THE ROYAL ENGINEERS JOURNAL

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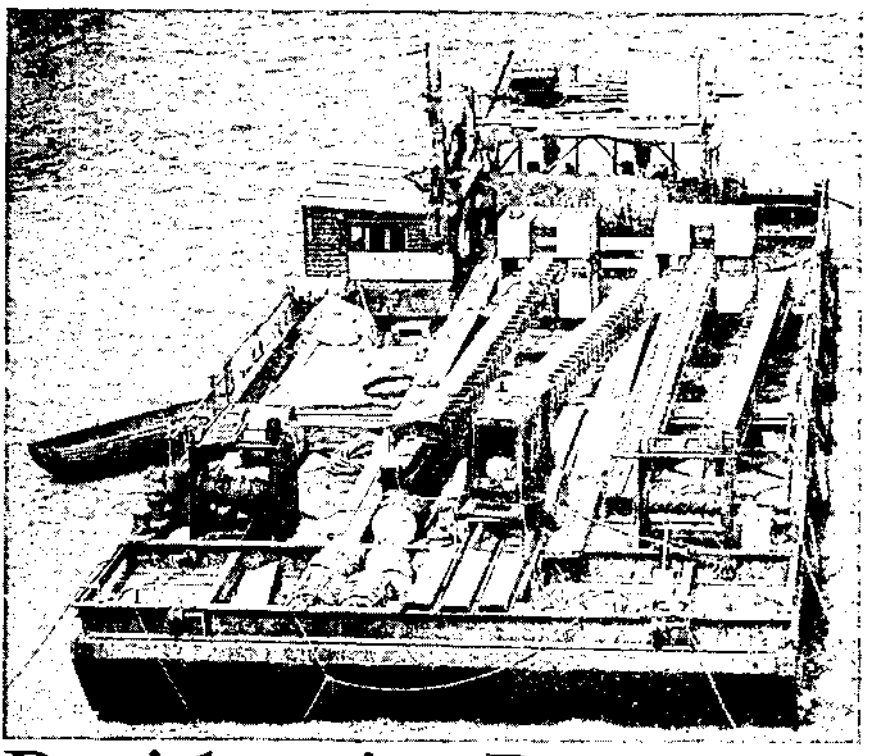

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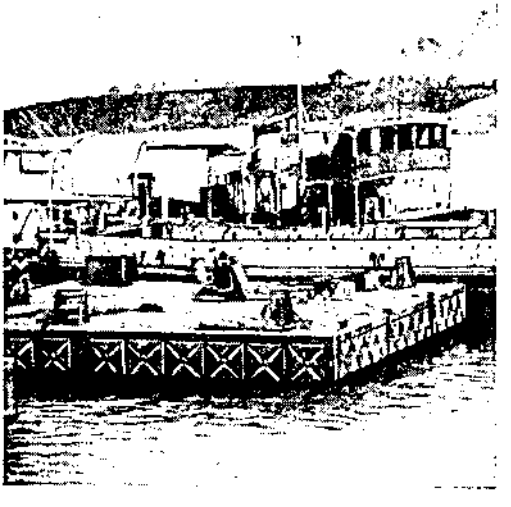

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Corps Notes

It is with deep regret that the recent deaths are recorded of two Colonel Commandants Royal Engineers (Retired), General Sir Maurice C. Taylor, KCB, CMG, DSO and Major-General C. G. Fuller, CB, CMG, DSO. Obituary notices of these two famous Sapper Officers appear in this edition of the *Journal.*

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Major-General T. H. F. Foulkes, OBE assumed the appointment of Engineer-in-Chief, the War Office, on 29 April 1960 in place of Major-General Sir Henry H. C. Sugden, KBE, CB, DSO, who retires. The Corps will be anxious to congratulate General Foulkes and to wish him all success in his most important post; to General Sugden will go our thanks for all he has done for the Corps and for the Institution, and our best wishes to him and Lady Sugden for the future.

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The Corps will wish to congratulate too Lieut-General Sir Charles P. Jones, KCB, CBE, MC on his appointment as Commander 1 (British) Corps.

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Our congratulations also go to Major A. B. Hartley, MBE, GM on his recent award of the George Medal for courage and determination during many hours of difficult and hazardous work in disposing of a booby-trapped 250 kilogramme unexploded bomb found in a sewer in Putney. The bomb had two clockwork fuses both of which, it was discovered, had stopped within a few ticks of firing and were liable to be restarted by any small movement or vibration. The bomb was lying awkwardly with the fuses underneath it and Major Hartley had to work for many hours hampered by the stench and fumes from the sewer in a dark, airless space at the bottom of a shaft.

Those who read his article in the December 1959 issue of this *Journal* will realize fully the exacting nature of this still active task of clearing unexploded bombs.

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Major and Quartermaster V. C. Traynor and Major and Quartermaster W. B. Traynor, the twin sons of the late Sergeant W. B. Traynor VC of the West Yorkshire Regiment who gained his Victoria Cross in the South African War, retired from the Army on 6 April 1960, having between them completed just over eighty years' service in the Royal Engineers. They both enlisted as boy tradesmen in the Corps on the same day in March 1920. They started their man's service simultaneously. They both received their first stripe in April 1923. They both joined the Establishment for Engineer Services and, after splendid service, both rose to the rank of Major in the Corps. A truly magnificent record worthy of their gallant father.

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On 3 April 1960 at a parade held on Christmas Island the CRE and Commander Army Garrison, Lieut-Colonel J. P. Asher, MBE, RE, on behalf of the Corps presented a silver cigarette box, inscribed with the Corps and Fiji Military Forces cap badges and the words "Christmas Island 1958–60", to the Fiji Engineers to commemorate their close association with the Corps of Royal Engineers on the Island. The outstanding work of the Fiji Engineers was recognized by the award last year of the British Empire Medal to Sergeant Isoa Wilfred Vavaitmana, better known to those who served on the Island as "Sergeant Wilfred". His full, real name was, it is understood, known only to Sergeant Wilfred himself and to the Pay NCO.

17 Independent Field Squadron returns from Christmas Island leaving only 73 (Christmas Island) Squadron behind. 17 Field Squadron, on arriving home, amalgamates with 63 Field Squadron to form 17 Field Squadron of 38 Corps Engineer Regiment at Ripon.

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An autographed photograph of HRH the Duke of Edinburgh has been presented by the Corps to the Madras Engineer Group to commemorate the visit by His Royal Highness to the Group Mess last year.

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For the past year 50 Gurkha Engineer Regiment has been engaged in developing the Training Area in North Borneo and one of their many tasks has been the construction of a 700-foot under-water Causeway across the River Tempasuk. Lady Mountbatten watched the Gurkha Sappers at work the day before she died on 20 February while on a tour of North Borneo. With the permission of Admiral Lord Mountbatten the Causeway was named after her when opened by the Governor of British North Borneo last April.

* * * * *

In an article in the December 1959 edition of this *Journal* on the centenary of 101 (London) Field Engineer Regiment (TA) it was stated that this Regiment was descended from the 1st Middlesex Volunteer Engineers, raised in January 1860, and was the senior Territorial Royal Engineer Regiment. This is in fact not strictly correct for, although 101 (London) Field Engineer Regiment (TA) appears to have the longest service in the Territorial Army, the Royal Monmouthshire Royal Engineers (Militia) is the senior unit by virtue of having been part of the Special Reserve formed originally from Militia units. Subsequent transfers to the Supplementary Reserve and, later, to the Territorial Army were made subject to the proviso that the unit retained its precedence in the Army and its position has recently been confirmed by Her Majesty the Queen.

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We are indebted to the Royal United Service Institution for permission to publish in this edition of our *Journal* the lecture delivered by Lieut-General Sir John Cowley to the RUSI last November. It will be remembered that his lecture aroused considerable interest and controversy at the time, was the subject of discussion in Parliment and gave rise to a first leading article in *The Times* and many articles in other sections of the Press. The present position regarding an independent "British Deterrent" lends topicality and added interest to General Cowley's lecture and the discussion that followed it.

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It is hoped to hold the first of a series of Professional Meetings (as described in the March 1960 *Supplement*) at the Institution of Civil Engineers, probably during February 1961. The paper for discussion will be published in the December 1960 issue of the *RE Journal*. It is of interest to note that the article on the "Preservative Treatment of Constructional Timbers" by Major D. F. Densham-Booth, that appears in this issue of the *Journal*, was recently discussed at a Pan-Malayan Conference on Wood Preservation, thus establishing a precedent for Professional Meetings in overseas stations.

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The Council of the Institution of Royal Engineers has agreed that, to encourage would-be authors, an award of £10 will be made for the best article published in each issue of the *RE Journal*, over and above the normal award for articles published. In addition two prizes are awarded annually for articles published in the *Journal*:—

(a) *The Montgomerie Prize* given for the encouragement of contributions to the *Journal* on professional subjects by RE Officers who are not above the rank of substantive Major, and

(b) *The Arthur ffolliott Garrett Prize* given to the best article on irrigation, water supply, railways and survey appearing in the *RE Journal*.

The 1959 winners of these two prizes were respectively Major F. W. L. Shephard for his article on "Prefabricated Buildings" that appeared in the March 1959 issue of the *Journal* and Captain A. G. Bomford for his article on "The South Georgia Surveys" that appeared in the June 1959 issue.

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Amended copies of the "Charter, Bye-Laws and Rules of the Institution of Royal Engineers" have been printed and are available to Members of the Institution on application to the Secretary.

Future Trends in Warfare

By Lieut-General Sir John G. Cowley, KBE, CB, MA

The following is reproduced, by the kind permission of the Editor, from the February 1960 *Journal* of the Royal United Service Institution.

On Wednesday, 4 November 1959 at 3 pm

Admiral Sir J. Peter L. Reid, KCB, CVO, in the Chair

The Chairman: It gives me great pleasure to introduce our speaker today, Lieut-General Sir John Cowley. He is to speak to us on a subject which I know is of great interest to everyone. General Cowley has been the Controller of Munitions for the last two years in the Ministry of Supply. As that Ministry has recently evaporated, he has found himself, anyhow momentarily, soaring up in the Ministry of Aviation, but I believe he will come back to earth in a few days.

In spite of his preoccupations, I am glad that he has been able to be with us this afternoon, and I will now ask him to address us.

Lecture

You will see that I have chosen to talk to you about one of the most difficult and controversial subjects that I could have chosen. Many of you may be wondering what right or qualification I have to undertake this task. The reason is that I have given lectures on this type of subject for some years to various military audiences, and someone must have suggested my name as a possible lecturer to the Royal United Service Institution. I find that my lectures at these places create an element of spirited disagreement and promote an interesting discussion. I hope that they will have the same effect here. I will state my own personal opinion and I do not ask you to agree with me. In fact I will be disappointed if you do.

I am a Regular serving officer, at the moment employed in the armaments business, and I have had the advantage, during the last two years, of being able to see the Service ministries from a vantage point slightly outside any of them. Early this year I spent six weeks travelling round America and Canada and seeing the various military weapons and equipments which they are developing and equipping for future wars. I believe it is not possible to get a true perspective of the whole problem of warfare without making such a visit. The American scale of effort on defence is so vast compared with ours that it is an experience worth having to look at it from close quarters.

There is little point in quoting figures to demonstrate the comparative effort of our two countries, but there is one figure that sticks in my mind. It was given to me by a major-general in the American Army Ordnance Corps, who is now employed at Ordnance Missile Command. His responsibility covers the development and production of guided weapons for the American Army, a very specialized field which at the moment does not play a big part in the British Army weapons development programme. I asked him how much money he was allotted by the American Government for this work, and he replied that his annual budget was $2,000 million. This figure he repeated in a public speech to a number of American businessmen, so there is nothing secret about it. He then told me rather sadly that the American Air Force was given far more money than he was for their guided weapons programme. $2,000 million at the present rate of exchange is some £700 million, which you will recognize as nearly half as much again as the total British Army annual Vote. It is easy to draw conclusions from this type of information that our effort is so small compared with the American effort that it tends to be insignificant. I am convinced that such a conclusion is completely wrong. I will come back to this subject later, but anybody who argues about the measure of defence effort entirely in terms of money and effort is basing his argument on a faulty premise. There are many other factors which come into it.

There are certain other general points which I would like to deal with before getting down to the various forms which future war may take. The first is that I find the point of view of a serving officer on the whole subject of defence is inclined to be shaded by the colour of the uniform he is wearing. For instance, when talking about the deterrent, officers dressed in dark blue have a distinct leaning towards a missile of the Polaris type fired from a submarine, while officers dressed in light blue have a leaning towards another generation of V bombers carrying an improved stand-off guided bomb. Officers dressed in khaki are inclined to doubt whether the deterrent has any

real value at all. This colouring of one's outlook may be very natural, but I am sure that senior officers should try to develop an inter-Service outlook and should not be prejudiced too much by thinking of the future of their own particular branch of the Service.

The last general observation I will make is the danger of jumping to conclusions. It is easy to read a well-written article or book and to be convinced that the author is right. Not long ago in a famous London newspaper I saw these headlines: "After forty years of study, the greatest living expert in the art of war has come to this conclusion: 'All military knowledge is now useless'." When I went down to the Staff College recently I offered that to the Commandant as a text to be displayed over the entrance to the Rawlinson Hall. "All military knowledge is now useless." My offer was not accepted. Nor was it accepted at Latimer, which is the home of the Joint Services Staff College. The trouble is that this sweeping conclusion has an element of truth in it, so that although it clearly must not be accepted at its face value, do not dismiss it as pure nonsense.

To summarize, then, the general points. Do not be misled by the tremendous effort the United States is making into thinking the British effort is insignificant. Do not have too much prejudice connected with the colour of the uniform you are wearing, and do not jump to conclusions too quickly.

As I have been trained as a soldier, my talk is going to be confined mainly to the problems of fighting on land, rather than fighting in the air or on the sea. I make no apologies for this, as I regard land fighting as more varied and more difficult than fighting in either of the other two elements. One of the main reasons for this complication and difficulty is the problem of logistics. A ship at sea is self-contained for a number of months. An aeroplane returns to its main base to be re-supplied, but soldiers remain isolated and scattered in inaccessible parts of the world without being able to carry with them more than a few days' food or ammunition. The problem of land warfare is mainly a problem of logistics, and the introduction of modern weapons has made this problem even more difficult. The easiest way to kill an army is not to attack its teeth and claws in front, but to cut off its tail; and modern weapons have made the means of cutting off the tail much more speedy and effective. This is a theme which will run through the whole of my talk.

I will now get down to the various forms which warfare may take in future. It is conventional to describe these as the cold war, limited war, and total war. I dislike the terms "cold war" and "limited war", as nobody knows exactly what they mean.

Cold war is a state of political tension and has no direct connexion with warfare in the true sense of the world, but during this period of tension there will be a continuing series of incidents calling for the use of force. There is also a need to define more closely the term "limited war". To some people it means a war fought anywhere in the world, including Western Europe, but without the use of large nuclear weapons. Other people think it means a war fought anywhere except in Western Europe. In this talk I am going to define it as any international armed conflict other than total war, and when I talk about total war I mean a war between the USA and her allies on the one side and Russia and her satellites on the other, whatever weapons may be used. I am not implying, by defining it, that this type of war is inevitable. In fact I sincerely believe that it will not happen, but I will deal with this subject in more detail later.

I will start at the easy end, military force in aid of the civil power. I call it the easy end because we in Great Britain know all about this type of fighting, as we have been doing it for many generations and there is very little doubt that we will continue to do it for many more. It used to be called imperial policing, and this is probably still the best description of it although the term itself is no longer fashionable. It is the kind of job we were doing recently in Malaya, Cyprus, and Kenya. There have been in the past, and are bound to be in the future, situations where the local police are unable to maintain law and order and as a result call on military help. In the British colonies the military is normally the British Army, and it is their duty to help the police when asked to do so. I am sure everybody will agree that the British Army is not only very experienced but very expert at doing this type of job. They have had plenty of practice at it.

In addition to imperial policing, there is also the frontier defence of the territories for which Great Britain is responsible. A good example is the recent disturbance on the frontiers of Aden—something more than helping out the police but well short of a limited war.

The main requirement for both policing and frontier defence is the infantryman armed with his personal weapons. He is the basic necessity, and the other arms, such as gunners and armoured car units, are required to help the infantryman to do his job. The force must be transported to the trouble spot quickly and be equipped so as to take action immediately on arrival. An incident which can be dealt with by a company of infantrymen today may need a battalion tomorrow or two brigade groups next week.

The best and sometimes the only way to arrive quickly is by air, and this means we should have sufficient aircraft to lift both men and their essential equipment from the nearest centre where British troops are stationed to the place where they are wanted. The aircraft must be able to land on improvised airstrips or, better still, be able to land or take off vertically without an airstrip at all. There is, therefore, a need in both this type of war, and even more in the limited wars which I will mention shortly, for two types of aircraft, one heavier type to do the longer distances between main airfields, and one lighter type to do the short trips from main airfields to points as near as possible to where the troops are wanted. Supply by light aircraft or helicopter is not difficult to arrange for these lightly equipped forces, as was demonstrated in a recent exercise on Salisbury Plain.

The only other observation I will make in connexion with police actions is the need for improved equipment for night fighting. When I was visiting Malaya I was impressed by the ease with which terrorists escaped under the noses of the troops during the hours of darkness. There is scope here for improvement in night fighting equipment.

I will now turn to limited war, and immediately the problems become more difficult. The kind of wars I am referring to now are represented by the fighting in Korea, the Israel *versus* Egypt campaign, the French wars in Indo-China and in North Africa, and our short and ill-fated operation at Port Said. Such campaigns are clearly more than police actions or frontier defence, but equally clearly they fall short of the total war of East *versus* West.

There are two questions which must be asked about this type of war. The first is can we go it alone? The second is, will nuclear weapons be used? I will deal with these two questions separately, and in dealing with them I am prepared for a large measure of disagreement.

Could we go it alone? Could Great Britain alone and unaided launch a force of several brigade groups in a limited war? My personal belief is that we are unlikely to engage in anything more than a police or frontier defence action except with the knowledge and support of our friends, even though they make no direct military contribution. Clearly we must retain the ability to go to the aid of a friendly country which asks for our help. A good example is the help we recently gave to Jordan. In a larger scale limited war of the Korean type, the British contribution can only be as part of a large Allied force of which the main partner is likely to be the United States.

Whether we are sending a British force to help a friendly country, or contributing to a larger Allied force in a Korean-type war, we must have the ability to arrive quickly. Once again it is better to send a small force tomorrow than a larger force in a month's time. This again comes down to the use of transport aircraft of all types. I realize that a force which is entirely moved and supplied by air cannot have such powerful weapons as a force which is supplied by sea or overland. The man who gets out of an aeroplane is bound to feel a bit naked if he is confronted with a well-equipped enemy, so the sea tail must not be long in catching him up. It is possible, however, to carry around in modern aircraft some extremely effective and hard-hitting weapons capable of dealing with enemy tanks, and also capable of projecting missiles many miles. Such weapons are an essential part of any British Army of the future. Our own tanks and guns, which will be wanted if the fighting becomes heavy, will have to come along by sea, but the emphasis in limited war should once more be on rapid arrival rather than on heavy armament.

The second question is whether or not nuclear weapons will be used in this kind of war. Here again, opinion is sharply divided between the people who answer "yes" and the people who answer "no". I will try to put both cases as fairly as I can.

First, the people who answer "yes". They argue that a nuclear weapon is just a development of a high-explosive weapon, and nuclear weapons of various sizes have already been introduced into some armies and will inevitably be introduced into many others in the next ten or twenty years. They say that people who try to prevent the use of these weapons are exactly the same people who in the fourteenth century tried to prevent the use of gunpowder. Here is a natural development of military weapons and it is quite unrealistic to believe that wars in future will be fought without them.

They argue also that if we are to confine ourselves to conventional weapons, the first-class Powers will find themselves with little or no advantage over second-class Powers, who are already in possession of the best types of conventional weapons. The improvements in conventional guns and tanks and armoured vehicles in future are marginal, and there will be little difference in performance in a few years' time in such weapons possessed by the less-developed countries than those possessed by the British Army. Our only real advantage will be that we can have in our armoury an assortment of nuclear weapons which the other side may not possess, and if we do not use these weapons we will fight with one hand behind our back.

I will now try to present the case of the people who say nuclear weapons will not be used in a limited war. There are three arguments against their use; the first one is morality, the second is one of expediency, and the third is the danger of extending, by the use of such weapons, the scope of limited war until we slide quickly into total war. I will deal with these three arguments separately.

First, the moral argument. Can we, who claim to have morality on our side, who claim to be fighting for right against the forces of evil, can we afford to be the first to use these weapons of mass destruction? Even the tactical nuclear weapons, which in military exercises are thrown freely about the battlefield, can have warheads of far greater power than the bombs that destroyed Hiroshima or Nagasaki. These are the only two atomic bombs which have ever been dropped on human targets and one has only to think of what happened in those places to realize what a tremendous impact even small bombs would have on the people in or near the target area. The change from high explosives to atomic weapons is not of the same order as the change from bows and arrows to gunpowder; for more than a century the longbow remained a better weapon than the musket. The point is that the change then was gradual, while the change today is violent and sudden, and alters the whole aspect of warfare. It can be argued with conviction that for us to be the first to use these weapons against an enemy who does not possess them is unthinkable on moral grounds. You will all remember the world-wide indignation that was stirred up when poison gas was used against the Abyssinians. It is perhaps easier for a military audience to play down this moral issue, but I believe it to be an extremely powerful one. If nuclear weapons are used by the enemy first, then of course we must be prepared to use them back, but if he has not got them or does not choose to use them against us, then I can see a strong moral objection to using them against him in a limited war.

The next argument is not one of morality but one of expediency. If, indeed, the enemy has nuclear weapons or has a big brother who is willing to lend him some, then should we gain by their use by both sides? The answer clearly is "no". Wherever we fight a limited war, it is certain that our Army will be in a foreign country, maintained from an overseas base by a line of communication which will run through a port, or over beaches, or through a series of airfields and landing grounds, or more likely a combination of all of these. There is no target which is more ideally suitable for destruction by a nuclear weapon than a port, and it is almost as easy to knock out a beach or an airfield. The enemy will normally be supplied overland and will therefore not be so dependent on points of concentration on his lines of communication. In other words, whatever logistic system we may employ to maintain our Army in a limited war, we are bound to be more dependent than the enemy on targets which can be knocked out by enemy nuclear weapons. It is unrealistic to think that we shall have 100 per cent air protection of these targets. I believe we must face the unpleasant fact that the logistic system of a limited war force fighting overseas can be destroyed once nuclear weapons are used by the enemy. To take cases from recent campaigns; suppose that during the Korean campaign Pusan had received a hit from an atomic bomb, there can be no doubt that the maintenance of the Allied forces in Korea would have been impossible. Had the Mulberry Harbour received a direct hit from a nuclear bomb during the Normandy landings and the subsequent operations in Northern France, the British Army could not have been maintained. And later on, had Antwerp been hit by a nuclear bomb, it would have made the logistic support of 21 Army Group impossible. Our Suez campaign three years ago would have come to an even more sudden stop if the harbour in Port Said had been put out of action by a nuclear bomb.

I am not saying it is absolutely impossible to maintain a force overseas in the face of a nuclear attack. Such a force could be maintained by making use of every available beach, helicopter, vertical take-off and landing aircraft, and by having the organization and equipment to disperse the logistic system over wide areas. At great expense I think it might be possible to maintain a small force even if nuclear weapons were used against the lines of communication, but I also believe that the logistic effort involved would be out of all proportion to the military value of such a force. If we intend to fight limited wars with nuclear weapons, and we expect to have them used back at us by the enemy, then the type and size of force that we can maintain under these conditions is a small number of commando and parachute troops only. Even the supply of this small force would be dependent on an overseas base at which the landing craft and aeroplanes would have to load. Could we be sure that this base itself would not become a nuclear target?

And this brings me to my third point. Is it possible to limit the size and the range of nuclear weapons once they are used by both sides? My answer to this is that it is easy for the side that is winning to make some voluntary limitation of the size and range of weapons, but it is not nearly so easy for the side that is losing to draw an arbitrary line beyond which they will not go. One side or the other has to be willing to lose the war rather than to extend it. It is easy to be meticulous about obeying the rules if you are winning the match, but it is much more difficult if you are being soundly beaten, especially when you are fighting for your life. I personally do not believe that any arbitrary limitation of range and size of nuclear weapons can be imposed once these weapons are used at all. It is no good us having a book of rules on how these weapons should be limited in warfare unless we are quite certain that the other side is working to the same rules as we are.

There used to be military exercises in which the number of nuclear weapons allotted to each side was limited and the range of these weapons was also limited. You will remember the kind of thing; both the enemy and our side had twenty such weapons, each with a yield of ten kilotons and each with a range of 100 miles. The first day of the exercise was employed in siting all our vulnerable installations just over 100 miles from the enemy launching sites. The second day was spent deciding how best to use our twenty bombs so as to destroy the enemy. I am glad to say that these exercises are now out of fashion, as I believe they are totally unrealistic.

There, then you have the arguments for both sides. One side says that we cannot stop these weapons, which are a natural development, and the other side says that both on grounds of morality and expediency, and with the difficulty of limiting the use of the weapons once they start, we must on no account be the first to use them in a limited war. My personal opinion is that the second school, the school that says "no", is the right one from the British point of view. I realize that if the enemy uses them on us, we must reply with them and reply quickly, but directly this starts we must also realize that our logistic system is bound to be so vulnerable to nuclear weapons that we may well be unable to maintain our Army. In other words, we must start such a war with no intention of using nuclear weapons unless they are used on us, but we must have the ability to use such weapons in retaliation the moment the other side starts. We must realize that directly they are used by both sides, the whole character of the fighting will change and the logistic supply of both armies, especially our own, may well become

impossible. I believe we would be wrong to spend a vast quantity of money in trying to make our logistic system impervious to nuclear attack, as the money spent trying to do that would be out of all proportion to the money available for the fighting end of the Army.

If we accept this idea, then we must be careful not to become involved in parts of the world where our small Army could be overwhelmed by masses of enemy equipped with conventional weapons. There are places in the world where the forces the enemy could bring up against us are bound to be limited owing to their own logistic problems, and I can see us fighting limited wars in such places. What we must avoid is any place where we may be confronted with masses of enemy who could overwhelm us with conventional weapons and where the only alternatives might be to pull out or to start the use of nuclear weapons in order to hold them off.

To sum up my opinion about limited wars, I suggest that we should be able to send a force quickly to the aid of a friendly power who invites our help. I believe that normally the British force would be a part of an Allied force. In any case, we must have the strategic mobility to arrive quickly. We should not become involved in a limited war where masses of enemy can be deployed against us. Our force should be equipped with conventional weapons, but also it should have available to it nuclear weapons, but with no intention of using them first. We should, however, have the ability to retaliate immediately with nuclear weapons once these had been used against us, realizing that from the moment these weapons were used, the whole nature of the fighting would change and our logistic system might be rapidly put out of action.

I come now to the most difficult war of all, the ultimate war between the United States and her allies on the one side and Russia and her satellites on the other. The prospect of such a war is so hideous that it must be clear to everybody that the main object is to prevent it ever happening. This leads me to the theory of the deterrent. The idea is that the Western Powers can deliver such a tremendous and immediate knock-out blow to any potential aggressor that such an aggressor is deterred from ever starting a major war. It is the old theory of the fear of the policeman deterring the criminal from committing a crime.

When considering the deterrent, one thing must be remembered. It is effective because of its existence and it ceases to be of any use to anybody once it is used; this is a paradox worthy, I think, of Lewis Carroll. You will remember a delightful character represented by an old man sitting on a gate who had several provocative theories of life and who kept on being asked, "Come tell me how you live and what it is you do?" He answered one of these questions by saying:

> "I am thinking of a plan to turn my whiskers green,
> and then to use so large a fan that they should not be seen."

Another verse could be added:

> "I also have a plan to spend a thousand million pounds,
> To buy some guided missiles and to hide them in the ground,
> And then to clearly paint on each 'these things must not be used',
> No wonder that our citizens are getting so confused."

Whatever we may think about the deterrent, there is no doubt that, since 1945, minor incidents have not blown up into major wars, and the advocates

of the deterrent can argue with justification that this has been owing to the presence of the American Strategic Air Command, which has clearly been able, for the last fourteen years, to deliver a crushing blow on any aggressor without the fear of an equally crushing blow being delivered back on the United States. But this situation has now changed, and both East and West are equally capable of devastating the opposite side. The deterrent theory has therefore become complicated by the argument of credibility. It is comparatively easy to say to a burglar, "If you move one pace forward I will shoot you and kill you," but it is not so convincing to say to him, "If you move one pace forward we will shoot and kill each other simultaneously."

The great deterrent, now that it is accompanied by the certainty of equally devastating retaliation, is only effective as an ultimate weapon to be used in the ultimate circumstances where the vital interests of the country possessing the deterrent are threatened. The objectives which can be seized by either side short of provoking mutual annihilation have grown more substantial. The range of conditions with which the deterrent can deal has narrowed until all sorts of unpleasant things can happen without the deterrent being used, or even being threatened with conviction.

This poses a vital question to Great Britain. Is an immediate and mortal threat to this country alone going to trigger off anyone else's deterrent? If not, then we must in such circumstances either do without a deterrent at all, or provide one of our own. If, therefore, you subscribe to the deterrent theory, I think there is a case for Great Britain to have an independent deterrent of her own, if only to retain some independence in the terrifying game of international poker.

It is clear that we cannot afford a deterrent force of a size to be compared to the deterrent forces possessed by Russia and the United States, but it could have an influence out of all proportion to its size. Could Russia afford to be considerably weakened by British nuclear attack while the USA was still unharmed, even if this country were knocked out in the process? But if we are right to have our own independent deterrent in this country, we must realize that other Western Powers have an equal right to have their own independent deterrents, and the prospect of large destructive nuclear weapons in the hands of a number of independent countries is very frightening.

If we are to have a British independent deterrent at all, there is a minimum size below which it ceases to impose any real threat. To work out exactly what that size should be is not an exact mathematical calculation. It is an exercise in the game of bluff, but we have to take a view in order to plan the shape and size of our deterrent. Moreover, just as the deterrent to be credible must be of a certain size, it must also be up to date. It is no use for instance relying on manned aircraft with free-falling bombs once the enemy defences are so effective that they could bring down practically all the aircraft before they reach their target.

I must point out certain consequences of these two factors. To maintain a deterrent sufficiently large and sufficiently modern to meet its purpose is an extremely expensive business. Our deterrent now costs something like 20 per cent of the total defence budget, or more than half as much as the whole Army Vote. Assuming that we must maintain an effective independent deterrent, I do not see how we can avoid its being a fixed claimant on the defence budget because it cannot be reduced either in size or in cost below the minimum credible size, whatever that may be, without invalidating the whole

object of the exercise. It is therefore necessary to assess the minimum credible size of the deterrent necessary to maintain an unacceptable threat, and to resist any temptation to increase it above this minimum. If, having done this exercise, there should still be a direct conflict within the total Defence Vote between, on the one hand, the minimum credible deterrent and, on the other, the minimum necessary forces to give timely military aid to friendly countries who ask for military help, then my choice would be the latter. I believe that the British contribution to the peace of the world can be far more useful in other directions than in producing weapons which are only useful because of their threat, and which can only be threatened in very exceptional circumstances. In saying this I realize I may be accused of colouring my point of view by the colour of the uniform I wear.

Having dealt at some length on the business of the deterrent, I must now say something about what might happen if fighting should break out in Western Europe in spite of the existence of the deterrent. I find here three schools of thought, which I can best describe as, first, the "big bombs from the beginning" school; second, the "delay in pulling the plug" school; and third, the "gas in the last war" school. I find there are plenty of advocates of each of these three schools.

The "big bombs from the beginning" school is still the official school in this country. I will read out a quotation from a recent White Paper on Defence: "A full-scale Soviet attack could not be repelled without resource to massive nuclear bombardment of the sources of power in Russia." There is no doubt that this would lead to equivalent massive nuclear bombardment of the sources of power in this country and, indeed, in Western Europe and America. Whether this results in the end of the human race is debatable, but there is little doubt that it would result in the destruction of Great Britain. The official school then argues that a full-scale Soviet attack could not be repelled except at the cost of the destruction of this country. Here, then, is the dilemma. Unless we bring the nuclear deterrent into play we are bound to be beaten, and if we do bring it into play we are bound to commit suicide. Either of these alternatives is so drastic that perhaps there is a method of avoiding or at least postponing the issue, and that leads me to the second school, which I called the "delay in pulling the plug" school. This school, I find, is becoming more and more popular. Its adherents maintain that Soviet attack in Western Europe, should one happen, must be halted so as to give time to the statesmen on both sides to realize that unless the fighting stopped, both East and West would be annihilated. In other words, we must have sufficient forces in Western Europe to check the Russian advance for a few days, or even weeks, before the deterrent is put into use. The only way to check the advance of an enemy who is numerically far stronger is to use defensive weapons which counteract the weight of numbers. How can this be done? Assuming both sides have tactical nuclear weapons, it is clear that a large army equipped with tactical nuclear weapons will beat a small one similarly equipped. But I believe that the existence of these weapons would impose so great a threat to any large concentrations of troops necessary before a major attack, that the advantages of possessing a superiority in numbers might be counter-balanced. These weapons would act as a form of deterrent on a tactical level. I believe, therefore, that to arm the Western Powers in Germany with tactical nuclear weapons is a wise thing to do. The threat of these weapons might give a breathing space so that the Governments

of both sides, East and West, could come to their senses before the ultimate weapons were used.

There are many people who go farther along the road and compare nuclear weapons, even in total war, to gas in the last war. They argue that gas existed on both sides but was never used, so we may well fight the next world war with nuclear weapons on both sides never being used. This would mean another long-term slogging match similar to the wars of 1914 and 1939, during which both sides would resist the temptation to use nuclear weapons. I cannot believe that this makes much sense.

To sum up my belief about total war, I believe that it is unlikely that it will ever start, and if it does start we must be able to hold up the advance of land forces in Europe for a few days, or even weeks, until statesmen on both sides realize that the alternatives are to stop fighting or to destroy the world. If they decide on the second alternative, then there is nothing we can do about it, except come to the conclusion that the world has gone mad and the human race deserves to be annihilated. I am still optimistic that this situation will not arise.

From this talk you will have realized that the problem of military operations in future is full of dilemmas. In limited war we can either choose to be lightly armed and quick, or strongly armed and slow. In total war we can either choose immediate suicide by using large nuclear weapons or gradual defeat by overwhelming numbers by using conventional weapons only. At first sight it would seem that we have to make one hideous choice or another, but I do not believe the situation is nearly as bad as it looks. For the limited war, I would choose mobility and light equipment in preference to slowness and powerful equipment. As regards total war, in the first place I am optimistic enough to think that it will never happen, and if it should do so, I am sure we should not release our massive deterrent in its early stages.

Nobody in the Army, nor indeed either of the other two services, has any ambition to play a prominent part in the battle of Armageddon. Our job is to keep peace in the world by rapidly extinguishing any sparks which might, if left unattended, lead to this battle.

Before finishing this lecture, I must say a word about the ethical problems which are raised by weapons of mass destruction, as I believe these to be extremely important and relevant to the whole business of future warfare. The choice between death and dishonour is the classic choice which faced the heroine of Victorian melodrama, and she was expected by tradition to give the virtuous reply. This reply would not perhaps be given so readily by the heroine of a modern play. Against a more serious and realistic background, the choice of death or dishonour is one which has always faced the professional fighting man, and there must be no doubt in his mind what his answer must be. He chooses death for himself so that his country may survive, or on a grander scale so that the principles for which he is fighting may survive. Now we are facing a somewhat different situation, when the reply is not to be given by individuals but by countries as a whole. Is it right for the Government of a country to choose complete destruction of the population rather than some other alternative, however unpleasant that other alternative may be? Should we in any circumstances be morally right to choose not only the termination of our own existence as a nation, but also the existence of future generations of our own countrymen and even of the whole civilized world? To take an example from history, it might well have been that the inhabitants

of the Roman Empire, threatened with inevitable conquest by the barbarian hordes, might have considered that the total destruction of humanity would be preferable than the immediate prospects that faced them. How wrong they would have been. The human race can in time recover from almost anything, but it cannot recover from universal death.

I believe that in 100 years people will look back on the middle of the twentieth century as a nightmare period when mankind suddenly discovered the means to destroy itself, and was seriously considering using this as a preferable alternative to reconciling differing political views. The Arthur Bryant of 100 years hence will, I hope, record in his book *The Age of Insanity* that this period of madness did not last long, and in the early 1960s these weapons of mass destruction were outlawed and destroyed for ever.

