Royal United Services Institution. Journal

Publication details, including instructions for authors
and subscription information:

<http://www.tandfonline.com/loi/rusi19>

Military Defence Work By Civil Engineers

G. Lacy Good M. Inst. C. E., M. S. A.

Published online: 11 Sep 2009.

To cite this article: G. Lacy Good M. Inst. C. E., M. S. A. (1907) Military Defence Work
By Civil Engineers, Royal United Services Institution. Journal, 51:350, 434-449, DOI:
[10.1080/03071840709416823](https://doi.org/10.1080/03071840709416823)

To link to this article: <http://dx.doi.org/10.1080/03071840709416823>

PLEASE SCROLL DOWN FOR ARTICLE

Taylor & Francis makes every effort to ensure the accuracy of all the information (the "Content") contained in the publications on our platform. However, Taylor & Francis, our agents, and our licensors make no representations or warranties whatsoever as to the accuracy, completeness, or suitability for any purpose of the Content. Any opinions and views expressed in this publication are the opinions and views of the authors, and are not the views of or endorsed by Taylor & Francis. The accuracy of the Content should not be relied upon and should be independently verified with primary sources of information. Taylor and Francis shall not be liable for any losses, actions, claims, proceedings, demands, costs, expenses, damages, and other liabilities whatsoever or howsoever caused arising directly or indirectly in connection with, in relation to or arising out of the use of the Content.

This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan,

sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at <http://www.tandfonline.com/page/terms-and-conditions>

MILITARY DEFENCE WORK BY CIVIL ENGINEERS.

By G. LACY GOOD, M.Inst.C.E., M.S.A.

Thursday, 1st November, 1906, at 3 p.m.

Brigadier-General R. M. RUCK, R.E., Director of Fortifications and Works, in the Chair.

DURING the recent war in South Africa, whilst Government Engineer in charge of the first District of the Klipplaat-Oudtshoorn railway construction, the author was consulted by the military authorities upon the best means of placing Klipplaat in a proper state of defence.

This Midland village, which, besides a church, magistrate's court, gaol and police station, consists only of a small hotel, a couple of stores, and a few scattered houses, was, nevertheless, of considerable strategic importance, being the newly-formed junction of the Port Elizabeth, Graaf Reinet and Oudtshoorn lines of railway, at the same time forming a depôt of the Army Service Corps and a remount station. Furthermore, during the second invasion of the Colony, the Boer commandoes were very active in the immediate neighbourhood, wrecking trains, destroying Government buildings, burning homesteads, etc., on one occasion burning some 30,000 sleepers and destroying every temporary bridge and tank stand over a length of about 20 miles on the new railway.

At the time referred to—the early part of 1901—the only defence works that existed at Klipplaat were a roughly built stone fort on the most commanding hill, and a small blockhouse, formed of sand-bags, near the railway station.

The author's recommendation was, accordingly, that the number of forts or blockhouses should be increased by three, undertaking himself, in conjunction with other Government officials and civilians, to man one of the forts, that to be more particularly described, whenever the enemy might threaten the place.

Sites were accordingly selected and triangulation made, in order to ascertain the ranges, etc., and the erection of the additional blockhouses was commenced at once.

The methods of construction adopted will now be given.

In order to increase the advantage the gentle rise selected for the fort, of which illustrations are given, already afforded, and at the same time to get an all-round fire, as well as secure a covered entrance, the author decided to build up a base 6 or 7 feet in height, of stone and debris filling, suitable material being obtainable from

the walls of a cattle kraal, which it was deemed advisable to level with the ground, owing to the possibility of its affording cover to an attacking force.

The superstructure it was decided to form of sandbags and Tasmanian stringy bark sleepers.

Before settling the form of construction, however, a number of experiments were tried in connection with the penetrative power of the Lee-Enfield rifle, the annexed table giving the results obtained.

A scrutiny of this table will give some idea of the marvellous propulsive power of cordite behind a nickel pointed bullet.

Experiments made to determine the Penetrative Power of the Lee-Enfield Rifle. Point-blank range—15 yards.

Materials Tested.	Penetration.	Remarks.
	inches.	
10 by 5 inches Tasmanian Stringy Bark Sleepers ...	19	Three Sleepers being placed close together on the flat.
10 by 5 inches Creosoted Baltic Fir Sleepers ...	31	Four Sleepers being placed close together on the flat.
Two $\frac{1}{8}$ -inch Galvanised Iron Telegraph Anchor Plates	$\frac{1}{2}$	Passes right through, tearing a hole 1-inch square out of the back plate.
Ditto... ..	—	Striking at an angle of 45°, bulges both plates without perforating.
Portland Cement Concrete	3	Splitting a piece 6 inches thick.
$\frac{1}{2}$ -inch web of 60 lb. Carnegie Steel Rail ...	—	Bulges the web. The experiment was tried upon a 3 feet length of rail, which the bullet overturned.
Gravelly Sand placed between two $1\frac{1}{2}$ -inch Boards	10	Bullet flattens and splits against the gravel.

I should mention that the projectile appeared none the worse after penetrating the timber, but always flattened or broke up in contact with the gravel. It will, of course, be remembered that the Boers invading the Colony possessed no artillery, and that it was not necessary, therefore, to provide against anything but rifle fire.

As the contractor for the railway works had a large stock of material at Klipplaat, both Tasmanian and Baltic sleepers were obtainable near at hand.

