in. plate, the front one of which was composed of three tiers of horizontal plates about 3 ft. 3 in. wide, and the rear one of plates 3 ft. 2 in. wide, standing vertically.

The ribs were vertical, and spaced as in the other portion, but they were here 10 in. deep instead of 7 in., and were made up of angle irons, 10 in. by $3\frac{1}{2}$ in. by $\frac{1}{2}$ in., attached to the skin by means of two angle irons, 3 in. by $2\frac{1}{2}$ in. by $\frac{1}{2}$ in. With this spacing of the ribs every third rib covered a vertical joint in the rear thickness of skin plating. All the joints in the front thickness of skin were covered by strips 12 in. wide by $\frac{3}{4}$ in. thick.

The front armour plates were held to the 5-in. plates by thirty-one 3-in. bolts with spherical nuts at each end, set in cup-shaped holes. The inner armour was held on by twenty-four 3-in. bolts with spherical nuts on their front ends, and common hexagon nuts on their rear ends at the back of the skin, or, as in the case of fourteen of them, at the back of the timbers of the supporting framework in rear of the target. From end to end of the target, at its top and bottom, there was an angle iron, 7 in. by $3\frac{1}{2}$ in. by $\frac{1}{2}$ in., securely attached to the ribs for the purpose of confining the back layer of teak.

The principal points deserving attention in the tables of practice against this target are the following :

1st—That the 11 in. large cored Palliser projectile, whether used as a shot or a shell, passed clean through the 13 in. portion when fired direct at it at 200 yards (see rounds 1830, 1832, 1842, with battering charges of 85 lbs. of pebble powder, and 1843 with a reduced charge of 75 lbs. of the same powder); whereas in the trial of No. 35 target before described, which was protected by 14 in. of armour, disposed in a similar way, the 11 in. projectiles fired at the same range with battering charges were stopped (see rounds 1802 and 1810 in Table III.) Unless there be some unexplained cause of weakness in the armour of No. 33 target, which however cannot be detected until it is taken to pieces, or a great difference in the quality of the projectiles, the "margin of protection" in the case of No. 35 must have been even less than the committee supposed.

2nd—As regards the 10-in. gun (rounds 1851-2) against the 13-in. portion of this target no reliable results were obtained, as one struck on the joint of the front armour, and the other on the joint of the inner armour. The fact of the target having been set on fire in both of these rounds deserves notice, especially as it occurred with a shot as well as a shell. This is the first instance on record of a *shot* setting fire to timber.

3rd—The effect of the 9-in. projectiles fired direct at the 8-in. portion of this target bore out generally the results obtained with similar targets in the years 1866 and 1869. On the present occasion the Palliser shell (round 1829) passed through the target, and the shot did not, (round 1827 and 1828). Of the only two fair hits with 9-in. steel shell, one (round 1839), the velocity of which was not taken, very nearly passed through, and the other (round 1841) with a reduced velocity, passed quite through the target. When fired obliquely at this portion, the 9-in. Palliser shot striking at angles of 65 deg. and 66 deg. went through the target in one instance (round 1859), and very nearly through in the others (rounds 1857 and 1858). To reconcile these results with rounds 1827 and 1828, when the shot striking direct only bulged and cracked the skin slightly, the difference of energy of about 97 to 158 foot tons must be taken into account, as also perhaps some difference in the quality of the shot.

4th—The singular uncertainty that seems to attend the oblique blows of pointed projectiles on armour, is particularly noticeable in rounds 1860 and 1861, where of two similar shot striking at an angle of 60 deg., one merely made a graze in the plate $3\frac{1}{2}$ in. deep, and the other went through the armour and deep into the target.

In round 1856 it will be noticed that a shot striking at an angle of $64\frac{1}{2}$ deg. turned in so that its head was bedded in the plate with its axis as nearly as possible perpendicular to the face of the target.

5th—The fact of the timber of this target having been again set on fire by a *shot* in round 1863, is too important to be overlooked.

6th—The two rounds (Nos. 1836 and 1837) with Palliser large cored shot, used as shell, from the 9-in. gun, against the 13-in. portion of the target, are

interesting, as they were intended to test the value of Mr. Abel's new explosive compound of ammonium-picrate and saltpetre, to which he has given the name of "picric powder."

Mr. Abel, in a lecture delivered at the meeting of the British association at Edinburgh, in August, 1871, while speaking of this material, says:—"If the mixture is strongly confined, as in shells, it explodes violently, and exerts a destructive action less formidable than that of gun-cotton, nitro-glycerine preparations, and potassium-picrate powder, but considerably greater than that of gunpowder, and, therefore, it is likely to prove a valuable substitute for the latter when greater violence of action is desired with shells of small capacity." He also speaks as to his experiments having established its safety and stability for naval and military uses, and as to its preparation being at any rate not more dangerous than the manufacture of gunpowder.

The single instance (round 1837) in which a bursting charge of picric powder has been used in a shell for attacking an armour plated structure, cannot fairly be taken as affording conclusive results, but, as a matter of fact, the effect upon this target of the 4 lb. bursting charge of picric powder in round 1837 was certainly not greater than that of the 3 lb. 11 oz. of powder in round 1836. What the effect may be with this agent, when used in shells under circumstances where the explosion shall find less free vent than in the present instance, remains to be proved by further experiment.

Nov. 1871.

T. I.

TABLE IV.
PROOF TARGET N^o. 33.
Report of Practice on the 20th June, 12th and 21st July, and
9th November, 1871.—Range 200 Yards.