Discussion

Colonel N. de P. MacRoberts: The lecturer in his intensely interesting and thoughtful address posed the question, is it possible to limit the size of a nuclear weapon? He never answered that question and I shall ask it again. It is fourteen years since the last nuclear weapon was used, and I should like to know whether, in the meantime, the scientists have been able to reduce its power so that it can be used in conventional weapons? For instance, is it possible to reduce the power of a nuclear weapon to a twenty-five pounder gun?

The Lecturer: Yes, it is possible to make atomic weapons considerably smaller than a few years ago. It is not possible to reduce them to the size of hand grenades yet, but we can reduce them to the size of mortar bombs. A nuclear weapon makes a tremendous bang at the other end, whatever kind of projector you project it from. My point was whether it was possible to use nuclear weapons of a limited size without somebody replying with a weapon which is slightly bigger. Then, if he replied with a weapon slightly bigger, would not you reply in turn with a weapon which is bigger still? It is possible to make small nuclear weapons, but can you see either side which possesses the whole range of these weapons limiting themselves to the use of small ones if they are being beaten? Will not the temptation to use the bigger weapons be too great, and the whole business become rapidly out of control?

Colonel N. de P. MacRoberts: Have British troops ever been exposed to the blast of atomic weapons? I know the Americans have put their troops within two miles of it, but have we put our troops in?

The Lecturer: Yes, British troops have been exposed to these things on Christmas Island.

Colonel MacRoberts: They are experimental troops. Have the infantry been exposed to the blast?

The Lecturer: Infantry battalions have gone to these places and have been exposed to blast. Whether it is better to expose them to an experimental one than any other kind I do not know.

Lieut-Colonel L. V. S. Blacker: May I suggest that there is another way out of the *impasse*, and that is the use of the weapons described in the issue of *Engineering* of 16 October.

The Lecturer: Is it the same as that mentioned in the second leading article in *The Times* a short time ago?

LIEUT-COLONEL BLACKER: No. It consists of a series of long-range multi-stage rockets which are non-atomic. There is a whole-page article in that journal in the reading room upstairs.

THE LECTURER: There is a great deal of talk about using weapons of mass destruction, other than atomic or nuclear, of a type which are forbidden by the Geneva Convention. You are not thinking of those?

LIEUT-COLONEL BLACKER: No, this is a system which does not afford excuse for nuclear retaliation, but is equally as effective as a nuclear weapon and offers a complete tactical deterrent.

SECOND-LIEUTENANT N. T. P. MURPHY: There is, I believe, an American gas now which produces a form of paralysis of the nerves and does not take life. The Americans have been experimenting with this and are very proud of it, since it is not covered by the League Convention. Its effect is to paralyse the nerve system for a length of time which can be decided beforehand. They also have the D22 chemical which can destroy vegetation throughout the world in a matter of weeks. Can the lecturer think of any weapon produced in the past which was not at some time or other outlawed?

THE LECTURER: There are a number of experiments going on in the United States on the particular weapon which you mention. I think it is in its very early stages, and it produces tremendous logistic problems. If it should prove possible to disable on a large scale without killing, this might be a good answer. What I am trying to avoid all the time is the inevitable slide into weapons which are bound to destroy the human race. If you really believe that there is no possibility of preventing the use of weapon of mass destruction, then you must subscribe to the theory that we have not got long to live. I am hoping there is a way round it.

SECOND-LIEUTENANT MURPHY: I was hoping that the paralysis gas might be the only way round it.

THE LECTURER: I agree, it could be one way round it.

BRIGADIER F. R. WEBSTER: The lecturer mentioned the possibility of only employing limited tactical nuclear weapons for a period of days or possibly weeks. Is it possible for that theory to be put into practice? Surely the Power which decides to break the truce is going to have overwhelming advantage?

THE LECTURER: I was only trying to find a way out of a terrible dilemma, The existing situation seems to be that once they decide to attack in force you are faced with two alternatives. One is to be defeated slowly by conventional weapons or destroyed rapidly by nuclear weapons. Is there nothing one can do? Is not it possible to hold an attack up for a little time until the Governments of the world see some sense? Is there a fate which hangs over us all that we are bound to be destroyed? It is a terrible thing to think.

With regard to tactical nuclear weapons, if they know we have these weapons and can destroy concentrations of troops, for instance, at bridgeheads, they may not be quite so willing to form these concentrations.

Mr. A. P. BENSON: Is it not possible that in the event of total war being entered upon, retaliation would be difficult because it was in the hands possibly of a subordinate commander rather than a statesman? Might not the need for instantaneous retaliation be in dangerous hands in the chain of command?

THE LECTURER: I take it this concerns the possibility of sudden surprise attack out of the blue with hydrogen bombs on Western cities.

MR. BENSON: If we do not all die, there may be some need for immediate

retaliation, and I envisage this being in the hands of some irresponsible person who might act without sufficient provocation—an error of judgment.

THE LECTURER: I do not think that these nuclear weapons are ever to be put into operation without the highest in the land giving the word "go". There is no question at present of their use being decentralized. There is no question of arming the British soldier with these weapons to fire off when he thinks fit.

COMMANDER V. N. GRAVES: You referred to the need to take drastic action if vital British interests are threatened. How are vital interests now defined? If retaliation is to be automatic and annihilating, one would think that the only interest of importance is our continuing existence. Further, if our interests are eroded very gradually, how is it possible to choose the moment at which to cry halt?

THE LECTURER: It is a matter of opinion, and your opinion corresponds with mine, that is, that the ultimate British interest is that the British nation should remain alive. I cannot believe that the old lady living in Bristol would consider that it was better to be dead than that the Russian army should cross the Elbe. At what stage does she say, "I would rather die than this should happen to me"? At what stage do you say, "The situation is so terrible that I prefer to destroy my country than let it go on any further"?

MAJOR G. ANDREWS-SPEED: It would seem that Mr. Khrushchev has made the same appreciation, and that the future possibly lies in an economic and subversive struggle rather than in open warfare. Is that the lecturer's view?

THE LECTURER: Yes, I quite agree. This lecture was on the future trends of warfare, but there is something going on which is much more sinister than that. If we spend more money than we can afford in preparing for the war which will never happen, and the Americans do the same, we may lose in the other race which is going on all the time.

MR. F. H. HARRISON: Will it be necessary to go on spending all this money on a deterrent, or will there be a time when we can say that we have enough of these weapons to form an effective deterrent?

THE LECTURER: This is the question of how effective a deterrent we should have. The problem is that the deterrent gets out of date rather quickly. At no stage can you say we have enough and shall not spend any more on it. It has to remain not only big enough—and that may be fairly small—but modern enough. The V bomber with a free-falling bomb is going out of date already. Would you say that is all we want, or would you have something more up to date? If you subscribe to the deterrent theory at all, you must keep it up to date. I would say, keep it up to date, but do not have it bigger than is required. After all, it is only a threat. If you can have a small one and pretend it is big, then so much the better!

CAPTAIN A. F. CAMPBELL: If that is so, does the lecturer think that, as one type of weapon becomes obsolete, we might borrow the American's "last year's number"? In that case we shall not have as much to pay in the Defence budget.

THE LECTURER: The Americans may give us last year's number but with a string attached. They have the key of the cupboard and they alone can unlock it. Even if they let you have the key, it will still be attached to a string.

MAJOR-GENERAL G. G. WATERHOUSE: It seems from the lecture which we have had that, from the materialistic standpoint, we have come to the end of

the corridor. There is no way out of the *impasse*, and unless we can raise the whole question to a higher level, it seems that the problem is insoluble.

THE LECTURER: I agree. It is more a problem for the Archbishop of Canterbury than the CIGS!

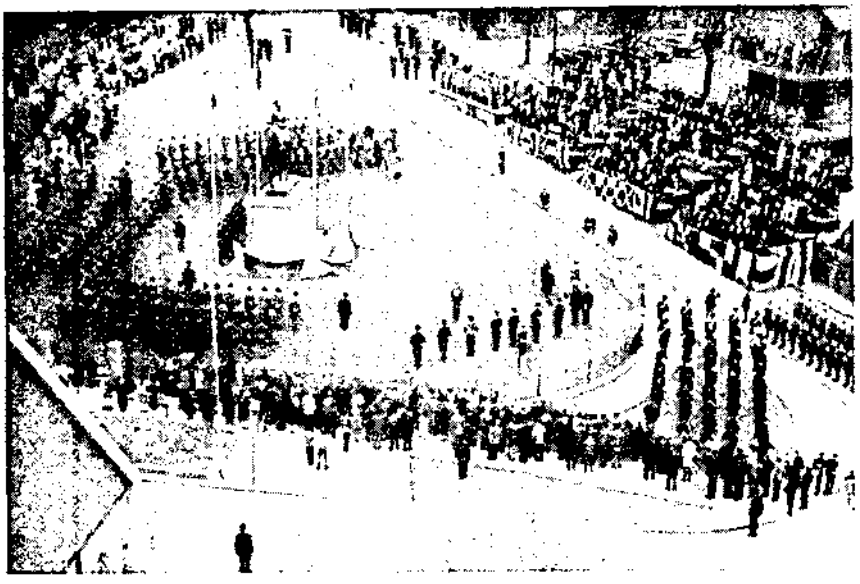
THE CHAIRMAN: It remains for me to thank General Cowley for his most penetrating, arresting, and interesting lecture on this most important subject. I think he has laid out the changing situation as he sees it in a way which I am sure you all found as interesting as I did. (*Applause.*)

GENERAL SIR CAMPBELL HARDY: I am sure you would like me on your behalf to thank our Chairman for having presided over this meeting this afternoon. (*Applause.*)

Unveiling of the Statue of Field-Marshal Earl Kitchener of Khartoum by the Secretary of State for War at Chatham on 25 April 1960

AT an impressive ceremony the statue of Field-Marshal Earl Kitchener, repatriated last year from the Sudan, was unveiled at Chatham on the morning of 25 April 1960 by the Secretary of State for War, the Right Honourable Christopher Soames, CBE, MP.

A short history of the statue was given in the June 1959 edition of the *RE Journal*. It is a replica of the original by Mr Sydney March erected on the Maidan in Calcutta. It stood in Khartoum from 1921 to 1958 when it was returned to this country and presented to the Corps. A site outside the lower entrance to Kitchener Barracks facing Dock Road, Chatham, was chosen for the statue. After considerable landscaping of the immediate surroundings the statue was placed upon a pedestal made to a design approved by the sculptor Mr Sydney March and constructed by Sapper tradesmen. The stone for the pedestal came from the now disused Amherst Redoubt which at one time enfiladed the Gun Wharf reach of the River Medway. A stand for spectators was constructed by 36 Corps Engineer Regiment. Many senior RE Officers and their wives attended the unveiling ceremony and amongst the official guests were the present Earl Kitchener of Khartoum, his mother Viscountess Broome and other members of the Kitchener family, a representative of the Sudanese Ambassador, the C-in-C the Nore and Lady Durnford Slater, the Bishop of Rochester and Mrs Chavasse, Mr J. M. G. Critchley, MP and Mrs Critchley, the Mayors and Mayoresses of the Medway Towns, Brigadier H. King Lewis, Secretary of the Kent Territorial and Auxiliary Forces Association, Mr F. J. Root representing the Minister of Works, Mr C. G. M. Broom representing the Kitchener Scholars Association, Brigadier F. C. Nottingham from the Gordon Boys' School, Woking, and Mrs Nottingham, Mr Sydney March the sculptor and twelve Chelsea Pensioners.



A Guard of Honour, found by the Officer Cadet Squadron RE, was mounted for the War Minister and a Quarter Guard, formed by the Depot Regiment RE paid compliments to other senior officers attending the ceremony. A Detachment, formed by the Depot Regiment RE, 12 SME Regiment and 59 Field Squadron RE, and a Detachment of the Royal Engineers' Association, Chatham Branch, with their Banner flanked the statue. The Royal Engineers Band and Trumpeters completed the Parade.

The Secretary of State for War and his wife were received by the Chief Royal Engineer, General Sir Kenneth N. Crawford, KCB, MC, who, when requesting the War Minister to unveil the statue, said: "Secretary of State, My Lord, Ladies and Gentlemen. This is a very special occasion in the history of the Royal Engineers. We have here a distinguished company to witness the unveiling of the statue of a distinguished Sapper, Lord Kitchener of Khartoum, and I am glad that it has been possible for some of his family to be present.

"This statue was for many years in Khartoum, and recently the Government of the Sudan—whose Ambassador is represented here today by Mr Sayed Hassan M. el Amin whom we greatly welcome—decided to present the statue to the British Government, following which the Army Council allotted it to the Corps to be erected here in Chatham.

"The pedestal which you will see presently was made by RE tradesmen in Chatham to the design approved by Mr Sydney March, the original sculptor of the statue, whom I am very glad to see here with us today. The surroundings were designed and executed by RE Chatham with the full and generous co-operation of the Mayor and Corporation of the Borough of Chatham.

"This site was selected by us for three main reasons. First, it is just outside the Barracks which already bear Kitchener's name; secondly, it is a site which we think—and I hope you will agree—is a fine position; and, thirdly, it is not

actually in the Barrack area and, consequently, the citizens of this town will be able the more easily to see it. Kitchener was, of course, a National figure and we feel that it is more appropriate that he should be seen by all and not kept to ourselves within the Barracks.

"We are glad—very glad—to have this Memorial to so distinguished a Sapper back in his old home. He was the first, and I should say the only Royal Engineer Officer ever to be a Secretary of State for War and, as you all know, he was Secretary of State at the time of his tragic death. I, therefore, think it is most fitting that his successor of today should unveil this statue, and I am truly delighted that he has been able to come and do so. I shall, therefore, proceed to invite, with the greatest pleasure, the Secretary of State for War, the Right Honourable Christopher Soames, to unveil this statue."

In replying the Secretary of State for War said: "My Lord, Ladies and Gentlemen, I am honoured to have been invited to take part in this ceremony of tribute to a man of great distinction whose career was ended, as you, General, have remarked, so tragically at a time when he held the Seals of Office which I am now privileged to hold.

"This statue of Lord Kitchener which is about to be unveiled for the second time, has had an adventurous life. It is a replica of a statue on the Maidan in Calcutta by Mr Sydney March, the British sculptor, who we are so glad was able to be with us today. The First World War delayed its arrival at Port Sudan until November 1920. When it reached Khartoum the Civil Secretary's Office was informed in the usual way that a parcel had arrived for it and an orderly was sent along on a bicycle to collect it. The parcel which confronted the astonished man was this weighty statue.

"It was first erected in 1921 on a site opposite the Law Courts in Khartoum and in 1929 it was moved to an open space facing the Blue Nile Embankment. On 11 December 1958 it was moved again at an impressive Military Ceremony. Most properly it has now been re-erected at the School of Military Engineering, where Kitchener served in his early years as a young Subaltern in the Royal Engineers.

"Kitchener's martial exploits are part of the fabric of our history, but his fame does not rest on these alone. It was he who mapped out plans for the new town of Khartoum and began its rebuilding. It was he who put forward the idea of Gordon College, which is now Khartoum University, and energetically gathered money for it. Fittingly, the title which he took when he was ennobled was not the name of one of his many battles but of his chief civil and administrative success.

"Kitchener was, of course, first in the long and distinguished line of Governors General of the Sudan. In a memorandum issued in 1899 he set a pattern for the future of establishing the principle to be followed by all British officials. He said: 'The task before us all is to acquire the confidence of the people, to develop their resources and to raise them to a higher level.' In the fifty-five years of British administration that followed Kitchener's departure from the Sudan, this principle was faithfully followed until it led naturally to Sudanese independence.

"The result is there for all to see in the great fund of mutual respect and affection that now exists between the peoples of our two countries. If Kitchener were alive today, how delighted he would be that the friendship of Britain and Sudan, to which he devoted himself, is now so firmly based. He would be particularly gratified at the close friendship between the British

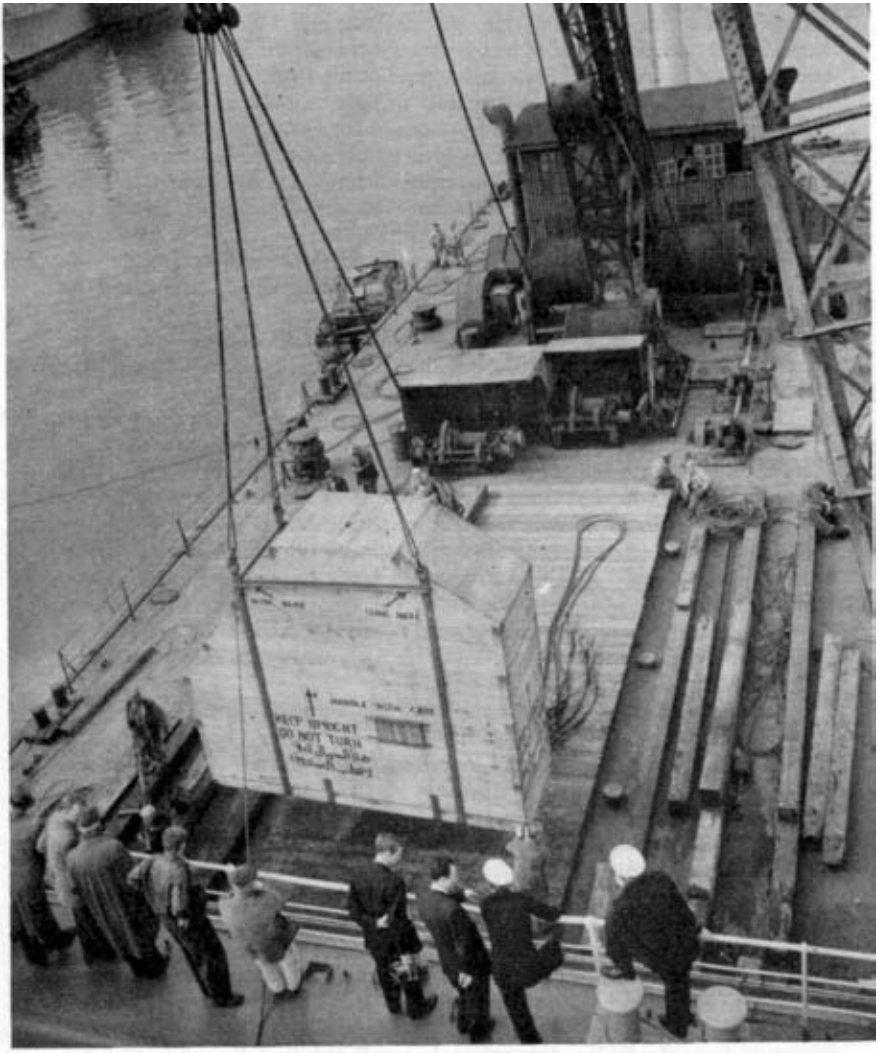
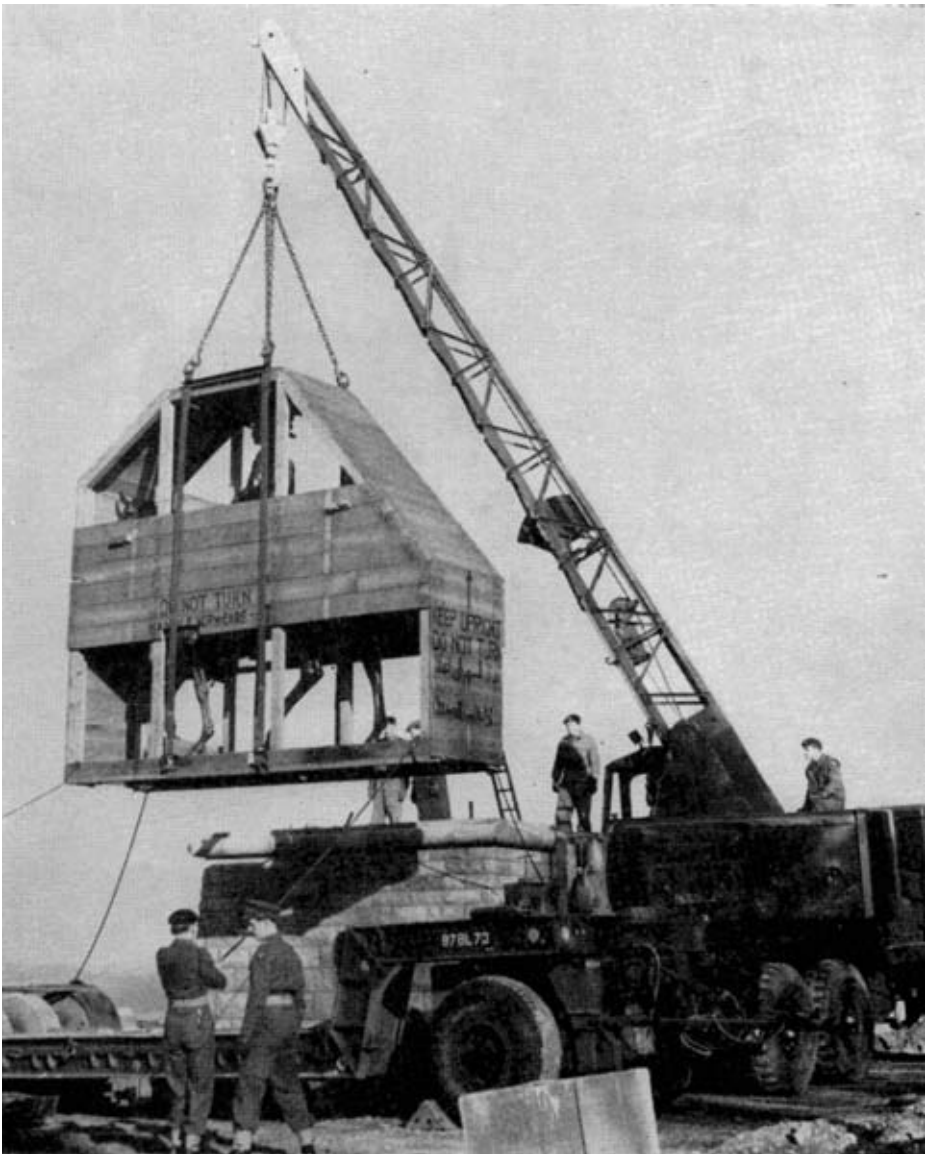
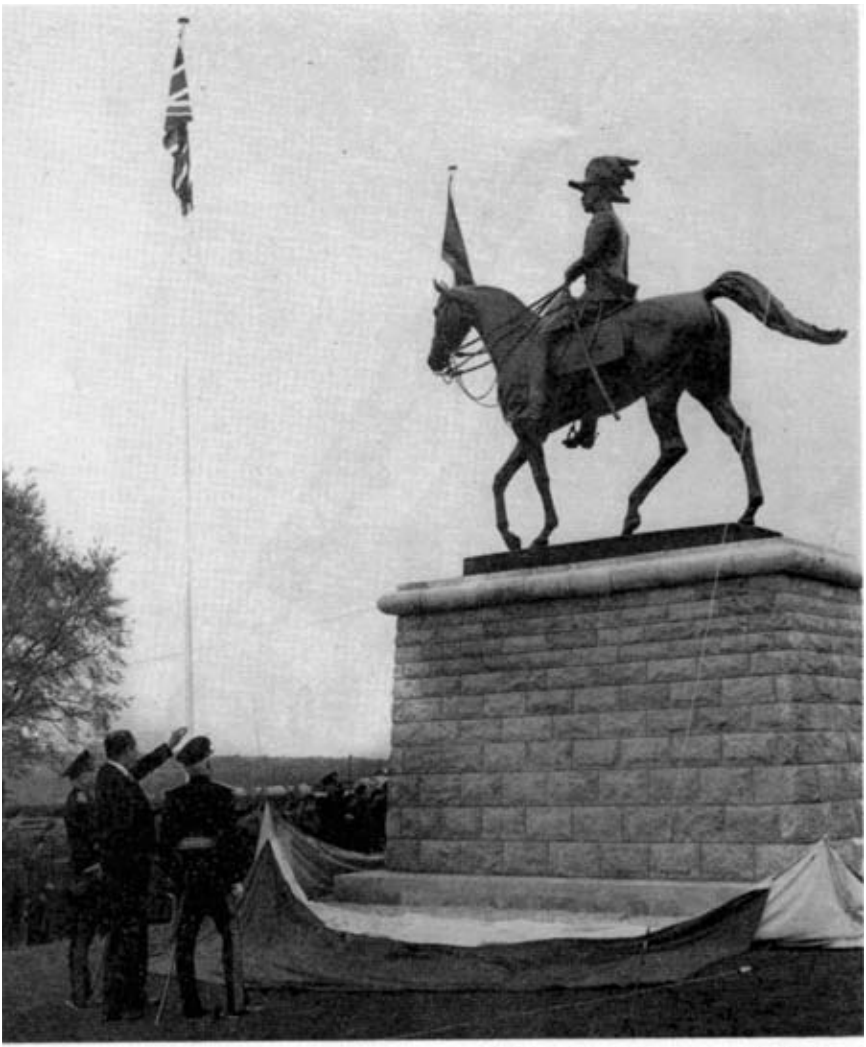


Photo 1. Arrival of crated statue at Chatham Dockyard.

Unveiling of the statue of Earl Kitchener 1



Unveiling of the statue of Earl Kitchener 2



By kind permission of the Sport & General Press Agency Ltd.

Photo 3. The unveiled statue.

Unveiling of the statue of Earl Kitchener 3

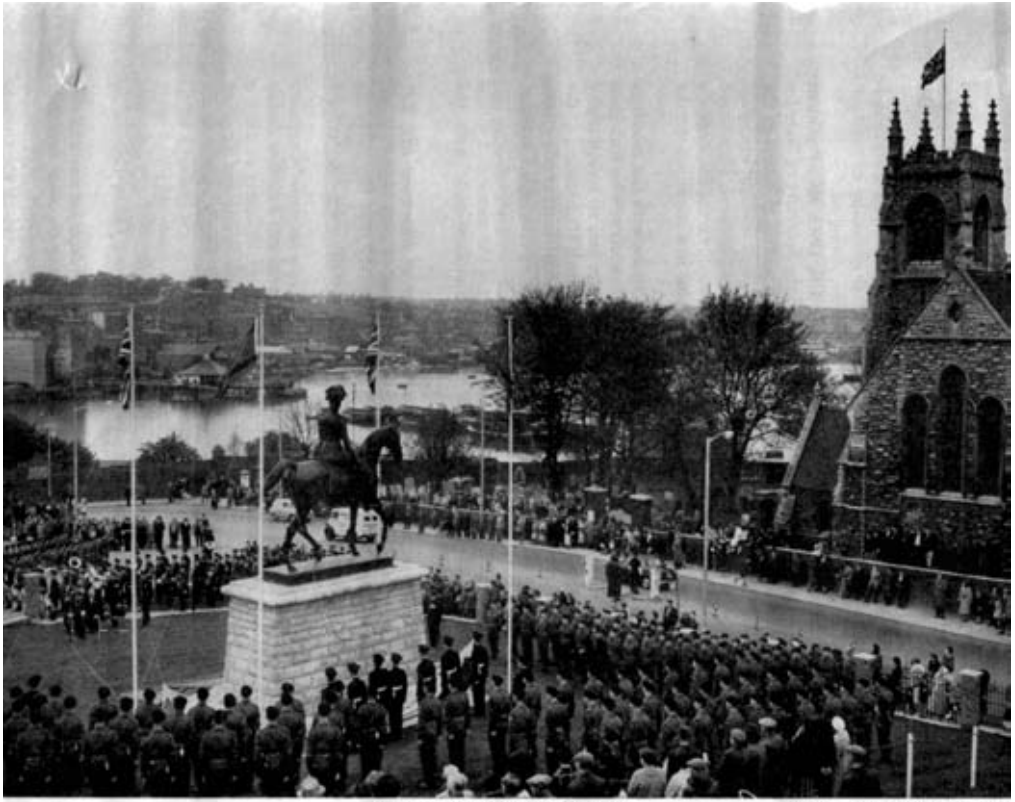


Photo 4. The Unveiling Ceremony. *By kind permission of "Chatham Observer"*

Unveiling of the statue of Earl Kitchener 4

Army, of which he was so distinguished a leader, and the Sudanese Forces which not so very long ago fought side by side with us.

"So, in the presence of this distinguished company, which includes the present Lord Kitchener and members of his family, and a number of old soldiers who served with him, I now unveil this statue of the greatest Sapper of all in the place which saw him first as a Young Officer and which is the home of his great Corps."

The War Minister then pulled the cord letting fall the bunting surrounding the statue and leaving horse, rider and pedestal glistening in the faint spring sunshine. The Trumpeters sounded a Fanfare, *Actum est.*

Major-General Sir A. Douglas Campbell, KBE, CB, DSO, MC, President of the Institution of Royal Engineers, then thanked the Secretary of State for unveiling the statue and said that with the Council and all Members of the Institution, he was very proud indeed of the great honour that had been paid in entrusting to them the safe-keeping of this historic monument. He assured the Secretary of State and the Army Council that it would be the Institution's pride and privilege to care for and maintain the statue in a condition worthy of the great Sapper whom it commemorated.

At the conclusion of the Ceremony Mr Soames spoke with the members of the Chatham Branch of the Royal Engineers Association who had been on parade and with the Chelsea Pensioners. The latter had all served under Kitchener; the eldest had been a Private in the Seaforth Highlanders at the Battle of Omdurman; another had at one time been Earl Kitchener's groom and had had in his care Democrat, the spirited charger upon which Kitchener is depicted mounted in the statue.

A metal plaque on a stone mount, placed in front of the statue and within reading distance of Dock Road, was unveiled simultaneously with the statue. It bears the inscription:

"*This statue of Field Marshal Earl Kitchener of Khartoum KG, KP, GCB, OM, GCSI, GCMG, GCIE, PC, Colonel Commandant Royal Engineers, at one time stood in Khartoum. It was unveiled on this site by the Rt Hon Christopher Soames, CBE, MP, Secretary of State for War on 25 April 1960.*

"*Horatio Herbert Kitchener was commissioned into the Royal Engineers in 1871. Much of his early service was spent in Cyprus and Palestine and in 1892 he was appointed Sirdar of the Egyptian Army, defeating in 1896 a Dervish force at Dongola. In 1898, in command of all British and Egyptian Forces, he avenged the murder of Gordon when he finally overthrew the Dervishes at Atbara and Omdurman.*

"*In 1900 he was appointed Commander-in-Chief South African Forces and brought the war there to a successful end in May 1902. Later he was made Commander-in-Chief in India and in 1911 he became Consul-General in Egypt.*

"*On 6 August 1914 he was appointed Secretary of State for war and will always be remembered for the part he played in raising the New Volunteer Armies.*

"*He was drowned in* HMS *Hampshire when she sank off the Orkneys on 5 June 1916 bound for Russia.*"

The statue looks out over the old Gun Wharf, now being demolished to make way for an open space leading down to the River. The mounted figure

of Field-Marshal Lord Kitchener, standing high on its pedestal of Amherst Redoubt stone, will therefore become a most striking Chatham landmark.

The Guests attending the Ceremony were entertained later at a luncheon in the Officers' Mess, Brompton Barracks. The Kitchener exhibits from the RE Museum and the RE Mess were on view. His Field-Marshal's Baton and his Orders, decorations and medals, however, could not be shown. They are lost for ever. They went down with their illustrious owner in HMS *Hampshire* on that tragic June day in 1916.

The Royal Monmouthshire Royal Engineers (Militia)

By LIEUT-COLONEL J. H. BOND, MC, RE

THE Royal Monmouthshire Royal Engineers (Militia) are celebrating their Tercentenary this year during the Regiment's Annual Camp which is being held in Monmouth from 12–26 June.

A short history of the Royal Monmouthshire Royal Engineers (Militia) by Lieut-Colonel D. A. Smith, MC, RE, was published in the September 1954 edition of the *RE Journal* and so only the major events of the past 300 years will be mentioned again. The Regiment was originally the "Monmouth Militia" and was embodied for service on at least four occasions prior to 1800. In 1793 it was combined with the Brecknock Militia to form the Monmouth and Brecon Militia but in 1820 they were separated again and at the same time each was given the prefix "Royal". There were further lengthy periods of embodiment during both the Napoleonic and Crimean Wars. The Regiment did not serve overseas but relieved regular units to enable them to do so. It also provided many drafts of volunteers and in the Crimea not only did the Commanding Officer serve on attachment for three months with the 23 Royal Welsh Fusiliers but a large percentage of that Battalion had volunteered from the Royal Monmouth Militia.

In 1877 the Regiment was selected, on account of its great efficiency, for conversion into Royal Engineers and became the "Royal Monmouthshire Engineer Militia". Some twenty years later the title was changed to the present one.

During the South African War members of the Regiment served overseas for the first time, a section joining the Bridging Battalion RE early in 1900. Later a Company was sent which was employed mainly on railway work.

In the First World War the Regiment ran its own Depot in Monmouth from which it maintained two Army Troops Companies, two Railway Companies and four Siege Companies in France. Throughout the war it operated in effect as a separate Corps within the Corps of Royal Engineers, enlisting and training 76 officers and 2,113 other ranks.

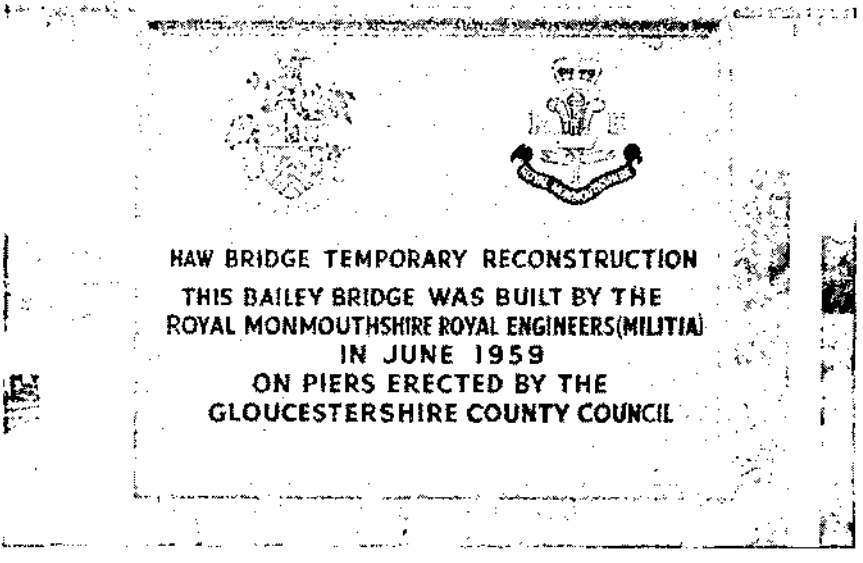
In 1939, however, the same procedure was not followed again and the two Companies, 100 and 101, which, with the RHQ, comprised the Regiment at that time, were maintained from the general pool of RE manpower. Both

Companies went to France in September 1939, 100 Field Company being largely captured at Dunkirk whilst fighting as Infantry. 101 Field Company were more fortunate and they, with the reformed 100 Field Company, spent most of the rest of the war as two of the Companies of 8 Corps Troops RE. They returned to France in June 1944 and played a prominent part in the subsequent operations of the British Liberation Armies.

The Regiment, to which 111 Field Squadron has now been added, is the senior Regiment of any Arm in the Territorial Army. To mark their Tercentenary they are being inspected at 3 pm on 24 June by the Duke of Beaufort, one of whose ancestors was the second Commanding Officer and whose family have been closely associated with the Regiment on many occasions since. Following the Inspection there will be a display of past and present equipments and uniforms. At 6.30 pm the Ceremony of Beating Retreat will be performed in Monmouth and finally there will be both a Mayoral Banquet for invited guests and an All Ranks Dance. There will be a veterans detachment on The Parade and all ex-members of the Regiment will be most welcome and are invited to tea afterwards. Those intending to come should if possible notify the Adjutant at The Castle, Monmouth, beforehand.

Construction of Haw Bridge over the River Severn by the Royal Monmouthshire Royal Engineers (Militia)

By Lieut-Colonel J. H. Bond, MC, RE



On 20 December 1958 an oil barge, the *Darley Dale H*, was coming down the River Severn in ballast, the river being in flood with a current of something over five knots. The *Darley Dale H* was one of the biggest barges in use on the Severn and the skipper was thoroughly familiar both with the river and his job. As he approached Haw Bridge, the only crossing between Tewkesbury and Gloucester, he had to negotiate a sharp left-hand bend and pass under the very centre of the right-hand span of the bridge. It was just after 5 p.m., and quite dark. Haw bridge was designed by Telford some 150 years ago. It had three spans, each of approximately 80 feet, the main members being of arched cast iron construction. The skipper misjudged his approach and in the swirling current failed to keep his barge central to the span. The resultant impact between the superstructure of the barge and the archribs of the western span fractured the latter and the complete span collapsed on to the barge and into the river. Although the skipper was killed the two remaining members of the crew managed to get the barge tied up to the shore almost immediately. With the collapse of one span the horizontal thrust from the adjacent span proved too much for the intermediate stone pier which sheared horizontally and the central span disintegrated. Within four minutes of the accident the third span collapsed in a like manner. Fortunately no road traffic was using the bridge at the time and local inhabitants managed to get barriers across the road before anybody drove into the void. The photo at Plate 1 was taken on the following morning and shows nothing but the piers and some portions of handrail remaining. The water level at the time was about twelve feet above normal summer level as shown in Plates 2 and 3 which were taken nearly six months later.