From a reference to the accompanying diagrams it will be seen that the first four courses of the fort proper, which was circular in plan, were formed of double rows of sacks, filled with gravelly sand, laid as stretchers, each bag measuring about 2 feet 10 inches by 1 foot 10 inches by 10 inches when compressed, their weight being about 400 lbs. Upon these, at a height of 3 feet 4 inches above the main deck or platform, a double octagon of 7 feet by 10 inches by 5 inches Tasmanian stringy bark sleepers was arranged in groups of six, giving a thickness of 30 inches, the ends of the sleepers being set at 4 inches apart; the embrasures, or portholes thus formed, having an angle of fire of 45°, fire from each pair of ports intersecting at

about 6 or 7 feet from the outside of the fort. Each group of six sleepers was strongly bound together with strap iron, and on either side of each embrasure two 3-16 inch galvanised iron telegraph anchor plates were bolted on to the sleepers, in order to deflect any bullet that might pierce the timber obliquely. Above the sleeper courses the bag work was continued, a look-out bridge, or sentry walk being thrown across at a height of 7 feet 6 inches above the main deck, or 14 feet 6 inches above the ground. The decking of this gangway, which was formed of creosoted Baltic fir sleepers 7 feet by 10 inches by 5 inches, was supported by two 60 lb. Carnegie steel rails, access to the bridge being obtained by projecting steps and man-ropes. The sandbags, forming the bulwarks of the bridge, were pierced in six places for rifle fire, the embrasures being shaped by wooden boxes. From the bridge a commanding view was obtained, over the bush, etc., of the other forts and surrounding country.

Protecting the covered way into the blockhouse was a mantelet of sandbags, 7 feet 6 inches in height, with an entrance at one corner, an embrasure being formed through the bags, commanding the approach pathway. Altogether 23 loop holes were provided. It had been intended to have erected an outer wall, 7 feet in height, round the base of the fort, but there was not sufficient stone available.

In order to give each of the crew absolute immunity from all but a shot entering directly through his particular port hole, a bullet-proof shield of gravel, filled in between timber sheeting, was erected inside the fort, which shield at the same time gave protection to the water tank and ammunition.

As will be seen from the gun racks under the port holes, etc., everything in this fort was arranged in man-of-war fashion, each man having his station, and rifle to hand.

Over all, from a flagstaff, formed of telegraph poles, floated the Union flag.

At a distance of 50 feet from the stone base to the fort, a barbed wire entanglement was erected, and, as this was specially designed, views of it are given in the plate. Tins with stones in them, forming alarm rattles, were fixed all round the topmost wire, and, as all the wires were laced together, none could be tampered with without the rattles announcing it.

With regard to the other two additional forts the author has pleasure in referring to one designed and erected by Mr. L. E. Heberden, first assistant engineer. This fort was formed entirely of 60 lb. steel rails, bonded flush at the angles. The flooring of this fort, which was 24 feet square inside, was fixed at a height of about 4 feet above the ground, upon a stack of rails already lying in the contractor's yard. The sides were made 7 feet high, and the whole roofed in with rails laid close together, 24 embrasures being formed by spacing 3-foot lengths, that had been cut for expropriation beacons, 6 inches apart, fire from each pair of embrasures intersecting close to the outside of the fort.

Undoubtedly, with the exception of the fine, cut stone forts, built to protect the great railway bridges, this steel fort was the most serviceable of the whole chain of blockhouses erected during the war. It must be borne in mind, however, that such a form of construction could only be economically and rapidly constructed at spots where rails in large quantities were stacked.

The third blockhouse was constructed on a raised platform of stones, with two concentric sheets of corrugated iron set 2 feet apart, and filled with gravelly sand, the sheets of iron being supplied, ready rolled into shape, and pierced for rifle fire, with the necessary timber framing, from the Uitenhage locomotive shops. This system, a rough and ready but very effective one, was, latterly, generally adopted throughout the long line of blockhouses, the iron being painted brown to assimilate with the surrounding landscape.

Later on a sixth blockhouse, commanding the Port Elizabeth road, was erected, being built of stones, and pierced for 20 rifles.

Whilst, from an engineering point of view, the works above described are of small importance, the conditions under which they were carried out, and their value from a military standpoint, must not be overlooked. On several occasions the forts had to be hastily manned, whilst three, including the first described, were in course of construction, owing to the enemy's threatening demonstrations in the near neighbourhood. Then the author had no skilled labour at his disposal and no plant; it will therefore be readily understood that the handling of some 500 sandbags each weighing about 400 lbs., and raising these from 7 to 20 feet above the ground, was no light work. By using a couple of rails as slides, and parbuckling, double purchase was obtained and the work lightened.

The author might here suggest certain improvements in those useful machines, the railway velocipedes, with which he was able to assist the scouting parties.

Those supplied for use on the Klipplaat-Oudtshoorn Railway were not provided with guards in front of the wheels, consequently, the tyres were always getting dented and the spokes loosened by contact with stones on the line, great risk being also run of the machine being thrown off the rails. The author rectified this on his by fixing steel guards, with a stiff piece of leather clamped on, which actually touched the rails, at an angle of 45° , stones measuring 4 inches diameter being therewith swept clear of the line. Another weakness was in the india-rubber tyres, which, being only glued on, frequently became detached, rendering further progress impossible without destroying the thin steel tyre and spoke attachments. This could easily be rectified by the provision of a rim to the outside edge of the steel tyre over which the rubber could be stretched.