Photographic No. of Round.	Target.	Gun.	Charge and brand of Powder. lbs.	PROJECTILE. — Nature and total weight.	Striking Velocity. feet.	Total energy in foot tons on impact.	Energy per in. of shot's circum- ference, ft. tons.	Observed Effects.
1816	8-inch portion.	9-inch M.L.R., No. 247.	43 R. L. G. 12. 7. 70. Lot 1626.	Palliser shot, small cored. 249 lbs. 1.25 D. head,	1324	3027	108.0	Struck on lower plate, 12 in. from right end and 4.5 in. from top, inclined off to left, and scooped out a piece of the plate 18 in. by 14 in.; broke large timber support in halves; top plate raised up 1 in. at point of impact, touching at other end. <i>In rear.</i> —Nos. 1 and 2 ribs broken, No. 1 at 4 ft., and No. 2 at 4 ft. 9 in. from bottom; skin at point of impact bulged 3 in.; armour bolt on edge of shot hole driven back 15 in.; 5 rivets and 15 wood bolts broken; 1 wood bolt driven out by shot; several washers slightly started.
1817	"	"	"	"	1335	3077	109.8	Struck top of target 6 ft. 4 in. from right end, and took away a piece of plate 18 in. at top by 12 in. vertical. Armour bolt on edge of shot hole driven in 1.5 in. The fracture showed deficient welding in the plate. <i>In rear.</i> —Nil.
1818	"	"	"	"	1318	2999	107.0	Struck on junction of plates 4 ft. 3 in. from right end. THROUGH. Diameter of hole 10 in. by 9.2 in. <i>In rear.</i> —Angle iron broken in two. Armour bolts close to right edge of shot hole not moved, but washers twisted inwards by bulging of skin and angle iron. 2 wood bolts and 10 rivets broken. Head of shot recovered and examined, point unchanged in form, and about 2 in. of sand body remaining.
1827	"	"	"	251 lbs. 1.5 D. head.	1292	2905	103.7	Struck upper plate 6 ft. 4 in. from proper right, and 12 in. from bottom. Diameter of indent 10 in. by 10.5 in.; edge of indent touching a bolt head. Shot remained in hole, depth 7.5 in. to back of head of shot. Total penetration 13.5 in. <i>In rear.</i> —Two ribs in path of shot buckled 1 in. and 0.7 in., respectively, and one of them cracked slightly; one wood bolt between the ribs started in. No rivets started.
1828	"	"	"	large cored. 244 lbs. 1.5 D. head.	1306	2969	105.9	Struck upper plate 9 ft. 6 in. from proper left, and 14.5 in. from bottom. Diameter of indent 9.3 in. by 9.3 in. Shot head remained in hole, depth to back

Photographic No. of Round.	Target.	Gun.	Charge and brand of powder, lbs.	PROJECTILE. Nature, and total weight.	Striking velocity, feet.	Total energy in foot tons on impact.	Energy per in. of shot's circum- ference, ft. tons.	Observed Effects.
1828 contd.								of plug (driven into fore end of core) 18 in. Total penetration about 24 in. <i>In rear.</i> —Two ribs in path of shot buckled 2 in. and 3 in. respectively, and both broken across rear flange. Two rivets in skin, and two connecting ribs to skin, broken; skin slightly bulged and cracked beside the rib most buckled.
1829	8-inch portion.	8-inch M.L.R., No. 247.	43 R. L. G. 12. 7. 70. Lot 1626.	Palliser shell, 250 lbs. Bursting charge, 5 lbs. 8 ozs.	1315	2998	107.0	Struck lower plate 7 ft. 9 in. from proper right, and 24 in. from bottom. THROUGH. Diameter of hole 9.5 in. by 9.5 in. <i>In rear.</i> —THROUGH, making a hole in skin about 1 ft. 6 in. square, and carrying away a portion of one rib; 4 rivets round the margin of the hole broken; 77 lbs. of shot, in 29 pieces, picked up inside target. 1 wood bolt and 10 rivets picked up in rear.
1831	"	"	"	Palliser shot, large cored, 248 lbs., filled with 4 lbs. powder. 1.5 D. head.	1306	2933	104.7	Struck on junction of upper and lower plates. THROUGH. The burst took place in rear of the target. <i>In rear.</i> —THROUGH, midway between two ribs; one armour bolt head just in upper margin of hole broken off at screw thread, and thrown violently to rear. About 2 ft. 8 in. of the web of the rib on left of the hole (damaged by round 1828) now broken away; skin cracked from hole to horizontal joint, length of crack about 9 in.; 11 rivets and 2 wood bolts broken round the margin of the hole. 2 wood bolts and 30 rivets picked up; 30 fragments, weighing 112 lbs., found in rear.
1833	"	"	"	Swedish (Finspong) solid chilled shot, 253.5 lbs. 1.25 D. head.	—	—	—	Struck on upper plate 7 ft. 6 in. from proper right, 15 in. from bottom of plate, close to an old shot hole (No. 1827); shot broke up, head remaining in plate—deflected downwards and to the left at an angle of 45 degrees. <i>Missed both wire screens.</i> <i>In rear.</i> —Rib buckled 1.7 in., and broken $\frac{1}{2}$ in. at rear flange; angle iron cracked.
1834	"	"	"	"	1307	2997	106.9	Struck 3 ft. from proper right, and 5 in. from top of lower plate, partly on hole made by No. 1818; shot broke up and passed THROUGH.
1835	"	"	"	Firth's steel shell, 248.75 lbs. Bursting charge, 7 lbs. 12 ozs.	1306	2942	105.0	Missed target, and lodged in brickwork of casemate in rear.

Photographic No. of Round.	Target.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, and total weight.	Striking Velocity. feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference. ft. tons.	Observed Effects.
1836	13-inch portion.	9-inch M. L. R. No. 247.	43 R. L. G. 12. 7. 70. Lot 1626.	Palliser large cored shot, 244.7 lbs., filled with 3 lbs. 11 ozs. powder, 1.5 D. head	1310	2912	103.9	Struck lower plate 3 ft. from proper right, and 1 ft. from bot- tom. Diameter of indent 9.5 in. by 10 in. Head of shot remain- ing in indent. Total penetration 18.2 in. <i>In rear.</i> —6 rivets in skin, and 18 rivets connecting skin and ribs, broken; 1 wood bolt broken. Struck lower plate 4 ft. 1 in. from proper right, and 2 ft. 6 in. from bottom. Diameter of in- dent 9.3 in. by 9.5 in. Head of shot remaining in indent. Total penetration, 17.9 in. <i>In rear.</i> —Rib in shot's path driven 3 in. into lower timber. 16 rivets broken, and 2 loosened. Grazed on ground 12 ft. in front of target, and ricocheted on to face, point uppermost; scoop, 15 in. long, 5 in. wide, and 3 in. deep.
1837	"	"	"	245 lbs. filled with 4 lbs. picric powder.	Not ob- servd.	—	—	
1838	8-inch portion.	"	"	Firth's steel shell, 247.6 lbs., Bursting charge, 6 lbs. 9 ozs.	"	—	—	
1839	"	"	"	247.9 lbs. Bursting charge, 7 lbs. 14 ozs.	"	—	—	Struck upper plate 11 ft. 6 in. from proper right, and 2 ft. 8 in. from bottom. Diameter of in- dent 9.7 by 9.8 in. Shell burst in wood backing. Head remained in target, but its point, un- changed in form, protruded 8.25 in. through inner skin. <i>In rear.</i> —Skin cracked verti- cally down to horizontal joint; 2 ribs cracked through.
1840	"	"	"	Swedish (Finspong) cored chilled shot, 250.5 lbs., 1.25 D. head.	1281	2850	101.7	Struck upper plate 11 ft. 9 in. from proper right, and 1 ft. 6 in. from top. Diameter of indent, 12 in. by 9 in.; penetration about 11.5 in. Point of shot turned upwards at an angle of 45 deg. A portion of about 13 in., inclu- ding head, rebounded 5 ft. to the front, with 6 or 8 long fissures in it. This was ultimately broken in halves at the tenth blow of a heavy sledge hammer.
1841	"	"	"	Firth's steel shell, 249.6 lbs. Bursting charge, 7 lbs. 10 ozs., enclosed in double bag.	1261	2752	98.2	Struck upper plate 6 ft. from proper left, and 1 ft. 9 in. from top, bursting well in wood backing, which it set on fire. THROUGH. Diameter of hole 9 in. by 9 in. <i>In rear.</i> —2 ribs broken and twisted; skin cracked through from hole upwards to horizontal joint. Most of the fragments of shell fell close to back of target.
1830	13-inch portion.	11-inch M. L. R. Expl. No. 394.	85 Pebble. 9. 5. 70. Lot 1621.	Palliser shot, large cored, 530 lbs., 1.5 D. head	1250	5742	167.4	Struck upper plate 8 ft. 5 in. from proper right, and 15 in. from bottom. THROUGH. Dia- meter of hole 11 in. by 11.5 in. The plate lifted up 1.25 in. at proper right end. <i>In rear.</i> —THROUGH, almost in line of a rib; the rib was much twisted and torn from the skin for its whole length; 36 rivets connecting the 4 adjoining ribs