Three or four days later one of my officers living locally, with my permission, contacted a representative of the Gloucester County Council Highways Department to see if we could assist in restoring communication on a temporary basis. He came away from the meeting with far more ambitious plans involving the construction of a Bailey bridge, the project to be carried out working over a series of weekends. One thing at least became clear—that the Gloucester County Council would like us to help and was prepared to meet the various financial and other requirements laid down in the relevant Army Council Instructions.

The Outline Plan

In designing the bridge many alternatives were considered within the proviso that it must be high enough above the water to allow the free passage of barges at all normal conditions of the river. Originally the County Council considered using the old alignment for their new permanent bridge, making new embanked approach roads to the Bailey site. It then became apparent that the time required to build these and to put the necessary piled piers into the river bed would cause excessive delay in rebridging the river so the old alignment was chosen for the temporary Bailey bridge. Of the two original stone piers one was obviously unsafe for further use but the other looked sound, so a design was evolved using one original and one piled pier and a maximum span of 110 feet. This necessitated triple-single construction to provide the requisite Class 30 bridge. Stores demands and planning went ahead on this basis, although it was soon apparent that to build the bridge over a series of weekends was not feasible and that the only possible time was during annual camp which was already fixed for the period 30 May to

12 June. Further, since the duration of the bridging operation could not be forecasted exactly, it was necessary to start camp at Haw Bridge and go on to other training later. Thus 30 May 1959 became fixed as the only possible starting date.

By the beginning of April the river level had fallen sufficiently for divers to be able to examine the supposedly sound stone pier. The results showed that this pier too had sheared horizontally below water level and some 300 tons of masonry had been shifted 9 in. laterally. It's an ill wind which blows nobody any good and, although the decision to abandon the use of this stone pier meant that three piled piers would be required, it reduced the maximum span of 70 feet which permitted double-single construction throughout. This was a welcome change despite the lateness of the hour. We set to work rapidly to reassess our stores bid and had to ask for the charges for hire of equipment which the County Council were going to pay to be recalculated also. Fortunately everyone was understanding and co-operative and our revised requirements were agreed to in a remarkably short space of time. Meanwhile the County Council had obtained trades union agreement to the task being undertaken by military labour. By the end of April, therefore, every major decision had been made and we could plan the details.

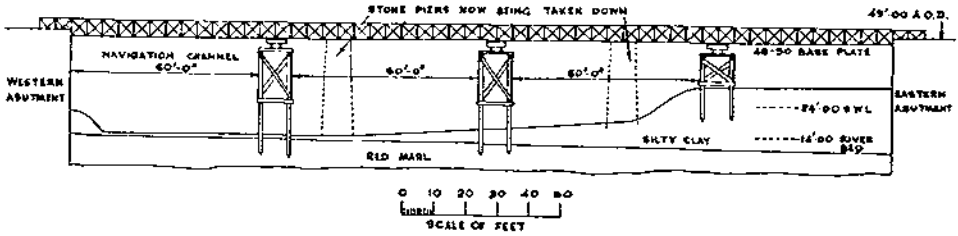
Amongst the decisions not previously mentioned were two which did not have to be altered when the design was changed. We had been in two minds whether to camp on the site under the "Greenfields" scheme, or to look for accommodation with a local unit. We had expected the latter would involve overcrowding and difficulties generally but when we saw what No 1 UK Comcan Signals Squadron were prepared to offer in their hutted barracks at Gloucester we quickly accepted. A part of these barracks had recently been vacated by the Depot, The Gloucestershire Regiment, and, since the Signals themselves ran a round-the-clock system of shifts, there were few of the expected difficulties of fitting our proposed working hours into their meal timings. Despite the attractions of running our own show on the site we never regretted going to Gloucester where we could not have been made more welcome. Our "Q" staff were quite busy enough as it was, and to have had to pitch and subsequently strike our own tents, maybe in the rain, would have put up the regimentally-employed commitment and prevented our forming two full working shifts.

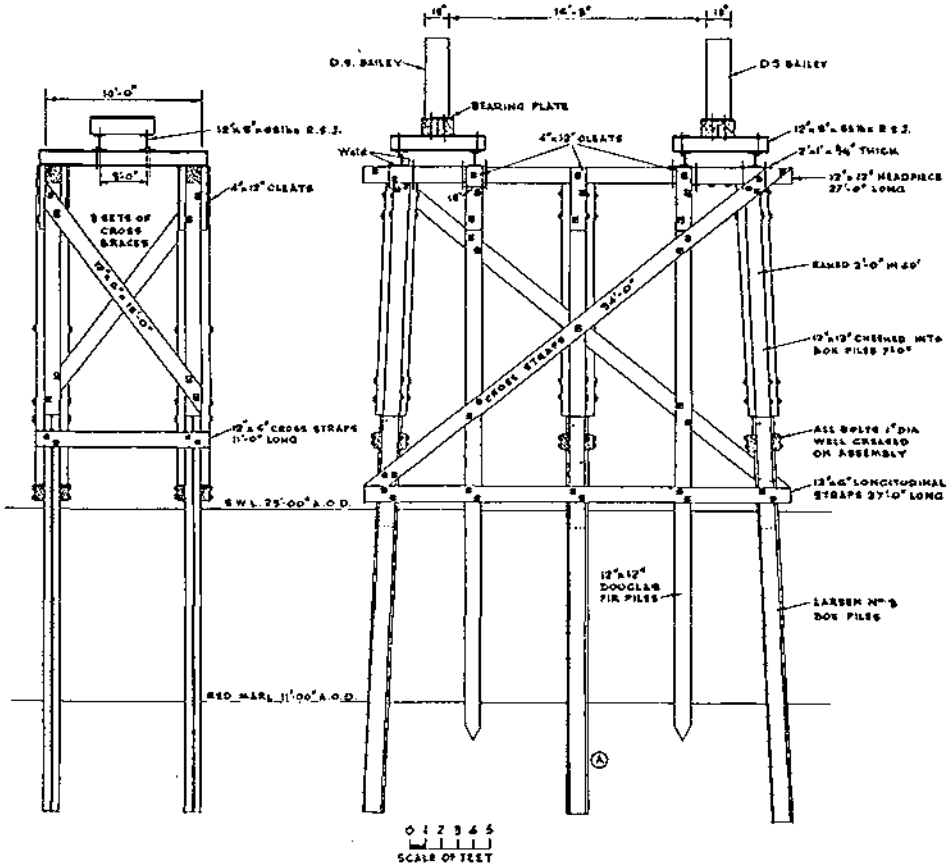
The other early decision worth recording was that the bankseats would be dug down to the extent necessary to provide a level road surface throughout.

Design and Construction of Piers and Bankseats

It had been realized from the beginning that the Regiment could not construct the piled piers for two reasons—the task would take longer than the fortnight available for Annual Camp and also the driving of the actual piles would be extremely tricky if the river happened to be in spate during the vital period. The County Surveyor's Department, therefore, designed these piers (see drawing), after making trial borings to determine the nature of the river bed, and arranged for their construction by a contractor as soon as the removal from the river of the considerable debris from the old bridge had been effected by a grab. The river bed was found to consist of a layer of silt on top of red marl. The former was only a foot or so thick on the outside of the bend (west bank) but increased to nearly twenty feet at the east bank. Since it would probably be impossible to drive a 12 × 12 inch timber pile into

COUNTY OF GLOUCESTER





DETAIL OF TRESTLE FOR WESTERN PIER AS SHOWN
CENTRAL PIER AS SHOWN BUT CENTRAL PILES (Ⓐ ABOVE) TO BE ENTIRELY OF TIMBER
EASTERN PIER PILES TO BE ENTIRELY OF TIMBER

TIMBER FRAME FOR "HAWBRIDGE" BAILEY

the marl for more than a foot or so, it was decided that at each corner of each pier a steel box pile of the same dimensions should be used. The plan area of each pier was dictated by the requirements of the bridge. To share the downward thrust from each girder of the bridge between four piles, the outer piles had to be some eighteen inches outside the centre line of the girder. This gave a dimension of 21 feet up and down the stream. To allow space for jacking clear of the packing supporting the bridge, a width of 10 feet was considered a reasonable minimum. Each pier was to consist of two bents of five piles and the centre legs of the western pier, where the silt was thinnest, were also to be box piles. All piles were to be driven to ¼ inch penetration using a 1½ ton monkey. The box piles were terminated at 4 feet above low-water level and 12 × 12 inch timber baulks fitted into them giving an effective splice of about six feet and extending beyond the box piles to give the required height of 20 feet above normal water level. All corner piles were raked to a slope of about one in twenty.

Diagonal bracing of each bent was by 12 × 6 inch timbers bolted with 1 inch diameter bolts to each leg on both sides and similar timbers and bolts were used both diagonally and horizontally to tie the bents together. Capsills were 12 × 12 inch baulks. Bents were positioned 10 feet apart and 12 × 8 inch RSJ's served as stringers with two joists under each main girder of the Bailey bridge. Between stringers and capsills was placed a steel plate which served to distribute the load and was also welded to the one and bolted to the other, thus effecting a further tie between the bents. The completed piers can be seen in the photograph at Plate 2.

Because of the state of the river, which had prolonged dredging operations, it was not possible to start pile driving until the second week in April. The eastern trestle pier, when the river was low, was within reach of a RB19 standing on exposed dry ground and this machine, rigged as a pile driver, was used for this pier. For the other two piers a barge-mounted pile driver was employed. The only difficulty encountered was in accurately mooring the barge when working on the western pier since, as a navigation channel had to be left clear, it was not possible to pass a hawser to the west bank. Pile driving was completed by 10 May, only two weeks before the Regiment's advance party was due to start work, but at least the vagaries of the river could no longer affect operations.

The contractor only just succeeded in completing his capping and bracing in time despite working overtime and with very few interruptions from the weather. He was still completing his last pier as we started hauling our rocking rollers on to the first one. It had been a close thing.

As well as constructing the trestle piers the County Council provided concrete bank seats on top of the existing masonry abutments to our design. This task could not appropriately be undertaken by the Regiment because it was a task on which few men could be employed and it had to be done far enough ahead for the concrete to set before construction commenced.

The design for each abutment consisted basically of two concrete slabs, one under the baseplates and the other for the ends of the ramp sections. The former was 23 feet 6 inch by 7 feet 6 inch in plan area and 10 inch thick and was reinforced with BRC mesh. The bending moment in this slab depends on the give in the abutment beneath it when under load but tends to be sagging under each base plate and hogging mid-way between them. Since the abutment was extremely solid this bending moment would be small and the BRC

mesh was therefore placed half way down the slab giving it a moment of resistance against bending in any direction equivalent to a slab of some six inches thickness. The upper surface of this concrete was dug down 2 feet 7 inch below road level to eliminate any slope on the approach ramp, this dimension allowing 1 inch for skin decking.

The excavation was continued back on a level plane to the far end of the ramp where the second concrete slab was positioned by building up in mass concrete to a height 9 inch below road level. The top surface was sloped slightly downwards towards the river to give a good seating for the sloping ends of the ramp sections. It was made 2 feet wide to provide an adequate supported length of ramp and to allow both for expansion and any possible minor errors in gap measurement. Finally a 3-inch lean concrete skin was placed over the ground between the two main slabs, its purpose being both to tidy things up and to waterproof the area.

Design of the Bridge

The design of the bridge and spacing of the piers were naturally closely related and, as already explained, the latter also had to take into account the width of the navigation channel and the necessity, for reasons of expense, of avoiding trying to drive piles on the site of the old masonry piers. To have used one new central pier would have meant triple-truss, double-storey construction for the Bailey girders and this clearly was not practicable. Two piers could have been used, either with two spans of 110 feet and a short central one of 50 feet, or with one of 70, one of 90 and again 110 feet over the navigation channel. This would have to have been in triple-single construction, whereas the use of three piers, with three spans of 70 feet and one of 60, using double-single girders, not only lessened the work for the constructional party but also reduced the hire charges payable for the equipment thus offsetting to some extent the cost of the extra pier. The three pier design would also incidentally produce a more balanced-looking bridge.

Regimental Planning

The main essentials of our plan were:—

(*a*) An advance party to position all rollers before the arrival of the main body and to erect store and administration tentage.

(*b*) Stores to be laid out along the verge of the eastern approach road (now in effect a cul-de-sac) and ferried up to the bridge building point by fork lift truck. For this purpose we used two of the new interim light-wheeled tractors fitted with fork lift attachments kindly loaned to us by 22 Field Engineer Regiment RE.

(*c*) To work in two shifts each of about forty men organized to the last detail. This is slightly more than required by the book (*ME*, Vol III, Part V) but allowed for such extra commitments as fork lift drivers and assistants, picket boat crew and an extra senior NCO with each panel party and transom party, of which more anon. Our detailed breakdown is given at Appendix A, which was designed to suit the special circumstances of a TA Regiment, namely, almost a regiment's worth of Officers and senior NCOs to a working strength of barely one squadron. We found a worth-while task for everybody even if it was only keeping the press and public informed or operating a camera for record purposes.

(*d*) To train intensively on model equipment during evening drills in the

month before the operation. Thus all NCOs would know their exact task as well as the whole construction drill and all Sappers would be familiar with the nomenclature of parts and know in general how things went together. It should be remembered that some 10 per cent of those employed had only been in the Regiment for a month or two and had no previous RE experience whilst for many more this was their first introduction to Bailey bridging equipment.

Stores Organization

The Engineer Stores Depot, Long Marston, being only 30 miles from the site, it was agreed that all bridging stores should come from there and that they could be drawn by County Council vehicles. We established an excellent liaison with the ESD at all levels and they could not have been more co-operative either with us or with the County Council's representatives whom we took along to meet them. A planning meeting, attended by all concerned, was held at Long Marston in the middle of April. Only one snag occurred and that was rapidly put to rights as soon as it was discovered. We do not own a copy of the Royal Engineer Vocabulary of Stores and so in our indents used the suffixes BB and EWBB to differentiate between items, such as transoms, which differ in the extra widened as compared with the normal Bailey bridge. Unfortunately there are some items, such as ribands, which exist in both versions yet of which the BB type is used in extra-widened bridges. Although the list we sent to Command Headquarters was correct some of the stores when they arrived were not and the old lesson, that when indenting for stores one must somehow find out the right part number, was re-learnt.

The site was in some respects a difficult one from the stores layout aspect. The existing road was on a slight embankment as it crossed the water meadows adjoining the river and this embankment increased considerably over the last hundred yards when the road rose at a slope of 1 in 30 to the bridge. The width available between ditches was 30 feet. About fifty yards back there was access down a short, steep slope to a field adjoining the river and liable to flood. For want of anywhere better we had to use this field for our administrative tentage, latrines, etc, and accept the consequential risk of flooding which was not very serious in June. In the event there were no worries and at worst we should have had plenty of warning to evacuate.

To have placed the bridging stores in this field would have meant a most awkward carry up a steep and possibly slippery slope. The alternative was to use the verge and one edge of the road and to use fork lifts to ferry up those farthest from the construction site.

The County Council provided a sectional CGI hut to house our small stores and there was just room to stack all the transoms on a slight widening of the verge within ten yards of the construction site (see photograph at Plate 4). Farther down the road we placed first the panels and then the decking components since the latter were to be put on after launching. The panels were stacked at right angles to the road and in an upright position so that the fork lift could be driven up the verge and its prongs stuck through the diamonds, four panels at a time (see Plate 5). This layout worked excellently in practice. A squadron-quartermaster-sergeant was put in direct charge of small stores and tools and issued these to NCOs in charge of parties as required, making sure that all tools were returned after each shift and the

site was well scoured for bolts and nuts. The ESD were kind enough to say that we lost nothing. Whilst this may be too good to be true I am sure that very careful control in this manner in daylight did mean that very few items were mislaid.

Publicity

A project of this size and importance does not often come the way of any unit, regular or territorial, and the fact that part-time soldiers were capable of tackling it only served to add to its news value. The whole construction operation was very thoroughly covered by the press and by both television networks. All their representatives were most co-operative and only sought interviews when one wasn't too busy. It was early discovered that a fork lift in the fully elevated position makes an excellent camera tower avoiding even the fatigue of climbing to the top.

Advance Party

One TA Officer, a surveyor by profession, and fifteen men, of miscellaneous trades with miners predominating, arrived at the site three days ahead of the main body. Their mission was to prepare everything so that the main body could start straight away on bridge construction. Included in this task was the temporary decking down, with chesses, of the top of each of the three piers and the accurate positioning or stacking thereon of everything which would be required throughout both the construction and jacking down phases. One pier could be reached from dry land due to the low level of the water, and there was also a contractor's RB19 rigged as a crane within range. To get things weighing up to 200 lb on the other two piers, each 20 feet out of the water, was not so easy. We tried rigging a small derrick improvised from 3-inch tubular scaffolding and strapped to a pier leg but it was difficult to obtain sufficient clearance above the top of the pier to swing the things in board. Rather than spend more time on a more complicated derrick it was found that a straight heave up by plenty of men on top was really the simplest method.

The County Council's Resident Engineer had, as was to be expected, capped his piers at precisely the level we had requested. The positioning of the rocking rollers was, therefore, relatively simple once they had been coaxed to the top of the pier. The rollers were placed centrally between the two bents and the platform carrying them was made large enough to carry the jacks positioned 5 feet away and immediately above a pair of legs. Since we were going to use hydraulic jacks on the piers with a lift of 10 inches the largest packing pieces used were 9 × 9 inch. With two lengths of 9 × 3 inch and two of 9 × 1 inch also available at each jacking point raising or lowering by anything from one to nine inches at a time was possible. In addition to their main task on the piers the advance party placed the construction rollers on the road and on the already prepared concrete bankseats. This and their tent pitching tasks took them only two and a half days so they earned a small respite to see the sights of Gloucester before joining their shift to build the bridge.

Bridge Construction

General Organization. As already mentioned the main working strength of the Regiment was divided into two shifts, the detailed organization of which is given at Appendix A. In addition certain people, such as fork lift

truck operators and stores NCOs, whose jobs did not involve great physical effort, worked through both shifts. The first shift was formed mainly from personnel of 100 Field Squadron (Newport) and 101 Field Squadron (Blackwood) under command of the OC of the former. The second shift was from RHQ and 111 Field Squadron (Monmouth) with the Squadron Commander in charge. As Regimental Commander I exercised general control on the site throughout, in which I was assisted by my Second-in-Command. Besides the supervision of the work a good deal of our time was taken up with senior visitors, which was probably no bad thing since it prevented one trying to do the Squadron Commander's job as well. In practice operationally it would be very rare for a Regimental Commander to be able to spare the time to be present on one site for anything like the whole of the operation.

We built the bridge undecked for lightness in both booming out and jacking down. It would have saved some physical effort on the part of controlling Officers if we had built a temporary walkway above the transoms but its absence in no way delayed operations and enabled us to leave the chesses loaded in lorries which we eventually backed over the bridge decking down as they went. Since chesses weigh over a hundredweight each this reduction in handling meant a great saving in physical effort at a time when the men were still willing but getting tired.

Timings. The first shift saw the site for the first time at 7.45 am on Sunday 31 May and had got themselves organized and the first panel in position 25 min later. We had five bays of nose, with a link two bays back, which was a slight over-insurance that could do no harm. It took three-quarters of an hour to build this, a relatively slow rate of progress, not occasioned by any major snags, but by the necessity constantly to move the whole structure laterally by small amounts to keep it straight when booming out. In rear of the launching rollers we had plain rollers at 27 feet and 52 feet and once the bridge became long enough to rest on all three positions the problem of keeping straight was much reduced. From the time the nose landed on the first pier no further difficulties of this nature were met. After 2 hours the shift had their first break by which time they had completed three bays of bridge proper and had started the fourth. In addition the SWR towing strop had been coupled up to the nose ready for the rope from the Scammel on the far bank to be fixed to the snatch block on the towing strop.

All along, the outside panels were kept at least a bay ahead of the inside ones in each truss and the transom and bracing parties followed one bay each farther behind. Booming forward was carried out three bays at a time, this being the most that could be built before the rear of the bridge became too high off the ground for the panel parties to lift their panels into position. We contemplated coupling up three or four panels in rear of the building site and lifting these into position by crane but, on our narrow site, the crane would have got so much in the way of other parties and of the fork lift trucks that the whole operation would undoubtedly have been slowed down. Panel parties, although hard worked, all lasted out their shifts without undue fatigue since all panels were ferried to within five yards of their destination by fork lift truck.

At 12.20 pm the nose reached the first pier with ten bays of bridge built behind it. Because the ground sloped away from the launching rollers it was now possible to remove the 52 feet construction rollers, thus lowering the tail slightly and reducing the lift for the panel parties. During this phase there

had been no snags beyond a couple of extremely obstinate rakers. An hour later the first shift knocked off having built a further five bays and pushed the bridge to within ten feet of the second pier. In their final push they were assisted by the light-wheeled tractor pushing on a transom placed on its side behind a panel vertical This method proved extremely effective and was far easier for the Officer in charge of bridge to control than using the Scammel on the far bank. The light-wheeled tractor proved quite powerful enough to push the bridge even in its final stages giving a smooth, controlled performance. We tried pulling by Scammel also and this too worked quite satisfactorily although we made one mistake in not providing a platform of some sort for the snatch block designed to equalize the pull in the 2-inch SWR towing strop, to rest on. This block, dangling in the air just forward of the nose, was too heavy and the strop slipped out of the sheaf and jammed in the block.

The second shift soon showed that they were not prepared to be outdone by the fine rate of progress achieved by their predecessors. In just over two hours, at 3.40 pm, the last panel was in bridge and the transom and bracing parties followed suit 10 minutes later. This was the signal for a well earned 35 minutes break. The final launch went without difficulty and at 4.45 p.m. the bridge reached its final position and proved our setting out measurements to have been accurate.

The complete re-organization of the shift into jacking down parties and getting them into position, together with dismantling the nose, took nearly an hour and a half. This time could undoubtedly have been improved but we were let down by the failure of a shear pin in the propulsion unit of our folding boat and, although we had a spare, the old one just would not come out. There were also such minor things to be done as the issue of life jackets to men working over the water. However, at 6.15 pm, the jacking down got under way and in the two hours remaining the bridge was lowered 1 foot at each of the five jacking points. We took a good deal of trouble in organizing this jacking and in working out the packing which would be required at every stage. Since our system worked well I have included further details of it at Appendix B.

On the following morning two further hours on the jacks saw the bridge down on its bearing by 9.45 am. The decking operation and final check that everything was tight and shipshape took from ten until four o'clock but this included one interval for a NAAFI break and another to consume a pint of beer per head very kindly provided by the County Council, whose Chairman visited the site at this time and spoke to many of the men. These final stages of the operation are shown in Plate 6. Amongst others who had visited us were the Representative Colonel Commandant Royal Engineers, the District Commander, the Chairman of the Monmouthshire Territorial and Auxiliary Forces Association, the Chief Engineer, Western Command, the Commander 23 Engineer Group and our own Honorary Colonel.

Conclusions. That the job went so smoothly, efficiently and quickly, despite the relative lack of training of many of those taking part, was due in my opinion to:—

(*a*) The very detailed organization before the construction phase was reached at all.

(*b*) The fact that all Officers and senior NCOs really knew exactly what

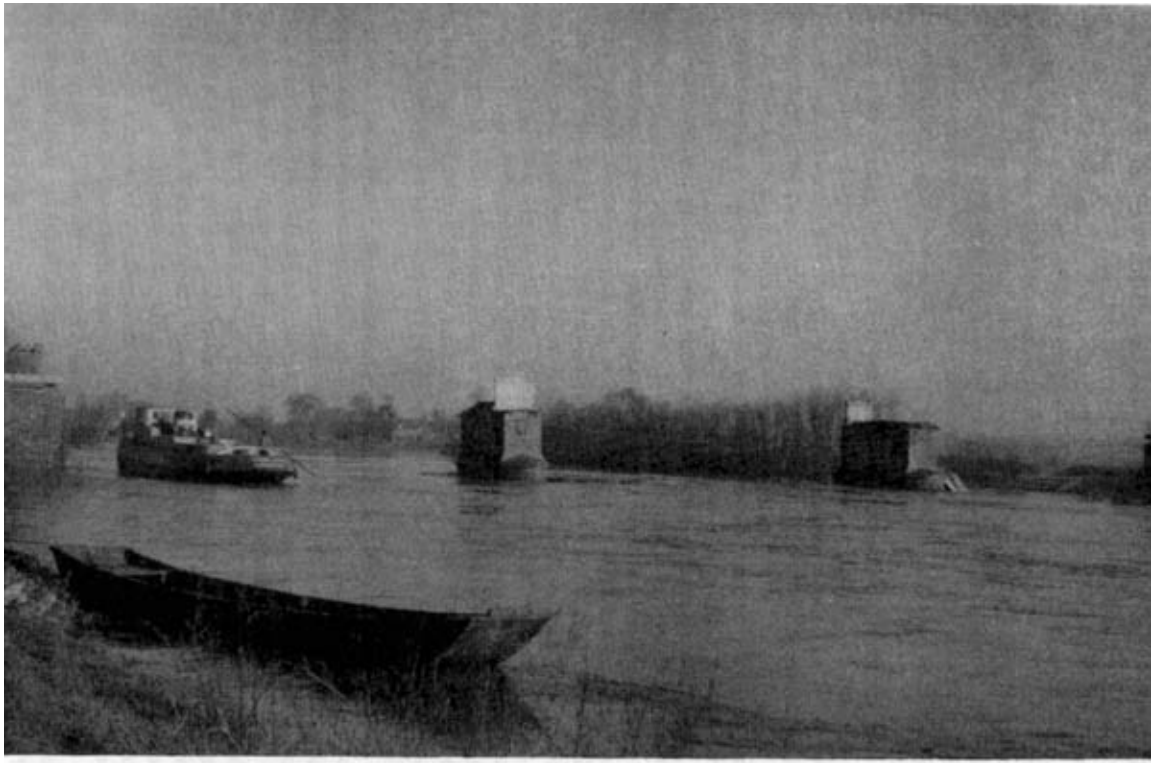


Plate 1. The scene on the morning after the accident with the river in flood conditions.

Construction of Haw Bridge over River Seven 1.

Plate 2. The nose of the bridge reaching the final pier, details of which are clearly shown. The remains of the eastern stone pier will be just submerged under flood conditions.

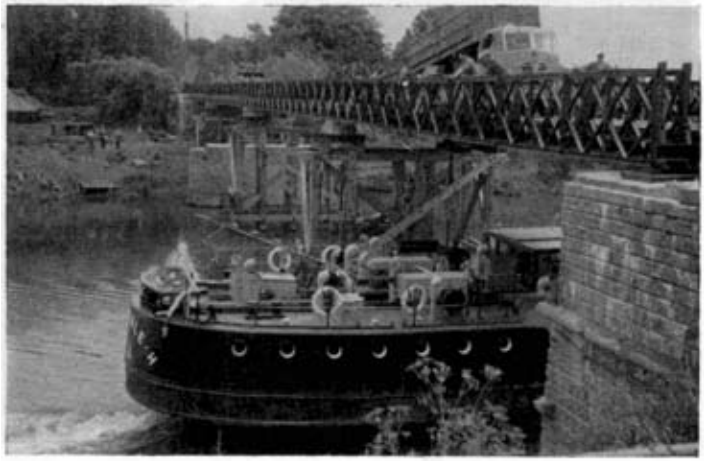


Plate 3. An oil barge of the same class as that which caused the original accident passes under the almost completed Bailey bridge.

Construction of Haw Bridge over River Seven 2 & 3

Plate 4. The construction site just before work commenced.

Plate 5. The light-wheeled tractor delivering a load of panels to the construction site.

Construction of Haw Bridge over River Seven 4 & 5

Plate 6. The last few bays of decking going down watched amongst others by Colonel Lord Raglan, J.P., HM's Lieutenant for Monmouthshire, Chairman of the Monmouthshire Territorial and Auxiliary Forces Association.

Plate 7. The Regiment, headed by its band, marching over the bridge as part of the opening ceremony. Safety precautions and surfacing improvements by the County Council can be clearly seen.

Construction of Haw Bridge over River Seven 6 & 7

they were required to do and had studied it in detail beforehand. The men, therefore, worked well for them.

(*c*) Nothing breeds success like success and it was obvious to all that we got away to an excellent start.

(*d*) The beautiful sunny weather with which we were blessed, except for a brief interval on the second morning, and which kept everyone's morale in top gear.

(*e*) The competitive spirit engendered between the shifts and between parties in each shift. Starting with the panel parties on each side of the bridge this spread backwards with no party prepared to allow itself to be the one holding up the operation.

Subsequent Work by the County Council

Since the bridge is to remain in position for some two years, the County Council have carried out a good many improvements which would be unnecessary to the same extent in an operational, or short life, bridge. These can be classed under the headings of wearing surface, safety precautions and anchoring. They also erected at each end an impressive notice board, a picture of which appears at the head of this article, bearing both our crests and an appropriate text.

Wearing Surface. After considerable investigation of the relative costs of timber and asphalt the latter seemed to hold all the advantages providing it did not crack and break up. To prevent it crushing down between the chesses timber fillets the full depth of the chesses were inserted into all the larger intervals between them. On top of this a layer of sisalcraft was laid and then 2 inch of hot rolled asphalt made from ¾-inch chippings. This surface has now stood up to three months usage without any signs of breaking up. To bridge the gap between the last chess and the road, a gap which will vary with the expansion and contraction of the bridge, a steel plate has been placed under the asphalt.

Safety Precautions. The bridge is for use by pedestrians in both directions simultaneously with one-way vehicular traffic controlled by lights. Normal Bailey footwalks outside the trusses would be totally unsuitable for civilian pedestrians of all ages and sexes so the roadway was partitioned by a 6 × 6 inch riband bolted down to give a width of 2 feet 6 inch for pedestrians and 10 feet 10 inch for wheeled traffic. The footpath was surfaced with 1 inch of tarmac, in lieu of the asphalt described above, this being just sufficient to prevent the pointed heels of modern women's shoes from sticking down into the interval between the chesses. The walking sticks of old men would presumably come into about the same point load class. In addition, along the inner faces of both trusses a 3-foot high length of chain link fencing has been lashed and it fits most excellently and looks very well. To fill the horizontal gap between the ends of the chesses and this chain link, timber planks have been laid on top of the transoms and wing fences have been placed on both sides of the ramps. The whole is now thought to be reasonably proof even against small children dallying on their way to school unless they actually scramble on to the girders.

Anchoring. The simplest method of anchoring and one perfectly suitable to a short term bridge would probably be to fix one end firmly and let the rest go free to allow for expansion and contraction; but this might in certain circumstances tend to push over the tops of the piers which it was difficult

to anchor firmly at right angles to the current without interference with navigation. To overcome this the bridge has been firmly fixed to the central pier and movement away from this pier has been restricted at each baseplate by struts operating between the ends posts of the bridge and the concrete pad supporting the ends of the ramps. The struts are so placed that even at maximum expansion the length of the bridge will be just less than the distance between the struts. Also by anchoring at mid point the maximum movement at the worst point is halved and there is thus less tendency for piers to be pushed over if the bridge truss fails to slide on its bearing plate.

Costings

The cost of this project to the County Council may well be of interest. The asphalt surfacing came to just under £150 and the timber used for the footwalk ribands, fillets between chesses, etc; together with the chain link fencing cost a similar amount. The three piers themselves are estimated to have cost a total of £5,500. The War Department charges were in round figures £400 for troop labour and £1,500 to hire the equipment for two years. The transporting of stores from Long Marston to site, together with returning the items required only for construction, all of which the County Council did in their own lorries, probably cost them about £300. This would give a grand total for the bridge for two years use of £8,000.

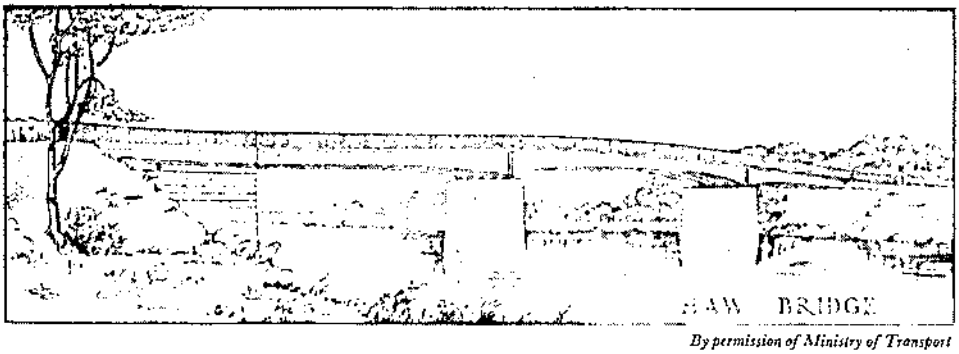
Opening Ceremony

Having completed our share of the bridge and arranged the return of constructional tools and equipment, the Regiment went to Wyke Regis for the remainder of Annual Camp. During this interval the County Council carried out all the final improvements described above so that when we returned for the opening ceremony ten days later on our way back to Monmouth the bridge was really finished. They had made a most impressive job of it.

The ceremony consisted of short addresses first by the Chairman of the local Parish Council, then myself and finally the Chairman of the Highways Committee of the Gloucestershire County Council, Major Mealing, who also cut the tape. This was the signal for our band to march across the bridge, followed by Major Mealing and myself standing in a Land Rover whilst the Regiment, under the Second-in-Command, brought up the rear (see Plate 7). Two public houses are conveniently situated within fifty yards of the bridge and the Parish Council had most generously arranged for a pint of beer a head to be available. It was a lovely warm sunny day and following on a 100-mile drive, for many in the back of a three-tonner, this drink was indeed welcome. It brought what had been a most interesting, instructive and useful project to a very appropriate ending.

Acknowledgements

I am greatly indebted to Mr S. C. Brown, AMICE, AMIStructE, The Gloucestershire County Council Bridge Engineer, and Mr J. Summerell of the County Surveyor's staff for their great assistance in providing data for this article, for allowing me to publish their drawing, and for correcting my draft. Mr Brown also took some of the photographs. I also wish to thank the Editor, *The Citizen*, Gloucester for permission to reproduce two of their photographs.



By permission of Ministry of Transport

Drawing of new permanent bridge designed by the Gloucestershire County Council Bridge Engineer and to be constructed a few yards downstream of the Bailey Bridge.

Appendix "A"

Organization of the Regiment for Work on Haw Bridge

1. *Personnel present on site throughout working hours:—*

Commanding Officer; Second-in-Command; Medical Officer; SQMS i/c small tools and stores and one Sapper; two OR driving light-wheeled tractors fitted with fork lifts (or the Coles crane if required); two OR assistants to the above fork lift truck operators. REME LAD of three OR responsible for operation of bridge pulling Scammel and other LAD duties as necessary.

Total three Officers and nine Other Ranks.

2. *Two working shifts (each):—*

Officer in charge of shift; Officer in charge of bridge construction; Officer in charge of bridging stores, including carrying to construction point and one OR assistant. He also controlled the fork lifts; Officer in charge of ferry and safety boat plus 1 NCO assistant; Press and Public Relations Officer; Squadron Sergeant Major; Bracing party consisting of: WO (permanent staff instructor) in charge; four Swaybrace men; two transom clamp men; two raker men; four bracing frame men; two senior NCOs as pin men; two panel parties each 1 NCO and six men; one transom party of 1 NCO and eight men.

Total (each shift) five Officers and forty-one Other Ranks.

Notes. (*a*) The construction parties are as laid down in *Military Engineering*, Vol. III, Part V, except that, having more senior NCOs available than would normally be the case in a regular unit producing the same total working party, we were able (i) to put a very experienced NCO in charge of the bracing party which is a key job; (ii) to have senior NCOs as pin men working outside the bracing party; (iii) to put an extra man in each panel and transom party thereby allowing a system of reliefs to operate within the party and the NCO normally to supervise and encourage rather than himself having to lift. These relatively small additions fully compensated for the lack of experience of many of the working numbers.