These may seem small matters, but on one occasion the author was prevented ambushing a party of 11 Boers by the rubber tyre, thus springing off when he had got about half way to a point on the main line to Port Elizabeth, where they were expected to, and did eventually, cross.

It should be mentioned that, during the whole of the time referred to, and up to the time peace was declared, the work of construction was proceeding on the Klipplaat-Oudtshoorn railway, necessitating the supervision of the Government Engineers. The fact that Klipplaat was never attacked, in no way detracts from, but rather emphasises, the utility of the forts and other defensive works, and it may be taken as the greatest compliment the enemy could have paid it, that, whilst spreading destruction far and near, he always gave this place a wide berth.

Acting concurrently with the author, further down the line, colleagues of his, both on the Government and contractor's (Mr. A. F. Hills, Chairman of the Thames Ironworks Co.) staffs, devoted

their energies to the defence of other strategic centres, laying mines round the towns and villages, forming telephonic communication with the blockhouses, mining, and barricading the mountain ravines, through which the Oudtshoorn railway passes, etc.

An excellent idea can be formed of the measures taken to bar the passage of an invading force at Toverwater Poort, a ravine on the Klipplaat-Oudtshoorn Railway, about 82 miles from the former place. (The Lecturer here exhibited some photographs of the spot in question.) The ravine, which forms the bed of the Traka River, the main tributary of the Oliphant's River, is about two miles in length, and from 80 to 100 yards in width, the precipitous sides towering to a height of about 700 feet.

In addition to the fort there constructed, three concealed charges of dynamite were laid in front and rear of the fort, arrangements being made to explode them by electricity. At points, above and below, the bed of the ravine had also been blocked by barbed wire entanglements. From an official inspection, made by the author, of these defences, he would say that it would have been impossible for the strongest commando the enemy then had in the neighbourhood to have forced a passage.

At the time of which this paper treats, the rail end had reached Toverwater Poort, and the large numbers of workmen encamped there and in the neighbourhood of Willowmore, and the quantity of material available, admitted of defence works, on a large scale, being constructed at those points, and of their being strongly manned. It should be mentioned that, with few exceptions, every engineer and workman in the Government service, so far as their duties allowed, enrolled in some local force, or gave his services willingly in some form or other, in the defence of the Colony. Nothing could have been more splendid than the devotion of the engine drivers and stokers, and it is only those who have seen wrecked trains being dragged back to the base by two powerful engines, the woodwork of the carriages and trucks destroyed by fire, and the engines pitted by bullets, that can get a true idea of the awful risks these brave fellows, unflinchingly, took.

Though in no way connected with the matter, the author thinks it would not be inappropriate to mention the unique service rendered by one of the District Engineers of the Table Bay Harbour Board, Mr. G. T. Nicholson,¹ who, near the close of the war proper, as captain in the Cape Garrison Artillery, took one of the 9·2-inch guns, the heaviest weapon ever used in land warfare, from Craig's Battery, Table Bay, up by railway to Machadodorp. This gun was of the disappearing type, and a special carriage was designed and built for its conveyance to the front, at the Salt River Railway Works, Cape Town. Photo graph No. 6 gives a good idea of the appearance of the gun on its railway carriage.

It throws a shell weighing 380 lbs., of which, I believe, as much as 270 lbs. is lyddite.

The original intention, I understood at the time, was, that this gun should be used in the reduction of the Pretoria forts, but that, before it could be brought up, the place had fallen. The gun was then taken on to Machadodorp, but the only service it was put to was the

¹ Now Lieut.-Colonel, C.G.A.

shelling some Boers from a kopje, at a range of eight miles, which it appears to have done most effectively.

The author's first experience in a military capacity was whilst in charge of the Mossel Bay-Oudtshoorn Railway construction, January—March, 1901, when, as a member of the hastily formed Town Guard, he took part with a naval contingent landed from the flag-ship "Doris," and three other men-of-war, in the defence of the town of Mossel Bay.

This paper might have been extended had it been necessary to adduce further evidence to show that, should the outposts of the Empire ever again be threatened, Civil Engineers, in whatsoever part of His Majesty's Dominions they may be stationed, will come forward and freely give their services to their country.

Colonel C. B. MAYNE, R.E. :—My only regret with regard to this very interesting lecture is that Mr. Lacy Good has not given us more details of what he thinks should be done. I should like to have heard from a man of Mr. Lacy Good's experience his arguments on the wider principles involved, but at the same time perhaps such remarks had better come from a military advocate as being less prejudiced. Personally, in my career I have always advocated, wherever I have been able to do so, closer association with the civil engineers in the locality where I was stationed, subject of course to certain conditions. I would like to speak, first of all, on the subject of the opportunities for the employment of civil engineers on military works, and, secondly, on the conditions required for such employment. As regards the opportunities of employment, they may be taken as being embraced roughly in the words "stationary warfare," that is along the lines of communication, as Mr. Lacy Good was employed in South Africa, and also at our defended ports and fortresses. Along the lines of communication there are, of course, an immense number of works to be done, such as the erection of camps and huts of all kinds for all branches of the Service, the erection of defensive lines, including such fortified posts as Mr. Lacy Good threw up in South Africa, motor traction, drainage, water supply, roads, bridges, piers, wharves, workshops, etc., and railways and electric communications, which would be worked by their respective civil official staffs under the control of the military staff. Many of these various points referred to are matters of ordinary engineering; but still they are necessary, and at times we are very hard pressed for want of military officers, and are only too grateful for any help that we can receive from civil engineers. I also mentioned defended ports and fortresses. I was Commanding Royal Engineer at one of our important defended ports, and as such I had to work out the defence scheme under certain reserved conditions, which scheme was accepted after reference to home with very slight modifications. At that port we had to deal with the port authorities, the municipal authorities (because there were large gas, water, drainage, and other works in the vicinity that had to be considered), and also, being a very large railway centre, there were on the spot a great number of talented railway engineers. The defence of this defended port was spread over a very considerable area, so that it was impossible for the half dozen military engineers available to attempt to do it themselves. Therefore in the scheme a very large amount of work was expected from these civil engineers belonging to these different civil departments. I had also in my charge the building works of a naval dockyard, and of course we relied on the engineering staff there as well. I pleaded (I cannot say successfully while I was there) that the work which we expected from these gentlemen should be told