NOTE.—One of the Firth's steel shells was found cracked when taken from store.

Photographic No. of Round.	Target.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. Nature, and total weight.	Striking Velocity. feet.	Total Energy in foot tons on impact.	Energy per in. of shot's circum- ference. ft. tons.	Observed Effects.
1830 contd.								
1832	13-inch portion.	11-inch M. L. R., Expl. No. 394.	85 Pebble. 9. 5. 70. Lot 1621.	Palliser shot, large cored, 533·4 lbs., filled with 6 lbs. powder, 1·5 D. head.	1275	6013	175·3	<p>to skin broken, and 5 rivets in skin itself. The ribs on either side of the detached rib were started 0·5 in. off the skin, and buckled 1·2 in. and 2·4 in.; skin bulged over a space of about 3 ft. square with a starred opening in centre, the shot having burst on its way through the skin without carrying any away; 38 rivets picked up. The head of the shot (weight 228 lbs.), after passing through, indented an iron target in rear, and was picked up some distance to right; 37 fragments, weighing 137 lbs., also found in rear.</p> <p>Struck upper plate 16 ft. 6 in. from proper left, and 2 ft. from bottom. THROUGH. Diameter of hole 11 in. by 11·4 in. Shell burst in passing through.</p> <p>In rear.—THROUGH, bursting in the thickness of the target and setting the wood backing on fire. One piece of teak belonging to front layer of backing was forced out at top, thrown high in air, and fell behind the target; the ribs on either side of the hole twisted aside and started off the skin, one for its whole length, the other for about one-third of its length, and broken in shot's path so as to gape 2·5 in. at back; 10 of the rivets attaching this rib to skin broken, the next rib beyond had 5 rivets broken, the rib next beyond the detached one buckled 2·3 in. backwards, and 1·9 in. sideways, and 8 of its rivets broken, the next rib beyond had 3 rivets broken; 5 skin rivets broken. The hole in the skin was nearly circular, a piece about 12 in. in diameter having been broken away from front skin plate, and a piece 15 in. in diameter out of the rear one.</p> <p>30 fragments, weighing 101 lbs., were found in rear; 36 rivets were picked up.</p>
1842	"	"	31. 5. and 14. 9. 70. Lot 1621.	Palliser shell, 527 lbs. Bursting charge, 9 lbs. 1·5 D head.	1258	5783	168·6	<p>Struck lower plate 18 in. from top, and 3 ft. 6 in. from proper right. THROUGH. Shell burst when passing through skin. Diameter of hole 11·6 in. by 11·2 in.</p> <p>In rear.—Rib on right of shell hole rent through its whole length, and much twisted. Rib on left buckled sideways 3 in., and backwards 3·25 in. Hole in skin 12 in. diameter.</p>
1843	"	"	75 "	Palliser large cored shot, 539 lbs. filled with 5 lbs. powder. 1·5 D head.	1184	5239	152·7	<p>Struck upper plate 19 in. from proper left, and 16 in. from bottom, close to a bolt head. THROUGH. Diameter of hole 11·1 in. by 11·2 in.</p>

Photographic No. of Round.	Target.	Gun.	Charge and brand of Powder. lbs.	PROJECTILE. — Nature, and total weight.	Striking Velocity. feet.	Total Energy in foot tons on impact.	Energy per in. of shot's circum- ference. ft. tons.	Observed Effects.
1843 contd.								<i>In rear.</i> —2 ribs detached from skin their entire length; one on left broken. Shot burst apparently on passing through the skin; it struck near centre of space in which 40 rivets had been previously broken by rounds Nos. 1836 and 1837.
1851	13-inch portion.	10-inch M. L. R., No. 2.	70 Pebble.	Palliser large cored shot, head 1.5 D. 26 ins. 395 lbs. 9.92 ins.	1345	4955	159.0	Struck lower plate 14 ft. from proper left of target, and on junction of 5 in. plates; head and part of body of shot remained in target. <i>In rear.</i> —Struck between two ribs, bulging and breaking both in halves, 3 ft. 9 in. and 4 ft. 6 in. from bottom; rivets of one rib sheared from top to bottom; point of the shot projects about 3 in. through the skin, which is much bulged and torn. A 3-in. bolt fastening 5-in. plate to skin, sheared off on left of indent at screw thread; the bolt was a double-nutted one (hexagonal), with plate washer. A number of skin rivets and wood bolts sheared.
1852	"	"	"	401 lbs. filled with 4.5 lbs. powder.	1336	4963	159.3	Target set on fire. Struck on junction of plates, 10 ft. 7 in. to edge, from proper left; THROUGH. Part of recesses of two bolt heads filled up by the plate being forced in to the bolt. <i>In rear.</i> —Struck between 11th and 12th ribs, but nearly on the 11th, which is broken in halves in line with the hole; also broke away all the rivets fastening rib to skin. Shot made a hole in skin 16 in. by 14 in., and to all appearance burst just as it passed through; great number of rib rivets on each side of hole sheared off; head of the shot after passing through broke up on an old target in rear. Target set on fire again. Considerable difficulty was experienced in putting it out, and an engine had eventually to be employed.

TABLE V.
PROOF TARGET, No. 33.
Report of Practice on the 26th and 30th of October, 1871.
Range, 82 and 70 Yards.