(*b*) the numbers of Officers available was out of normal proportion to the number of OR and it was important to find as many as possible a worthwhile task. Undoubtedly a small reduction in their number could have been accepted without detriment to the project.

3. Administrative personnel, working in the barracks at Gloucester, but some of whom paid visits to the site: Adjutant and Assistant Adjutant; Quartermaster; Regimental Sergeant Major; Office Staff (two OR); Cookhouse and Mess Staff (twenty-four OR); MT Staff (one Officer and ten OR); QM Staff (six OR); Padre and assistant (who also ran the Regimental Canteen at the bridge site).

Total six Officers and forty-three Other Ranks.

4. Nightguard at bridge site of four OR.

5. Advance party for Wyke Regis camp (two Officers and four OR).

Grand total twenty-one Officers and 138 Other Ranks.

Appendix B

The Jacking Down Operation

The total distance that the bridge had to be jacked down was almost exactly two feet and since the level of our construction rollers was only 1 inch above road level this was the minimum possible. It was decided to jack at five points namely at both ends and on each pier. Theoretically we could have used three points that is omitting the two outer piers, but in this case the jack up necessary to lift the bridge clear of the rollers on the outer piers would have been so great as more than to nullify the saving achieved by reducing the number of jacking points.

We decided to use the standard 15-ton ratchet and lever jacks for the ends of the bridge where, in conjunction with their shoes, they are easy to operate and control. For the piers we selected the 12-ton hydraulic jacks which can be operated with far less physical effort, if more slowly and which were, therefore, ideal for the relatively restricted position on the pier tops. In all cases we had one jack per truss but, to equalize the load between each pair of hydraulic jacks, a short RSJ was interposed between them and the bottom chords.

The main rules and sequence of operations laid down were:—

(*a*) Removal of all rollers and substitution of appropriate packing, working on not more than two non-adjacent positions at a time.

(*b*) Jacking down by 6 in stages working again two positions at a time not adjacent to each other.

(*c*) Packing to be kept in position within 3 in of the bottom chord at all times.

(*d*) An Officer, Warrant Officer or Sergeant to be in charge at each of the five jacking points and to be responsible for organizing his point, ensuring that all four jacks worked in unison and keeping to the above rules.

(*e*) Personnel working on piers over the water to wear life jackets.

The supply of packing pieces at each point was organized with particular care. These were 3 feet lengths of 9 × 9 inch, 9 × 3 inch and 9 × 1 inch timber. We worked out the quantities required starting jacking on the heads of the jacks and then moving down to the toes for the later stages. All this was explained to the individuals in charge at each point so that there was no danger of their running out of a particular size yet only minimum quantities had to be provided.

The time of four hours taken for the complete operation was not perhaps particularly rapid but none of us had ever jacked down a big bridge before

and we were not going to risk spoiling a good job at the last moment. Perhaps some of the rules laid down erred on the side of over insurance but I felt that the disaster of the bridge falling off a jack was a thing of which one would get little or no warning and, unless there were sufficient points firmly on packing to withstand collapse at one point, then the disaster would certainly be a major one.

In the event all went well and we never had a moment's qualm. A well-drilled team, which we never pretended to be, might have saved an hour or so and if such a saving was vital one would have taken the risks. In our case this certainly was not so.

The Infantry Brigade Group Field Squadron

By MAJOR M. J. W. WRIGHT, RE

THE PROBLEM

MANY articles have appeared in the *Royal Engineers Journal* during the last few years on the future organization of engineer units to meet conditions of nuclear warfare. None of these otherwise excellent articles have really got down to the essential problem—the mechanics of how the field squadron is going to support the brigade group. It is unrealistic to plan on the assumption that any resources beyond those in the theatre on M-day will be available to fight a nuclear war, and therefore, since the concept of brigade groups has now been accepted, our studies should be directed to how a field squadron can support its own brigade without outside assistance except from the Corps Engineer Group.

So many developments are now under way in the equipment and weapons fields that the field squadron of ten years ahead will probably look very different from the unit with which we are familiar today, but since the *raison d'être* of field engineers is to support other arms, it is pointless to carry out a large-scale reorganization of the field squadron at this time as these other arms are not yet firm on their own future plans. What is required is a modification of the existing unit to enable it to carry out its new role over the next few years.

The aim of this article is to suggest several ways in which this modification could be achieved.

SOME CANADIAN COMPARISONS

This article is partially based on experience gained by the author while serving in Canada for the last two years, and in particular, on observations while acting as an umpire in Canadian brigade group exercises.

It is necessary first to explain one or two differences between the Canadian and the British concept of nuclear operations and engineer organization; but it will be seen that in spite of these differences the points raised in this article are equally valid both to the British and the Canadian Army.

Nuclear Operations. The main difference between the Canadian and the British doctrine is that whereas the British concept refers to phases of the

battle, i.e. the delaying action on the enemy side of the obstacle, the battle on the obstacle, etc., the Canadian concept relates these phases of the battle to the place where they will be fought, and divides the battlefield up into zones accordingly. These zones are the reconnaissance zone, forward defence zone, main defence zone and the corps reserve zone. Since one or more brigades will be allocated to each zone, and each zone has definite boundaries, the engineer responsibilities are quite clear-cut.

Engineer Organization. The Canadian field squadron is very similar to the British Independent Field Squadron in that it has its own park troop. Each of the field troops, however, has four sections of twelve men and so, although the total working strength of the squadron is similar to a British squadron, there are three extra sections.

APCs. The Canadian Army is now considering buying a very large number of a new Canadian-designed and built APC, the "Bobcat". This is an armoured tracked amphibious vehicle with good cross-country performance. It is available in its basic form as an APC and in various modified forms such as a light reconnaissance tank, a 105 mm SP gun and a load carrier. The use of the "Bobcat" as the basic vehicle within the Brigade Group will greatly simplify the engineer task in the brigade area; however, even with APCs the mobility of the formation will still be affected by natural and artificial obstacles.

Command and Control

Split Squadron HQ. It is essential that the squadron commander remain at brigade HQ or with the brigade commander for most of his time. If he does not, the brigade staff are very apt to forget the Sapper problems.

However, the brigade HQ is now so large that the complete field squadron HQ would not be welcome as a permanent lodger in the brigade HQ area, and so it is necessaryto split the squadron HQ.

Furthermore, the present teaching is that an alternative HQ must be available to control the brigade should a nuclear strike knock out main HQ. The obvious place for the balance of the split squadron HQ is, therefore, with the alternative brigade HQ.

With present establishments it is very difficult to operate the HQ split. The two parts must each be on the brigade command net, and each be capable of acting as control for the squadron net. Both must be manned twenty-four hours a day, and logs, tactical and engineer maps kept right up to date in both places. While it will be necessary to have an officer at each HQ most of the time, it will not be possible to have an officer on the sets. It will be necessary, therefore, to train teams of NCOs to man the sets, logs and maps.

One solution would be to train three teams of two NCOs each. Each team would do eight hours at Sqn HQ, eight hours at alternate HQ and eight hours resting. During the eight-hour shift, one of each pair on duty could rest or eat, except in peak periods. These men would have to be highly trained and perhaps a new trade of "engineer intelligence assistant" might be needed.

If sufficient officers were available, the ideal solution would be to have a subaltern and two NCOs in each team.

Communications. It is an annoying *cliché* that good communications are only a matter of good training. While this is partially true, even with the best training in the world reasonable equipment is required in the first place. In the case of the brigade group field squadron, as the unit is always deployed

over the whole of the brigade sector, it is essential that the squadron net should work on the same type of set, and with the same standard of operators, as the brigade command net.

If it is considered that the importance of the squadron net does not warrant the expenditure of the considerable signals effort involved, then it must be accepted that in many types of country and at long range the squadron net cannot be relied upon, and time must then be given on the brigade command net for the passage of engineer information.

It may also be necessary to make much more use of CW. This would need a higher standard of training for unit signallers and would prevent officer to officer conversations. With an all-regular army it should be possible to achieve this high standard and squadrons should be trained to work on CW.

One Commander—One Sapper. It is accepted that at each level of command the commander has only to deal with one Gunner. The battalion commander, for example, deals only with the commander of his affiliated battery, even though at times this battery commander may be controlling the fire of several regiments. Extending this principle to Sappers, each battalion must have its own troop commander, and any engineer work within the battalion boundary must be controlled by that troop commander.

This is particularly important in the recce zone and in the forward defence zone, where battle groups of company/squadron size will be continually moving about, and pre-planned nuclear fire being brought down. Therefore the battle group commanders must know exactly where all our own troops are located.

If this principle of one Commander—one Sapper is accepted then it follows that it will no longer be possible to have engineer boundaries that do not coincide with the normal formation boundaries. In the past it has been usual, if a division has had too much engineer work for its own engineers, for the CCRE to take over part of the area by moving the corps engineer boundary forward. In the future this procedure would be highly dangerous, and the correct answer would be for the CCRE to place a troop or squadron from the Corps Engineer Group under command of the Brigade Group and to leave engineer boundaries to coincide with normal formation boundaries.

Mobility

APCs. The sad fact has emerged on many exercises in recent years that when battalion or regimental groups have been formed with infantry, armour, artillery and engineer components, the Sappers, put into the group to help its mobility, are the very people who limit the mobility of the group. A normal field troop, on present organization, has one scout car and one APC. This is not comparable to the protection behind armour and cross-country mobility found in the units the field troop is supposed to be supporting.

Enough APCs to move all field sections at once would be needed, and with present and foreseeable APCs, this would mean two APCs per section. While two APCs per section may seem to be an unwarranted luxury, this mobility would be necessary for the type of tasks a brigade group field squadron would be likely to carry out in the opening stages of a nuclear war, i.e. the movement of small parties about the countryside preparing and firing demolitions.

Load Carriers. Whichever load carrier is used as the "work horse" in the field squadron, none of the vehicles available now or in the short-term future has characteristics which really make them suitable as part of the permanent establishment of field troops. They are all too high, lack armour and lack cross-country mobility.

With the issue of two APCs to each field section, and a cutting down on the impedimenta carried, field troops would be able to move without any conventional load carriers. All the three-tonners or five-tonners considered necessary in the squadron could be kept as a pool, either in the park troop or in HQ troop.

Such a move would increase the mobility of field troops and permit a reduction in the number of 3 or 5-ton vehicles.

In the future, when cargo helicopters are available in the army, this transport pool should also include one or more cargo helicopters.

Support from a Park Unit

Command of the Unit. In the Canadian organization, each field squadron has its own park troop, and there is much merit in this rather than the UK method of centralizing this support into a squadron under the CRE.

The park unit, whether a troop or a squadron, holds, maintains and operates plant, runs a small workshop and has a stores-handling capability. These activities require a high degree of co-operation between the user—the field squadron—and the supplier—the park unit. In the old regimental organization, this co-operation was quite easy to achieve, as the park squadron only had to deal with three field squadrons, and so soon built up close relations with them. In the future, however, with divisions consisting of a varying number of brigade groups, the relationship of the past will be hard to achieve. Furthermore, with brigade groups moving between divisions, plant and operators may well become separated from the park squadron.

It is suggested, therefore, that while it is unquestionably more economical to keep park services centralized rather than divide them up into independent troops, this economy is valueless if by centralization the park unit cannot give adequate support to the field squadrons.

It is suggested, therefore, that park support should be provided by park troops in each squadron, as in the old independent field squadrons.

Location of the Park Troop. Since the task of the park troop will be to provide initimate and immediate support to the field troops, it must be well forward; if the unit were located to the rear in a brigade administration area, it would not be able to give such support.

To draw a parallel between a field squadron and an armoured regiment or infantry battalion, the field troops would be the "F" echelon, the park troop would be "A" echelon, and a few LOBs would be "B" echelon. The park troop, if formed, must therefore be well forward.

Flexibility

If the principle of "one Commander, one Sapper" is accepted, then several problems at once arise within the brigade group.

Firstly, with only three field troops, troops can be affiliated to the three infantry battalions; while this is perfectly satisfactory most of the time since the brigade will be operating in three batalion groups, there will be occasions when a fourth battle group is formed based on the armoured regiment. If

this happens under present organization, it is not possible to provide engineer support for it without upsetting normal affiliations.

Secondly, with all three troops in the areas of their affiliated battalion, the squadron commander is left with no reserve.

Thirdly, the work load in the three battalion areas will rarely be the same in each area, and so one troop may be sitting idle while the other two troops are over extended.

These problems could be overcome by the formation of a fourth troop to be affiliated to the armoured regiment, but normally to be kept in reserve. In the Canadian organization this troop could be formed within the existing manpower ceiling by withdrawing the fourth section from each troop.

The corollary to this is that a more flexible use must be made of sections. If "A" troop has work for one section only, for example, then two sections should be withdrawn to squadron reserve. This arrangement may not be completely satisfactory since it means that a troop commander will often lose control of his sections for periods, and hence the sections may suffer from lack of attention, but in a short war with very limited manpower, there may be no alternative.

This arrangement implies a new concept of squadron organization. The squadron would consist of a framework of HQs at brigade and battalion levels, consisting of squadron and troop HQs, for the command, planning and control of engineer work. To this framework would be added field sections and plant, according to the priorities within the brigade. If necessary, all twelve sections would work under one troop HQ.

It would be necessary, therefore, for the troop HQs to be trained to command any number of sections, and for the sections themselves to be self-contained and capable of working for long periods under any troop HQ. If the suggestion made above, that each section should have two APCs, is ever accepted, it may be possible to take this concept a stage further, and consider the half-section in its own APC as the basic brick on which working parties for a particular task should be built.

Summary

In this short paper, only a few of the many problems have been considered. Nothing has been said about helicopters for recce, cargo carrying or as flying cranes; no mention has been made of armoured engineer equipment or of conventional plant. Problems of administrating a squadron split up all over the brigade sector with sections moving from troop to troop have not been considered.

Ways have been discussed, however, in which the existing squadron can be adjusted without major changes in establishment to meet conditions of nuclear war during the next few years.

In summary, these ways are:—

(*a*) That squadron HQ should train to function, on a split basis, and that pending recognition of the fact by the establishments committee that the officers in squadron HQ are grossly overworked in peace and war, three teams of NCOs should be formed to operate the split HQ.

(*b*) That the squadron net should train on CW as well as on RT.

(*c*) That Brigade Staffs and battalion commanders should be trained by their Sapper to accept the principle of "one Commander, one Sapper", and

that the Sapper must, therefore, always be part of the brigade or battalion "R" or "O" groups.

(*d*) That engineer boundaries should in future coincide with normal formation boundaries.

(*e*) That the load carriers in the squadron should be grouped into a pool, and if no park troop is in the squadron, this pool should be part of HQ troop.

(*f*) That the nucleus of a fourth troop be formed to control the sections made available by the other three troops. This nucleus in peace would be the HQ troop subaltern who would be available for this task in war when many of his duties would vanish with the end of peacetime accounting. In peacetime, this officer should establish good liaison with the armoured regiment.

(*g*) That the field sections should be organized and trained to operate under any troop HQ, so that administration complications are reduced when sections are switched from troop to troop.

Two other points made in this paper, the formation of a park troop within the squadron and the allocation of two APCs to each field section, while being most desirable, are outside the control of the squadron command to implement.

One closing thought: much has been said in this article about mobility, mobility based on APCs. It has already been said that the *raison d'être* of the field squadron is to support the other arms. It follows, therefore, that if the infantry intend to seek mobility by organic APCs, the Sappers must do the same.

However, if the infantry seek their mobility by use of a "light" organization, as tried out in the trials in UK in 1958, or by organic helicopters, or indeed by any other method, so their supporting Sappers must be prepared to follow suit; if they do not, then they cannot supply support where needed.

Role of the AER in the Port Task Force

By COLONEL C. A. MACFARLANE, TD, BA
Commander 1 Port Task Force

A PORT TASK FORCE is a self-contained flexible formation designed to unload ships and to move the cargo through ports or over beaches. There is nothing new in the task. What is new, or at least what is a change from previously established practice, is:—

(*a*) A unified command and control for operations previously carried out by units brought together under *ad hoc* arrangements.

(*b*) The integration, in peace time, in one formation of AER and TA units.

Military operation of a port—or of a beach being used for throughput of cargo—requires the employment of a number of units from different arms of the service. The textbook organization is shown in *ME*, Vol VIII—Transportation—Part VI. Briefly a Port Commandant, who is the Senior Movements Officer in the area, exercises control of, but does not command, the units allotted to the task of working the port. Such an organization did work during the last war, when an association was built up between units and indi-

viduals who worked together on many occasions, but it resulted in a waste of manpower through duplication—or even triplication—of effort. In fact the resultant organization in a port frequently could have served as an admirable example of the workings of Parkinson's Law.

Suez indicated that the organization laid down was far from ideal. Whilst units individually had been trained in their own specialist roles, that training had to some extent been taking place in a vacuum. It had been solely unit training, there had been no co-ordination with other units who would be operating on the same task and, therefore, there had been no opportunity for officers or men to acquire experience of working along with other units as a team. Suez showed also that the AER, as at present constituted, could not deploy reserve units in sufficient force to supply the whole of the manpower necessary to handle the supplies for an operation of any size. This is a serious failing and its solution is irrevocably tied up with the future of the Reserve Army as a whole.

The creation in peace time of Port Task Forces has great advantages. The training of the component units remains much the same, but they see rather more of the whole picture than before, and are given a chance of "belonging" to a formation, as against being units controlled by a War Office Directorate with no continuing loyalty to one Commander, or interdependence with other units who may be operating on a particular task. The Port Task Forces thus become entities with opportunities for realistic collective training periodically in the training cycle.

The Transportation Units in the main are AER. Some RASC Units are AER and some TA, and the same applies to the RMP. The Signals are TA, Royal Pioneer Corps Groups AER, and Specialist Detachments are usually AER.

How do TA and AER bed down together in one formation? There are some minor difficulties in administration. AER units have a higher ratio of officers among their volunteers than the TA, which means that they can accept the task of various officer appointments during camp, but leaves them a bit short of men to do their share of chores. It also leads to a lack of balance in an exercise, in that the volunteer rank and file strength of a TA squadron may be higher than that of an AER regiment. But largely both AER and TA have quickly accepted each other. Messes have both AER and TA members. Many friendships have been formed at camp between AER and TA units and individuals who have been living in the same Messes and working on the same training.

AER officers have gladly availed themselves of the opportunity of week-end training along with TA officers at week-end exercises. Unfortunately, it has not yet been possible to arrange any out of camp training for ORs of the AER units. If this could be done there would be an enthusiastic response—except perhaps from the Treasury.

There is at present need in the AER for recruits, particularly for junior officers and for men in the ranks. The training is interesting and exercises can be more realistically staged than for some other units and formations. Anyone interested in port working, in mechanical or civil engineering, in signals, in transport, in traffic control—or even in messing about in small boats—can find a job to do in a Port Task Force. Specialist knowledge is an advantage in such units as port regiments, but it is not essential. Common sense and a desire to serve are the indispensable requirements.

The Preservative Treatment of Constructional Timbers in Malaya

By Major D. F. Densham-Booth, RE, AIOB, ARSH

This article describes the writer's personal experiences in perfecting an economic method of preserving Malayan timbers by the Dual Bath Open Tank system. The principles involved are equally applicable to the treatment of timbers in other parts of the world and the method of impregnation described is equally suitable for field or commercial application.

The subject matter of this paper was recently presented by the author when asked to address the Pan-Malayan Conference on Wood Preservation on the problems of timber preservation by non-pressure methods.

Introduction

Malaya is a well-forested peninsula, with at present, an ample supply of timbers suitable for constructional purposes, and it may be said that timber is the traditional building material of the country. Apart from normal domestic and industrial use, considerable quantities of timber have been used for telephone and power line cables, railway sleepers, and in the construction of bridges and tin mine workings ("palongs"). With such a plentiful supply of this useful material so readily available, it is not surprising that the War Department have chosen it as a medium for building large encampments and installations in temporary or semi-permanent construction throughout Malaya. Unfortunately, it would appear from the considerable amount of reconstruction work that has proved necessary in recent years, that insufficient care has been taken in the adequate preservation of the Malayan timbers, many of which without adequate treatment are classified as "non-durable" and have a very limited life. Coupled with this inherent defect is of course the grave risk of destruction by termites and the ravages of numerous diseases often caused by lack of proper seasoning.

The timbers of Malaya fall into three categories: Heavy or Primary Hardwoods, Medium or Secondary Hardwoods, and Light Hardwoods. The latter are roughly identical to some common softwoods although there are no true softwoods (or conifers) of any commercial value in Malaya. Among the most common species of the three different classes are the following:—

Heavy. Balau, Chengal, Resak, Merbau.

Medium. Kapur, Kempas, Keruing, Punah.

Light. Gerongang, Mersawa, Red Meranti, White Meranti.

There are of course many more species available in the forests in varying quantities, and no less than forty-seven varieties are specified in the Grading Rules for Malayan Timbers. The important factor to be borne in mind, however, when considering the application of Malayan timber for constructional purposes, is that relatively few species are themselves resistant to attack by termites, fungal diseases or decay. Only the heavy hardwood species of Chengal, Merbau and Resak can be termed as "naturally durable". Almost all other species, particularly those of the medium and light hardwood groups are classed as "non-durable", without preservation, particularly if placed in contact with the soil.

In the past, the most common form of preservation adopted by the War Department in general construction work throughout Malaya, has been the application of creosote by dipping, spray or brush. "Tanalized" timber has been specified to a very limited extent, due to the high cost of treatment (£5 to £6 per ton of 50 cu ft) and the additional handling and transport charges. "Tanlith" treatment plants operated by the Forest Department only exist at Ipoh, in North Malaya, and Kuala Lumpur, in Central Malaya. More often than not the concealed carcassing timbers have not been treated at all, and even where creosote has been used this has not always been effective in deterring the termite, or white ant. The result of this lack of serious attention to the proper preservation of Malayan timber has been a very heavy maintenance charge in the replacement of decayed and termite destroyed woodwork. In the writer's opinion, if future timber construction is to enjoy an economic life, then there is need for a sound policy with regard to preservation methods. It is this need which prompted the writer's recent research which forms the subject of this article.

The Properties of Typical Malayan Timbers

To illustrate the widely differing properties of typical Malayan timbers which are in general use at the present time for constructional purposes, a table is included which covers four common species from each category of heavy, medium and light hardwood. The allowable working stresses quoted are those laid down by the Malayan Forest Service based on their laboratory experiments under local climatic conditions. Where "strongest" and "weakest" figures are given this indicates that there are a wide variety of types of timbers within the particular species.

As the table indicates, certain of the lighter timbers have working strengths almost equal to the heavy hardwoods which are now becoming both rare and expensive due to past exploitation. Unfortunately, many of the lighter timbers are not durable, but if they can be made more permanent by the application of suitable preservatives, then full advantage can be taken of their physical properties. By substituting cheap, and readily available medium or light hardwoods, for expensive naturally durable heavy timbers, a very considerable economic advantage is to be gained.

Certain of the lighter timbers are difficult to preserve due to their resistance to impregnation and these are to be avoided where possible, or alternatively subjected to the full vacuum/pressure "Tanalith" process to ensure full penetration.

Seasoning is another important factor which is all too often overlooked. Certain Malayan timbers shrink and distort very badly on drying and it is particularly essential that these species are adequately seasoned before being built into new constructional work. It should also be remembered that well seasoned timber has a far greater working strength than "green" timber. The figures shown in the table only obtain for timber dried to 15 per cent moisture content. Wet timber may reach only half the strengths indicated, and it should be noted that many Malayan species when felled contain 100 per cent or more moisture content against their oven dry weight.

Timber Pests and Diseases

Before considering the need for preservation and the type of chemicals or treatment to be adopted, it is necessary to have some understanding of the

PROPERTIES OF TYPICAL MALAYAN TIMBERS—FOREST DEPARTMENT RECOMMENDATIONS

Species At 15 per cent Moisture Content		Average Weight lbs cu ft	Modulus of Elasticity	Allowable Working Stresses (in lb sq in)				Durability (in ground contact)	Other Remarks
				Bending	Compn. pll to grain	Compn. perp to grain	Shear along grain		
Heavy Hardwoods									
Balau	Strongest	67	3,210	3,000	2,550	1,030	185	Moderately durable, 2–5 years	Heavy construction work. Shrinks and splits on seasoning
	Weakest	60	2,670	2,750	2,150	620	165		
Chengal		59	2,630	2,900	2,500	1,020	195	Durable, 5–10 years	Durable to termite and fungal attack. Seasons well. Works easily
Resak	Strongest	67	2,620	2,500	2,200	950	180	Very durable. Over 10 years	Difficult to work due to resin. Seasons badly, checks and distorts
	Weakest	48	2,020	1,950	1,500	410	135		
Merbau		50	2,020	2,100	1,650	530	155	Durable. 5–10 years	Seasons slowly and shrinks very little. Excellent for flooring
Medium Hardwoods									
Keruing	Strongest	61	3,000	2,500	1,950	500	130	Not durable. 0–2 years	Suitable for constructional work if preserved. Needs careful seasoning
	Weakest	49	2,170	1,700	1,400	300	105		
Kempas		54	2,410	2,400	1,950	520	145	Not durable, 0–2 years	Stronger than teak but difficult to work. Must be preserved
Kapur		50	2,310	2,000	1,650	350	120	Not durable. 0–2 years	Stronger than teak. Difficult to impregnate
Punah		49	1,860	1,600	1,100	310	120	Moderately durable. 2–5 years	Needs preserving and careful seasoning. Works easily
Light Hardwoods									
Red Meranti	Strongest	31	1,650	1,400	1,050	210	90	Not durable. 0–2 years	Stronger than pine. Works easily. Seasons well. Needs preserving
	Weakest	28	1,350	1,200	900	170	85		
White Meranti	Strongest	41	2,040	1,850	1,450	330	110	Moderately durable. 2–5 years	Some species stronger than teak. Difficult to saw. Peels well for ply
	Weakest	35	1,840	1,500	1,200	210	83		
Mersawa	Strongest	39	1,650	1,450	1,150	350	103	Durable, 5–10 years	Seasons slowly. Easy to work. Sapwood needs preserving
	Weakest	38	1,580	1,350	1,000	340	95		
Gerongang		29	1,160	950	650	160	70	Not durable, 0–2 years	Seasons quickly and is easily worked. Takes preservatives freely

various types of timber pests and diseases likely to attack the particular timbers which have been selected for constructional use. The many different types of attack described in the following paragraphs are not necessarily peculiar to Malaya, but are likely to be found in a variety of geographical locations.

Powder Post Beetles. These insects will attack either seasoned or partly seasoned timbers. There are two species—the Lyctus Beetle and the Bostrychid Beetle. Both have a similar damaging effect on timber, which, as the general name implies, is to reduce the attacked wood to fine powder. They favour the sap wood of ring-porous and large pored hardwoods, and for this reason the sapwoods of the majority of Malayan timbers are liable to attack unless adequately treated with a toxic preservative. Not only will adult borers attack external timbers, but many species will also attack interior timbers although free from infection prior to installation.

Pin-hole Borers. These small beetles commonly attack timbers which grow in tropical countries and many Malayan timbers are thus affected. Once the timber has been felled and properly seasoned the insect dies and will cause no further damage. Prompt and adequate seasoning of the timber is a sure means of controlling damage, but if correct seasoning cannot be guaranteed then a toxic preservative should be used.

Longhorn Beetle. These are a larger type of insect being ¾ to 3 inch in length, with long antennae. They infect common hardwoods mostly in the sapwood, but in trees having pronounced heartwood they can cause extensive damage by deep and general penetration. The main control of these pests is by good forestry and extraction methods, but infected timber may be protected from further damage by suitable preservatives.

Wood Wasps. The boring of wood wasps is carried out by the larvae, and the damage is easily recognized by the large diameter tunnels, from ⅜ to ½ inch, circular in cross section. The bore holes are usually packed tightly with wood dust. The larvae are large white grubs having brown heads armed with strong jaws. Adult insects are commonly mistaken for hornets, the female having bands of black and yellow about the body, and clear membranous wings. As with other borers, constructional timber can only be properly safeguarded from attack by wood wasps by treating with a toxic preservative.

Termites (White Ants.) These are of two main species; the ground inhabiting termite, and the winged dry-wood termite. The former is the most widespread and destructive and possibly causes the greatest amount of damage to erected timber throughout Malaya. Although they favour wood which is in contact with the ground, they will build covered runways over brick, concrete or other materials to reach and destroy timber which is above ground. The covered run keeps the insect in contact with the ground and its supply of moisture which is necessary for its survival. Termites are capable of eating out the entire core of the woodwork leaving only a paper-thin shell. Very often it is not until a building collapses or is demolished, that the full extent of termite damage can be revealed. Apart from numerous constructional measures which have been adopted to keep the termite at bay, the only satisfactory method is to impregnate all timbers which are not naturally resistant to attack with a preservative toxic to the termite.

Marine Borers. These are generally of two species; the Teredo (Shipworm) and Limnoria (Gribble), and of these, the Teredo is the most prevalent in

Malayan waters. Malayan timbers are attacked by this borer to such a high degree that timber marine structures must be regarded as very temporary, unless protected by sheathing of metal or concrete, or by heavy impregnation with creosote or other suitable preservative. The Teredo enters the pile or timber member at mud level, boring its way upwards and honey-combing the structure with holes $\frac{1}{2}$ inch upward in diameter. Very serious structural defects can rapidly occur under such attack. In recent years it has become the practice to construct piers and jetties with steel or concrete piles, since an economic and satisfactory method of preservation of Malayan timbers under marine conditions has not yet been discovered.

Sap Stain. Although not a disease in the true meaning of the word, abnormal discoloration and stains which may occur in timbers are a sure indication that conditions are right for further fungal diseases to take a hold. Sap staining is, therefore, accepted as a symptom and the control of further infection is recommended by means of a chemical dip. Certain sodium salts are preventatives against sap stain and mould growth, and this fact must be borne in mind when selecting a timber preservative.

Timber Decay. There are many forms of fungal growths which bring about the decay of timber, the two main types of decay, however, are distinguished as Brown Rots and White Rots. In the former the wood becomes dark brown in the decayed areas and tends to break up into brick-shaped cubes. White rots are more commonly found in hardwoods and are recognized by a lightening in colour of the decaying patches and a tendency for the timber to disintegrate into a lint-like material. The most common decay which affects building materials, particularly where inadequate ventilation of concealed timbers has been provided, is the dry rot, Merulius Lacrymans. Although timber liable to decay can be avoided by careful selection, and further protection gained by suitable building methods, the most reliable safeguard is the antiseptic treatment of constructional timbers with a preservative, or the application of heat at about 150°F to sterilize the timber and destroy the fungus.

Preservatives and Other Control Measures

From the foregoing brief summary of common pests and diseases which are liable to attack Malayan timbers it will be apparent that for a preservative treatment to be really effective it must have the following main characteristics:—

(*a*) High degree of toxicity to all forms of insects and borers.

(*b*) An antiseptic chemical composition that will destroy all forms of fungal growths.

(*c*) If possible, include the application of heat in the preservative process to ensure sterilization of any sapwood not sufficiently impregnated by preservatives.

Before considering the selection of a suitable preservative method to meet the foregoing requirements, all other possible supplementary control measures must be investigated in order that the full utilization of available timbers may be effected. It is appropriate to mention such additional controls at this stage:—

(*a*) Seasoning—The proper seasoning of green timbers down to not more than 25 per cent moisture content, prior to construction. For flooring, internal wall panelling and similar applications an endeavour should be made

to air or kiln dry down to 15 to 18 per cent to ensure fullest possible seasoning. Not only will good seasoning ensure greater structural stability, but also some of the common ailments such as sap stain and fungal growths may be eliminated.

(*b*) Construction Techniques—The adoption of improved techniques in building construction whereby adequate termite traps are provided, and all timber work is kept out of direct contact with the ground, and adequately ventilated.

(*c*) Durable Timbers—The use of naturally durable and resistant timbers in important constructional members, where such material is readily available at an economic price.

(*d*) Soil Poisoning—The application of soil poisons in areas where termite attack is unusually prevalent. Building sites may be impregnated with chemicals such as arsenates and chlorinated phenols, or specially treated "ground bait" in the form of attractively poisoned timber stakes can be used to some effect. By these methods termites may often be destroyed before they have the opportunity of reaching the main structure.

Having ensured that all practical supplementary measures have been fully considered and adopted where appropriate, the final safeguard is to preserve each individual timber member of the structure itself. The requirement then is to select a suitable preservative which combines as many desirable properties as possible, having regard to the ultimate use to which the building will be put. As a guide, the following properties are suggested, as these were used as the author's standard when making his selective experiments:—

(*a*) *Resistance to Fungal Attack.* The preservative must be toxic to all fungal growths which would normally attack the timber.

(*b*) *Resistance to Wood Destroying Insects.* The preservative must be toxic to all forms of insects, beetles, termites and borers. In river or sea construction work resistance to marine borers is of particular importance.

(*c*) *Antiseptic Properties.* The preservative should contain antiseptic chemicals which will retard sap stain and destroy wood moulds.

(*d*) *Dimensional Stability.* The preservative and method of application should be such that the finished timber does not appreciably shrink, swell, distort or suffer from degrade after treatment.

(*e*) *Discoloration.* The preservative should not discolour adjacent plasterwork and similar finishes, and should be capable of taking normal decoration in the form of oil paints, varnishes, emulsions, oil or water stains, etc.

(*f*) *Colour.* The colour should be as insignificant as possible to allow for the widest range of internal or external finishes which may be required on the exposed timber surfaces.

(*g*) *Odour.* The preservative should be odourless, particularly where applied to domestic structures in a tropical country. Persistent odour will be aggravated by heat and is likely to become objectionable.

(*h*) *Corrosion.* The preservative should not have a corrosive effect on any metals such as may be used in fittings, fixings, nails and screws, etc.

(*j*) *Glueability.* The treated timber should have similar gluing properties as non-treated timber.

When selecting a preservative, reference to the British Wood Preservative Register indicated that there were no less than seventy-five different proprietary compounds available, divided into five main categories, viz: Tar oil types, oil solvent, spirit solvent, organic solvent and water soluble. Each

has a different formula and many are designed for a single specialized purpose. From the view-point of economy, it was considered that water soluble salts would prove to be the cheapest and most easily transportable, since the mixing water could be added at no cost, on site. Bearing in mind also the advantages of sterilization by heat, it was thought safer to avoid oil or spirit solvents due to the possible fire hazard when heating the preservative in open tanks by unskilled labour. However, as will be described in the following section, both oil and water solvent types were tested in order that the most efficient method of impregnation could be determined.

Several attempts were made at compounding a simple yet effective preservative, and in particular a mixture of sodium pentachlorphenate and gammexane powder appeared to be a possible solution. Unfortunately the sodium salts are very light and when mixing large quantities there was considerable danger of causing severe inflammation of the nose and throat. Without the addition of suitable dispersal agents it was found difficult to ensure an even and complete dissolution of the chemicals and adequate diffusion within the timbers.

For the full scale trials and later production work Hickson's "Superwolmansalts" were chosen for their suitability in hot and cold treatment plants and for their extremely toxic compound of chemicals which includes potassium dichromate, sodium flouride, sodium arsenate, some phenols and dispersal agents. These salts appeared to meet the specified requirements mentioned in the foregoing paragraphs, and are similar to those used in the "Tanalith" process as carried out by the Forest Department vacuum/pressure plants. "Superwolmansalts" were available in 1 cwt and 5 cwt steel drums, requiring only the addition of water to make them ready for use. The cost per gallon of the recommended 4 per cent solution strength was found to be cheaper than any of the "home-made" preparations, and the difficulty of weighing, mixing and blending poisonous chemicals in large quantities was avoided.

The use of creosote and similar tar oil preservatives was not considered in these trials since the majority of new or reconstruction work at present comprises living accommodation and similar structures, where a decorative as well as preservative finish is now considered desirable. It should be mentioned, however, that tar oil preservatives may be applied by the hot and cold process which is later described, but with somewhat higher working temperatures to ensure sufficient fluidity and penetration.

Methods of Impregnation

While consideration was being given to the type of preservative to be used, experiments were put in hand in an improvised laboratory to determine the most effective method of impregnation. These experiments were conducted in four main stages as described in the following paragraphs:—

Stage I—*Cold Soaks*

Standard size billets 1 ft long and each $\frac{1}{16}$ ft cube of Meranti, Keruing, and Resak, representing light, medium and heavy hardwood respectively were subjected to a cold soaking of 48 hours and 7 days' duration in both water and kerosene solutions. The different samples of each specie were taken from the same scantling, and all were air dry to about 15 per cent moisture content.

The gains in weight after 48 hours were not particularly significant, but

after seven days cold soaking the average gain in weight for water solutions was 6 per cent while for oil solutions only 2 per cent.