them in peace time, of course in great secrecy, or at all events that it should be disclosed to the heads of the various departments. The idea was not accepted at the time, but up to the moment I left that place I fought in every way I could for the effective recognition of the principle that those who were going to be called upon for work in time of war should be informed of the part they were expected to play, so that they might be thoroughly acquainted with what was expected of them and be able to readily take up their part when the time came. In another defensive scheme out in the East, the works proposed to be carried out on the outbreak of war depended so very largely on the organisation and collection of native labour and material that it was very necessary to work the details out and arrange everything beforehand. There ought to be proper preparation and organisation, and the civil authorities ought to know what is expected from them. These are two cases in my own mind where I have done my best to obtain the co-operation of the civil engineers in the vicinity. Coming to the conditions of employment, of course the first thing to be considered is the question of military subordination, and the second point is a knowledge of the peculiar requirements of the various military units suited to their needs. That is a thing which ought to be known by those who are working for the Army and its various branches. The third point relates to the various principles of defence. As far as I can see from the plans provided by Mr. Lacy Good, there was no difficulty in picking a site for the works; but as a matter of fact, in hilly countries and in many other places, the site of the work is an extremely important consideration, which is apt to be lost sight of by those who are not, at all events to some extent, in touch with the needs of the rifle and the gun. I have in my mind a case on the Afghan frontier, where certain frontier defensive works were designed and erected by the officials of a civil department. The particular work that I am referring to was badly built, but I only refer to this fact because it played an important part in the subsequent events. The gentleman who designed and built it had no idea of the value of the siting of the fort, and of the necessity of bringing under the fire from some part of the fort what we call the "dead ground," where the enemy can collect unseen. This place, which was held by about twenty-five Sikhs, was attacked by several thousand Afghans. Although the Sikhs inflicted very heavy loss upon the Afghans, the latter crept up into the dead angles where they were unseen, and proceeded to pull the stonework down. If there had been no dead ground, the enemy would have been shot down while they were doing this, and the Sikhs would probably have been able to prolong the defence for a sufficient length of time to enable reinforcements to arrive. If civil engineers expect to play a part in the defence of our Empire, as I hope they do, there are certain conditions which they ought to make themselves acquainted with, and two of those conditions are the principles of defence as regard flank defence and dead ground, and the siting of works. One very amusing little instance took place at Lundi Kotal many years ago. There was a certain ravine near the camp from which the Afghans gave us a lot of trouble, and some very small defensive trenches had been thrown up to protect the troops, but they had been badly sited by somebody on the general's personal staff. It so happened that one day this general, who was noted for stone deafness when he did not want to understand what was said to him, came along for inspection purposes, and a very prominent general in our Army at the present time—he was then a captain—went up to him and asked him whether he might shift the defences, as they were not properly sited. As

they had been sited by an officer on the general's staff, he did not like to give this officer away. So the inspecting general replied: "I quite agree that they are very creditable to the officer who put them up." The young captain looked at him, and then walked round to the other side of the general and spoke in his other ear. This strategic movement so flabbergasted the general that, when the question was again put to him, he gave in and agreed that the trenches might be re-sited. The mere fact of these works being only three or four feet away from the proper place enabled the enemy to come up the ravine unseen at any time during the day or night. The fourth point I should like to raise is with regard to the keeping of accounts. During the last four years I have had to assist more or less in the administration of affairs dealing with South Africa, where a great many questions were raised with regard to the keeping of war accounts by those who are not accustomed to our system of military accounting. Their accounts were not made up according to recognised rules, and so gave a great deal of trouble at home; but still, if it could be arranged that civil engineers could be given some idea of the kind of accounts which should be kept, and what authority they should obtain for expenditure, it would greatly facilitate the subsequent closing up of the accounts of a war. Those are the four principal points that I think we may fairly ask civil engineers to study who are anxious to help us with regard to engineering problems in war. Military works are of extreme simplicity; but, as Mr. Lacy Good has realised (because he has referred to it in his lecture), they are required to be carried out under circumstances of great difficulty as regards the collection and application of material and skilled labour, and also as regards the speed at which they are required to be put up. What we call the military engineering course at Chatham is of value in giving details of time, material, and labour required, and the organisation of the necessary working parties so to cause the least confusion and admit of the work being executed in the most rapid manner, and also some idea of how best to make use of the materials that may be available at any particular place at the time. Those are the conditions which, I think, we may fairly ask civil engineers to undertake in peace time—to study those four points to enable them to give us that valuable help which I am certain myself and my brother officers are most anxious to receive from them. There is not the slightest doubt that the consensus of opinion, even in our military profession, is that those who have been employed on what we may call the civil engineering part of our profession are those who really do best in war. It is a great loss to any military engineer officer not to have been employed on the civil side of our professional work, so that civil engineering is really a very admirable training for those men who wish to assist us in the engineering works that are so necessary to the welfare of an Army in war. I do not know that I can say anything more on the subject, except to express my thanks to Mr. Lacy Wood for having brought the matter forward, and I hope that much good may result from the discussion here to-day. I for one am heartily in accord with the idea of co-operation between the military and civil branches of the engineering profession, as far as it can be done under the limitations, or rather the conditions, for employment that I have ventured to suggest.