Photographic No. of Round.	Target.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, weight, and diameter.	Calculated Striking velocity. feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference. ft. tons.	Observed Effects.
1856	8-inch portion, range, 82 yards	9-inch rifled M. L., No. 247.	43 R. L. G. 20. 7. 70. Lot 1628.	Palliser shot, large cored, head 1.5 D., 20.5 ins. 246 lbs. 8.92 ins.	1340	3063	109.3	Angle of incidence 64 deg. 30 in. Struck lower plate 3 ft. 10 in. from proper right, and 2 ft. from bottom. Diameter of hole, ex- ternal, 16 in. by 13 in.; internal, 11.5 in. by 9 in.; penetration, 5.5 in. to inside of core. Head of shot in plate, and turned in, so that the direction of the shot was eventually within 1 deg. of perpendicular. Remainder of shot broken up. <i>In rear.</i> —Two rivets broken. <i>This shot appeared to be in- differently chilled.</i>
1857	"	"	"	" small cored, head 1.5 D., 19.4 ins. 249 lbs. 8.92 ins.	1330	3054	109.0	Angle of incidence, 65 deg. Struck lower plate 5 ft. 10 in. from proper right to centre, and 2 ft. 2.5 in. from bottom. Dia- meter of indent, 15.5 in. by 13 in. Shot very nearly through. <i>In rear.</i> —The shot forced its way through the skin, breaking a rib and angle irons, and break- ing off one through bolt (hexa- gonal nut and flat plate washer) at screw thread. The shot pro- jected through, so that the dia- meter of broken part was about 8.5 in. The point broke off, and fell in rear of the target.
1858	"	"	"	" 250 lbs.	1330	3066	109.4	Angle of incidence, 66 deg. Struck on lower plate 4 ft. 3 in. from round No. 1857, <i>i. e.</i> , 10 ft. 1 in. from proper right, and 2 ft. 11 in. from bottom. Diameter on face, 14.5 in. by 12 in.; inside, 11 in. by 9 in. Shot nearly through—broken up. Head turned up, appearing through skin as though it followed up into a weak place damaged by round No. 1831.
1859	"	"	"	" large cored, head 1.5 D., 20.5 ins. 246 lbs. 8.92 ins.	1340	3063	109.3	Angle of incidence 66 deg. Struck lower plate 11 ft. 10 in. from proper right, and 2 ft. 5 in. from bottom. Diameter on face, 15 ft. by 13 in.; inside, 9.5 in. by 9 in. THROUGH. Effect very similar to round No. 1858. <i>In rear.</i> —A quantity of the head and body of shot through; base plug seen in hole. A hole

Photographic No. of Round.	Target.	Gun.	Charge and brand of powder. lbs.	PROJECTILE. — Nature, length, weight, and diameter.	Calculated Striking velocity. feet.	Total energy in foot tons on impact.	Energy per inch of shot's circum- ference. ft. tons.	Observed Effects.
1859 contd.								torn in the skin about 10 in. by 10 in., filled up with broken shot; head picked up in rear—broken off at extractor holes. One rib broken.
1860	8-inch portion, range, 70 yards	9-inch rifled M. L., No. 247.	43 R. L. G. 20. 7. 70. Lot 1628.	Palliser shot, large cored, head 1.5 D. 20.5 ins. 248.5 lbs. 8.92 ins.	1335	3071	109.6	Angle of incidence, 60 deg. Struck lower plate 15 ft. from proper right, and 2 ft. 6 in. from bottom; merely made a scoop, 18 in. by 11 in.; depth, 3.76 in. <i>In rear.</i> —Nil.
1861	"	"	"	248 lbs.	1335	3065	109.4	Angle of incidence 60 deg. Struck lower plate 17 ft. from proper right, and 2 ft. 7 in. from bottom. Head of shot in hole, body much broken up; 13 in. to nearest portion of broken shot. <i>In rear.</i> —One rib broken in halves, and several rivets and wood bolts broken.
1862	"	"	"	small cored, head 1.5 D. 19.4 ins. 249 lbs. 8.92 ins.	1330	3054	109.0	Angle of incidence 60 deg. Struck 13.5 ft. from proper right edge of upper plate, and 19 in. from bottom. Shot broke up very small, head remaining in target; point appeared to have broken off and turned to left in backing. <i>In rear.</i> —Nil.
1863	"	"	"	head 1.25 D. 18.8 ins. 248 lbs. 8.92 ins.	1335	3065	109.4	Angle of incidence 60 deg. Struck 15.5 ft. from proper right of upper plate, and 13 in. from bottom. Penetration, 13.3 in. to point of shot. Lower part of shot struck on a bolt, which was driven through target. <i>In rear.</i> —Bolt driven out, and 2 rivet heads broken. Base of shot broke up small. Target set on fire.

NOTE.—On the 9th of October, two rounds (Nos. 1854, 1855), corresponding exactly as to projectiles and charge with rounds Nos. 1856 and 1857, were fired at an unbacked 8-in proof plate belonging to the Admiralty, at an angle of incidence of 60 deg. In round 1854, the point of the shot passed through the plate, but not the body; and in rear the plate was broken away round the hole, to a depth of 3 in. In round 1855, the body of the shot remained in the plate, with the point shewing through in rear.

PAPER XI.

NOTES ON SOME OF THE WORKS OF FIELD ENGINEERING EXECUTED DURING THE WAR OF 1870-71, BETWEEN FRANCE AND GERMANY.

By MAJOR SCHAW, R.E.

The following notes are the result of observations made on the occasion of a visit to Paris in June, 1871, immediately after the suppression of the Communist revolution.

The object of the visit was to learn what had been the practice of the Germans in the defence of houses, villages, and positions forming the line of investment around Paris, and how far they had deviated from the old rules laid down on these subjects previous to the introduction of rifled artillery and small arms, and the development of the increased instruction and intelligence needed to make full use of them—to notice the effects of modern artillery fire on walls, buildings, earthen parapets, timber constructions, and on woods—and generally to obtain practical information on the subject of the attack and defence of posts and positions.

The visit was made in conjunction with Captain Philips, R.E., to whom we are mainly indebted for the drawings which accompany the notes. Lieutenant Fraser, R.E., was kind enough to allow me the advantage of perusing his journal previously to our visit, and the very full and clear notes which he had made of most of the objects of interest to a military Engineer, in and around Paris, were of the greatest assistance to us.

The whole line of investment occupied a circumference of about 50 miles, and embraced a great variety of positions.

On the west, from Sèvres to St. Cloud, and from Bougival to Epinay, the Seine formed a strong line which only needed to be watched; and on the south-east the Marne fulfilled the same office from near Mont Mesly to Noisy Le Grand, although at one time the French forced the passage at the re-entering loop between St. Maur and Brie Sur Marne.