These results indicated that cold soaks in light oil solvent preservatives were unlikely to be successful due to the resistance of the natural moisture in the timber to combine with the oil. Water solutions in cold soaks are thus likely to be more effective since similar fluids readily intermix and deeper penetration into the pores due to diffusion is possible.

STAGE II—*Hot and Cold Soaks (Single Tank)*

Following the local practice of hot and cold treatment by single tank process, experiments were continued with $\frac{1}{10}$ ft cube billets of well-seasoned medium and light hardwoods. For the purpose of comparison the absorption rate of water soluble salts was tested against a diesel oil solution of organic solvent type concentrate. The samples were placed in baths at air temperature (approx. 80°F) heated to 180°F over a period of 2 hours, weighed hot, cooled for 2 hours to about 80°F, reweighed, and finally left to soak for a further 16 hours and weighed again.

It will be appreciated that air entrained in the timber, and a certain amount of natural moisture is driven out by expansion on heating, and during the cooling period the partial vacuum thus formed causes the preservative to penetrate into the timber. A readily absorbent timber such as Keruing, gained only 4.6 per cent of its weight after 7 days cold soaking in water solution, but many samples of similar species gained between 20 and 40 per cent by the hot and cold process.

The average results from a number of these experiments showed that there was an appreciable gain in weight during the heating up period, but that prolonged soaking after the initial 2 hours cooling did not greatly increase the total gain. It was found that samples treated in water solutions, gained twice the weight of those treated under similar conditions in oil solutions. Further trials with oil solutions were, therefore, abandoned.

STAGE III—*Hot and Cold Soaks (Dual Bath)*

As a variation on the previous method of heating and cooling the timber in the same tank of preservative, two tanks were employed. In the first the timber and preservative were brought to required heat in a given period, and then after a brief delay while the hot wet weight was taken, the timber specimens were plunged into a second tank containing similar cold preservative of identical solution strength. From a number of tests it was found that the gain in weight after the 2 hours "cold plunge" was often 25 per cent greater than when the timber was merely permitted to cool down in the hot tank for a similar period.

It was at once appreciated that a double bath system would not only give an increased degree of impregnation, but there would also be the added economic advantage of releasing the hot tank at much shorter intervals to accommodate a fresh load of timber for treatment.

STAGE IV—*Impregnation Time Periods*

As a final stage in these experiments a series of trials were carried out using various size scantlings, and different species of timber. From the results of numerous tests it was considered that a 2-hour heating period during which the temperature was raised to 180°F followed by a 2-hour cold plunge at approximately 80°F would give good average results. Approximately 0.25

lb per cu ft dry salt retention was obtained by this method, which compares quite favourably with the standard dry salt retention of 0.35 lb per cu ft by the vacuum/pressure "Tanalith" process.

It was decided to adopt this simple time formula to facilitate the operation of the plant by unskilled labour. Loads of timber in mixed sizes and species are, therefore, taken through the preservation process without sorting. Only for specific loads of a timber which is particularly difficult to impregnate need the soaking periods be increased to 3 hours.

Design and Operation of Treatment Plant

Having obtained satisfactory results from the laboratory trials it was decided to design and construct a full scale plant in the DCRE Seremban depot, having a capacity of five to six tons per normal working day. The intended purpose of this plant was the treatment of maintenance timber stocks for use by DEL, and also the preservation of contractors' timber, particularly carcassing and weatherboarding, prior to construction in adjacent camp locations.

(*a*) *Design and Construction*

As will be seen from the accompanying drawing and photograph the layout and construction of the dual bath plant is extremely simple and relatively low in cost. Secondhand materials were used wherever possible in constructing this prototype, the hot tank being the only purpose-made item of equipment.

Both tanks are 20 ft long and 4 ft wide to accommodate normal lengths of timber, which is prestacked on angle iron cradles 8 ft long × 3 ft wide. The hot tank is raised off the ground on brick piers to provide a long continuous fire box with four fireplace openings. A simple draught-regulating plate is placed at each opening, and at the far end, a brick smoke box opens into a 23 inch diameter light metal smoke stack fitted with a damper. The hot tank bottom is of $\frac{1}{4}$-inch plate, sides and ends being of $\frac{1}{8}$-inch plate. All joints are welded and the tank is braced with angle iron. The cold tank is a normal Braithwaite water tank let slightly into the ground for ease of access. Light sheet metal covers are provided to reduce evaporation.

Two timber cradles are available so that continuous operation of the plant is possible, the cradles being submerged in both the hot and cold tanks respectively when the cycle is in motion. It is generally found necessary to add sinking weights to the timber on the cradles to ensure complete submersion in the preservative.

The hot tank is fired either by scrap timber recovered from demolished buildings, or when this supply is temporarily exhausted, by four improvised diesel burners. Wood firing is found to be quicker in bringing the tank to heat, but is difficult to control when a steady temperature is required. The diesel burners provide efficient heat control, but together consume about four gallons of fuel per hour.

(*b*) *Method of Operation*

A chargehand and two labourers can handle the plant throughout a full day's cycle of operations. Additional labour is of course required for trucking and restacking timber after treatment. Both tanks are charged with approximately 750 gallons of preservative solution at the commencement of the operation. The fire, either wood or oil, is lighted at about 6 am to commence

Photo 1. A collection of white ant queens and examples of damaged timber. One queen can produce enough "workers" to destroy a whole building.

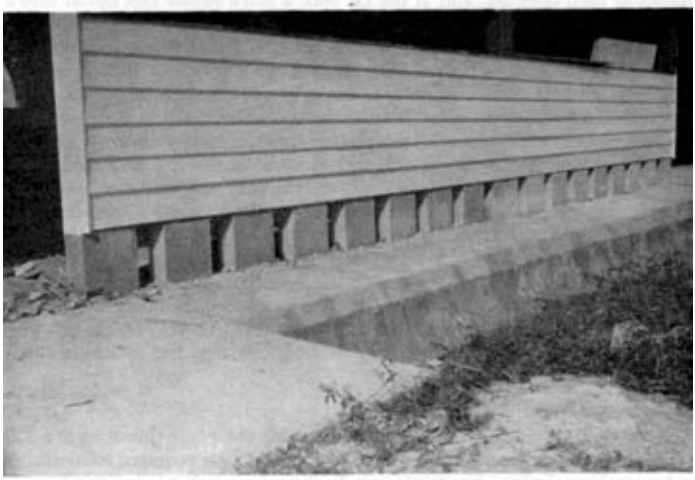


Photo 2. An example of anti-white ant construction. Timber work carried on concrete blocks.

The Preservative Treatment of constructional timbers 1,2

Photo 3. General view of "D-B" treatment plant, Seremban, Malaya.

Photo 4. Detail of "hot" and "cold" tanks. "D-B" treatment plant.

The Preservative Treatment of constructional timbers 3, 4

warming up the tank, and at 8 am the normal cycle of events begins, each tank being charged with timber at 2-hourly intervals. Four complete cycles are possible in an 8-hour day, and since the cradles will carry $1\frac{1}{2}$ tons each, an output of about 6 tons or 300 ft cube of treated timber per day is quite reasonably achieved.

(*c*) *Control of Impregnation*

It is essential that adequate control measures are maintained to ensure that sufficient impregnation of each batch of timber is achieved. The cost of salts absorbed may average about £2 per ton of treated timber, and the value of the timber to be protected will be about £20 per ton or more. Neither must chemicals be wasted therefore, nor valuable timber left inadequately protected due to inefficient preservation.

Time and temperature is controlled by the chargehand, whilst solution strengths are checked by hydrometer and weight analysis by higher grade supervisory staff. As the solution strengths increase due to evaporation, fresh water has to be added from time to time to adjust the specific gravity to match the standard sample of 4 per cent solution. Sections of timber, 1 ft long, are cut from sample lengths in the load both before and after impregnation. Moisture content of the timber can thus be checked by oven drying methods, and the gain in weight after impregnation also determined, to arrive at the dry salt retention.

Charge sheets are prepared for each load of timber and these form a complete record of the treatment given. Details of the timber are shown together with such other information as times, temperatures, holding periods, solution strengths, fluid consumed, estimated dry salt retention in lb per ft cube, hydrometer readings for both tanks. A chemical stock book is also maintained from which can be ascertained the monthly consumption of salts against the total tonnage of timber passing through the plant. By this means there is an additional check on the average dry salt retention per cu ft of timber.

It has been found from practical experience that these controls are quite easily carried out and provide a reliable safeguard to ensure that all timber treated in the plant is adequately protected and that money expended on both equipment and preservative materials is not wasted.

Conclusion

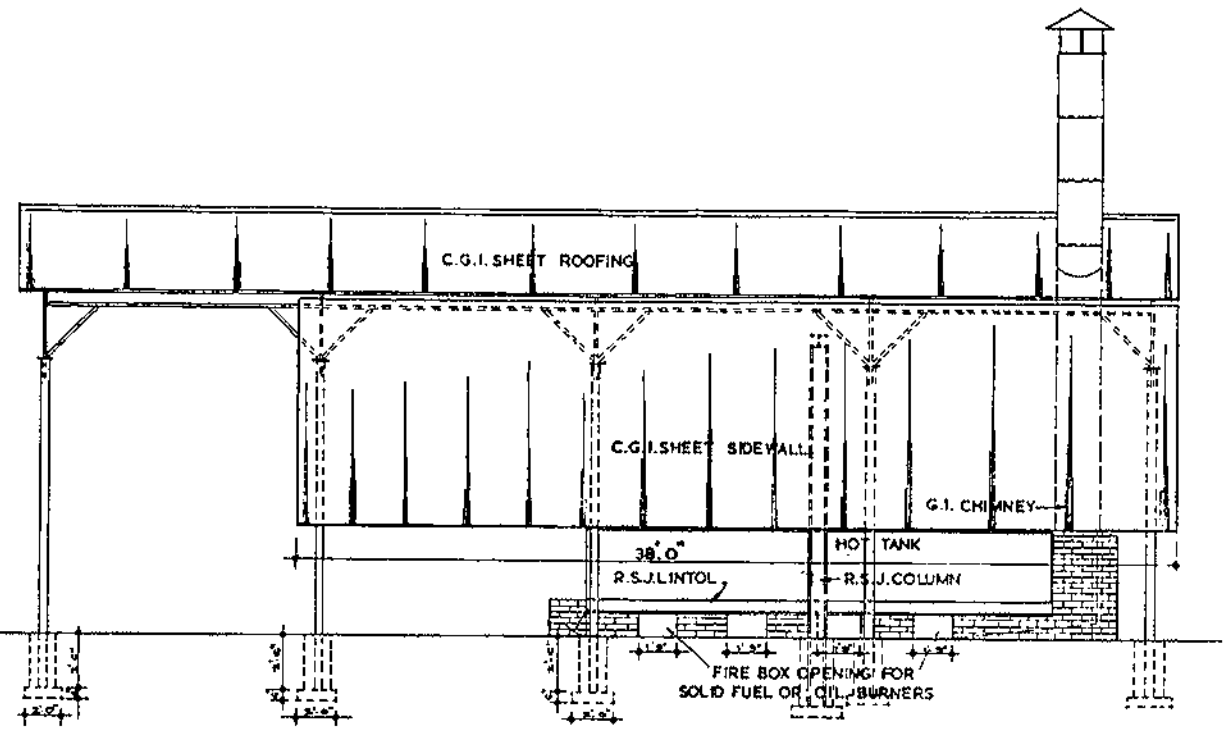
If the writer's aim has been achieved in drawing attention to the need for adequate preservation of timbers for constructional purposes, both in Malaya and elsewhere, then there is little to be said in conclusion.

It is, however, particularly stressed that the proper seasoning of timber by either air or kiln drying methods is a prerequisite to effective preservation by the hot and cold dual bath process.

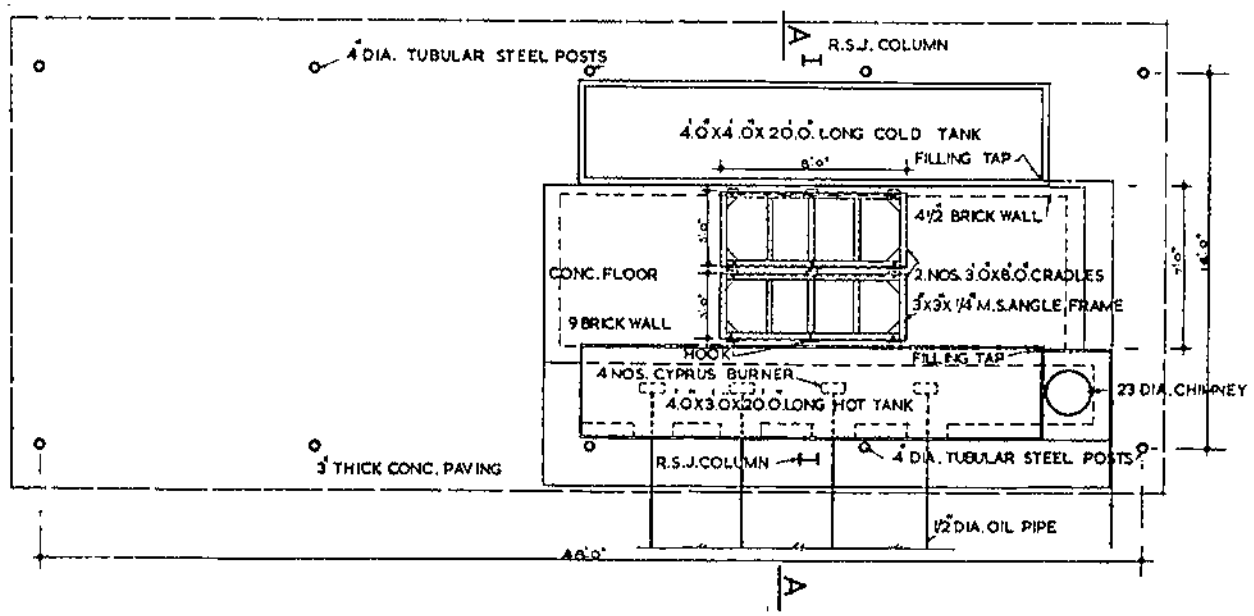
Finally, if as a result of this short discourse, the simple method of water soluble salt impregnation by this process is taken more widely into use, then this modest endeavour will not have been in vain.

* * * * *

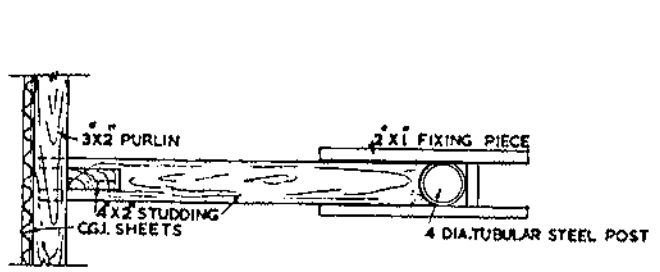
Author's Note. The words "Tanalith", "Tanalized", and "Superwolmansalts" are the Registered Trade Marks of Hickson's Timber Impregnation Coy. (G.B.) Ltd., Castleford, Yorkshire.



ELEVATION



PLAN
SCALE ½" = 1 FOOT



1/8 F.S. DETAILS AT 'A'

SECTION A - A.
SCALE ½" = ONE FOOT

DETAILS OF 'CYPRUS' DIESEL BURNER

DRAWN BY G.Y. DHARAN
DATE. 9 · 10 · 1959

DUAL BATH ("D - B") TIMBER PRESERVATIVE PLANT FOR D.C.R.E SEREMBAN.

MAJOR R.E.
D.C.R.E SEREMBAN.

D.C.R.E SEREMBAN
SK. No. 53/B

A Demolition Week-end Exercise with the Territorial Army

By Lieut-Colonel J. E. Weller, MC, RE

One of the Civic Trust's laudable aims is to tidy up Britain and, in this connexion, it operates a work camps scheme whereby unpaid volunteers clear derelict military buildings and defence works put up during the war. There are still innumerable gun sites and pillboxes scattered throughout the country, which owners are not, themselves, prepared or able to clear and which present too tough a job for the Civic Trust's unskilled volunteers. Some would say that the Services have a moral obligation to help in this matter but, that quite apart, it certainly offers the Corps interesting and practical demolition tasks which are not readily available from normal military sources. At best the sites should be cleared of debris but, at worst, they can be left to be cleared later by the Civic Trust's volunteers.

When, therefore,—as a London unit—I was looking for a demolition task and felt that my first idea of tackling the Albert Memorial might lead to needless recrimination, what better than to approach the Civic Trust? Through them, I was put in touch with the Headmaster of an approved school in Surrey who turned out to be most helpful. He agreed that, if I could blow some pillboxes up sufficiently to drop the roof to the ground, then he would use his "inmates" as fatigue parties to break up the rubble and remove it to provide hard core for his farm roads. This was ideal for me as I knew my soldiers would enjoy making a nice mess, but that tidying up afterwards would not be popular.

It might be of interest to readers if at this juncture I made a few observations about the approved school. The Headmaster was a man of strong character who told me that he didn't cane the boys very often, but when he did, he made a good job of it. The boys were all serving sentences of some sort, and the Headmaster told me that after the "course" at his school about seven out of every ten would never go to prison again.

Some of his old boys have been successful in politics and even reached the House. The school buildings were modern, attractive, clean, centrally heated etc., and functionally more suitable for their purpose than those of many public schools. Besides the ordinary classrooms, there were workshops for trade training, a few acres for market gardening, and a 250-acre farm for training in farm work. There were football, rugger and cricket grounds and a swimming bath. It all looked, and was, very efficiently run at a total cost to the taxpayer of £8–£9 per week per boy. As their "terms" last for fifty-two weeks, the cost to the taxpayer per annum is comparable with the fees at Eton. I left, wondering what crime I should have to persuade my son to perpetrate to qualify for entrance to the school and save myself the burden of school fees. However, I have now dropped the idea, as at a later visit, my Adjutant, while chatting to one of the boys, was told by one of them, aged 15, in tones of pride rather than repentance, that he was "in" for rape.

I returned to London thinking that I had found just what I wanted; but my troubles now began. The War Department, for reasons I don't quite understand, do not accept responsibility for any accidents in training that

occur on land which is not WD land. The form of indemnity in ACI 38/57 makes it quite clear that anyone getting assistance from the War Department, do so entirely at their own risk. I was, therefore, obliged to go to the school again armed with indemnity forms, covered with 6*d* stamps, and explain to the Headmaster that if he wanted his pillboxes to go he must sign. After some discussion we concluded that if an accident did occur the claims would require inter-departmental action between the War Office and the Home Office and, consequently, no worry was likely to occur at our level during our lifetime. The Headmaster, however, was to take out an insurance policy.

It was not long before an insurance agent arrived at my office, armed with the latest amendment to RE SPB No 4, which gave the minimum safety distance for borehole charges as 300 yds and concussion charges as 1,000 yds. There must be few points in Surrey where there is no house, farm building, road or overhead cable for 1,000 yds. Certainly there was none in the approved school grounds. The insurance agent was only prepared to insure outside these distances. I told him to go ahead on this basis; at the same time I tried hard to recall the effects of other demolitions I had done in my life; I thought of one of the pillboxes, which the Headmaster particularly wanted removed, lying 20 ft from a shed housing an enormous prize bull; I even considered the possibility of always firing simultaneously two pillboxes 300 yards apart, so that any brick could always have come from the one farthest away, but considered that this would be dishonest; I consulted the SME and technical reports. I decided to keep my fingers crossed and hope for the best.

Until this time I had never had anything to do with Trade Unions. Before the Army may undertake any work connected with civilians, the Trade Union's consent must be obtained. Their channels are not dissimilar to Army ones, in that the local Trade Union near the school said that we would have to go to a higher level, i.e. the Trade Union at Redhill. At Redhill, we were told to go to a higher level at an address in London. In London, we were told they couldn't sign the document, we must go to Guildford. Fortunately the man at Guildford, in a weak moment, signed it. I expected him to send me back to Redhill or the local branch, and I should then do the circuit again.

There were other anxieties in the preparatory stage of this exercise. I did not want several of the T.A. soldiers to be tied up on guard duty during the exercise, but I was haunted by the prospect of the charming little inmates of the school stealing explosives from us and staging a spectacular bank robbery or blowing up the school.

Finally, however, all the formalities were completed (except getting permission from the Employers' Union—we never found anyone who belonged to it, although the Command Secretary was most anxious that we should).

There were twelve pillboxes—three were only brick structures and nine were reinforced concrete. The former had only 2 foot thick brick walls, the latter had 3 foot thick walls and 18 inch thick roof. The majority were pentagonal with three loopholes. The inside dimensions were approximately 6 feet sides and 6 feet from floor to roof. Some of the reinforced concrete ones were very close to houses (50 yds away) and farm buildings. Each squadron was given the task of demolishing four pillboxes. I took all officers on a reconnaissance of their particular pillboxes on the week-end prior to the exercise.

The general idea was that we should work on those farthest from buildings

first and from our experience gained in doing these, decide whether we could tackle those in more difficult situations without damage to property.

The 2/ic of the Regiment, aided by all the regimental wireless sets, was made officer-in-charge of all safety precautions, and nothing could be fired without his permission. This worked extremely well and even saved us the embarrassment of blowing up the Group Commander's car.

The brick ones presented no problem. The directional effect of a beehive was put to good purpose. One 6-inch beehive was placed so that the "bullet" would go through the wall which faced the safest area. The beehive was put about eighteen inches from the floor, and aimed slightly downwards and through the middle of the "safest" wall. The doorway and loopholes were tamped with sandbags. The result on firing was described by the Headmaster as a "brilliant job". (One of them lay 20 yds from the school swimming baths and 50 yds from his home.) The wall at which the beehive was aimed was largely disintegrated; it was spread over about eighty yards in the direction the beehive was pointed. The remaining walls fell outwards, almost *in toto*, and the roof dropped almost exactly on the floor.

The reinforced concrete pillboxes were not so easy. The more remote ones were tackled by a combination of boreholes drilled from the outside at the corners, and small concussion charges inside. Several of the boreholes were successfully burnt by an oxygen torch provided by a team from the SME. The torch drilled quickly and well but this method was wasteful in time as we were obliged to wait for the holes to cool off before we could fill them with explosives. With a total of 20 lbs of explosive, the roof did not come down completely but hung perilously from a few reinforcing bars which stuck out from the top of the half-demolished walls. This left attractive and dangerous little hideouts under the roof for boys who might want to conceal themselves or things from authority's gaze and we had to have a second go. Inspection of the site seemed to show that no large pieces flew more than 50 yds. This, however, was more than we could accept for those pillboxes nearer in, and we tried different techniques as we got on more delicate ground.

I shall describe in some detail how the last pillbox was demolished, as it was the one situated in the farmyard area, with the bull pen 20 feet away on one side, the cowshed 30 feet away on another and the farmhouse 50 yds away. The Headmaster was particularly anxious for this one to go, as he wished to put a new cowshed on the ground where the pillbox lay.

We decided to fill it with water. This simple process was complicated by the fact that, as fast as we could pump it in, it leaked out between the floor and the walls. We had to delay firing it for a week so that in the meantime, the PSI, aided by the storeman, could make a cement fillet round the walls and floor joints. They also filled the doorway with a cement fondu mix, just leaving sufficient room at the top for the demolition party to be able to squeeze through.

The 26 lb charge was placed as follows: 5 lb in each of the three corners away from the buildings, and 3 lb in the two corners nearest the buildings. To ensure an outward demolition wave, a 5-lb charge was placed near the middle of the pillbox—not dead centre, as we did not want the roof to go straight up and land down again on top of the walls.

The pillbox was filled three-quarters full of water, and the bull was removed to another stall a good 70 yds away.

The result of the explosion was eminently successful. The roof was completely detached from the walls. Two walls had fallen outwards and the remaining corners were sufficiently cracked for an acetylene cutter to cut the reinforcing bars holding the corner together. A Class I tractor was able to pull the roof clear with its winch and then each wall was dragged away in turn by the tractor. The only damage was four windows cracked in the farmhouse.

Perhaps the moral to be drawn from this little exercise is that Sapper TA Regiments can do exercises that are useful, and they can do technically interesting training, but owing to the enormous amount of red tape to be got through in order to organize it, every Sapper TA Regiment must have a Regular Training Officer as well as an Adjutant.

Note: If any other TA unit would like a similar task, they should contact the Civic Trust, 79 Buckingham Palace Road, SW1.

The Package Deal

By MAJOR D. M. R. ESSON, BSc(ENG), AMICE

RECENT discussion on "Whither the Corps"[1] shows that the wind of change is blowing in engineering. In the civilian field an icy blast is assailing the traditional relationship of the consulting engineer and his client. It may not be out of place, therefore, to describe the new system, and to try to evaluate its future.

The traditional method for a man or organization to execute works, by which is meant every form of constructional work "for the use or convenience of man", has been to place one's entire and absolute trust in that form of professional man called a consulting engineer, being a specialist in the particular type of work envisaged. Under the co-ordinated control of this consultant other professional men may be employed, either directly or indirectly. The consulting engineer will design the works for their particular purpose, to cost no more than a stipulated sum, and for ease of construction and maintenance. After obtaining the client's approval of his design, he will obtain tenders for the work from suitable contractors and recommend the acceptance of one or other of these. After the client's acceptance, the consultant will supervise the execution of the work by the successful contractor. The consultant's remuneration will be a fee from the client and no more. Strict rules lay down the standards of professional conduct he must follow[2]. In particular he is forbidden to be both consultant and contractor.[3] The most important of the consultant's assistants is the quantity surveyor. He is responsible for measuring the works as they proceed, and it is on the basis of this measurement that the client pays the contractor.

[1] *R.E. Journal*, Vol. LXXII, p. 352, Vol. LXXIII p. 17, 85, 209, 341. (December 1958, March, June and September 1959.)

[2] By-Laws and Regulations of the Institution of Civil Engineers, Section IV.

[3] Ibid, para. 26.

The conditions of the contract usually require the contractor to provide particulars of how he will perform his tasks,[1] and submit any necessary calculations for temporary structures.[2] This means that contractors must maintain a design staff, for whom work may become sporadic. This was one of the factors which helped to introduce the "package deal".

There is provision in most engineering codes of practice for competitions, but they are much more common in architecture. Liverpool Cathedral was an example of a competition design. Once contractors began to employ architects they also began to encourage competition entries: with the resources of a large contracting firm behind him the cost of an entry for a young and struggling architect was eliminated; the only condition was that the successful architect appointed his own firm to do the work. The rules of professional conduct were strained, but that was no concern of the contractor, and it formed another factor in introducing the "package deal".

When engaged upon development work, contractors also found that clients frequently wanted substantial variation to their speculative designs. It was only business sense to gratify these desires.

Under the "package deal" system the contractor approaches the client (most unprofessional!). He arranges to design and execute the entire work to requirements of the client. This is usually based on a priced schedule of quantities, but there appears to be no fixed rule about this. He invites the client to appoint an independent quantity surveyor to measure the work as it proceeds, and to certify any necessary sums for payment. The contractor "sells" his work, and in the course thereof he claims that the elimination of the consultant will save the client 5 to 10 per cent of the total outlay.

The recent dispute about the Staines By-Pass Bridge is interesting and gives a lead to the direction of modern trends. Here a firm of contractors offered to do the work at a greatly reduced price if they were allowed to redesign the bridge. Their offer was not accepted, but the Minister of Transport has since announced that he will in future invite competition tendering for similar works.

If this is the position today, what will the future bring? The traditional clients are unlikely to desert the consulting engineer: the central government and their principal agents, the county councils, rely on the consultant for almost all their abnormal work; the nationalized industries still follow the procedures tried and found satisfactory in the past, and this is particularly so where major developments are taking place. Many of the older companies, both abroad and at home, have old ties and valued contacts in Victoria Street; their staid and stately ways form a bulwark against which the "package dealer" will make little progress. But the new client, the mushrooming enterprises of the new towns, the zealots of progress, the captains of finance, are interested in this new idea. Its development represents fresh approach to the problem of executing new capital works. So long as the "package dealer" is a respectable firm, interested in obtaining and keeping a reputation for straightforward dealing, all will be well: it is the undesirable intruder who must be eliminated, yet by the very tenor of our national life, a newcomer must be given an opportunity to prove himself. It would not be in accord with our national characteristics to attempt to solve this problem by

[1] *General Conditions of Contract*, 4th edition, p. 3, para 14.

[2] *The Collapse of the Second Narrows Bridge, Vancouver*, by R. Freeman and J. B. H. Otter, 12 Proc. ICE, April 1959, p. N36.

any formal rules, but "package dealers" must combine in some fashion to exclude from their business all those whose behaviour is a menace to our public life.

In the past consulting engineers were to be found who would accept part payment of their fees speculatively: instead of receiving their full remuneration in cash, they would rest content with three-quarters in cash and the balance in debentures, preference shares or even the equity of the enterprise for whom they were working. These arrangements were, of course, private, but the facts "leaked" and many fortunes were built on the granting of such facilities. We may expect the "package dealers" to do the same, but it will be much more blatant, and being a hard-driven bargain, may be the means of converting a simple contracting enterprise into a vast policy-controlling financial empire. The "package dealing" millionaire of today may well be the Rothschild of tomorrow.

The forthcoming struggle between the "package dealer" and the consulting engineer may well be fought out in private in the council chambers of the great engineering institutions, but as engineers we should have a right to hear both sides of the argument, and to decide our own individual attitude before it is decided for us.

The "package dealer's" case is:—

I am 5 to 10 per cent cheaper.

My work may be supervised from outside, in fact I would like you to employ a quantity surveyor.

Since there is no question of going out to tender I am quicker.

I am not a consultant and I am not bound by the restrictions of their professional code, so I can compete with my rivals, both at the design stage and for construction; thus not only the client but the community at large will benefit by keeping costs down and inflation at bay.

The consulting engineer's reply is:—

My liability for a bad design or a professional mistake is unlimited: my private fortune is at stake.

I follow a rigid code of professional etiquette, designed to protect my client. I object to having my function usurped by a contractor.

The contractor's competition is unfair; I may not "solicit professional work"[1]; he does so with all the resources of modern commercial propaganda.

By employing me you are sure of getting nothing less than the very best, it is true that the "package deal" may be cheaper, but there is a very serious element of risk for the client.

The old method has proved its value; if you go "package dealing" you are entering a field where there is no tried referee; do you really want that?

The problems of this development are many, and the solutions offered are various. Nevertheless, in my opinion, "package dealing" has come, not only to stay, but ultimately to supersede the old system. We may mourn its passing, but we must also hope that the new system will give the client, and the country, as good a service as the old.

[1] By-Laws and Regulations of the Institution of Civil Engineers, Section IV, para. 22 (g).

Northern Ireland Command Army Days 1959. Battle Simulation Tasks by 146 (Antrim Artillery) Field Engineer Regiment RE TA

By "PERMANENT STAFF"

GENERAL DESCRIPTION

EACH year Northern Ireland Command hold Army Days during which the general public are able to see certain aspects of army life and tasks. In 1959 Ballykinlar was chosen as the site and the theme was "The Army in the Field." The demonstration consisted of:—

(*a*) Company attack by 2nd Bn Greenjackets, KRRC, supported by armour, artillery and aircraft.

(*b*) Static display by North Irish Brigade of a Battalion Rest Area in the Field.

(*c*) Demonstration by 1st Bn The Duke of Wellington's Regiment of battalion supporting arms, together with many side shows and special features.

SAPPER TASKS

146 (Antrim Artillery) Fd Engr Regt RE (TA) was given the responsibility of providing battle simulation for the infantry attack demonstrations, and to assist GE Ballykinlar in erecting certain structures for the various displays and demonstrations. In order to perform these tasks, the authority was obtained to raise a Composite Troop of Permanent Staff and TA Volunteers for a twelve-day period from 13–20 July 1959. The Troop, composed from all Squadrons under command, consisted of: Adjutant; RSM and 3 permanent Staff Instructors; 1 Sergeant and 14 NCOs and Sappers from the TA. The Troop was accommodated by 2nd Greenjackets, and lived and operated in all respects as a regular Troop.

BATTLE SIMULATION TASKS

The attack demonstration represented an "Advance to Contact" action of a small force striking inland from an adjoining beach and took place over sand dune terrain. The layout of the relevant positions is given in Fig. 1. Initially a troop of Armoured Cars advanced in a tactical formation until fired upon by an enemy anti-tank gun. One armoured car "brewed up" and called for assistance from the Force Commander. A Troop of 25-pr guns then ranged on the enemy and gave covering fire to an infantry Platoon required to assault the enemy. The infantry formed up under cover of smoke, and by fire and movement worked their way to an assaulting position. At this stage aircraft carried out strikes on the enemy position. The infantry

made their final assault and in turn were counter-attacked by a rebel force which was defeated. The whole demonstration lasted about twenty-five minutes. The effects required to be simulated by the Sappers were briefly:

(*a*) A "nuclear bomb" effect
(*b*) Armoured car brew-up
(*c*) Artillery ranging
(*d*) Aircraft strike
(*e*) Artillery barrage
(*f*) Close quarter combat

Some of these effects were complicated by the fact that the "enemy" were live and most effects had to be placed close to them for realism, yet sufficiently far away for safety. The main task on the Sapper side was the successful combination of these conflicting requirements.

Preliminary Planning

Certain planning and stores requirements had been made before it was decided to call in the Sappers. As soon as the commitment was known a recce of the site was made and the Troop Commander briefed by the KRRC. Imminence of Annual Camp precluded a close follow up, but a revised stores list was drawn up.

At this stage the requirement was confined to a one minute artillery barrage, the brew up, strike and nuclear bomb. Eventually the one-minute barrage was extended to "bangs for twenty minutes", which were provided in one form or another. A visit to the GSO II RE at the School of Infantry produced an offer of a team to set off a large atom bomb (350-lb charge). Unfortunately finance dictated that something more economical be used, and a training simulator was specified instead. As will be seen however, in the end a local bomb had to be produced in a hurry.

Special RE Problems

As stated, safety was the overall consideration. Not only were simulation charges required to be set off near the enemy and assaulting infantry, but the areas chosen were bisected by tracks through which other troops and VIPs were required to pass immediately before each demonstration. In addition the area was bounded by a battalion camp with quarters, which limited the size of charge for the atom bomb. The close limits which were operative will be seen later. It was on these points that Sapper advice had to be firm and clear. Safety limits were reduced as experience was gained from the particular condition of the ground. It was necessary to reduce the safety limits of the ½-lb charges to 35 yards, but this was only done after careful practical tests. All charges were laid within a "bang" fence marked by wire, visible to attacking troops, but invisible to the public. A "count down" procedure in liaison with Spectator Control enabled the Troop Commander to give orders by wireless to the firing parties to arm the various charges.

Time

Two demonstrations a day were given. One and a quarter hours was available for resetting the stage for the second demonstration. This meant that most of the simulation had to be duplicated and pre-laid, time only being available for connecting up. The greatest amount of pre-assembly of initiation sets and devices was carried out. This was of absolute necessity, otherwise the second demonstration could not have been mounted in the time available.