Colonel G. K. SCOTT MONCRIEFF, C.I.E., R.E. :—I wish very heartily to endorse what Colonel Mayne has said about the desirability of co-operation between ourselves and our brethren in the civil engineering profession. I have had a good deal of experience in this respect, both on the frontiers of India and in China. In China the whole of the defence works in con-

nection with the defence of the British Legation at Pekin were designed and executed by an American missionary, Mr. Gamewell, who had been a civil engineer—a gentleman who was as skilful as he was brave and as modest as he was skilful. He carried out the whole of the defence works there with very great success, and when I tell you that the defence works that were carried out by other Powers in every case were driven back, while in Mr. Gamewell's case the defence advanced in the course of the siege, I think you will recognise that his work carried with it the greatest success. When, as commanding engineer of the relief column, it was my duty to take over the works which had been carried out by this ex-civil engineer, I complimented him very highly upon the work, and asked him how it was that he had gained so much military knowledge. The technical details, such, for instance, as overhead cover, thickness of parapets, of traverses, of communications, of lines of fire and so forth were all so skilfully done that I could hardly believe they had not been carried out by a professional soldier. He told me that he had been a professor of engineering at one time, and that subsequently in his missionary capacity he was constantly employed in the construction of various works for the Missionary Board, of which he was a member, and that when the thunder-cloud of war was likely to break he went to one of his military friends on the staff at Pekin and asked him to give him a few hints of a general nature. This gentleman gave him a work on fortification, which he studied and used, as I have already said, with much success. It may possibly be argued that a success of that nature does away with the necessity for a military engineer at all. I think this gentleman himself, however, would be the first to acknowledge that the reading which he accomplished was not his only instructor, but that he had to learn his work, and how to apply it, from the stern necessities of actual war itself. In other words, he was constantly exposing himself to see how he could best carry out the work; he never allowed himself any rest. Some of his colleagues were killed and wounded, but he kept pushing on the works and carefully observing what was necessary at every point. I notice that the lecturer, in his very interesting lecture, started his work by making experiments on the penetrative power of bullets—a course which I think was not only wise but admirably adapted to the circumstances. In the case of Pekin which I am alluding to, they did not require to carry out any experiments because they were carried out for them by the enemy. Although the work which this gentleman carried out on this occasion was so successful, I should hardly feel that we were justified in always placing the defence of any particular spot in the hands of civil engineers, however capable they might be, provided there were military men there who were equal to undertaking the work. Later on in the campaign we found that the services of the railway civil engineers, who had been previously employed in China, were of the greatest possible help to us. We employed them in conjunction with our own officers and men, and we found that their local knowledge, their knowledge of dealing with the natives of the country, their knowledge of the resources of the country, and so forth was of the greatest possible use in carrying out the work. I personally see no reason why there should not be this co-operation. I am aware that some officers rather objected to companies of sappers being employed under the direction of the resident engineers on the railway. I myself can see no reason why that should not be done. There was no interference with the discipline, because the officers commanding the companies had that entirely in their own hands. The resident engineer gave the directions with regard to the work that was to be done, the sappers

under their own officers carried it out. I had many colleagues on the Indian Frontier who were civil engineers, both under me and in consultation with me, and I found that the work which they did was excellent for the most part. There were, however, one or two points wherein I think their work was not quite what it might have been. For one thing, they were very much in the position of architects carrying out the wishes of clients; that is to say, they had no special knowledge of defence questions themselves, and therefore they simply looked upon themselves as the executive agents to carry out the work which infantry officers suggested. Now I think that in that respect they were not in such a favourable position as engineer officers would be who had carefully studied questions of defence. We are all aware that the opinions put forward by the officers commanding troops who have to defend a work must be treated with the greatest possible deference, and I am sure we would always do so; but, at the same time, that would not necessitate our simply following their ideas without having any sort of plan of our own. I found that in certain of the works which my civil engineering colleagues designed there were a great many points which I could not agree with. That may possibly have been my own mistake; but there was an absence of simplicity, and there was also an absence of some of the broad principles which have been drilled into us from the early days we started our professional career at Woolwich. I can only say, in conclusion, that I thank the lecturer for drawing attention to this important matter. I am sure we have, in the great civil engineering profession, a number of gentlemen who, in time of war, would be of the greatest possible use to us, and I heartily welcome any movement which would tend to a closer co-operation between the civil and military branches.