The line between St. Cloud and Bougival was strongly fortified, because the fortress of Mont Valerien formed an excellent bridge head for the French on this side, and greatly facilitated sorties in force, having for their object the headquarters of the German army at Versailles.*

* For details of this part of the line, see "Journal of the R. U. S. Institution," Vol. XV., No. LXV., "On the position and lines of defence of the 5th Corps before Versailles during the winter of 1870-71, by Major General Beauchamp Walker, C.B."

The high ground from Sèvres to Fontenay aux Roses, was also strongly defended both to cover Versailles and also to hold the heights from whence the bombardment of the Forts Issy, Vanvers, and Montrouge, and even of Paris itself could be effected.

The line thence to Choisy le Roi lay across an open and nearly level country, and was strengthened chiefly by the defence of the villages of Bourg La Reine, L'Hay, Chevilly, Thiais, and Choisy le Roi.

A strong position on Mont Mesly was the central point of defence of the line between the Seine and Marne. Previous to the sortie of the 30th November, the line of the Marne appears to have been held by the German army; but, subsequently, a strong position was carefully prepared between Champigny and Brie, which may be looked upon as an excellent study of a fortified position.

North of the Marne, the Saxon line ran through Gagny, Raincy, and the forest of Bondy, between which and the village of Stains, held by the Germans, opposite St. Denis, the village of Le Bourget was the principal connecting link in the front line. This village was the scene of many fierce struggles, but could not be wrested by the French from the grip of the investing force, to whom it was a very important point, because the stream le Moleret, on which it is situated, formed their first line of investment for a distance of about four miles, and had Le Bourget fallen into the hands of the French, the Germans would have lost their line of communication between the northern and eastern investing forces, which was the road from Dugney to Stains, crossing a valley so intersected by watercourses as to be otherwise impassable.

From Dugney to Aunay, through Pont Iblon and Blanc Mesnil, ran their second line of investment, following the line of watercourses.

On the north, the first line ran through the villages of Stains, Pierrefite, Villeteuse, Ormesson, and Epinay; Montmagny and Deuil, supported in rear by the heights of the Richebourg and Montmorency, formed the second line.

From this brief sketch of the investing line, it will be seen how largely villages and woods were employed in it. The villages and enclosure walls round Paris are built substantially of a soft stone which apparently does not splinter when struck by shells. The roofs of the houses are generally tiled, and it was a fact worthy of note that many of these villages were held—as for instance, Choisy le Roi, Thiais, Chevilly, &c., on the south, and Le Bourget and Stains on the north-east—under the fire of heavy garrison artillery. It did not appear that the houses had been set fire to by shells which had penetrated and burst inside them, nor was this effect of incendiarism noticed in those parts of Paris, near the Point du Jour more especially, which had been ruined by the successive bombardments, firstly Prussian and then by French siege guns.

I did not notice that any houses had been strengthened against artillery fire by banking earth against the bottoms of their outside walls, as recommended in books, a proceeding which has always appeared to me somewhat like that of the ostrich—hiding its head and fancying its whole body secure. Enclosure walls, where much exposed to artillery fire, were strengthened generally on the inside by sinking a wide trench, and forming a banquette and thin parapet with the

excavated earth. The defenders remained under cover in the trench, or in bomb-proofs opening out of it, while a cannonade lasted; but stood to their breastwork if infantry advanced to the assault. Occasionally, in advanced posts, such as walled cemeteries, held to give a flanking fire along the front of a line, and therefore liable to be subjected to a concentrated fire of artillery, a thick earthen parapet was made outside the wall, the earth being taken from a ditch in front. The former plan was, however, most usual, and the damage done by shells was very much less than might have been expected. The walls were generally crenelated at the top, and banquettes were often formed of branches and a little earth. Occasionally, a double tier of fire was obtained, as shown in the sketch of the garden wall of the chateau at La Bergerie.

Woods were of great value to the investing force; they concealed their numbers and movements, and protected them in a great measure from the French projectiles, while the immense extent of abattis formed around Paris was the principal obstacle to the egress of the defenders.

As regards the protection afforded by woods to troops occupying them, my observations led me to conclude that in woods of some years' growth, where the trunks of the trees are of sufficient size to burst a shell, there is—at such a distance back in the wood as that the view towards the enemy is entirely obstructed by the trunks of the trees—almost complete immunity from the effect of horizontal fire, whether of artillery or small arms. Vertical fire will, of course, take effect; but its destructive action is very much reduced, the majority of the splinters being stopped by the trees. Copse woods give little protection from artillery fire, but the concealment they afford is often of great value.

Plate I. shows the defensive arrangements made by the Prussians at the fore post known as "La Bergerie," the most important advanced post on the line between St. Cloud and Bougival, and therefore, as before mentioned, one of the most important points in the whole line. That it was considered so by both sides was testified by the care bestowed on its defences by the Prussians, and by the numerous large graves in the vicinity containing the bodies of the French who fell in the sortie of the 19th January.

The post consisted of a chateau (the property of the Princess de Craon, a descendant of the first Napoleon's great cavalry General, Murat, whom he made Prince de Craon) with gardens and out-houses, and of the farm belonging to the same property, and called "la Bergerie." In advance of the farm-yard was a meadow, enclosed by a stone wall, 7 ft. high, which was made use of as an outer line of defence. The general plan of the system of defence was this:—Commencing on the right, the eastern garden wall of the chateau, about 130 yards long, had a double tier of loopholes, and gave a powerful flanking fire down the valley of Garche, which was covered with low vines and currants, and difficult to move troops over, and also obstructed by abattis.

The two buildings of the chateau, and the gardener's house in the corner were

loopholed on both floors to fire to the front, and a strong abattis was formed in front of them, apparently out of the elm trees which formed the avenue, and which had been felled at this part, though the remainder were left standing. The wall on the left of the chateau was broken down and formed into a low breastwork which could be run over. A similar breastwork was made on the line of the elm trees on the far side of the avenue for about 90 yards; then the line was taken up by an enclosure wall and small building in rear of it. This enclosure wall was strengthened with earth in rear, so as to give protection from splinters of shells, and the hedge bounding the avenue on the far side was left as an obstacle. The entrance gate was pierced for two or three rifles to fire down the avenue; and the eastern road wall, also loopholed, formed the line of defence as far as the prolongation of the farm-yard wall, where a barricade was made. The western road wall, which was also the wall of the field, now was taken as the defensive line; the other wall being broken down to within 3 ft. of the ground, and an abattis formed in front of it. The north wall of the field was flanked by the out-buildings near the west angle; and the western wall had additional strength from an old open drain which ran parallel to and close outside it. The buildings in the farm-yard were loopholed, and one on the left had been formed into a bomb-proof, by removing the roof and upper story and laying heavy beams covered with earth across the remaining lower part of the walls. A bomb-proof was also formed in the cellar of the chateau, and an entrance broken into it from the outside. These bomb-proofs were evidently intended to give security to the guard against fire from Valerien, the large shells from which fort (fired blindly, for the intervening woods obscured the view) had frequently struck the buildings and left ugly holes and rents where they had passed through.