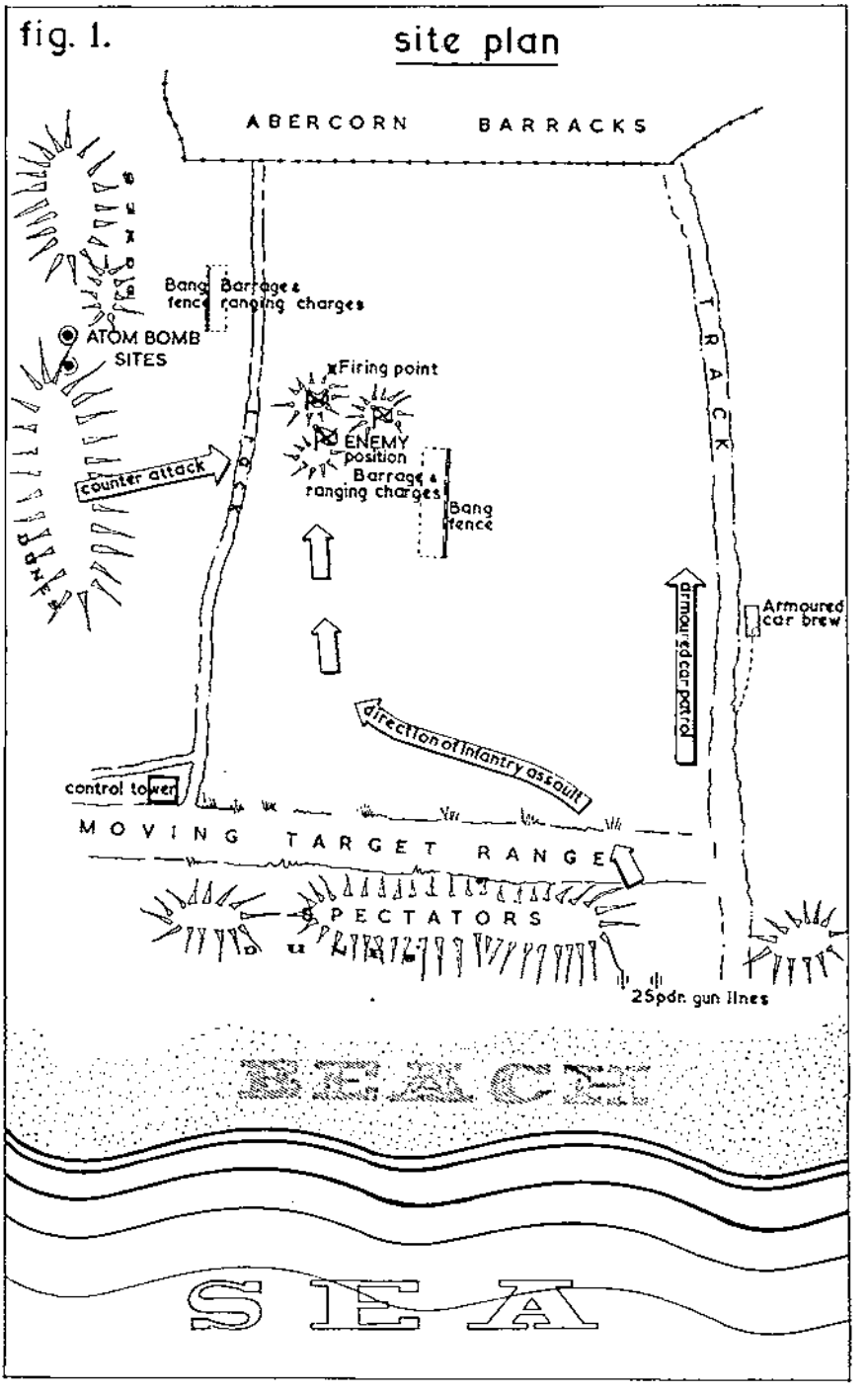


fig. 1.
site plan
ABERCORN BARRACKS
Bang Barrage & fence ranging charges
ATOM BOMB SITES
Firing point
ENEMY position
Barrage & ranging charges
Bang fence
counter attack
TRACK
armoured car patrol
Armoured car brew
direction of infantry assault
control tower
MOVING TARGET RANGE
SPECTATORS
25pdr. gun lines
BEACH
SEA

In addition early rehearsals put the Troop at full stretch before the main framework of the charges and effects were fully prepared and perfected. It was necessary to work up effects gradually, even at the expense of some shortcomings in the early rehearsals. Further complications were caused by re-siting "bang" areas to give additional realism.

Manpower

The number of hands available to prepare explosives was limited to the Permanent Staff and a very few TA Sappers. There was simply no time to train anyone not familiar with explosives, and no chances could be taken with the inexperienced. A small team of TA NCOs and Sappers became practised very quickly, and were assisted by a senior NCO of the KRRC who specialized in close combat charges.

Overall Control

The proximity of the charges for the barrage to the enemy positions dictated that the firing party be included with the enemy. For convenience as many of the other charges were fired from the same point. The Troop Commander was located in the Control Tower. At the appropriate place in the commentary he gave fire orders by means of pre-arranged code words by wireless. His task was made much easier by the expert "ad libbing" of the commentator who covered up the inevitable "blind" with considerable aplomb.

Details of Special Effects

ARMOURED CAR BREW-UP

(*a*) *Requirement.* During the initial engagement an Armoured Car was required to be hit and brewed up. This was achieved by placing a ½-lb charge hidden between the spectators and the car, with a brew on the far side of the car to simulate a fire. Topography dictated that both devices be self-initiating, due to lack of manpower to fire the charges. An outline of the device used is shown in Fig 2.

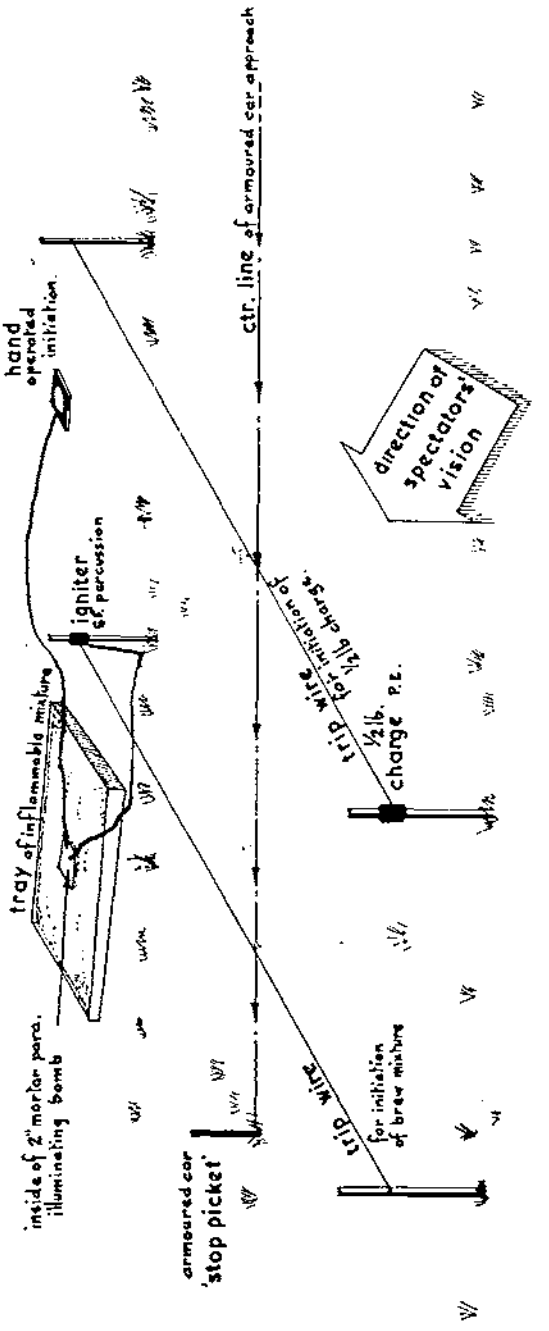
(*b*) *General Outline.* Two trip wires were set up between pickets placed in the path of the car. The car tripped the first, which initiated the ½-lb charge and then went on to the second which initiated a tray of inflammable mixture; the car then stopped at a predetermined spot so sited as to give a realistic brew.

The centre line and stop point of the car's run were determined by trial and error, and marked by tape and picket.

(*c*) *Flame Mixture.* Normally flame-thrower fuel (FTF) gives an ideal flame of good intensity and duration. This was not available so a mixture was improvised. Into a metal tray 5 ft by 2 ft 6 in was placed a 2–2–1 mixture of petrol, diesel and kerosene, to provide the flame, old sump oil and a cut rubber tyre to form the black smoke, and a sprinkling of cordite to give an initial flash. To ignite all this a length of fuse instantaneous led from the trip mechanism to the inside of a 2-inch mortar parachute illuminating bomb. In case of failure, a separate hand-operated mechanism was laid for operation by the car crew, when they "bailed out."

(*d*) *Results.* After early disappointments, it was found necessary to add the petrol just before arming, otherwise evaporation left the mixture too weak

fig. 2. armoured car brew



to ignite. The combination of the charge followed by the flash was most realistic, particularly with the crew members bailing out against a background of flame. The duration of the blaze was about twenty minutes.

THE ATOM BOMB

(*a*) *Development.* No initial planning for a bomb was carried out as it was expected that the School of Infantry would provide. When this was cancelled reliance was made on an Atomic Simulator used for training. On the first rehearsal this proved to be no more than an overgrown firework and, in the words of the CO, "absolutely useless". Something had to be done pretty quickly and advice was obtained which suggested that a reasonable answer could be obtained from a buried 44-gallon drum of petrol with a charge underneath. At the next rehearsal time and availability of material precluded a full bomb, but a mixture was tried with a 5-gallon drum and 4-lb charge. The result was not good and the Brigadier expressed his displeasure. However, sufficient know how had been acquired to produce an acceptable atomic for the Press Rehearsal the next day.

(*b*) *Composition.* A 44-gallon drum was buried on top of a 20 lb PE charge and the whole repacked lightly with earth. The drum contained a total of about 27 gallons of petrol, diesel, paraffin and old oil. Suspended in the mixture was the inside of a 2-in mortar parachute illuminating bomb. At a radius of several yards were four phosphorus grenades on a separate circuit.

(*c*) *Initiation.* Dual electrical circuits led to dual initiation cordtex leads to the various charges. Early experiments failed to obtain full vaporization of the fuel mixture, the result being too much black smoke and no fire ball. This was overcome by putting a SHORTER initiation lead to the initiating flare, then to the lifting charge under the drum. Consequently the fuel was already alight before being blown into the air, and a realistic fire-ball was obtained. This early initiation of the fuel was the main characteristic of this home-made bomb and undoubtedly was the chief reason behind its success.

(*d*) *Result.* A first-class "small" bomb was the result. A good bang with a large fire ball, an ensuing "mushroom" simulated most of the characteristics of the real thing. The trajectory of the phosphorus grenades produced local fall out and heath fires which all added to the spectacle. In order to produce two bombs in succession it was necessary to choose a duplicate site outside sympathetic detonation range, and also of the fires. It was discovered later that the use of phosphorus grenades to simulate fall out was forbidden, for reasons that now seem obvious. Equally obvious, however, was their spectacular effect at the time!

ARTILLERY BARRAGE

(*a*) *Development.* From the initial requirement of a Troop "stonk" of one minute's duration, the maximum barrage dependent on stocks and safety was later required. The initiation system was that described in Appx "N" Pamphlet No 3 Demolitions, Pt II. Due to the two daily demonstrations being run in quick succession, it was necessary to lay duplicate charges and merely reconnect during the interval. As some 400 charges were used for the barrage alone during two days, all the initiation sets were made up previously and a small drill was devised for this.

(*b*) *Circuits.* Four ripples each of twenty-five charges were used on each demonstration. To give the necessary interval between charges, ignitors safety

fuse electric ignited varying lengths of safety fuse which led to ½ lb charges of PE 3a. The length of safety fuse was carefully graduated from virtually nil to six inches. Demolition cable was used, with leads from a home-made ripple box with a common earth return. Initiation was by a dynamo condenser with a wandering lead for switching to terminals as required.

(*c*) *Results.* The result was a well simulated barrage which did much to enhance the spectacle of demonstration. PE 3a produced a good flash and puff of smoke easily visible to the spectators, and the impression of close artillery support came over clearly. In addition, ranging shots were fired in conjunction with the guns and commentary. Careful sighting of the charges and the timing of gun and charge produced a result which was technically accurate.

AIRCRAFT STRIKE

Included in the demonstration were two strikes by two Hunter fighters. Charges were fired as each aircraft approached the target. Neither the aircraft themselves nor information on their intentions had been available until the Press rehearsal, probably because the aircraft were based in England. A ground Liaison Officer with a mobile set appeared within ear-shot of the Control Tower. At the first rehearsal the aircraft carried out more strikes than there were charges laid, but their attack plan was subsequently tied up. However, the LO was thereafter otherwise engaged and left only an operator. Somehow it devolved on the Sapper Troop Commander to call in the aircraft when required. The NCO on the firing point let off the charge on sight. As the Troop Commander had little idea of the actual position of the aircraft or experience of their capabilities, the talk-down in relation to the commentary was a little haphazard and the ingenuity of the commentator to cover up was stretched to the limit. He never actually said that the aircraft were over the Isle of Man, but he must have thought it, judging by the time it took to bring them in. In fact the split-second timing of the charges in relation to the aircrafts' strike was most realistic.

CONTROL

Noise and smoke made it virtually impossible for the Firing Party to hear or see what was going on in the demonstration, and they relied almost on orders from the Troop Commander in the Control Tower. Good communications were vital. A simulation net based on eighty-eight sets was used over which prearranged code words were passed for the arming and firing of the various charges. This was duplicated by line to the main firing point, using two separate cables. In addition, if all were to fail, as it nearly did on one occasion, a system of flag signals for the more important effects was available as a reserve. The hoisting of a coloured flag was picked up by a Sapper with binoculars, disguised as an enemy. He passed the information on verbally to the Firing Point Commander. In fact the system was never used, but it was certainly practised.

OTHER FACTORS

(*a*) *Security.* Due to the Internal Security situation in Northern Ireland, a very careful watch had to be made on all explosives drawn, and a system of guards was essential, as was a physical check of all items used.

(*b*) *Fire.* Certain effects, especially the atom bomb, set off first-rate fires in their vicinity. These caused a certain amount of worry in case they spread

to areas where duplicate charges were already laid for the next demonstration. Fire beaters were available at the known danger spots but their control from the safety point of view had to be carefully supervised. A Sapper representative was attached to each main party to advise where it was safe to carry out beating operations.

Conclusion

Undoubtedly the simulation effects did much to enhance the demonstration. The effects were designed to supplement the infantry attack, and nothing was inserted purely for spectacle value alone. The public turned up in force, and a total of 15,000 spectators watched the demonstration.

A number of conflicting requirements had to be resolved, especially between those of realism and safety. When the public is present safety considerations must be overriding. Once these are met, the resources and scope open to the Sappers are very wide. The next requirement is to give the Infantry what they want, without stealing the show altogether.

Arras 1917

(Into battle with a horsed Field Company RE forty years ago)

By Brigadier J. A. C. Pennycuick, DSO

"The capture of Monchy-le-Preux was one of the outstanding feats of the whole battle . . ." So says the precise language of the *Official History of the War*, referring to one of those confused, murderous trench offensives of World War I. A battle which surged from Arras to Monchy; with the individual counting for nothing and a unit for very little.

What did the horsed Field Companies do in such a conflict? Their work may have been shrugged off as pioneer stuff, but they upheld the honour and prestige of the Corps, so here are some still vivid recollections of what one of the Companies found itself doing in those April days forty-three years ago.

I was given command of the 154 Field Company, in 37 Division in March 1917. The Division was commanded by a Sapper: H. B. Williams, his GSO1 was John Dill, famous as a Field Marshal in World War II, the CRE was Pollard-Lowsley.

Pollard-Lowsley came from India, where he had been attached to the PWD, but like so many good Sappers, he managed to get home and over to France. When the war ended he went quietly back to India to be boss of the PWD Central Provinces, he was a first-rate engineer.

In March 1917 37 Division was in a rest area, out of the line, being fattened up for the coming offensive on either side of the River Scarpe; Arras-Vimy ridge.

My Field Company had no Captain, but five Subalterns, none of them regulars, all good officers, two of them, Lewes and Carruthers, outstandingly good; these two were both killed later that year.

The NCOs and Sappers and Drivers of the Company were excellent, well up to the high standard of the Corps.

We had permanently attached to us, two officers and 100 infantry, twenty-five from each of the four battalions of the Infantry Brigade to which we were affiliated. These officers and men lived and trained with us. Their presence saved demands for small day to day working parties, it was a very sound arrangement.

For transport we relied on riding horses and mules, all the draught animals being mules. It was my first experience of an entirely mule outfit, they appeared a little light to pull heavy wagons, but proved to be good willing animals.

One had to get accustomed to their ways and a picket line of mules could provide much entertainment. An animal would, quite suddenly and for no apparent reason, put its ears back, turn round to get into position and then let fly with both heels. Crash! Whack! Into the stomach of its next neighbour.

The next mule would accept this with agonized grunts and groans then, when it was over, cock an ear, turn itself about and give it all back. At first I was horrified, but it was seldom that harm came of these displays of feeling, mules were hardy creatures.

Work in the rest area consisted in the construction of bunks and of all sorts of camp structures, to conform to a stream of drawings, specifications and scales sent out by the CRE. One favoured item, said to be efficacious against lice, was a so-called Russian bath, a steam bath. This was a contraption made out of oil drums and piping. Of course, we built one for ourselves.

On my return to billets, after some tour of inspection, I was surprised to find what seemed to be a large shell hole, where our Russian bath had been. As we were supposed to be in a safe area I made anxious inquiries, but was told that it wasn't a shell hole, our bath had suddenly exploded with extreme violence.

No one had been hurt, though two men had fled through the village naked in alarm. Whether the accident was due to the CRE's drawings not being fool-proof was never settled, but we came in for a good deal of chaff. "The engineer hoist with his own petard."

The April battle planned for the capture of the German trench system in front of Arras which at that time had a depth of about four miles; the final objective being the village of Monchy-le-Preux, which stood on high ground and appeared to be clear of trenches.

On our VI Corps front, immediately south of the River Scarpe, 3, 12 and 15 Divisions were to carry out the initial attack as far as the enemy reserve line, the "brown" line, 37 Division was then to pass through to capture Monchy.

Visits were made to the trenches to see the ground. Staff work was good, the engineer problems of the coming battle were certainly tackled in great detail.

An extraordinary series of caves existed in the chalk under Arras, their origin was obscure, but, for the most part they were artificial. They were enlarged and extended to provide an elaborate mined approach system 30 to 40 ft underground, from behind Arras station forward to below the front line trenches.

There were complete underground HQ and great galleries for the assembly of assault troops, lit by electric light. There was even a light railway underground.

Mined approaches, just below the surface of the ground, ready to be opened up into trenches after zero hour, were also taken across no-man's-land.

Camouflaged dumps of engineer stores of all kinds were established and preparations made to repair roads, to construct tracks and bridges in the enemy trench system, to build a pipe line and form water points and so on.

The individual task planned for my Company was the construction of four strong points just behind Monchy and arrangements were made for the delivery of revetting materials to us at Monchy.

As I had commanded a Field Company in the Somme battle the year before and had had experience of the confusion that accompanied these terrible trench battles, I was a bit sceptical about this part of the plan; but the care and thoroughness with which the operation was worked out was impressive. Morale was high, there was an expectation of success which might even lead to great results.

The artillery plan was equally thorough, there were guns everywhere. To give a sample of the scale of the bombardments of those days; near the village of Blangy, in the German line, there was a feature, believed to harbour machine guns—it showed up in air photos as a rectangle of about fifty yards by seventy yards. In the attack plan, over and above the very thorough barrage and searching fire, this small area was allotted a special, private hate of ninety 9.2-in shells just before zero. The 9.2 being that formidable howitzer, whose stone effigy now forms the central theme of the Artillery War Memorial at Hyde Park Corner.

Our battle was due to start on 9 April and on the day before we moved to a dry billet in an empty factory west of Arras. The weather, which had been good, unfortunately broke giving us rain and then snow, on the eve of the offensive.

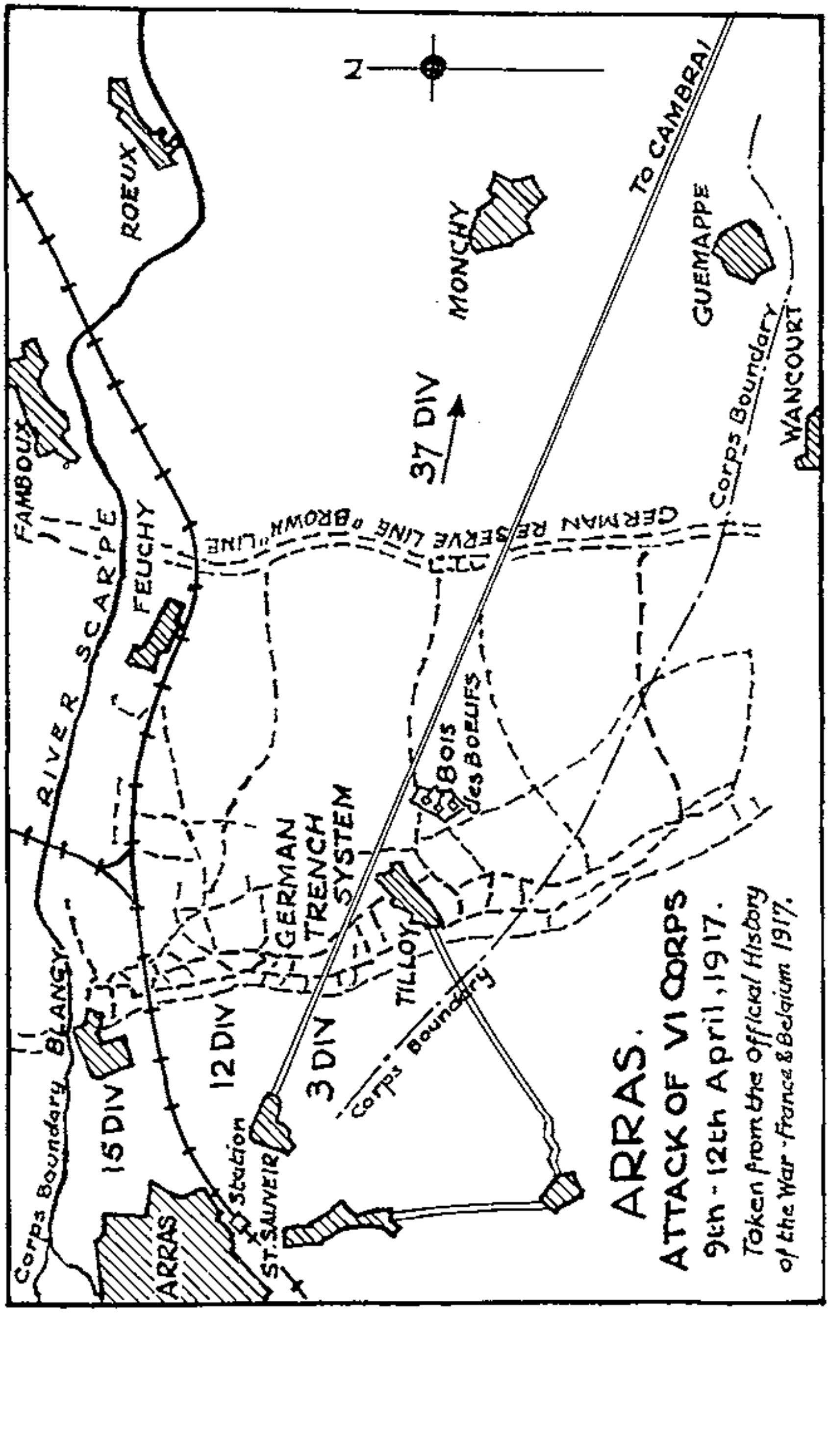
Arras itself, although so close behind the line, had not been badly knocked about, not like Ypres for example. There was indeed a restaurant by the station, whose proprietor boasted that he had never closed his doors. Because of our transport, however, we knew that we could not go into the mined galleries but would have to walk right through the town and the German barrage on the first morning of the battle, a forbidding prospect.

Units were very carefully routed to a rigid time table, having to pass specified check points at given times. Our Company marched spread out with a distance of 30 yds. between Sections.

Shelling was heavy, but we were lucky with our timings, though there were some near misses. On the east side of Arras we had to turn to our right along a lateral road running parallel to the railway, then turn left again at the station and go forward across the railway and out on to the main road leading to Cambrai.

As I reached the lateral road a large German shell, an 8 or 11 inch crump, burst on my immediate left. I turned away from it to my right at the corner and then heard the German battery fire and the other three shells of the salvo coming.

It was a most unpleasant moment. If that first shell had come from the right hand gun—we were all walking plumb in the target. The Company was well spread out so there was just nothing to be done about it, we could hear those three shells coming, like the noise of a train in the sky, for about fifteen seconds. It gave a long, long time for reflection. Fortunately the first shell was from the left hand gun, the remainder of the salvo fell behind us.



ARRAS.
ATTACK OF VI CORPS
9th - 12th April, 1917.
Taken from the Official History of the War · France & Belgium 1917.

Scale approx 1 inch to 1 mile

I turned in the saddle and looked back as they burst and could see the men coming along quite unconcernedly and the mules' heads nodding rhythmically as they walked, it was, somehow, very comforting and reassuring.

The salvo had a curious after-effect. The railway ran in a shallow cutting behind us, crossed by an iron footbridge, underneath which there was an ammunition dump. One of the shells must have set off this dump because, after a momentary pause, there was a thunderous explosion; then a great piece of the footbridge came sailing slowly overhead, turning over end for end and making an extraordinary humming noise. It fell in the road in front of us and caused a short halt, while No 1 Section removed it.

When we got clear of Arras station we seemed to leave much of the shelling behind us, a good sign indicating that the battle was going well. Our allotted route took us off the main Cambrai road and along a marked track across what had been our front line trench, through no-man's-land, then over the German front line. Trenches had been filled in at crossing places.

At a marked assembly area, which the Company reached in good order, we expected to receive news of the battle and instructions; but there was no sign of anyone being interested in our doings.

A fortunate contact with Divisional Signals produced a confused jumble of information. Our affiliated Brigade, the 111 Infantry Brigade, were lost (it transpired later that they had somehow got sandwiched into 12 Division). The leading Divisions, after initial success, had not reached their final objectives—the brown line. Our Division was not, therefore, engaged.

We got an order to wait. Our bivouac sheets were on our wagons, there was a water point functioning close to us, we stayed in the assembly area for the night.

The next morning there were still no orders so I determined to leave our transport parked and to set out with the Company to find 111 Brigade. We took with us the limbered tool carts, as they had a good cross country performance, two pack mules for each Section and a couple of wagons loaded with trench bridges. These bridges could span a gap of 9 ft and two, side by side, carried a vehicle.

The bridges were an awkward load, and they were soon expended, then the going became difficult so loads were readjusted. The pack mules were loaded with cutting tools, shovels and picks were issued to the men to carry, all wheels were left behind.

We now had a stimulating march, threading our way slowly for over two miles through the enemy trench system. Mopping up parties were at work and groups of prisoners kept passing. Our progress took us by many well camouflaged batteries, with guns and instruments still in position.

Presently we approached the German reserve trench—the brown line—that had been the set objective of the leading Divisions. This was on the forward slope of the feature leading to Monchy-le-Preux, the village itself being, as it were, hull down on the horizon.

The German trench was a formidable work strengthened with concrete pill-boxes at regular intervals, we approached it with caution, but reconnaissance revealed that it was not occupied by the enemy. When we reached it we found, at last, our lost 111 Brigade HQ just establishing themselves in one of the larger pill-boxes. They were pleased to see us, but had forgotten about us.

We now heard that an attempt to capture Monchy had failed where the Brigade itself had apparently taken a "bloody nose". The exact position of the front line troops was uncertain, no work was yet possible at the place where we were due to construct our strong points, another attack was pending.

In the meantime the Company was ordered to man the German trench in case of counter-attack, so we set to work to convert the parados into a parapet, to improvise fire steps and fire recesses in the back of the trench.

While this work was going on an unusual and dramatic episode occurred; a complete Cavalry Brigade[1] rode up to the brown line trench, headed by the Brigadier with a mounted orderly carrying a blue pennant on his lance.

The Brigadier, Bulkeley Johnson, a tall confident soldier, got off his horse and I showed him the Infantry Brigade pill-box and took advantage of the opportunity to follow him into it to listen in.

He said that as our troops were so nearly through the German trenches and wire, there seemed to be an opportunity for his Brigade to get through past Monchy and behind the enemy.

What a prospect that offered! Such a manœuvre, at that moment, might well have caused the collapse of much of the German defensive system south of the Scarpe.

He was not given much encouragement, but some sort of co-operation was fixed up between the two Brigadiers. The Cavalry then rode away up the white slopes before us in two columns, with their machine guns still on the pack saddles, to seize their chance, their fleeting chance. The right column in the direction of Wancourt and Gemappe, the left column straight forward to the right of Monchy.

I watched through my glasses, but snow flurries made it difficult to see what was happening. The German defence was, however, still solid; after a little while horsemen came cantering back with many loose riderless horses among them—the Brigadier was killed.

Bulkeley Johnson is but a name in the long casualty list, but it was a near thing, a chance bravely taken. We cannot always score a goal from a try.

There were more attempts by the Cavalry to find a gap to go through, but, by the next day, any opportunity of such a break had passed, enemy artillery fire quickly became too formidable.

As the daylight began to fade I received permission from our Infantry Brigade to go forward to try to commence work on our projected strong points, or to find something else to do if that should prove to be impracticable. Revetting material, provided for in the original plan, had not, of course, materialized.

One Section, with its twenty-five attached infantry, was left in reserve, to make crossings over the German trench and to improve the track up which we had come. Our eight pack mules, which had been provided with nose bag feeds and watered from a shell hole, were left with this Section. The rest of us, a total working strength of nearly 200, then set out towards Monchy.

As we came to the brow of the slope leading to the village, we found that the light was still too strong for so large a party and came under bursts of long range enemy machine gun fire, which forced us to take cover in a German trench. The men were left in this trench and I went on with Lewes, Carruthers and our orderlies.

[1] 8 Cavalry Brigade.

It is difficult to give an impression of the desolation of a battlefield, isolated buildings and all landmarks had been obliterated by shell fire, snow made an even blanket over everything, it was painfully easy to get lost in the gathering darkness.

We walked forward counting our paces, then our immediate problem was solved by an encounter with a couple of signallers mending a telephone line. By picking up this wire and letting it run through our hands we were led to the front line battalion HQ, established in a deep, muddy shell hole. This was close under the outer ruins of Monchy, from which place German MGs made a quite deafening noise as they traversed across the front. The ruins were, however, perched well above us and these MGs were firing high.

The CO of the battalion didn't seem to be clear as to where his forward piquets were, so we set out quietly, with him, to find out. Some men were well forward, others behind battalion HQ. Units were very mixed up, there were groups of men, not only from other battalions, but from another Division, 12 Division, mixed together in little parties, spread out along the ground, just where the tide of battle had washed them up against the outskirts of the village.

During this reconnaissance we were startled by a sudden clamour coming from the darkness and the snow, somewhere near our boots, with the sound of deep bass voices murmuring in chorus:

"Pardon, oh pardon—Kamerad!"

"Mercy, oh mercy—Kamerad!"

Lewes had distinguished himself by falling into a shell crater occupied by four Germans! The delighted Sapper orderlies, looking very fierce with their fixed bayonets, quickly had them out of it. They proved to be members of a small enemy ration party who had lost their bearings and, unlike the tough machine-gunners, they were only too pleased to surrender.

As a result of our investigations I could not think of any useful Sapper work to do in the front line piquets. Yet to site and dig, in the darkness, strong points which might never be occupied, made little appeal. The impending attack on Monchy created a strong sense of urgency—to do something for the tired infantry.

On our return to the battalion HQ shell hole the CO was persuaded to outline his plan. He said that he must have adequate artillery support and to get this he would have to withdraw his forward posts to straighten his line; simple and sensible reasoning.

I said that I would bring up our Company and be responsible for digging a front line assembly trench for him. It was agreed that his withdrawal should not commence before 11 pm to allow our trench to get well started. He would tell his men to go back until they found the Sappers digging and there to stop. The movement to be completed by midnight.

There was nothing much to go wrong with this, I took our small Sapper party back about 150 yards along the telephone wire, chose the place where the trench would cross it and sent the Subalterns off to bring up the Company.

My orderly and I sat down to wait in a shell hole whereupon he at once produced from his pockets samples of the German rations looted from Lewes's prisoners. He offered: a lump of sour smelling black bread, small hard biscuits and a tin of meat paste.

After some hesitation I accepted a biscuit, smeared it with meat paste and ate it. The taste was horrible.

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It was not until daylight the next morning that the alleged meat paste was identified as being dubbin, being brought up for the machine-gunners' wet boots!

When the Company came up they were put out very quickly, on a compass bearing, to dig a long line of rifle pits, that is to say a trench with traverses left out. It was wonderful to see how speedily the men disappeared, like moles, into the ground. By the time the Infantry came trickling back there was a lot to show them, they were quite delighted to find good cover being dug for them.

The Subalterns were told to work on until 2 am and then to disengage. They were instructed to take their Sections to the transport assembly area, rather a long way back, but the men would be sure of a hot meal and of dry bivouac shelters.

I went myself to report to Brigade HQ though I was not too sure of my reception as I did not then know the brigade staff very well. "Ground" was such a fetish at that stage of the war, that a withdrawal of even a couple of hundred yards could cause consternation. The Brigadier (Compton) and his Brigade Major (Paris)[1] were, however, old hands and all was well.

They had with them a gunner Colonel, distractedly working out fuses and ranges for a "saw-tooth" barrage, on very inexact information of the position of the front piquets. I was able to put our trench accurately on to his map and he gave a whoop of relief, flinging away his complicated tables to substitute for them a straightforward rolling barrage.

I also learnt, with a good deal of satisfaction, that our reserve Section, left behind in the brown line trench, had shown commendable initiative, helping to bring forward bogged guns.

In the early hours of the morning Monchy was successfully captured, with the help of effective artillery support and remarkably few casualties. The next night 37 Division, having taken its objectives, was relieved.

To sum up: Inevitably we had spent time waiting about; but we had had few casualties. Our night's work, well forward, had cost us two killed and four wounded, with in addition, among the transport, two Drivers and two animals wounded—less than on many a night of routine work.

The battle had produced no spectacular break-through, no one, as an individual, had much to show for his exertions. All ranks could feel, however, that, as a RE company, they had made a small but positive contribution to the success of the Divisional offensive.

Pioneer stuff perhaps, but so much of it was what was required of us in the grinding battles of those days.

[1] Paris commanded an Infantry Brigade in Singapore, in World War II and there lost his life.

Anneliese's Adventure

By Major C. A. A. Crouch, RE

We said good-bye to her on the front at Limassol leaving her, looking rather forlorn, with the agent, while we went on to the docks to come home by trooper.

Anneliese was due to follow the next day, on the *Bosphorus,* belonging to Nor-Med Lines. We had selected the *Bosphorus* so that we should arrive in England a few days ahead, as we planned to collect *Anneliese* from the docks in England; we had been told that this was quite impossible, that one had to use agents, but we had been so appalled by stories of the bills the agents submitted that we were determined to have a shot ourselves. And the *Bosphorus* was a London ship, which suited us.

Anneliese was a big girl now, over 7 years old. She had had a three-year spell in Germany first (as 980 PBZ), and had been re-christened SLH 98 (not "Slush", if you please) on being imported tax-free into England. Now she was AP 252, and slightly sunburnt. I still had her English registration book, and sent this on ahead, with the usual kit, to get her re-licensed.

When we got to London, we rang up Nor-Med Lines, to hear that the *Bosphorus* wasn't having quite such a quick passage as we had been led to believe, and had we got the manifests? We hadn't? Perhaps we would ring again when we had.

This damped our ardour a trifle, but the new licence had arrived, to compensate. And a few days later the manifests arrived from Cyprus; they referred to *Anneliese* as "old, travel-stained"—what cheek! This time I decided on a personal call. It was really very easy. My papers were checked, I signed the manifest in the presence of the Nor-Med rep, and he added a hieroglyph. He affected surprise that we should actually want to collect the car ourselves, but couldn't really think of any particular reason why it should be impossible; he gave the impression that we were breaking new and dangerous ground, but he wished us luck, and implied that we would need it. If we rang up again next week he would tell us when the car would be ready, and he'd be glad to hear how we got on.

Slightly nervous now, I re-checked my papers. U.K. and Cyprus registration books, licence, certificate of insurance, manifest, and a bit of my old carnet. We had driven out to Cyprus on a carnet, and I had since cancelled it. But there was one page, referring to re-importing, that I had retained. All this bumph looked pretty imposing, but I thought I would check with the AA.

We went to Fanum House, in Coventry Street. There several young gentlemen worked out how much purchase tax I would have to pay, and offered me a variety of hand-outs. When I could get a word in edgeways, I was told that the AA didn't deal with *unaccompanied* cars, but they could

put me in touch with the agents who did; they had never heard of anyone actually trying to do it themselves. We emerged more shaken than ever. Poor *Anneliese*—would we ever see her again? And we were so looking forward to our motoring holiday in Cornwall, before the winter set in.

In due course, we were told that H-hour would be at 1430 on the following Monday, RV Canary Wharf, West India Docks. At last the great day dawned —only just, through a heavy drizzle. We set off, after an early and anxious lunch, laden with a can of petrol, some oil, a screw-driver, a pair of pliers, some rags, and the precious bumph. We emerged into the light of day [*sic*] at Aldgate tube station. Here we caught a bus. When we reached the nearest point to the West India Docks the conductor, all the passengers, and even the driver, gave us directions—we couldn't miss it. For once they were right. Less than a quarter of a mile along, past a succession of Chinese restaurants with exotic names like "The Best Chinese Restaurant—Lunch 2/6", we came to the entrance to the docks. A policeman on duty directed us, correctly, to Canary Wharf, and there was the *Bosphorus*, busily discharging. Morale was high again.