Mr. H. G. HUMBY (Mem. Inst. C.E.):—I was not quite prepared to be called upon to address the meeting to-day, but as my name has been mentioned I will endeavour to make a few remarks. With a view to bearing out the statements which Mr. Lacy Good has made, I should like to say that in Natal there is ample evidence of the assistance which civil engineers may render in the time of war. It is, perhaps, not generally known, although it is to most military men, I believe, that during the South African War the whole railway system in Natal was managed and worked by the Government railway staff. When I say was "worked" by them, I mean, of course, that they took their instructions from the officers commanding the forces there, but the execution of the details was left to them. The destruction of railway bridges in the course of the war was enormous, considering the length of the railway, and the repairs of those bridges were left in the hands of the railway staff. Every bridge between Mooi River and considerably north of Ladysmith was destroyed by the Boers, and I believe it was General Buller himself who applied to the Natal Government to appoint one of their engineers to take charge of the reconstruction. My brother (Mr. A. J. Humby, M.I.C.E.) was selected to carry out those works, and he was nominally under the direction of the officer commanding Royal Engineers; but all the executive work was done by him and his staff. Many of the bridges were entirely reconstructed. The Tugela Bridge has been singled out for mention, because perhaps that is an engineering feat, both from a civil engineer's point of view and also from a military point of view. That bridge was 660 feet long, 32 feet high above the bed of the river, constructed of 14-inch square timbers, and was built partly whilst the river was in flood. The timber was brought up from Durban, where there was a large stock in hand previous to the war, designated for use in the mines. That timber

was made use of, and the whole bridge was constructed within three weeks. I think those gentlemen who have seen that bridge will bear me out that it was a wonderful piece of engineering to carry out such an enormous structure of framed timbers, not merely lashed together as spars might be, but bolted together. It is also important to bear in mind that the bridge was erected whilst the men were being daily sniped at from the northern side of the Tugela. It was ready for the Princess Christian's ambulance train to cross the day after the troops got into Ladysmith. The emplacements for the batteries at Chieveley and other hills on the south side of the Tugela were, with one or two exceptions, all carried out by the railway staff. Not only were the emplacements prepared, but each one was connected with the main line, so that ammunition and provisions for the troops were brought up almost as soon as the guns were in place. I merely mention these facts to point out how ready civil engineers are—at any rate, British civil engineers—to assist their brothers in arms, and I am perfectly certain that should any war break out, the Army will always get the most patriotic help from civil engineers. The Natal railway engineers have carried out several other works during the South African War, and I should like also to mention work which they did long before that, viz., in the first Zulu War of 1879. At that time the railway only extended to half-way between Durban and Maritzburg. The Zulus were expected down almost every night; there was only a very small number of troops in the country at the time, so that they could render no assistance to the Colonial population. The Government therefore asked the Railway Department if they could assist, and they readily came to their aid and built a number of laagers, composed of rails and sleepers, which luckily were not required, but would no doubt have been extremely useful if necessity had arisen.

Mr. HENRY THWAITES (Mem. Inst. C.E.):—I do not know that I have anything very particular to say on the subject of the author's paper, because I left South Africa very soon after the war commenced; but I should like to add, in reference to the Table Bay Harbour Works, of which I was chief resident engineer for more than twenty years, that I think I was of considerable help, both to the military and naval authorities, in suggesting means of defence for that port. There were several occasions on which I was consulted in regard to that matter. I may remark that probably civil engineers, knowing the configuration of the ground and all the details of the country in which they are carrying out works, may be able to prove themselves of great assistance in time of war. As I was not present during the principal part of the South African campaign, I cannot personally say what help was afforded to the military authorities by the civil engineers; but from all sources I have heard that they rendered most efficient service during that period. I may add that owing to the exceptional advantages possessed by the Table Bay Harbour Works in the shape of special labour such as electricians, divers, skilled workmen, sailors, etc., with the necessary machinery and appliances, a very valuable and efficient corps could be formed for the protection of the port, both by sea and land, and as a fact the local land forces were materially augmented, both as to officers and men, from these works.

Mr. H. P. B. RICHY (Mem. Inst. C.E.):—Like the last speaker, I scarcely expected to be called upon to say anything this afternoon. I received an invitation to attend this meeting, and it has given me the greatest possible pleasure to hear the paper which has been read by

Mr. Lacy Good. Like himself, I had something to do in connection with the late war as an ordinary civil engineer, and I was called upon in many instances to assist both in carrying out works and in giving advice to the local military authorities in Cape Town. With regard to the question of organisation, which one of the speakers has said is a very important part of the duties of the military authorities, I found that the detailed organisation in many cases was not always perfect. No doubt, looked at from a military point of view, there are things which should be dealt with in detail which ordinary civilian engineers have no knowledge of. At the same time, I found in many instances it was very difficult to carry out works in a satisfactory and economical manner through the civil engineer not being sufficiently allowed behind the scenes. Of course, as a civilian I fully recognise there are matters which must be kept within the purview of the military authorities only, but there are certain details which can be carried out very much better by a civil engineer who is outside the military staff if he has more definite knowledge of what the intentions are. It is only by foreseeing the requirements of the future, and by giving engineers a certain knowledge of military matters which will make them competent to act at the necessary time in a most efficient way, that things will be properly carried out. I would submit as a proposition that if the military authorities were to make a suggestion to some of our engineering bodies, such as the Institution of Civil Engineers, that they should introduce into the curriculum or the teaching of ordinary civil engineers a certain amount of knowledge regarding military engineering, it would be a step in the right direction. Would it not be wise to suggest, in connection with the examinations which have to be passed before an ordinary civil engineer can be raised to the position of an Associate Member of the Institution, that questions regarding military engineering should be put to the students? This would necessitate the engineer during his training giving a certain amount of attention to military matters and military engineering especially. After the engineer had had a certain amount of practical experience he would be in a position, when war did occur, to render much better assistance than he would without that knowledge. The bringing closer together of military engineers and civil engineers is most desirable. When I say civil engineers I use the words with a certain amount of caution, because nowadays, outside certain spheres, any man may call himself a civil engineer; if he only rounds a broom in the street he calls himself a civil engineer, and therefore a certain line must be drawn. When a man has attained a particular status, either by experience or by passing certain examinations, then to my mind he should be admitted to a certain knowledge of military matters which will enable him to be of the best use and service to his country. My experience in South Africa showed that every engineer who was worthy of the name gave the whole of his attention, and submerged his own duties in trying to be of service to his country; but in many cases he was handicapped very considerably by the apparent overawing knowledge of the military engineer. The heads of the Royal Engineers were men who always commanded the greatest respect, but that was not the case with the junior officers; and the fact that that was so, tended to create discord, and wherever discord comes about in a camp, things do not move satisfactorily. The paper seems to me to be a good introductory to a better understanding being brought about between civil engineers and military engineers; and there is no doubt that, by constant communication between the two, future arrangements can be made which will be of the greatest service to the country.