The only entrance to the field of "la Bergerie" appeared to be through a shed in the farm-yard. The retreat of the troops defending these walls was, therefore, not contemplated. On the other hand, the whole of the garden wall in rear of the chateau had been levelled; and about 150 yards in rear of its position, a substantial house on a knoll had been loopholed and prepared for defence, so as to act as a keep or reduit to the whole post; while the low breastworks and gaps left between the chateau and the farm facilitated the retreat of the pickets and sentries, or the advance of troops from the rear. Any attempt on the part of an enemy to follow up retreating defenders, was to be met by the formidable flanking fire from the walls of the farm, &c., on the left. An enclosure wall, which had extended along the brow of the hill in continuation of the eastern garden wall of the chateau, was broken down, so as to lay the ground completely open to this flanking fire, and prevent an enemy from being covered by it when attacking the north-east angle of the garden of the chateau.*

Shelter trenches connected the farm with a series of earthworks which had been thrown up along the edge of a wood, about 400 yards in rear.

* In the lecture before referred to, Major General Walker states that the garrison of this post was one company (250 men).

A few points seem to deserve notice in connection with the defence of this post.

1st.—That although, as before mentioned, the blind fire from the fortress of Mont Valerien had repeatedly struck the buildings, they were never subjected to a concentrated artillery fire. On the 19th January, when the French attacked, their infantry were entirely unsupported by artillery. Had the French artillery gained the plateau in sufficient numbers to cope with the German guns, and to concentrate their fire on the chateau and enfilade the long walls of the field at La Bergerie, their infantry ought to have been able to take the post; as it was, the attempt was hopeless.

2nd.—One observes that the flanking fire from the wall on the left was so oblique, that had German soldiers been taught to fire perpendicularly to the line they occupied, as our soldiers are supposed to do, they would have hit their comrades in the chateau and the adjoining breastworks. They seem, however, to have learnt the lesson that they must fire at their enemy, not blindly to their front.

3rd.—The farm "La Bergerie," was the key of the post. It was in an advanced position and was closed in rear, and as long as it was held, the defences of the chateau could not be turned on the left. The left of the chateau was accordingly but weakly defended, and ample space was given between the farm and the chateau for the movements of troops to the front or rear. The men defending the garden wall of the chateau, and flanking the valley towards Garche on the right, were defiladed by the chateau and by the fall of the ground from the flanking fire of their brethren on the left; and men kneeling down and firing over the low wall on the left of the chateau were protected from the fire of their comrades defending wall H, by the high wall I, which was not itself defended, as the men firing over it would have directly opposed their comrades at H. The whole of the rear of the premises of the chateau was seen from the house held as a keep behind it.

Plate II. shows the defences of the "Haras," an enclosure formerly used for a breeding stud of horses, which lay about a mile to the west of "La Bergerie," and was made into a very strong fort. The enclosure wall was flanked in front by three block houses and a sort of bastion which covered the entrance. A line of abattis had evidently been formed in front, and the wood, which originally came close up to the wall, had been felled for about 100 yards from it, so as to leave a cleared belt of about that width exposed to the fire from the wall. At the period of our visit, the felled trees had been partially removed, and the lines of retreat for the advanced pickets to retire through, could not be distinguished. Inside the enclosure, earthworks had been thrown up, forming reduits to the outer line in case it should be forced. The trace and profile of the most important of these works is given. (The measurements are chiefly from Lieutenant Fraser's notes.) This work was well and carefully made, and is interesting as showing that the Germans do not reject the bastioned trace for field-works; but that they modify the length of the exterior side and the perpendicular to suit the powers of modern small arms. The work was not prepared for the reception of artillery.

M. Violet-Le-Duc in his "Memoire sur la defense de Paris," states that the semi-circular projection to the left of the bastioned field work was prepared for artillery. We did not notice this, but it may have been so. I must observe, however, that there are so many inaccuracies in the work referred to, that one cannot give implicit belief to the statements made by its author*. To the left of this semi-circular projection and in the angle of the enclosure, was a smaller earthwork, of which I have given an approximate outline, but it was not measured.

The construction of the block-houses flanking the front wall is given in Pl. III. They were roughly but solidly constructed of logs, and were large enough to give a flanking fire of five or six rifles on each side. The interstices between the logs were closed by short posts at the loop-holes, but numerous chinks were left which would have admitted bullets. The roof timbers were merely laid on; their weight and that of the covering of earth kept them in place.

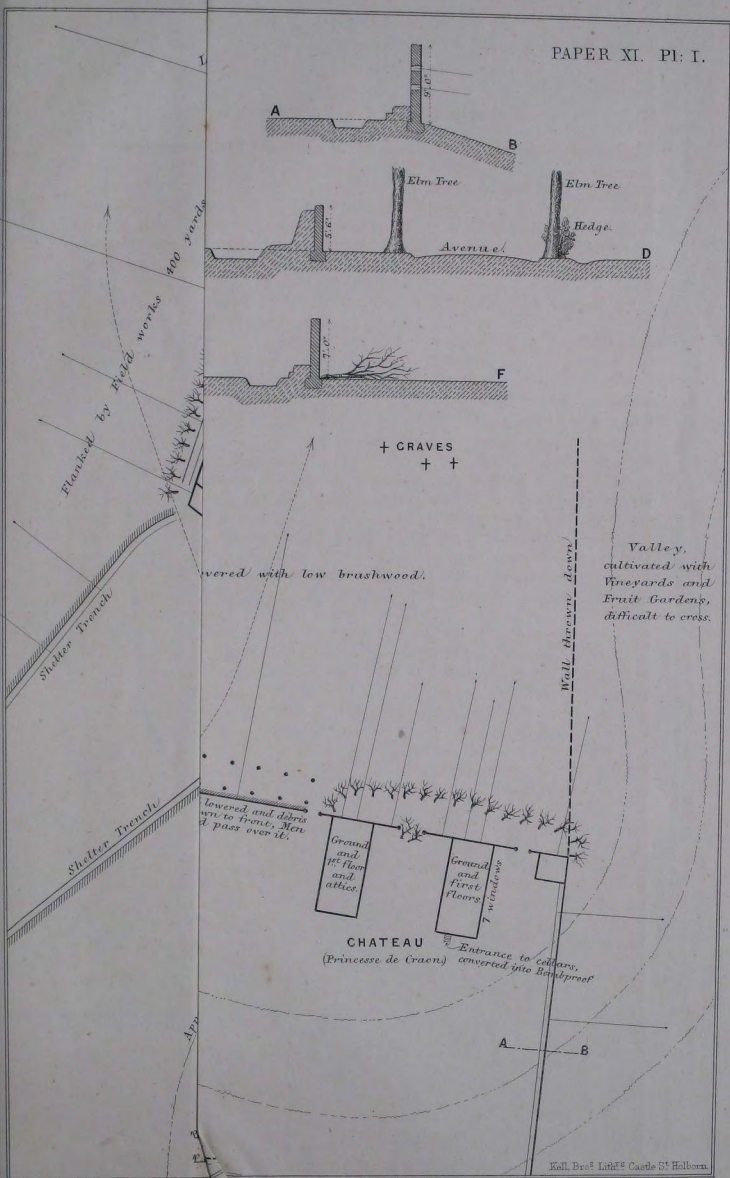
The rectangular shape of these block-houses on plan has always appeared to me to be correct in principle; the triangular heads usually recommended for tambours are too confined for use, and it is better to adopt in this case Choumara's principle of the "independence of parapets," *i.e.*, let the parapets be placed in the most convenient position for the flanking fire which is to issue from them, while the obstacle of abattis, &c., is arranged so as to be flanked from the main line.