We were a little early so we walked round the warehouse, and even dared to look inside. No sign of *Anneliese*! The stevedores were intent on their duties, and we didn't quite know what to do next. However, we summoned up courage to ask a man wearing a dust-coat, and looking like a greengrocer, if he could help, and mentioned the name of the Nor-Med agent for Canary Wharf (we had been given this name on the telephone). The greengrocer took us in tow, and, after an abortive reconnaissance inside the warehouse (still no sign of *Anneliese*), led us away to a wooden hut labelled "Fruit Lines Limited".

Inside this hot-house we found the agent. After some formalities, including the surrendering of the bumph, he confirmed that *Anneliese* had arrived, and had been unloaded. He took us back to the warehouse, collected a Customs and Excise man, and led us round an enormous pile of barrels—and there she was! But what a state she was in! She certainly looked old and travel-stained now, and I wondered what scars the thick coat of dust concealed. Something awful had happened to one head-lamp, which hung down like an eye-ball gouged from its socket, giving her an unattractive, dissolute look. Poor *Anneliese*. But we were delighted to see her.

While the Customs man ferreted about, trying to find the engine and chassis numbers, a helpful spectator rendered first-aid to the head-lamp, and I discovered that the battery was as flat as a pancake. It had not been disconnected. The tyres were on the flat side, too. However, this sorry inventory was interrupted by the good news that *Anneliese* had passed Customs. It was now necessary to move her outside the warehouse.

Not so easy. First the mountain of barrels had to be moved, then we had to push her through an open door in the middle distance. Fortunately, everyone was very helpful, and we got her outside in under twenty minutes. Then back to Fruit Lines Limited, for more steam-heating and paper-work. There was a nasty moment over the manifest—a technicality I didn't understand; it seemed that it should be signed after the car had been cleared by Customs, and I had visions of trapesing back to the City to the Nor-Med offices again; but a telephone call solved the problem, though I was left in no doubt that the whole thing was highly unethical. Finally, and after the most tremendous calculations, I was presented with a bill for wharfage charges, at the rate of

28 shillings per ton, for a car weighing 971 kilograms, plus a 54½ per cent overcharge ("in accordance with the cost of living index"). They made it £2 1*s* 2*d*.

After paying it, I was given a piece of paper which I was told I could exchange in the warehouse for a clearance to get *Anneliese* out of the docks. Thankfully I left the hot-house for the icy warehouse, found the office I wanted, and waited hopefully. I was invited to "sign here"—a document certifying that *Anneliese* was in lickety-split order, and hadn't suffered so much as a scratch during her voyage. I was rather loath to do this, but there didn't seem much option; if I didn't, I couldn't take the car. We had waited a fortnight already, and I didn't see, short of washing her down and having a full-scale inspection, how I could satisfy myself that there was no damage. And what if I did? Besides, I was feeling rather limp after my quick changes from temperatures of 100°C to freezing point, and it was clear that at least one of us had had enough. I signed. In return, I was given a slip authorizing me to take AP 252 out of the docks.

This was a snag. The new licence was made out for SLH 89, and the number plates (which had travelled in the boot) were in the process of being put on instead of the old AP 252 ones.

I rushed across to cancel that order, and diverted our energies to pumping up the tyres. This was a combined effort, as the connexion from the foot-pump kept blowing off, for some reason. The stevedores were openly interested in this operation, and offered much advice.

About this time we noticed a curious fact. Not only had unloading stopped on the *Bosphorus*, but the cargoes which had been unloaded were now being craned back on board. The ship had been declared black, and could not be discharged in England. Panic! We couldn't bear the thought of losing *Anneliese*—so near and yet so far! We abandoned the tyres, tipped in the petrol (she was almost empty), and tried feverishly to start her up. I cranked and cranked. Not a peep. And the attitude of the stevedores now seemed ominous.

In fact it wasn't. Although of course they couldn't permit themselves to stoop to anything so like manual labour as to push, an electric trolley was diverted from some other task, and, with its bow wrapped in sacking, nuzzled *Anneliese* gently in the rear. It didn't seem quite proper, but it did the trick. With the engine racing like mad, we took off.

The last hazard was the policeman at the gate. Would he notice that the licence was made out for SLH 89, while the release-note was for AP 252? He didn't. But he did notice a cardboard container on the rear seat. I then had to explain, ignominiously and at some length, above the roar of the racing engine, that when we were marched out of our house in Limassol some of the china had failed to "ring", though there was, to us, no visible sign of damage, and we had been too mean to leave them behind. A brown tea-pot, two pudding basins, and three cups were displayed for his inspection.

He clearly thought we were lunatics, and waved us out of the gate.

Memoirs

GENERAL SIR MAURICE GROVE TAYLOR, KCB, CMG, DSO

MAURICE GROVE TAYLOR, Colonel Commandant, RE (Retired), who died on 6 April 1960 aged 79 years, was born on 31 May 1881, the son of Franklin Taylor. He was educated at St Mark's School, Windsor and the Royal Military Academy, Woolwich. He was commissioned into the Corps on 2 May 1900. After completing his Courses at the School of Military Engineering, Chatham he was posted to 22 (Submarine Mining) Company in the Isle of Wight. After a year spent in Gibraltar with 1 (Fortress) Company he returned in November 1906 to 4 (Fortress) Company at Gosport.

His next appointment was Adjutant to the 1 (Lanarkshire) Royal Engineers Volunteers who, on the formation of the Territorial Force in 1908, became the Scottish Command Telegraph Company Royal Engineers (TF). When due for overseas service again in April 1912 he was posted to Malta as Assistant Officer for Telephones, 28 (Fortress) Company. He was promoted Captain on 2 May 1910 and passed into the Staff College, Camberley in January 1914.

On the outbreak of war he was mobilized and sent to France on 7 August 1914 as a Railway Transport Officer. He was invalided home in December of that year and in 1915 he joined the Mediterranean Expeditionary Force and served with 13 Field Company in Gallipoli. On the evacuation of the Peninsula he joined the staff of the engineer stores organization in Egypt and was at one time in charge of all seagoing craft plying between Egyptian ports and those of other countries in the Levant base. In March 1916 he was posted as AQMG I ANZAC Corps and moved with that formation from the Middle East to the Western Front and served with it until being posted in November 1917 as an AQMG at General Headquarters. In February 1918 he was promoted Brigadier-General (Q) which appointment he held until April 1919. For his services in the First World War he was awarded the DSO in June 1916 and made a Brevet Major whilst serving with the ANZAC Corps; he was made a Brevet Lieutenant-Colonel in June 1917 and a Brevet Colonel in June 1919, in that year also he was awarded the CMG. He was seven times mentioned in dispatches.

After the war he became Deputy, and later, Assistant Director of Movements at the War Office and during this appointment he was engaged on the production of the first draft of the *Manual of Movement*. In October 1921 he became Senior Instructor in Administration at the Staff College, Camberley, and when that appointment was abolished in 1924 he was for a year employed at the War Office in the production of the revised *Field Service Regulations, Part I*. He was then for two years employed as AQMG Headquarters Eastern Command and, in December 1927, he was given command of 165 (South Lancashire and Cheshire) Infantry Brigade (TA) at Orford Barracks, Warrington.

He was promoted Major-General in May 1931 and received his CB that year. After a short period on half pay he became General-Officer-Commanding 46 (North Midland) Division (TA) at Derby and after two years in command he was made Major-General i/c Administration, Aldershot Command in

General Sir Maurice Grove Taylor KCB CMG DSO
Colonel Commandant RE

April 1934 and in this appointment his control of the Services which support the fighting units was marked by exercises of outstanding value.

In October 1937 he was promoted Lieutenant-General and made Deputy Master General of the Ordnance under Admiral Brown who had been appointed Director-General of Munitions Production at the War Office when the 1936 Rearmament Programme was initiated. At that time the lack of a properly constituted body of mechanical engineers in the Army to maintain the ever increasing number of motor vehicles in units and complexity of equipment in general use was being keenly felt and there was a school of thought that the Corps, in its customary manner, should father this body. A Committee was set up by the DGMP in June 1938 to consider this controversial problem and from that beginning the Corps of Royal Electrical and Mechanical Engineers eventually took shape in 1941 in time to prove their great value in the critical battles of 1942 and subsequently. For his outstanding services as DMGO Maurice Taylor was made a Knight Commander of the Bath in June 1938 and in July of the same year he became a Colonel Commandant Royal Engineers.

In 1939 he was appointed the Senior Military Adviser to the Ministry of Supply and for the first two crucial years of the Second World War he held this highly responsible and exacting post. On 14 March 1940 he was promoted General and he retired after forty-one years outstanding service on 31 May 1941.

He married in 1906 Winifrid Hilda, widow of John Pratt Anderson and daughter of Samuel J. Thacker. She died in 1955. They had one son.

Maurice Taylor was good at most games and he was a keen and proficient golfer and yachtsman. He was, besides, a talented musician and composer. As a Captain in Malta he composed the score of a musical play produced at the Royal Opera House. The orchestra, which he had trained and which was led by his wife, an accomplished violinist, was conducted by him throughout the run of the play. He combined the rare gifts of military skill and proficiency in the gentle arts usually associated with the first Elizabethan age; as Colonel R. F. A. Butterworth wrote in a moving tribute published in *The Times*: "I think it can be said of him in all sincerity 'et militavi non sine gloria'."

BRIGADIER-GENERAL H. G. JOLY DE LOTBINIERE, DSO

HENRI GUSTAVE JOLY DE LOTBINIERE was born on 10 March 1868, the third son of Sir Henri Joly de Lotbiniere KCMG, who first as Premier of the Quebec Provincial Parliament and later as Lieutenant-Governor of British Columbia, had dedicated much of his life to bringing together those of French and British stock in the Dominion, and reconciling them to becoming as far as possible, one great people. From this background came no doubt de Lotbiniere's life-long desire to serve his fellow men no matter what their race or origin.

As a younger son, he followed the family tradition by entering the Royal Military College, Kingston. He passed out at the Head of his Term, having won the Governor-General's Gold Medal and, like so many of his relatives, elected for a Commission in the Royal Engineers to which he was Gazetted in

Brig Gen HC Joly de Lotbiniere, DSO

June 1888. After the usual YO Courses at Chatham and a brief spell in Gibraltar, he proceeded to India where he served in the Military Works Department until April 1897. Part of this time was spent at Gilgit where he was able to indulge in his love of sport and obtained some very fine heads. Towards the end of the period, he was employed on Famine Relief in the Central Provinces, the kind of work for which his character was so well fitted.

In November 1897 he was appointed Company Officer, No 4 Company, Queens Own Madras Sappers and Miners for the Tirah Campaign but was invalided back to England early in 1898.

After a spell of sick leave in Canada, he returned in October to command a Depot Company at Chatham, and thence to temporary duty at the War Office. In June, 1899, he was promoted Captain.

Major-General Sir Percy Girouard, a fellow Sapper and Canadian, was one of de Lotbiniere's life-long friends. He had at that time made a name for himself as Director of Railways in Lord Kitchener's famous Sudan Campaign.

At the outbreak of the South African War, Girouard was appointed Director of Railways Field Force South Africa, and in November of that year de Lotbiniere accompanied him to South Africa as one of his Staff Officers. In November 1900, he was promoted Brevet Major and in June 1901, he was appointed Deputy Assistant Director of Railways. Later in this capacity he was placed in charge of the Native Refugeee Camps at Johannesburg and after the war was over he served for a time in the Repatriation Department. For his services in the South African War, he was twice mentioned in Dispatches and awarded the DSO.

In March 1903, he returned home on leave, and then followed a brief spell at the War Office.

In November 1903, he was sent on special duty to Somaliland for the Campaign against the Mad Mullah. His task was to bore for water along the L of C. In this he was unsuccessful, as the subsoil of that part of Somaliland is devoid of water, but he found consolation in securing some magnificent heads of Kudu and a good lion. On return to England he had a brief spell at the War Office and was then posted to Works Services in the Midlands.

In December 1906 he was seconded to the Survey Department of the Egyptian Government in Cairo, where he spent six very enjoyable years in a country that had much to offer when under the firm guidance first of Lord Cromer and later of Lord Kitchener. In August 1907 he was promoted Substantive Major.

It was characteristic of de Lotbiniere, that he was always quick to seek the happiness of others. For the better paid British Community there was the Gezireh Sporting Club with every kind of amenity, but for the juniors who could not afford this Club, life was not so pleasant. In conjunction with the late Sir William Wilcox, he founded and organized a modest Sports Club for these "forgotten men" which quickly became an outstanding success.

In 1912, he was posted home to Portsea and then as Division Officer, Upavon where he was responsible for the construction of the original hangars and quarters for the Royal Flying Corps.

At the outbreak of war in 1914 he was appointed to command 80 Field Company which formed part of the 18 (East Anglian) Division, one of the first formations of Kitchener's Army. De Lotbiniere had little experience up to that time of serving with British troops, but by temperament he was

ideally suited to deal with a unit of enthusiastic volunteers, and he soon attracted the favourable attention of General Sir Ivor Maxse, the Divisional Commander, who was famed at that time as being one of the best trainers of troops in the British Army. Whilst at Colchester, during Field Works training, a small mine was set off at the end of a long gallery. Against orders a young NCO entered the gallery and was overcome by fumes. A junior Subaltern, with great gallantry, went in to rescue him and was also overcome. De Lotbiniere hurried to the scene and led a party into the gallery and succeeded in bringing both men to the surface, but too late to save their lives. For this he was awarded the medal of the Royal Humane Society.

The Division proceeded to France in September 1915 and almost as soon as it landed he was appointed its CRE and promoted Lieutenant-Colonel a month later.

The Division fought in the Somme battles with great distinction. He was promoted Brevet Colonel in June 1916. In January 1917 General Maxse was promoted to command the XVIII Corps and took de Lotbiniere with him as his Chief Engineer. This corps was engaged in the Ypres and Somme battles and eventually formed part of the Fifth Army which had to bear the brunt of the German offensive in March 1918. The Corps was renamed the Eighth Corps in July 1918 and took part in the second battle of Arras. In October 1918 he came home after over three years of continuous service in France. After leave, he was posted CRE Cambridge in January 1919. For his services in France he was mentioned in dispatches five times and awarded the Belgian Croix de Guerre.

In May 1921 he retired with the Honorary Rank of Brigadier-General.

De Lotbiniere had married Mildred, daughter of Charles Seymour Grenfell, in 1902 and there were two sons of this ideally happy marriage. Shortly before his wife's death they celebrated their Golden Wedding with many of their family present.

At the end of 1918, he purchased Brandon Hall in Suffolk and there he made his permanent home on retirement. He had inherited a great interest in forestry derived from the family ownership of large areas of forest in their seigneury bordering the St Lawrence. At Brandon he was able to indulge this on a small scale and became a leading authority on the propagation of poplars. He was also a very keen farmer, a Justice of the Peace and a County Councillor. His energies were also devoted, as always, to the service of his fellow men. Some of his land was transformed into recreation grounds for the population of Brandon and he founded a very successful branch of the British Legion there.

September 1939 found him too old for any form of Military Service, so he devoted himself to the development of his farm with a view to producing the greatest possible amount of food. It was a great pleasure to him that the Army took over part of his home as a Brigade headquarters for which he would accept no payment. By a happy chance the first Brigade to move in was part of the Eighteenth Division for which he had a special affection owing to having been its CRE in France in 1915.

At the end of the Second World War he felt very keenly the hardship suffered by the ex-Servicemen who, on demobilization, found no houses in which to make their homes. He attracted the attention of the National Press by a well organized occupation of a deserted Army Camp at Brandon, this being a start of what became known as the "Squatters' Movement." He had

the advantage of having the unofficial aid of the local Garrison Engineer who happened to be a fellow Canadian. At first it was not a popular movement in the eyes of the Local Authority, but eventually they had to give in, take over the camp and administer it themselves.

De Lotbiniere will be greatly mourned by his family for whom he liked to keep open house as far as his circumstances would allow, after the style that his parents had been able to do in the family home in Canada. It was typical of him that his final illness was started by a stroke brought on through weeding his fields in the intense heat of June 1959.

A letter was received on his death by one of the NCOs of his old Eightieth Field Company describing him as his ideal Commanding Officer who "by his example and Christian Way of Life, turned a very undisciplined mob into a really smart and efficient Field Company." That is a tribute to him with which I end this Memoir.

E.J.L.

MAJOR-GENERAL C. G. FULLER, CB, CMG, DSO

Colonel Commandant, RE (retired)

MAJOR-GENERAL CUTHBERT GRAHAM FULLER, our senior Colonel Commandant (retired) who died on 15 March 1960 at the age of 85, had a most distinguished career both with the Corps, on the Staff and in Command.

He was born on 10 October 1874 and educated at St Paul's School and Beaumont College. He entered the Shop in 1891 and he was commissioned into the Corps on 25 July 1893. After his courses at the SME he specialized in Railways. He was attached for duty with the Midland Railway Traffic Department at Derby from 1895–6 before joining 8 Railway Company at Chattenden.

He sailed with this Company for South Africa in July 1899, but on arrival he was transferred to Durban as a Railway Staff Officer. In this appointment he acted as Disembarkation Officer for the bulk of General Buller's Army and the reinforcements from India. He then joined the staff of the Director of Railways before the battle of Colenso, and took part in the advance to Sanderton. He subsequently served under the Director of Railways, Johannesburg, and as Deputy Director of Railways, Lourenço Marques. For his services in the South African War he was awarded the Queen's Medal with five clasps "Tugela Heights", "Relief of Ladysmith", "Langs Nek", "Orange Free State" and "Transvaal" and the King's Medal with two clasps. He was also mentioned in dispatches.

From October 1902 to April 1904 he was Personal Assistant to the General Manager, Central South African Railways, a position of great responsibility for a young Sapper Subaltern.

On promotion to Captain he returned home to command 56 Railway Company at Longmoor. During his time with the Company he spent six months' language leave in Moscow and passed his Russian Interpretership Examination.

Major-General CG Fuller CB CMG DSO Colonel Commandant RE

In 1907 he was appointed Deputy Assistant Director of Railways (QMG3) at the War Office. During his two years in this post he qualified for the Staff College and spent the years 1909 and 1910 at Camberley.

A further five months' language leave in Russia and the command of "A" Depot Company at Chatham filled the years until 1912 when he was appointed GSOIII (MT1) Home Defence. This post entailed working out the detailed plans for the concentration of Territorial Divisions in the South of England and their billeting. During that period the first Billeting Act was passed compelling householders in time of war to billet soldiers on demand. Until then only innkeepers could be compelled to billet troops. In less than two years these plans had to be put into operation in grim earnest.

On the outbreak of war in August 1914 he was appointed GSO2 on the staff of General Sir Ian Hamilton and sailed with him to Tenedos, being present during the Naval Action there in March 1915. He witnessed the landing at Gallipoli in April from HMS *Queen Elizabeth*. In June of that year he was promoted Lieutenant-Colonel and appointed first as AA & QMG and later as GSO1 29 Division. With this formation he saw service at Gully Ravine, Cape Helles, Scimitar Hill, the evacuation of Sulva and the final evacuation of Helles on the night of 8/9 January 1916.

After the withdrawal from Gallipoli the Division was moved to Egypt for the defence of the Suez Canal, but shortly after arriving it was transferred to the Western Front where it took part in the battle of Albert on the Somme in July 1916, the last German cloud gas attack in the Ypres Salient in August and the battle of Transloy Ridges on the Somme in October. After wintering on the Somme the Division was moved to Arras and took part in the first and third battle of the Scarpe in April 1917. It then returned to the Ypres Salient and was engaged in the battle of Langemarck in August, the battle of Brookside and in the battle of Poelcapelle in October 1917. For his services with 29 Division Fuller was awarded the DSO.

On 15 October 1917 he was appointed Brigadier-General General Staff, III Corps, and was almost immediately engaged in the battle of Cambrai and the German counter-offensive in November. III Corps was then transferred farther south to take over the French line from opposite St Quentin to north of the Château de Coucy. In the spring of 1918 a German attack launched against this sector was finally repelled after heavy fighting. In August the Corps was engaged in the battles of Amiens, Albert and Bapaume and the final Advance to Victory. After the Armistice in November 1918 the Corps was moved to Hal near Brussels.

In March 1919 Fuller was appointed Brigadier-General General Staff, VI Corps, then at Cologne, and later in the year as Brigadier-General General Staff, British Army of the Rhine, which post he held until 1923. For his services during and immediately after the war he was awarded, in addition to his DSO won in 1917, the CMG and the Russian Order of Saint Stanislaus with Swords, he was also made a Commander of the French Legion of Honour and a Commander of the Crown of Belgium. He was eight times mentioned in dispatches. He was promoted Brevet Lieutenant-Colonel in January 1916 and a Brevet Colonel in June 1918.

In May 1923 he was appointed to command the 130 (Devon and Cornwall) Territorial Infantry Brigade at Exeter and carried out three training seasons with the Brigade before being posted in September 1925 to Egypt to command the Canal Brigade whose Headquarters was then at Ismailia with a

battalion detached at Alexandria and a company of infantry garrisoning Cyprus. He was awarded the CB while in command of this Brigade.

In July 1928 he was appointed Major-General i/c Administration, Headquarters Eastern Command. His tour of duty here coincided with a period of retrenchment and reduction in Government spending and such projects as the move of the Shop from Woolwich to Sandhurst, and the transfer of the RE Corps Library from the Horse Guards to Chatham, both subsequently carried out, were shelved for lack of funds. Nevertheless Major-General Fuller was instrumental in making a start to provide more Married Quarters for other ranks working in London.

His last appointment was the command of the Territorial 48 (South Midland) Division at Oxford and he retired in June 1935 after forty-two years' service.

In February 1937 he was appointed a Colonel Commandant RE and completed his tenure in October 1944.

On retirement he went to live at Mayfield in Sussex and for three and a half years he served on the Uckfield Rural District Council. In May 1940 he joined the Local Defence Volunteers, later known as the Home Guard, and served as a Major, Second-in-Command of 18 Battalion, Sussex Home Guard, until June 1942 when he had to resign due to age. He also served as the local Army Welfare Officer for the Uckfield-Crowborough District from November 1939 until the end of 1946. In July 1941 he was appointed by the Lord Lieutenant Colonel Commandant of the Army Cadet Forces in Sussex and under his energetic and efficient direction the strength of the Force increased sixfold during his tenure of office. He was also for many years President of the Mayfield Branch of the British Legion.

He was an expert at Winter Sports, being a Silver Medallist at Figure Skating (English style) in 1909 and skiing whenever the chance occurred in Switzerland and the Tyrol until his sixty-fifth year. He was also a good performer on the golf links and tennis court.

On 6 May 1912 he married Princess Sophia, the younger daughter of Prince Vladimir Shahoffsky of Pskov and Moscow. They had two sons and a daughter. The elder son, Lieutenant C. V. Fuller, the Dorset Regiment, died in 1937 shortly after having qualified as a Russian interpreter. The younger son, G. E. Fuller, was commissioned into the Corps and while at Cambridge he obtained his A flying certificate. He died on 18 February 1938 as a result of a skiing accident on the Grindelwald Standard course. He is survived by his widow and daughter and our sympathies go to them in their sad loss.

R.K.A.M. writes: I had the privilege of serving under Major-General Fuller in 29 Division when he was AA & QMG, and later GSO1, both in Gallipoli and on the Somme Front in France. As a staff officer he was ever approachable and kindly, his quiet and unruffled manner inspired confidence, his judgement was sound and his orders and instructions were always clear. Later, as a Field Company Commander, I greatly enjoyed serving under him in peace time in the Canal Brigade in Egypt where his great personal charm made him a most popular Commander.

Fuller came from a family of wide interests and he was himself a man of great intellectual attainments. He was fluent in Russian, German and French. His wife was an ideal hostess and their cosmopolitan interests stood them in

good stead when with the British Army of the Rhine and in the Canal Zone. When commanding 48 (West Midland) Division (TA) at Oxford he often became a link between the University and the War Office in many matters—a task that he relished to the full.

BRIGADIER H. L. WOODHOUSE, CBE, MC

HAROLD LISTER WOODHOUSE, who died on 6 January 1960, was born at Prestwich, near Manchester, on 30 January 1887. Educated at Birkenhead School and at Cheltenham, he entered the Shop in 1904, and was commissioned in the Corps on 25 July 1906. At the SME he won the Haynes Medal.

After a year's mechanical course with Messrs Willans and Robinson, Rugby, he was posted to India in 1909, and spent the whole of his service there, except during the 1914 and 1939 wars. After two years' Military Works service he joined 25 Railway Company, Sappers and Miners; in 1911 he was employed on construction of the Delhi Durbar light railway.

The Company, under his command, took part in the East African campaign from 1914 to 1918, when it was transferred to the Egyptian Expeditionary Force. In East Africa he was employed, with it, on construction of the 90-mile Voi–Moshi metre gauge line. This ran partly through unsurveyed virgin bush, but construction was pushed forward rapidly. At times railhead advanced two or three miles a day, with bush clearing and survey parties only a few miles ahead, guarded by armoured cars. Later he was in charge of repair work on damaged German lines, from Tanga to Moshi and Dar-es-Salaam to Tabora. He was mentioned in dispatches, and awarded the MC in 1917. From 1918 to 1920 he was employed, with 25 Company, on extensions of the Palestine Military Railway, and on the conversion from metre to standard gauge of the Jaffa–Jerusalem line. Those who served with him during this period recall his unfailing cheerfulness, and the respect and trust he inspired in those under his command.

On long leave after the war he took a post-graduate course in railway work at London University, obtaining a diploma in 1922. Returning to India as a Major in 1923, he held a number of appointments on the North Western Railway during the next ten years, first as Executive Engineer, and later becoming Divisional Superintendent. After promotion to Lieut-Colonel in 1930 and to Colonel in 1933 he served as Director of Civil Engineering on the Railway Board. On his return to England in 1939, on leave pending retirement, he was attached to the ARP Technical Branch of the Home Office.

On the outbreak of war in 1939 he was appointed DDGTn with the BEF in France. He was wounded in May 1940, during the evacuation of Boulogne, and after recovery served as ADTn, and later as DDTn, at the War Office, receiving the CBE in 1940. In that year he became a Member of the Institution of Civil Engineers. His services during the war period are well described in the subjoined tribute by the then DTn, Major-General Sir Donald McMullen.

After retirement in 1947 he settled at Woking and took an active interest in local affairs. As well as representing the Woking North Division on the

Brigadier HL Woodhouse CBE MC

Surrey County Council from 1947 onwards, entailing much committee work, he became either Chairman or Member of several local organizations, including two Hospital Management Committees and the Board of Governors of the Gordon Boys' School. He was also Chairman of the Woking Division Conservative Association for some years, and later one of its Vice-Presidents.

Though handicapped by poor health during the last two or three years of his life and much troubled by failing sight, he did not relinquish these activities, and maintained his habitual cheery demeanour to the end. Early in January 1960 he suffered a severe stroke, which led to his death three days later.

In 1921 he married Dorothy Frances, daughter of Professor S. L. Loney, MA (whose textbooks on Statics and Dynamics will probably be remembered by many generations of Sappers). She survives him, together with his only son, Lieutenant-Commander J. S. L. Woodhouse, RNR.

E.W.

A Tribute

In September 1939 Brigadier H. L. Woodhouse joined me as DDGTn BEF at Rennes—shortly afterwards Headquarters moved to the neighbourhood of Arras, Transportation being allocated the little country village of Hauteville.

My main impressions of H.L.W. were his sound reasoning and his innate cheerfulness under even the worst circumstances—he was an inspiration to all of us during the black days of 1940 and his example did much to keep up our morale. Rear HQ were ordered to evacuate the Arras area and move to Boulogne and at the same time the Channel ports of Boulogne, Calais and Dunkirk were to be opened for supplies and reinforcements. By this time we were cut off from our bases in the Biscay area and there was only the DGTn's staff to call on. H.L.W. was allotted to take charge of the port working and Tn Services at Boulogne while Lieutenant-Colonel Pennant went to Calais and Lieutenant-Colonel Jasper to Dunkirk on similar missions.

Boulogne was the first Channel port to come under German attack and when they got field guns to open up directly on the port area it was decided to evacuate those that remained on the destroyer which was to be the last vessel to leave the port—H.L.W. with the Sea Transport Officer were among the last to leave and as they went down the quay to the destroyer a shell burst nearby and H.L.W. was hit. He was taken aboard the destroyer as it moved out of the harbour—he eventually ended up in the hospital which had been set up in Hatfield House—I saw him there and found that his indomitable cheerful spirit had not been diminished by his very painful wound—he was as full of jokes as ever.

During the rest of the war he served in the Transportation Directorate at the War Office where he was in charge of the section dealing with Railway Operation, Workshops and Railway Construction firstly as ADTn and later as Brigadier DDTn (R).

His courage and high morale were again in evidence during the bombing of London and later the V1 flying bomb attack—during his period at the War Office he showed great tact and administrative ability coupled with expert technical knowledge.

I can only close this small tribute by expressing my great gratitude for such a loyal, efficient and cheerful member of my staff.

D.J.McM.

Brigadier D Morris OBE

BRIGADIER D. MORRIS, OBE

DAVID MORRIS, who died on 8 January 1959 after suffering for some fifteen years from severe arthritis, was born on 1 March 1896 the son of Major E. C. Morris the Loyal Regiment (North Lancashire).

He was educated at the Royal Naval College from January 1909 to December 1912, being a contemporary of the late King George VI. He applied for entry into Sandhurst in March 1913 and he was commissioned into the Corps in September 1914. During the 1914-18 War he served first with 1 Army Signal Company and later with 23 Signal Company in France and, on promotion to Captain in November 1917, he was posted to India and remained there until returning for his Supplementary Course at Chatham in February 1920. After his time at Chatham he went on a Railway Course at Longmoor and on its completion came back to Chatham to command C Company Training Battalion RE.

After a short tour of duty in Works appointments at Derby and at Catterick he was promoted Major in December 1929 and posted to India for a five year tour of duty spent as Garrison Engineer Ishapore and as Garrison Engineer at Fort William, Calcutta.

In March 1936 he was posted to Aldershot to command 6 Field Park Company and at the end of that year he took the unit to Palestine and later to Egypt. He returned to Aldershot in June 1937 to command 26 Field Company, being posted on promotion to Lieutenant-Colonel in February 1938 as CRE Northern Ireland District.

In March 1940 he was appointed DD Works, GHQ Middle East, serving under Major-General Sir Eustace Tickell, until September 1942. During this period he was promoted Colonel, and later Brigadier; for his distinguished services in this appointment he was awarded the OBE and mentioned in dispatches. His health, however, failed him and he was constantly in hospital until his retirement on account of disability in November 1945.

In August 1921 he married Nancy, younger daughter of Mr and Mrs Harold Graham of Highfield, Rochester, who survives him.

J.F.M.W. writes: David Morris was a joy and inspiration to all who knew him. His character was as big and as strong as his frame. He loved life, he loved people and bred happiness.

He made everything enjoyable. As a good games player he is remembered more for his chuckles of delight when something strange happened—good or bad. As fly-half for the Corps or for the Army, killing a rackets ball, fluffing a drive—it was all the same, all fun. He was a great reader and would quote freely and aptly. Without being a musician he delighted his friends with his Guest-Night renderings of Gilbert and Sullivan and others. There was no end to his interests, no pettiness in his outlook.

Arthritis struck him in his late forties and he had to change his way of life. He transposed the psalms for his village choir, played correspondence chess, carved, cast and painted medallions, watched and studied cricket—one of the few games in which he had not been very interested. He drew upon every resource, always active, always creative, always entertaining. He suffered great pain but his pluck never deserted him—a great example, a true friend.

He was blessed with a wonderful wife who shared his interests in health and in sickness. She tended him without a thought for herself through all the long years of his illness. Nancy, like David, gave and did not take.

Correspondence

Brigadier-General Sir H. Osborne Mance,
KBE, CB, CMG, DSO.
38 Evelyn Mansions,
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London, SW1.

The Editor,
R.E. Journal.

31 March 1960.

Dear Sir,

With reference to Brigadier R. E. Bagnall-Wild's letter in your March issue, as one who was closely concerned with transport in both the South African War and the First World War, I feel I must contribute my own recollections of the origin of Movements Control.

Certain RE Railway Officers, including the late Sir Percy Girouard, had studied a book entitled: *Les Chemins de Fer pendant la Guerre de* 1870/71 by F. Jacqmin (available in Corps Library), giving a graphic account of the utter chaos on the French railways resulting from military movements in that war. This definitely pointed to the need for an effective system of military control, which was fully organized in the South African War by Colonel Girouard and placed under Lieut-Colonel C. H. Cowie, as Assistant Director of Railways at Cape Town. Railway Sappers were appointed Deputy Assistant Directors of Railways for the different regions, and railway staff officers from various units at all stations of current military importance. There certainly was no movements muddle of the kind suggested.

For the First World War a similar organization had been provided from the start, but was not sent out in the first place as the French had undertaken to provide transport for the British Army. Colonel Henniker, who had been designated Assistant Director of Railways in the mobilization scheme was, however, sent out "to call for the others", whose need was anticipated at the War Office from the first. Colonel Twiss, the Director of Railways Designate, and Colonel Waghorn, the Deputy-General, were meanwhile employed on recruiting additional railway troops and assembling railway construction stores until they were sent for. Thus a Sapper-organized transportation staff was provided for from the first. This organization, increased from time to time to meet military requirements, continued throughout the expanded régime under Sir Eric Geddes, and was only transferred to QMG at the end of the war.

Yours faithfully,

H. O. Mance.

Editor's Note. The Memoirs of Major-General C. G. Fuller and Brigadier H. C. Joly de Lotbiniere, published in this issue of the *Journal*, narrate how these two officers served in Movements in the South African War, and General Sir Maurice Taylor, whose Memoir is also published, was sent straight from the Staff College, Camberley, to a Movements appointment on the outbreak of the 1914–18 War.

Book Reviews

THE VICTORY CAMPAIGN
THE OPERATIONS IN NORTH-WEST EUROPE
1944–1945

By COLONEL C. P. STACEY, OBE, CD, AM, LLD, FRSC

(Published by the Queen's Printer, Ottawa, 1960. Price $4)

The first two volumes of the official history of the Canadian Army in the Second World War have already been reviewed in this journal. The first covered the general activities of the Army throughout the hostilities and the second one described the Canadian part in the Italian Campaign. In this third volume, Colonel Stacey now completes the purely military part of the history with his account of the "Victory Campaign" in NW Europe.

It must have been with mingled satisfaction and relief that he saw the book go to print for it is indeed a *magnum opus*, running, as it does, to over 700 pages of which the index of references takes no less than fifty-six. Such emphasis on research reveals the author's determination to get as near to the elusive truth as is humanly possible. As a result of this, the history is, for the most part, severely objective and it strays but little into the jungles of controversy.

The Canadian Army fought with unrivalled distinction throughout the campaign, particularly so in the Normandy bridgehead, at the opening of the Scheldt and in the battle of the Rhineland. The first and third of these encounters are well known in outline from earlier histories. Even so, the details of the hazards, which were overcome on the beaches, are specially well portrayed, as is the closing of the Falaise gap, where Canadians and Poles became engaged in slaughter at close quarters on a scale seldom experienced in modern war.

The Scheldt affair, however, has been somewhat overlooked and the full account here given is of special interest. It now seems evident that Field-Marshal Montgomery, engrossed in his eager dispute with the Supreme Allied Commander about the command organization and the strategy for the advance across the Rhine, was not his usual infallible self about the situation at Antwerp. Whatever else was in question, the conception of an immediate thrust to the Ruhr with twenty to thirty divisions most certainly required that the remnants of the Fifteenth German Army should not escape through Walcheren and the S. Beveland isthmus to pester the flank of the advance. Immediately after the capture of Antwerp the bolt hole at Woensdrecht might have been stopped. But the chance was missed and nearly 90,000 Germans with 600 guns and 6,000 vehicles got away into Holland. The clearing of the Scheldt was another story and it did not end for over two months after the first triumphant surge of the Twenty-first Army Group into Antwerp. The long delay was not due to any shortcomings of the Canadian Army under Lieut-General Simonds, who when given the necessary resources, conducted the operation with great skill and determination.

The Victory Campaign can fairly be regarded as a mine of factual information, which, for years to come, will provide raw material for commentators and historians about the defeat of Germany in the West. Yet, because of this devotion to facts, the reader feels the absence of some final critical conclusions concerning the Allied conduct of the war as seen by Canada and the Canadians. It may be that the volume yet to come, which will deal with Canadian military policies in the broad sense, will fill the gap. In any event, it cannot fail to be interesting. B.T.W.