Mr. G. LACY GOOD, in reply, said:—I was very much interested in what Colonel Mayne and Colonel Scott Moncrieff mentioned in the course of their remarks. I quite agree with what they said as to the propriety of a study, on the part of civil engineers, of military tactics, in order that the value of their assistance in the design and construction of defensive works might be enhanced. Of course, it is necessary for civil engineers to act in subordination to the military authorities; but, as Mr. Rigby pointed out, it was a little galling in the late war to men of his and my age and standing to receive instructions from young fellows half our age. But no doubt this difficulty would be got over in any future war. Naturally, we all looked up to the older officers, with their far greater experience on purely technical matters. I had hoped that Mr. Thwaites would have told us something about what might have been done by the diving staff on the Harbour Works. Naturally, the resident engineer of the Harbour Works knows every sounding in the channel, and the divers also; and for laying mines or anything of that sort their services would have been most exceptional. I have not anything more to say, except to thank the audience for their kind reception of my paper. I omitted to hand round one photograph, which I have called "How we kept the colours flying at Klipplaat." There is a certain amount of interest attaching to the flags there, because they were made by a lady in Johannesburg, who was so patriotic and determined her child should be born under the British flag that she had the Union Jack spread over her bed!

The CHAIRMAN (Brigadier-General R. M. Ruck, R.E.):—I regret very much that there is not a larger attendance here to-day, but as regards the officers of the Royal Engineers there is a rival attraction. A lecture is being given this afternoon at Chatham by Major Sir Alexander Bannerman, R.E., upon the siege of Port Arthur, and as he was there throughout the whole of the siege, I have no doubt it has attracted a large number of engineer officers who would otherwise have been with us. Before making any general remarks on the subject of the lecture, I should like to read a letter which I have received from a very eminent civil engineer, Sir John Wolfe Barry. He says: "Dear General Ruck, I am sorry that I am engaged away from London on Thursday next, and so cannot be present at the lecture on the work of civil engineers in time of war. I have, as you know, taken some interest in the idea of securing for the country the assistance which civil engineers could render in time of war, and have, at the request of the War Office, laid my views on the subject before them. In the junior branches of the civil engineering profession there exists an important potential reserve which could be called upon in case of necessity, and I think that many young civil engineers would be ready to volunteer for such a reserve, and be willing to give some of their time towards qualifying themselves for their duties, provided they had some recognised position, and that their duties while in the reserve would not conflict with their civil work. The training of young engineers as resident engineers and assistant engineers of their seniors in the profession or on the staff of railway companies or contractors fits them thoroughly to execute many military engineering works, but still more importantly their education makes them acquainted with the management and control of large bodies of workmen of all classes. It also makes them well acquainted with the use of machinery and the organisation of transport. From all points of view I welcome a more intimate association between the Royal Engineers and the civil engineers for the above purposes, and I think a good scheme could be evolved on which such an association could be based. If I had been able to be present at the