One must observe that these block-houses were traced so as to fire into one another, and into the gorge of the bastion at the entrance. The defenders of the latter more especially must have had great confidence in the steady shooting of their comrades in the nearest flanking block-house.

The two guns in the small bastion at the entrance to the enclosure did not appear very judiciously placed, as their range was restricted, and they were in too salient a position to be very secure. Their safety, however, as well as that of the entrance to the enclosure, was provided for by the block-house forming a keep in the gorge of the bastion. The fire from this block-house commanded both the interior of the bastion and the entrance to the enclosure. The low breastwork on the left of the entrance seemed of little value—too low to protect the men in the bastion from oblique fire from their rear—too high to be easily got over by troops passing in or out.

In the great majority of regular field works thrown up by the Germans, the parapets were only 6 ft. thick at the top. They had not been subjected to artillery fire, and therefore their value had not been tested; but, in thinking over this subject—the thickness of parapet required to resist modern field artillery—it has occurred to me that the impossibility of advancing guns in the open to within short range of infantry, firing from behind cover, must have an influence on the question, 1st, because it is impossible for the attacking force to

* A plan of this portion of the investing lines, made by Captain Pirscher, of the German Engineers, lent to me by Lieutenant O'Brien, R.E., shows no guns here.—H. S.





use both artillery and infantry *at the same time*, and, therefore, that the majority of the defenders may lie down behind the lower and thicker part of the parapet while the preliminary cannonade is proceeding, and then defend their parapet when attacked by infantry; 2ndly, because the distance at which the attacking artillery will probably be placed will be so considerable that the penetration of the projectiles will be lessened in a corresponding degree. It has appeared to me also that this result of long range artillery practice, viz., diminished power of penetration, had been taken into account by the Germans in their siege works, and that in many of their distant batteries they had reduced the thickness of their parapets, and consequently their labour, below the standard we have adopted as necessary to give protection against heavy rifled artillery. Naturally the diminution in power due to long range is felt also by the besieger, and was very marked when one examined the effects of the German and French fire upon the revetments of the enceinte, which were but little injured by the long continued long range fire to which they were exposed.

H. S.

PAPER XII.

REMARKS ON SOME PRUSSIAN FIELD REDOUBTS USED IN THE INVESTMENT OF PARIS, 1870-71.

By CAPTAIN PHILIPS, R.E.

Fig. 1, with the profiles annexed, shows details of the centre of three redoubts constructed by the Prussians to resist an advance by the French along the plateau extending from above Clamart and Chatillon, past Plessis-Picquet, Villa Coublay, and Velizy, towards Versailles.

The plateau is traversed throughout its length by a good chaussée, which combined with the open and level nature of the ground, would have greatly facilitated a forward movement in force on the part of the French, had the latter been enabled to have obtained possession of Clamart, Chatillon, and Fontenay, with the heights immediately above, on which were situated many of the Prussian siege batteries.

The right of the three redoubts was situated on the right of the chaussée, and overlooked the valley in which Plessis-Piquet is situated, but from want of time I was unable to visit it, and, therefore, cannot give details of it; judging, however, from a distant view merely, it appeared to be similar to the others.

The centre redoubt (that shewn in detail in the plate) was on the left of the chaussée, and about 100 yards from it.

The left redoubt (sketched in outline in Fig. 2) was separated from the centre one by an interval of about 300 yards, and from the Bois de Meudon by an interval of about 700 yards. It had no traverses, but otherwise its details were similar to those of Fig. 1.

The general direction of the line occupied was perpendicular to the chaussée; the centre redoubt was, however, sufficiently in advance to permit of the outer works supporting each other, as well as the centre work. The level and open nature of the ground was favourable to this disposition.

At the time of my visit, July 6th, 1871, the ground about the redoubts was in close cultivation, the space inside the gorge tambours even being planted. All traces of shelter-trenches, had any existed, were therefore obliterated, at least, none were visible, nor were any remains of abattis to be traced. The use of abattis, which was so general elsewhere throughout the works of investment, ought not to have been dispensed with in connection with these redoubts, as there was every facility for its construction, owing to the proximity of trees along the chaussée and in the Bois de Meudon; but judging from the entire absence of any remains thereof, it seems fair to conclude that none was used. The earthwork of the redoubts was untouched, and appeared to have been executed with extreme neatness.

The following points in connection with these works appear noteworthy:—

1st.—Although the parapet had a sufficient thickness to have withstood any probable amount of fire from field guns, the cover inside was very limited.

2nd.—There was no blinded cover for any portion of the garrison.

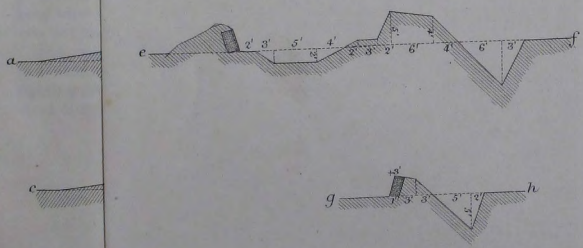
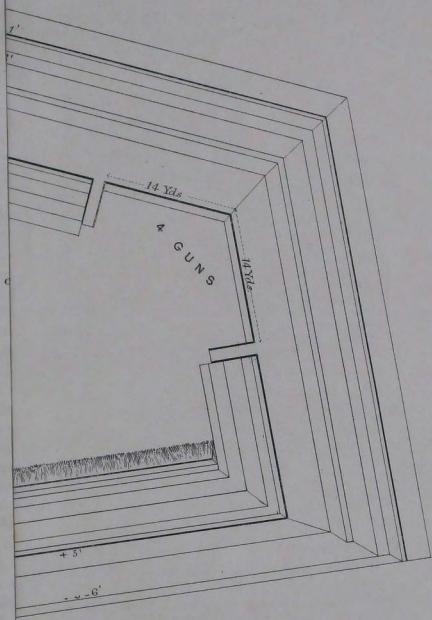
3rd.—The rough parapet, which formed a *parados* for the defenders of the gorge parapet during a cannonade, might also have served as a rallying position for the defenders generally in case of the work being forced in front.