HISTORICAL RECORDS OF THE SURVEY OF INDIA: Volume IV 1830–43

By COLONEL R. H. PHILLIMORE, CIE, DSO

(Published by the Survey of India, Dehra Dun UP, India. Price Rs 25 or £1 8s 6d)

The period covered by this volume was very important in the life of the Survey of India. During it the main arc of geodetic triangulation spanning the country from the southern tip of India to the Himalayas was completed, thus forming the backbone of the network which was subsequently extended to cover the whole of India and Burma. During it, too, policies took shape which have profoundly affected survey work in India to the present day.

In 1830 Everest, a Gunner Officer, assumed the appointments of Surveyor General and Superintendent of the Great Trigonometrical Survey of India on return from sick leave in England. During this leave he had spent much time studying the latest developments in geodesy. He at once threw his whole energies and abilities, which were great, into his geodetic work. During the next thirteen years in spite of ill health, incompetent subordinates, difficulties with government and considerable natural obstacles, he pushed on relentlessly; never allowing any departure from the most rigid standards of accuracy. Before he retired in 1843 he had the satisfaction of bringing his work to a successful conclusion in the foothills of the Himalayas near Dehra Dun.

While taking every opportunity to keep the needs of the trigonometrical survey constantly before the eyes of the authorities, Everest seems to have awaited the compulsion of events in his actions as Surveyor General. On his own admission he disliked office work and soon after his appointment we find him complaining to government that "It is impossible for any person however highly gifted to execute a task of this kind whilst his attention is liable to be distracted by office routine duties." We have the extraordinary situation in 1837 when the government appointed a committee to investigate survey and mapping policy without appointing a representative of the Survey Department to it. This committee regretted the absence of the Surveyor General in the field in central India while it was sitting in Calcutta and rightly drew the conclusion that, "Practically speaking the appointment of Surveyor General and that of the Superintendent of any survey is quite incompatible . . ." It seems a measure of Everest's want of appreciation of his responsibilities as Surveyor General that he persuaded the government to appoint his successor to fill the same two posts simultaneously.

The Survey of India will always be indebted to Everest for his work on the primary triangulation of India: but it is still paying the price of not having a Surveyor General during these formative years who could devote his whole time to the problems of future policy, organization and administration of his department.

Colonel Phillimore's method of quoting extensively from contemporary documents throws much light on the characters and behaviour of those involved; and these are illustrated by many entertaining anecdotes. One of the best of these arose from the straying of a female donkey belonging to the Surveyor General's tour office. This wandered into the compound of the local Station Staff Officer who impounded it and only released it on payment of a fine of two annas. This incident snowballed into a row which reached its culmination in a strongly worded letter from Everest to the Commander in Chief in India.

Everest's insistence on being referred to by his full designation even on the most inappropriate occasions may cause some surprise and amusement. On one occasion the Resident of Gwalior wrote a letter to the Durbar at Dholpur in Persian, asking for assistance for Everest in his work. Everest was furious that the letter did not refer to him by his full designation. In reply the Resident very reasonably pointed out that it would have been difficult to translate the designation into Persian and that in English it would have meant nothing to the recipient. Even so Everest does not appear to have been mollified.

Chapters are devoted to revenue and geographical surveys and there are fascinating glimpses of adventurous journeys of exploration through Afghanistan and Central Asia. In the field of revenue surveys there seems to have been a complete want of co-ordination. Things drifted from one expedient to another; and nowhere is the absence of a strong Surveyor General with the leisure to think out and apply a consistent policy throughout the country more evident.

This is not the sort of book to be read straight through from cover to cover; but those interested in survey matters and who enjoy glimpses of life as it was in India over a hundred years ago will find it full of interest and food for thought. Senior survey officers sometimes feel that the old times were better and long to get out of their offices into the field. This book may console them with the thought that even the great Everest could not do so without neglecting his other responsibilities.

The general production of the volume and especially of the coloured plates is excellent and fully up to the standard of its predecessors. G.F.H.

TO APPOMATTOX. NINE APRIL DAYS, 1865

By BURKE DAVIS

(Published in New York and Toronto by Rinehart & Co Inc and by Eyre & Spottiswoode (Publishers) Ltd in London. Price 50s.)

War has provided a universal theme for poetry and prose, and the final stages of victory and defeat always evoke the most poignant scenes. The book under review tells of the last nine days of the Army of North Virginia under General Lee; how it was out-manoeuvred and out-fought at the Battle of Five Forks and how the end came at Appomattox.

The story is told in an unusual way. There is little consecutive narrative, and less comment. It is a form of reporting, which is what one might expect of its author, who is a newspaperman. He has searched innumerable sources and has set down the thoughts and actions of people who were there at the time and who have left a written record. He makes no claim to have written a military history; he claims to present "a narrative of human beings under stress".

The reader will agree that he has succeeded in his aim, particularly in the final scenes of the surrender. The last act of surrender in McLean's House comes out vividly. Both Generals, Lee and Grant, bred in the same school, comrades-in-arms of former campaigns in Mexico, confront one another for the first time since the Civil War began. There seems to be a sort of technique of surrender, which most of us (happily) have never been called upon to practice.

In this book we see General Lee make up his mind to surrender his Army—a difficult decision in itself. He exchanges formal letters with his adversary; and finally, under a flag of truce, rides in his best uniform to meet him. Neither knows what to say nor how to execute the deed. It is Lee who brings the conversation to the point; and Grant fumbles for a pencil and writes—apparently without premeditation—a draft in his note-book. Lee reads it, points out a word omitted, and signifies agreement. The staff then find paper, pens and ink to make the final draft. The reader's pity will go out to Lee, and one is thankful that Grant is chivalrous to the defeated foe. Officers may keep their swords; and artillery men, who own their own horses, may take them home.

This is all vividly portrayed; though the student, who has never read the campaign, will find it hard to piece together why it came about at all. The book is not, therefore, a guide to the American Civil War for beginners. It is, however, excellent for adding flesh and blood to the dry bones of fact in the mind of the more advanced student.

It is, incidentally, an expensive book; and your reviewer would class it as one to take from the library, rather than to buy from the slender means of the young officer, seeking knowledge of his profession. M.C.A.H.

WHY THEY COLLABORATED

By EUGENE KINKEAD

(Published by Longmans, 1960. Price 21s.)

At the end of the war in Korea the United States Defence Department set up in 1953 a study group to investigate the treatment and conduct of American prisoners-of-war whilst in Communist hands. A parallel inquiry, but on a much smaller scale, was carried out by the British Ministry of Defence and its findings published as a pamphlet—*Treatment of British Prisoners of War in Korea*, HMSO, 1955.

The American study group worked on the subject for five years collecting and cross-checking the statements of returned prisoners, every one of whom (there were nearly 4,000) was questioned. No full report, however, has been published and Mr Kinkead's book, much of which has appeared at intervals in *The New Yorker*, to some extent provides a substitute.

The author was given access to the files of evidence but he relied mainly on interviews and conversations with members of the study group. To this extent his book must be considered as journalism—good journalism and very readable, but not authoritative in that the views expressed are those of individuals and not necessarily the considered judgment of the group as a body. But a good deal of light, some of it rather unexpected, is thrown on matters of current interest and concern to us all; on "brain washing" for instance. American prisoners in Korea, we read, were not subjected to anything that could properly be called "brain-washing", and only rarely to physical cruelty. Mr Hugh Milton, Assistant Secretary of the Army for Manpower, had this to say," . . . The Communists managed to persuade most of the captives to attend classes where Communist theory was drummed into them. The Army calls this indoctrination. The alternative phrase brain-washing has become a catch-phrase used for so many things that it no longer has any precise meaning." Indoctrination he defines as "an effort to change a man's viewpoint, while he is still a thinking individual, by regulating his thoughts and actions."

The power of Communist indoctrination on those who allow themselves to submit to it can be judged from the results in Korea. One in three of the American prisoners it is stated was guilty, whilst in captivity, of some degree of disloyalty to his country and one in seven of "serious disloyalty"—including agreeing to spy and organize for the Communists in the USA after the war. Nothing of this kind had ever occurred before in United States history.

Also investigated were the causes of the high death rate (38 per cent) among the American prisoners—the highest on record. That it was due primarily to maltreatment by the Communists could not, according to Mr Kinkead, be accepted. "Treatment of prisoners", he says, "rarely involved outright cruelty, and there was evidence that the high death rate could be accounted for largely by the ignorance and callousness of the prisoner themselves." This again was unprecedented.

The study group inquired also into what it calls "The Turkish Record". Of the 229 Turks taken prisoner in Korea, nearly half of them wounded, not one died in captivity and not one collaborated. (Two who showed signs of wishing to collaborate were suitably dealt with by their comrades.) The Turks apparently decided from the start not to co-operate in the so-called "lenient policy" of their captors and, perhaps more important, to maintain and operate their own chain of command. As a result the Chinese soon left them alone.

It is not surprising that Americans were shocked by these allegations—so alien to the great traditions of the United States Army. Said Secretary Milton: "The results of the Army study were distressing. And the most distressing thing we found is that the men needn't have yielded. Just as they needn't have died in such great numbers." Why then did so many do so? In the latter part of the book the author seeks the answer to this question. These later chapters will be of the greatest interest to the military reader—in particular a chapter entitled "Why our discipline failed" in which the author interviews a magnificently forthright Commanding Officer. It is

something of a cautionary tale and should provoke a good deal of reflection in those, including the editors of some British newspapers, who urge measures of so-called "democratization" for our own Army. Something of this sort apparently was imposed on the US Army in 1945 as a result of the Doolittle Board. This gets a heavy broadside from the Colonel. "It just about destroyed Army morale," he says, "and it has resulted in the Army trying to sell itself on comfort, and on rights and privileges, rather than on its appeal as an honourable fraternity of fighting men on whom the country depends for its security." "The worst way to prepare a man for such duty," he adds, "is to tell him where the snack-bar is." J.M.L.

TECHNOLOGY AND CULTURE

By MELVIN KRANZBERG

(Published by Wayne State University Press. Price $2)

Technology and Culture is a new American quarterly and is the official journal of The Society for the History of Technology. This Society, which was formed in the United States in 1958, has as its aim "to encourage the study of the development of technology and its relations with society and culture."

This dual aim is reflected in this, the first, number of the journal whose nine main articles fall into two clearly distinct groups. The six articles of the first group are concerned with the nature of technology itself. (Of the many definitions of technology cited none is really satisfactory. "Technologist" which is used to cover the inventor, the technical "improver" and the engineer is more easily definable.) They also provide a most interesting examination of the position, or status, of technology in present-day society. Of the three concluding articles, which form the second group, each deals with a specific branch of technological history—the making of chain-mail, the first railways and early skyscrapers.

The difference of manner as well as matter between the two groups of articles illustrates clearly, if unintentionally, the intellectual rift which forms the main subject of discussion in the earlier group.

In this country this rift is seen usually as one between Science and the Humanities, and British educationalists have been a good deal concerned about reducing it—for instance by proposals towards inculcating the "disciplines of history" in science students, and the "scientific approach" in students of the humanities. In the United States, it appears, the gap is seen more as one of "status", as between technology on the one hand and culture, represented by the arts, science, and the humanities on the other. Technology, it is maintained (and it seems to hurt) has not got the "respectability" of culture.

Doctor Howard Mumford Jones, Professor of English at Harvard, in his interesting article, puts it as follows:—

"A peace treaty, a poem, a painting, a system of philosophy, an anthropological report possess academic respectability; a lever or an ink eraser does not." This is true enough; but to seek to enhance the respectability, and hence the status, of technology by claiming it, as one contributor does, as an "element of culture" seems to be stretching the definition of culture too far.

For technology, however greatly it may have influenced culture (and its influence, both for good and ill, is undeniable) is concerned only with the "useful", whereas culture prizes things which, from a utilitarian point of view are useless. And surely, except in a completely materialistic society, this difference in values must be recognized and not blurred?

More likely to win support is the idea, inherent in the Society's aim, of raising the status of technology by giving it a history (a pedigree, even in these days, is often thought to confer some degree of respectability). There is no doubt that in the past technological progress has been much neglected by historians; most history books

are still, as children often complain, "all about wars". But the historians' neglect of technology is surely not "contemptuous" as one contributor thinks, but inevitable—for reasons well put by the journal's editor, Dr. Kranzberg. "Serious historical scholars," he writes, "shied away from the field (of technology) because of a feeling that they lacked the requisite technical knowledge to treat it properly. It was largely left to engineers to write technological history, and despite the fact that many engineers wrote gracefully, others found it easier to express themselves in blue prints, or in steel and concrete, than in words. Even when an engineer was articulate, his efforts would frequently reflect the fact that just as few historians are learned in technology, few engineers are skilled in the rigors of historical research." This dilemma seems to be part of a problem familiar to every Sapper Officer—how to express a technical theme in terms acceptable to the Layman.

Most readers of this number of *Technology and Culture*, though they may not agree with some of its arguments, will probably support its underlying aim—the encouragement and stimulation of technologists and inventors. Others may hold the view that technology is already producing more inventions than man's present vision can cope with, and that it is the humanists—the writers, poets, dramatists and philosophers, who need encouraging and stimulating. But apparently we have reached a stage where, as Professor Gabor the physicist pointed out the other day, "almost every important invention unbalances the front of progress and a new invention is needed to redress the balance . . . we cannot stop inventing because we are riding a tiger."

J.M.L.

CONCRETE FORMWORK DESIGNER'S HANDBOOK

By H. R. GILL

(Published by Concrete Publications Ltd, 14 Dartmouth Street, London, SW1. Price 15s)

The book describes the structural design of formwork in timber, including plywood, and steel, and gives a clear exposition of the forces and stresses involved. Methods of calculation are simplified by means of graphs and nomograms, and a practical method of solving most problems can be found among the examples given.

The book does not treat the subject of formwork in general—there are no descriptions of patent fastenings or methods which enable shuttering to be struck more easily. The Author has kept strictly to producing a compact and useful textbook on how to calculate the sizes, fixings, spacings, etc., of formwork for concrete. Some of the sections are particularly useful, such as the section describing the pressure exerted by concrete as it is poured, vibrated, and set. Another useful section deals with design methods using plywood of different qualities.

At first glance it may be difficult to pick out the example which most nearly fits a particular case. One needs to know the book, and its symbols well; but it will be a boon to anyone who frequently needs to design formwork for concrete. T.W.T.

THEODOLITE PRACTICE

By J. A. SANDOVER, PHD, AMICE

(Published by Cleaver-Hume Press Ltd., 31 Wright Lane, London, W.8. Price 16s.)

Although the primary purpose of this book is to explain the operation and uses of a theodolite the author in doing so gives a very good general outline of survey methods and includes simple mathematics necessary to the surveyor.

The reader need have no prior acquaintance with the theodolite or with surveying as the instrument, and the uses to which it can be put, are very clearly explained from first principles. Nevertheless the later chapters especially provide a very useful refresher for the initiate who has been out of touch with practical surveying.

As the author says in the opening chapter the work is of far greater value if the reader has a theodolite to examine and with which to practice.

With the aid of this book and a theodolite any reasonably intelligent person would be able to carry out a survey to a fair order of accuracy without additional instruction. Every possible piece of practical advice to the novice is given even down to such details as the need to carry a second pencil in case one is lost.

There is a special chapter on setting out curves and one describing other survey instruments and their uses. There is also a useful index. The text is illustrated with photographs and very clear diagrams.

This very comprehensive little book will be especially welcomed by students and those concerned with engineering or local land surveys. J.H.B.

ELECTRICAL EFFICIENCY IN INDUSTRIAL PLANTS

By EDWIN S. LINCOLN

(Published by F. W. Dodge Corporation, New York. Price $9.50.)

This publication is not an electrical textbook in the accepted sense. The author, an American consulting engineer, has had a vast experience from the smallest to the largest industrial installations.

Throughout the book the keynote is maximum efficiency of electrical installations combined with a minimum of capital and running costs. The numerous examples and surveys on the utilization of electricity serve as a constant reminder that a careful study is essential before beginning the actual planning. In the design of new systems great emphasis is laid upon flexibility and expansion.

Surveys on existing systems show how rearrangement of plant can often reduce the maximum demand and attention to low power factors can bring about considerable savings. The "down to earth" approach by the author to problems that really exist and the simple common-sense solutions make the book one to be recommended both to the electrical engineer and technician. D.B.

Technical Notes

CIVIL ENGINEERING

Notes from *Civil Engineering and Public Works Review*, January 1960.

"The Kingsway Bridge over the River Mersey": One of the interesting features in the construction of this bridge was the use of a temporary Bailey bridge for launching heavy precast beams. The beams were 55 ft long, and appear to have been 2 ft wide and at least 4 ft deep. They must have weighed some twenty-seven to thirty tons each, and were precast on site. These beams were rolled out into position by means of bogies which ran along the Bailey bridge, and were lifted out by a mobile crane positioned at each end. The Bailey bridge was moved after each beam was dealt with so that the heavy precast beams only needed to be lifted a short distance. The temporary bridge was probably shifted by means of the two cranes.

"The Permeability and Absorption of Precast Concrete Products": The problem is to determine the durability of precast concrete products from initial tests. Items such as lamp standards, kerbs, flagstones, pipes, tiles, and cast stone are commonly accepted as durable when produced in precast concrete. British Standards have been set which generally exclude poor quality units, but the tests can be improved to give better and quicker results. This article is the first of a series in which the author will describe such improved techniques.

Notes from *Civil Engineering and Public Works Review*, February, 1960.

"Engineering Developments in the USSR." Experiments have been carried out to see whether it is possible to reduce the resistance to the driving of sheet piles by sealing off the interlock, and preventing the ingress of soil. A simple device is described which acts as a non-recoverable driving shoe. The tests showed a 50 per cent decrease in driving time, with less tendency to lean and creep. Such results have far-reaching consequences, and more should be heard of this idea.

Another machine that is described is a hydro-vibratory soil compacting device. This is a self-contained unit mounted on a bulldozer, which, when plugged into the local electric mains and water supply, can compact 520 cubic yards of backfill (maximum depth 7 ft 3 in) in a day, employing only two men.

"An Introduction to Digital Computers." This article is a "child's guide" to the new era of the electronic brain. The picture is built up from simple analogies and first principles. One learns early on that the machine can do little more than a mere human, as far as each step of a "programme" is concerned. Add, subtract, multiply, divide, these are the normal tools of calculation. But these are done by the electronic wizard at fantastic speed, and can be checked and tested for accuracy as the operation proceeds. No article can give a true idea of the power of these machines to handle problems, because the words "millisecond" and "microsecond" are hard to comprehend fully. However, the article is very easy to follow, and demonstrates clearly its purpose, which is to show that a large variety of problems, some of which are extremely tedious, can be fed into a machine by using a fairly straightforward "code", and an accurate answer will be spat out at the other end in a very short space of time.

"Analysis of Structures with Reference to the Use of Digital Computers." This second article is not truly a child's guide, as it soon gets into the methods of Determinants; but it also is well written, and makes a very clear point that the electronic brain is a tool which can permit a very different approach to a problem than the approach we have been used to making. Because the computer is quite happy testing, verifying, substituting new values, and re-testing, it can be used for processes of successive approximations, etc. which used to be discounted as long-winded and tedious.

"Photogrammetric Survey Technique using Computers." The use of computers to analyse the data which can be supplied from aerial survey methods is outlined very briefly. The main value is to check volumes of cut, fill, topsoil, etc., related to different lines of level and alignment. By this means decisions can be made quickly for the most economical alignment for earth moving projects such as are involved in road making, airfield construction, etc.

"Stress Distribution in Deep Beams." This article gives tabulated coefficients which can be used to solve a large number of problems connected with beams which are nearly as deep as they are long. This is a reference of value to a design office.

"A 47 ft Span PC Bridge at Ripley." Precast concrete was used to replace a damaged three-span bridge over the Abbey Stream, near Ripley in Surrey. The design finally approved used pretensioning, to assist the handling of the precast beams, and post tensioning on site. The 47 ft main beams, 2 ft deep, weighed 5 tons; the parapet beams weighed 8 tons. The beams were cast with shear connectors projecting from the top surface, which was also left rough in order to improve the shear value between the precast beams and *in situ* topping. The beams were brought on site by road. A picture shows that a normal lorry fitted with a form of "timber bolster" was used—with the far end of the 47-ft beam supported on a separate axle and "bolster". No doubt rear lights and number plates had to be arranged at the far end! The beams were off-loaded and lifted into position by a single 19RB, which lifted one end at a time in order to avoid the expense of an additional crane. The bridge seats seem to have been straightforward. The fixed end was an RSJ embedded in concrete, while the other end rested on 4 in diameter roller bearings.

Notes from *The Civil Engineering and Public Works Review*, March 1960.

"Compensated Joint Unaffected by Thermal Expansion": The problem of joining pipes of different materials has always presented a problem to engineers. In the atomic energy field leak-tightness is imperative and a solution has recently been produced by a Harwell engineer. The article on page 367 deals with the leak-tight joint giving a diagram of its design. Very briefly, the joint is so designed that the plane of the joint and the plane of the pressure applied by the bolts are coincident hence there is no movement caused by thermal changes.

"Digital Computers": Four articles appear on digital computers. The first one, on page 369, deals with the use of Auto code in the Ferranti "Mercury" computer. The example described is particularly interesting as it deals with investigations at the Military Engineering Experimental Establishment on producing a suitable formula for classifying reinforced concrete tee-beam bridges. No theoretical basis could be found for a relationship between external dimensions and load classification, and it was hoped that some relationship could be found by analysing a large number of bridge designs. Two hundred and thirty bridges were analysed, preparatory work was four days and computer time 16 min, against an estimate of twenty days' work without the aid of the computer.

Grading and Two Dimensional Mass-haul Calculations are dealt with in another article on page 373. The first problem in site development is to choose a level such that the cut and the fill balance. While this can be done there may be technical or other considerations which restrict the choice of level. The problem then arises of

calculating the expected excess or deficiency of spoil and of devising a construction programme such that the two-dimensional mass-haul between areas is minimized.

This is considered in the article which illustrates the use of a computer in connexion with the calculation for a large oil refinery. It was found that the computer reduced the design engineering cost by 60 per cent.

"Small Footbridges in the Cairngorms": Mention is made of the use of a helicopter in transporting material and bridge parts to inaccessible places.

"Deflection of Beams due to Shear": Deflection is usually calculated from knowledge of the bending moments. Shear forces are also present and they distort the beam and cause deflection. The shear deflection is usually ignored as insignificant, but in short deep beams the shear deflection may constitute an appreciable part of the total deflection. The article shows how the shear deflection can be calculated. W.C.

Notes from *Civil Engineering and Public Works Review*, April 1960

"New Bridge over the River Aire": A heavy lattice girder bridge was successfully launched over a 107-ft clear gap using a launching nose made up of Bailey bridge equipment. The photo clearly shows how the Bailey panels were utilized and demonstrates how adaptable the equipment is for a wide variety of civil engineering tasks.

"Engineering Developments in the USSR": A mechanical well-digging machine is described which is claimed to enable a machine operator and two labourers to dig a 100-ft deep well with a 4 ft diameter shaft in 25 hrs digging time. The machine is a truck mounted power auger with cutting blades that can be extended to scoop out the earth from underneath a precast concrete sectional lining, and afterwards retract and be drawn up inside the cylinder. It is not clear how the spoil is removed, but the machine has an obvious importance in opening up new wells in rural areas.

Another article gives details of the use of helicopters to position Electrical Transmission Line Towers in remote areas where normal construction methods would have proved nearly impossible. An interesting point to note is that the pylons were easily transported in the horizontal position, but acted as a pendulum whenever they were suspended in a vertical position. The pylons were, therefore, erected on the site in a horizontal position with hinges connected to the pylon base. When ready, the helicopter lifted the head of the pylon, and swung the whole pylon into the vertical position about the hinged connexion.

"Remedial Measures Employing Powered Application of Aerated Mixes": There are many uses to which the Western Region of British Railways have put Aerocem and other aerated mixes. The author describes the grouting of slips in clay embankments, re-pointing deteriorated brickwork (especially in tunnel linings, and despite the presence of running water) the curing of soil failures beneath railway tracks, and the arresting of ground fires in embankments formed of combustible materials. Some points are discussed in an effort to show the mechanics of how the process works, but the main proof is offered in the number of cases quoted where (no matter how, or why) the process has been used with complete success.

"Repair of 'Live' Sewers": An old 9-in stoneware sewer was successfully repaired by pushing a new 6-in pitch fibre pipe through the old main, without having to interrupt the flow. The maximum length inserted in one operation (between man holes) was 90 ft. While the job was not pleasant, it was effective, and the idea might enable war damage to be repaired quickly.

"Laboratory and Field Tests on Cement-Stabilized Pulverized Fuel Ash": The article describes the suitability of some typical pulverized fuel ashes ("pfa") for cement stabilization. Promising results have been achieved using "pfa" stabilized with 10 per cent cement expressed as a percentage of the dry weight of the ash. Among some of the advantages described is the absence of frost heave in the material when used as a road base material. The "pfa" has also been used with sand and cement to give a cube crushing strength at seven days of 1,000 lb/sq in. T.W.T.

ENGINEERING JOURNAL OF CANADA

Notes from *The Engineering Journal of Canada*, December 1959.

"HIGHWAY RESEARCH ACTIVITIES IN CANADA": Current and projected programmes of road improvement in this country have stimulated public interest in various aspects of the layout and design of roads, and in the potential value of "traffic engineering". This account of the development and functions of the Canadian Good Roads Association, and of their recent survey of road research projects, is an authoritative summary of a complex subject.

In this country, planning is complicated by the haphazard growth of our communications and urban areas, and by many vested interests. It is interesting that experience in a "new" country has proved that the social and economic effects of highway improvement need as much study as the purely technical problems, to avoid the dislocation of industry, to reduce roadside sprawl, mixture of traffic types, and congestion, and to prevent an increase in the accident rate.

"THE USE OF FLY ASH IN CONCRETE": Fly ash, the finely divided residue from the combustion of pulverized coal, has the property of cementing when combined with lime in the presence of water. Field trials have shown that substantial percentages can be used successfully in concrete mixes. Economy, improved workability, and a reduction of thermal cracking have been achieved without loss of final strength, though a longer period is required for maturing. Though unlikely to be of immediate value to the military engineer, this paper adds something to general knowledge of concrete as a material.

"SOMETHING CAN BE DONE ABOUT NOISE": Noise abatement has been in the news in recent months, but its problems are not generally understood. This paper is well worth reading for its general interest, and it should enable any engineer to think, and talk, intelligently about the subject.

The analysis and measurement of unwanted sound is not altogether simple. Apart from sudden, very loud sounds, which startle most of us, noise affects different people in different degrees, and their reactions to it depend not only upon its intensity, but upon whether it is steady or intermittent, high or low in pitch, and whether it causes actual interference with hearing what they want to hear. A continuously noisy environment may lead to frustration, tenseness, weariness, or even to impairment of hearing.

The author discusses remedial measures primarily in relation to industrial plants and offices, where practical measures can often be taken to alleviate noise-distress among workers in the vicinity of noisy machines and appliances. He mentions the increasing number of claims against employers in the USA for compensation for deafness, and forecasts that Trade Unions may demand a contractual limitation of maximum noise levels. As with traffic noise and stentorian radio sets, the best solution is to use quieter apparatus, the demand for which can and will be met by machine manufacturers as soon as it becomes a real factor in a competitive market.

Notes from *The Engineering Journal of Canada*, January 1960.

"PLANNING AND CONSTRUCTION OF THE CHUTE-DES-PASSES HYDRO-ELECTRIC POWER PROJECT": *The Engineering Journal* has published many descriptions of hydro-electric installations. This particular project is notable because, owing to previous development in the area and to topographical and geological considerations, it was decided that underground construction would be most practicable and economical. A total of over 3 million cu yds of rock excavation was involved, and the total length of tunnelling, from about thirty-eight to fifty feet in diameter, is something over 50,000 feet. The power chamber is about 450 feet below the surface, and the installed capacity is 1 million hp.

The paper provides a lot of detailed information, but it is unusually well arranged and paragraphed, and technical data is clearly tabulated under headings of hydraulic losses, turbine data, generator data, and main transformer data. The last three tables, of much wider interest, summarize principal features, major construction equipment, and major construction quantities.

"THE NEW AKLAVIK": This is an interesting account of the preliminary stages of a most unusual project. Aklavik, the main settlement and potential centre of administration in NW Canada, was built in a permafrost area, on an organic silt with a very high moisture content. Surface drainage is difficult, subsoil drainage impracticable, and further clearing and development would inevitably lead to ground subsidence. The very restricted site has been subject to constant erosion. It was decided to move the town to a new site.

After setting out the factors leading to this decision, the authors of this paper list the basic requirements of the new site, and then describe the organization and methods of survey used in the investigation of the available alternatives. Preliminary planning has been completed, and work is now going on at the selected site. The new town, though still in the permafrost zone, will have modern drainage, water supply, and other amenities, and it is expected to be a going concern within a few years.

"RIVER CONTROL IN THE INTERNATIONAL RAPIDS SECTION OF THE ST LAWRENCE POWER PROJECT": Much has been published about the St Lawrence Seaway and Power Project, but in general such papers have dealt with specific installations, or with particular engineering aspects. This paper considers the over-all effect of the diverse and intricate operations carried out by numerous agencies and a host of different contractors.

A requirement by the Joint Commission was that all construction should proceed without adversely affecting upstream or downstream conditions, and that existing navigation facilities should be maintained. To this end a unified control system was established, to ensure the dovetailing of a complicated pattern of starting and completion dates, so that the effects of operations by the different contractors should balance out, to reduce over-all changes to the minimum. This involved the collation of data, meticulous planning, inspection of progress, continuous measurement of hydraulic effects, and the operation of control structures to regulate river conditions.

The organization and operation of the field control system are outlined, and some interesting examples of the handling of particular problems are given.

Notes from *The Engineering Journal of Canada*, February 1960.

"MOORING DOLPHINS FOR THE HARBOUR OF KITIMAT": In 1957, expansion of the aluminium plant at the new town of Kitimat necessitated the provision of additional harbour facilities. The planned extension of the 760-ft reinforced concrete wharf, built in 1953, did not yet appear justified, and it was decided to install mooring dolphins to accommodate vessels awaiting a berth.

Two main dolphins were provided, of sufficient strength to resist impact forces and the pull of spring and breast lines, with two smaller end dolphins to take bow and stern mooring lines, all of them being located to fit in with the projected permanent extension. Extreme tide conditions give a maximum rise and fall of 22½ ft, and the soil below the dredged bottom is mainly fine silty sand. Several types of pile construction were investigated before selecting the final design, using 30-in diameter tubular, high tensile steel piles.

Soil and loading tests are briefly described, and the design and construction of dolphins are clearly discussed. The methods adopted for handling and driving piles were unusual, and proved extremely successful.

"ST LAWRENCE RIVER DEVELOPMENTS": This issue contains four papers on the wider aspects of the Seaway and Power projects:—

Hydraulic problems.—This is a summary of the factors and restrictions governing the development of the St Lawrence River, based on the protection of legitimate interests.

It shows why the engineers were faced with many troublesome problems, and its interest will be enhanced if it is read in conjunction with the paper on "River control in the International Rapids section" in the January 1960 issue.

Backwater computations.—This subject is covered in two separate parts, written by different authors. Part A deals with hydraulic engineering aspects of the computations, Part B with calculations on a digital computer. The aim was to compute water elevations along the course of the river, after establishing a number of parameters, and to produce a comprehensive series of curves for use by designers. Both papers will be of interest primarily to the mathematically inclined.

Rehabilitation.—The development of new power installations caused the displacement of seven communities, and part of an eighth, on the Canadian side of the St Lawrence. This is a most interesting account of the relocation of housing, public buildings, and amenities, including the bodily removal of nearly 550 buildings, and the provision of new town sites with modern municipal services. Initial resistance and scepticism of the residents affected was overcome by sympathetic planning, and by consultation and co-operation with councils and public bodies. The paper contains much that will interest any engineer, and it demonstrates what can be achieved by a planning authority guided by imagination and good will, rather than by purely financial considerations. R.P.A.D.L.

THE MILITARY ENGINEER

Journal of the Society of American Military Engineers

January–February 1960

"Harnessing the Tides," by Brigadier-General Alden K. Silbey, United States Army, and William H. McNiece. A thorough engineer analysis of a project to utilize the tides at the entrance to the Bay of Fundy on the border between the USA and Canada has been carried out and this article is a résumé of the report. It is full enough to give a clear picture of the financial and technical issues involved and is well illustrated by maps and engineering drawings. The project is to close the entrances from the ocean to two interconnected bays. By keeping the level of one bay high and the other low the High Pool bay can be made to discharge continuously, though at varying differences of pressure according to tide conditions (into the Low Pool) through the power plant sited between the two bays. The paper gives details of the design of the various components of the scheme which include tidal dams, navigation locks as well as the hydroelectric power station. Tidal output varies with the tides and is out of step with the normal pattern of daily use of electricity. An auxiliary power plant on a river discharging into one of the bays is, therefore, included in the project. The proposal is now under examination by the United States and Canadian Governments.

"Combat Engineers, I. Mexican War 1847. They Asked to Fight." by Dr Jesse A. Remington. A brief account of engineer action in the Mexican War leading up to a spirited story of an assault in which the engineers volunteered to fight as infantry.

"Paratrooper Engineers," by Lieut-Colonel David L. Grundling. An account of an exercise carried out by an Airborne Engineer Battalion which involved constructing an airfield exclusively with plant and equipment dropped by parachute. The article is well illustrated with photographs which give a clear indication of the size of the plant units dealt with and the methods of rigging.

"Test Piling for Soil Determination", by 1st Lieut Philip D. Weinert, Corps of Engineers. A brief illustrated account of driving and loading a test pile as part of a subsoil investigation in connexion with the design of a cold storage plant in Korea. It is mainly interesting for the improvisations which were necessary.

"Electronic Computers in the Army Engineers," by Lieut-Colonel William N. Lucke, Corps of Engineers. A short account of the number and variety of the electronic computers used by the US Corps of Engineers in their various capacities. They are used largely for hydraulic and hydrologic problems but also for supply and logistic statistics, structural engineering, soils and earthworks, topography and geodesy. The article is interesting if only for the glimpse it gives of the wide field covered by the US Engineer Corps.

"Nuclear Radiation. Family Type Fall-out Shelters," by Lieut-Commander J. C. LeDoux Civil Engineer Corps, US Navy. A short illustrated description of two cheap and easily constructed shelters with specifications.

"From Atlanta to the Sea," by Lieut-Colonel Robert E. Ellis. Inspector General. A continuation of the account of General Sherman's operations in Georgia in 1864 including the celebrated march from Atlanta to the Sea. The contribution of Orlando Poe and the work of the engineers under him is given prominence. There are interesting contemporary photographs and sufficient maps.

"Prestressed Concrete for Runways", by J. P. McIntyre. This is a description of a test being carried out to compare the costs, techniques of construction and serviceability of conventional, non reinforced and reinforced concrete, with prestressed concrete for the construction of airfield runways. The article is illustrated with photographs and gives a clear account of the methods used in constructing the prestressed section for test. The test is not complete but the expected advantages of prestressed concrete are, a stronger pavement for withstanding increasingly heavy wheel loads, a 95 per cent reduction in the number of joints with a corresponding reduction in the damage to joint material from jet blasts, less maintenance, a thinner slab needing less initial grading, and a longer life. Costs are at present higher but these may come down when contractors have had more experience.

"Terrain Factors in Airborne Operations," by Richard H. Barnard. A résumé of the terrain factors which affect airborne operations with a recommendation that Intelligence and Survey should maintain maps giving the necessary information on the same lines as those kept for cross country movement of AFV's.

"Hydraulics through the Ages," by Captain C. J. Merdinger, Civil Engineer Corps, US Navy. *Part V, Docks and Part VI, Lighthouses.* This article completes the series started and continued in previous numbers. They are more historical than technical but the whole series gives a broad and interesting review of the subject.

"Survey and Maps," Army Map Service, Lunar Mapping. This is an interesting and ominous article on the steps which have already been taken by the Army Map Service to provide a 1 : 5 million scale map of the moon for the benefit of the first arrivals there. It is hoped that with the aid of artificial earth satellites it will be possible, in time, to make a 1 : 1 million scale map.

The methods used and the factors to be considered are given in some detail and there is a note with diagram on the projection selected. J.S.W.S.

THE CONTRACT JOURNAL

Notes from *The Contract Journal*, February 1960.

"Super-Sulphate Cement." BRS Digest No. 130 is reviewed, and this reference may be useful since Super-Sulphate Cement is now produced and marketed in Britain.

The advantage to be gained in using Super-Sulphate Cement is an added resistance to attack by such agents as sea water, weak organic and inorganic acids, linseed and other vegetable oils, sugars and phenols.

It is more expensive than normal PC and therefore would only be used where its special properties are required. T.W.T.

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