lecture I should have been very glad to have personally laid my views before the audience." I do not propose to detain you by remarks as to the detailed works described in the lecture. I would only say that we have listened with the greatest pleasure to the experiences of Mr. Good and the other gentlemen he has referred to how they adapted their knowledge of engineering matters to the defence of their country. Mr. Good alluded to some very valuable assistance rendered by the civil employes of the railway companies during the war; and on this subject, an officer who had served during that war has sent me a few notes, which, I think, may be of interest to you. He says: "In that war perhaps the chief example of the many cases where civil engineers gave their professional services to the country as military engineers, and did not only serve in a purely combatant capacity, was that of the late Major L. I. Seymour. This gentleman, one of the leading mechanical engineers employed in the gold mining industry of the Witwatersrand, originated the idea of organising the large amount of engineering and technical talent lying idle at the beginning of the war (owing to the occupation of the Rand by the enemy) so that it might be of some use to the British forces. The result of his exertions was the formation, in December, 1899, of an Irregular engineering corps of volunteers, called the Railway Pioneer Regiment. This corps, 1,050 strong, was, with the exception of a nucleus of Regular officers and non-commissioned officers, officered entirely by civil engineers and mine managers from the Rand who had engineering or technical knowledge. It did most valuable work in carrying out the heavy and semi-permanent repairs to the railways. In the ranks of the regiment were men of every trade and technical qualification. Major Seymour gave his life to this country, being killed in action on the 14th June, 1900, at Zand River, Orange River Colony, on which day another civil engineer was also killed, Lieutenant J. Clemens, of the same regiment. Another well-known case was that of Mr. Labram, the civil engineer who constructed a gun during the siege of Kimberley. He also was killed.. I only quote these cases as some of a large number of instances of a similar character." It appears to me from what we have heard to-day, and from general experience, that very valuable assistance can be offered to military engineers by their civil confrères; but I think the essence of the remarks that have been made here points to the fact that this assistance should be organised in time of peace. This organisation may be considered under two main requirements. The first I should call a reserve of the Royal Engineer officers. The Royal Engineer officers are very few in number, really extremely few considering the variety and extent of the duties they have to carry out. Practically the establishment is now fixed that there is not a single engineer officer who is not absolutely essential in time of war; and behind them there is practically no reserve. We have a few retired officers, but of course officers do not retire when they are quite young, so that very few of them would be available for war. What most of us would like to see very much indeed is a good reserve of Royal Engineer officers. A scheme has been mooted, to which Sir John Wolfe Barry has referred, and we have to a certain extent progressed with it, because we have approached that great institution which Mr. Rigby referred to, the Institution of Civil Engineers, and I believe that I may say that it has been favourably received. The general outline of such a scheme would be that a certain number of young engineers, during their more or less pupilage stage, should receive a really good military education, and join what would be called the R.E. Reserve of Officers, very much the same as the Royal Naval Reserve of Officers is

to the Navy, and that periodically they should go out for training with some of the field companies or fortress companies, whichever might be most suitable for them. I think that such an organisation might get over some of the difficulties that have been raised. Thus, when civil engineers are employed for defence works, everybody will, I think, agree from the discussion we have had to-day it is essential that they should have a considerable amount of military knowledge, which they would gain in the way I have mentioned. In addition to that, we have to consider the engineering work which has to be done on lines of communications, which Colonel Mayne alluded to more especially. As our Secretary of State for War (Mr. Haldane) said a few weeks ago, there is an enormous amount of work on the lines of communication—almost more than at the front. It is a well-known saying that the Army marches on its stomach, and the stomach is the line of communication. Therefore, it is an extremely important work. That work, as you know, consists largely of railway work, telegraph work, road building, hut building, and works of construction generally. I was very much impressed indeed in reading the accounts of the Japanese War, with the enormous numbers of men they employed on engineering work on the lines of communication. In the actual constructional work, that is, the building of cantonments, huts, and so on, literally thousands of men were employed. That description of work is work that a civil engineer is accustomed to from his earliest boyhood, and he does a great deal of it all through his life. Hence he would be able to do that kind of work without any special preparation. At the same time, it would be advisable, and in some cases essential, that he should have a certain knowledge of military training, military conditions, and military customs generally, and that, I think, can be obtained most readily in our auxiliary force organisations. We have, I am glad to say, a most efficient body of Engineer Militia and Volunteers, which, I think, could be modified and expanded as required. They could undertake the greater part of this kind of work, leaving the Royal Engineer to his more purely military duties. There are certain cases also—it may be either in the actual field of battle or on the lines of communication—when long, extensive lines of defence have to be made. We have all heard of Wellington's lines, and of the long lines of defence works which were put up in the late war. The execution of those works is sometimes carried out by soldiers and sometimes by civilians. Near the field of battle you may have to rely on the soldier to do this duty, but it very often happens that the works are executed in positions away from the actual battle-field, and then it is usual to employ thousands of civilians. There, again, I think you could get valuable assistance from civil engineers, associated with a certain number of military engineers. I think both Colonel Mayne and Colonel Scott Moncrieff alluded to the fact that the best military engineers are those who have had most experience of large civil works; and I think it is largely due to the fact, referred to by Sir John Wolfe Barry, that they understand and have an intimate knowledge of the employment of large gangs of workmen. Therefore, in the execution of these large defence works, civil engineers should be specially useful. Before concluding my remarks I should like to allude to the great assistance which civil engineers have already given military engineers in enabling them to prepare for war. For instance, all the young officers at Chatham have to visit certain civil engineering works, and we have always had the greatest possible assistance from the civil engineers engaged on these works, who help us in every possible way. We have also received very valuable assistance from the

large railway companies in the instruction of our officers. We have a system of sending officers for a year on to these lines of railways, and the railway companies take our young officers and acquaint them with all the knowledge they require to make them good railway engineers. Not only do the railway companies extend that privilege to us, but a certain number of private engineering firms and also the Admiralty give our officers similar facilities for instruction in other branches of engineering. I am sure that the Royal Engineers here and everywhere else would like me to say how very much we wish to reciprocate this assistance which we receive from civil engineers, and to add that we also are very proud of belonging to the great profession of engineering. I have now, on behalf of all present, to thank Mr. Lacy Good for the lecture he has so kindly given us, and which, to my mind, is of especial interest in its larger aspect. I should also like, on behalf of those Royal Engineer officers who served in South Africa, to take advantage of this opportunity of thanking those civil engineers who served in that war, and who assisted us in the most cordial and devoted manner, some of them, as has been mentioned before, even to the death.