4th.—The tambour at the gorge appeared a simple and efficient mode of covering the entrance at the same time that it flanked the gorge parapets. Also as these latter were traced so as to have their prolongations fall in advance of the salients of the collateral redoubts, the side faces of the tambour formed extra flanks in echelon with the main ones, and were, from their small command, invisible from the front.

G. P.

PAPER XII.

71.
37 Yds. 4 Cms.





PAPER XIII.

DESCRIPTION AND SKETCHES OF SOME FRENCH AND PRUSSIAN WORKS CONSTRUCTED DURING THE WAR OF 1870-71.

BY LIEUTENANT E. D. C. O'BRIEN, R.E.

Fortified post of Le Butard, near Versailles, Pl. I., figs. 1, 2, 3, 4.

The farm buildings of "Le Butard" formed an important post on the left of the third line of investment, constructed by the 5th Prussian Corps d'Armee, for the defence of Versailles against the sorties from Mont Valerien. They were situated on a main road leading from Versailles to the village of La Celle St. Cloud, and at the head of two valleys, the one running in a north-easterly direction towards the Seine at Bougival, the other nearly due east through Vaucresson and St. Cloud.

The post consisted of a farm-house, surrounded by an enclosure wall 10 ft. high, and a small ornamental two-storied building near it, which was favourably situated for flanking the approaches.

The farm-house itself was a low building with high slate roofs, and except, perhaps, from the attic windows, fire from it could not be made use of.

The enclosure wall was loopholed on three sides, at about 7 ft. 6 in. from the ground, a rough banquette of logs and earth being formed inside; and on the fourth side, where it was unflanked (E,F), there were two rows of loopholes, the upper ones broken down from the top of the wall, and the lower tier at the level of the earthen banquette, or about 6 ft. above the level of the ground outside. These latter had evidently been intended for use by men lying down on the banquette slope. They were in the intervals between the upper ones. The iron gates in front of the farm were barricaded with a log parapet, the only entrance being through a small wicket gate.

Across the road, a very rough stockade had been constructed to flank the approach on the side most exposed to attack, and the whole of the woods which originally surrounded the post, had been cut down, forming a vast entanglement and abattis some hundred yards wide, so thick as to be almost impassable.

The detached summer-house was well built of Ashlar masonry, and stood on a projecting spur of the hill somewhat in rear of the farm. The windows had been barricaded, and a rough tambour constructed to cover the entrance, but it was not loopholed. The small enclosure wall round it, which carried an iron railing, was about 2 ft. high, and had been converted into a parapet, as shown in section AB. There were no graves, bullet marks, or other indications of the fighting ever having reached this point, though there were numerous marks a short distance further up the road.

Portion of large French battery on the slope above St. Cloud, Pl. I., Figs. 5 & 6. This battery was constructed by the French, in the second siege, to bombard Paris. In addition to the look-out place shown on plan, there was a small sort of cavalier, about 10 ft. high above the ground, a few yards in rear of the centre of the battery.

Blinded passage to a magazine in Fort Issy, Pl. I., Fig. 7. This was penetrated by a shell (*pièce de 24*) during the French bombardment.*

Unfinished Prussian redoubt at Meudon, Pl. II., Figs. 8 & 9. This redoubt, which faces to the rear, was apparently intended to guard against a successful sortie which might have broken through the front line of investment temporarily to the east or west of Meudon, and so have turned the position of the Germans

on the terrace.

Emplacement for two field guns (Prussian) on the slope above Choisy le Roi, Paris, Pl. II., Figs. 10 and 11. No trace of limber-pit or cover for horses could be found near this work.

Prussian redoubt on the plateau of La Celle, St. Cloud, Pl. II., Figs. 12 and 13.

The stockade had been removed when this work was visited, 24th June, 1871.

Prussian redoubt near Metz, Pl. II., Figs. 14 & 15.

This work commanded the road from Metz to Point du Jour and Gravelotte. There was a row of five gun-pits, 40 yards in front of and to the left of the redoubt.

French temporary Hospitals in the Park of St. Cloud, Pl. II Fig. 16.

This small camp, visited 30th of June, 1871, remarkable for its cleanliness and good order, was under the management of the French "*Société de secours aux blessés*," and, when I visited it, was receiving some of the worst cases of wounded from the Paris hospitals, at that time crowded by sufferers from the second siege.

The encampment was situated in the midst of the park, and consisted of 8 hospital wooden huts, for 12 men each, of about the section shewn in the sketch. There were, of course, numerous other offices, kitchens, &c. The characteristics of the system seemed to be

1st—The ample ventilation, allowed for by having one side of the huts open to the air by day, and at night only closed by lowering the awning of the verandah.

2nd—There being two beds provided for each patient, an arrangement said to be very desirable for men so badly wounded as these, as they could more easily be lifted on a sheet from one bed to another than moved in their own, when changing the linen, &c. The beds were about 2 ft. 6 in. apart.

The only difference between the huts for the officers and the men was, that in the former a curtain divided the patients from one another.

E. D. C. O'B.

* At Strasburg, in the new hollow traverses, the Prussians are giving a minimum thickness of 8 feet of earth over roofs of railway bars.

Fig: 5.
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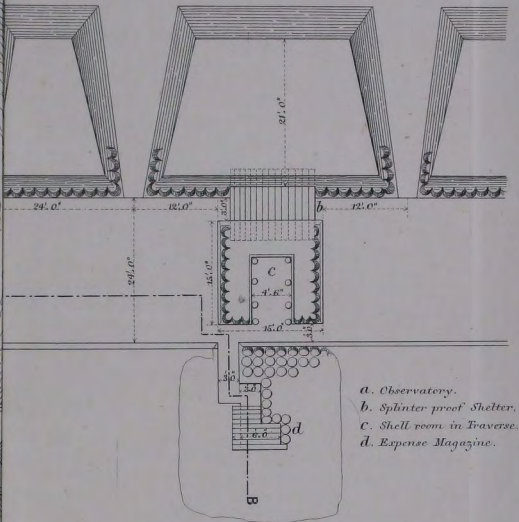


Fig: 7.

