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New Royal Portrait for RE Headquarters Mess

THE Corps Committee recently commissioned a new painting of Her Majesty The Queen. It is now hanging in the Dining Room of the Headquarters Mess.

It has been painted by Mr William E. Narraway of the Royal Society of Portrait Painters. The picture, which measures 7 ft by 4 ft 6 in, shows Her Majesty against a plain background dressed in a lime yellow evening dress. She is wearing the Garter sash together with the Corps diamond brooch. One of her corgis is shown beside her; this is a unique feature in that no other portrait of the Queen has included an animal.

The painting was formally handed over at a Corps Guest Night on 20 May 1971 presided over by the Chief Royal Engineer, General Sir Charles Jones.

During June the painting was exhibited at the 77th Annual Exhibition of the Royal Society of Portrait Painters at the Mall Galleries in London.



The Royal Potrait For RE Headquaters Mess

1971 Annual General Meeting Address by the Engineer-in-Chief

At the Annual General Meeting of the Corps, held on 23 June 1971, the Engineerin-Chief, Major-General F. G. Caldwell, OBE, MC*, gave a talk on the state of the Corps. He said:

I want first to welcome you all and to say how pleased I am to see so many serving and retired members of the Corps here this afternoon. It is customary at this annual meeting for the Engineer in Chief to highlight the major events of the past year. I want also to look forward a little to what we might achieve in the future.

CURRENT DEPLOYMENT

Let us begin with a look at where the Corps is deployed now. Withdrawais from the Far East and the Persian Gulf in the past year have resulted in a number of changes in the Corps deployment worldwide. Let us take the Far East first; the Headquarters of the Gurkha Engineers in Malaysia moved to Hong Kong last September to join the two Gurkha Field Squadrons and the Hong Kong Support Squadron already there. Three weeks ago HQ RE FareIf closed and CRE Hong Kong assumed control of most of our affairs in the Far East.

After the final withdrawal from Singapore later this year, a joint Australian, New Zealand, United Kingdom (ANSUK) Force will remain in the area, which will include a British infantry Battalion group. The supporting field squadron will include two officers and forty-six men from 37 Engineer Regiment who will provide a complete field troop for the squadron as well as one or two members of the headquarters and support troop.

On 24 May HQ RE Persian Gulf closed, leaving a field troop under command of Commander British Forces Gulf, and Military Engineer Service elements in Bahrein, Sharjah and Salalah.

And in September last year HQ RE Malta was closed although we still have a specialist team on the island. I believe CRE NEARELF will have to extend his sphere of influence over a much wider area than before to include Malta and possibly the Gulf area and Oman, although a final decision on this has not yet been made.

Currently detachments from UK units are deployed as follows:

In Anguilla we still maintain a detachment on the island. Their work has included a well-drilling operation, the building of another school, a laboratory, a public library, airfield control towers and a prison block.

In Singapore a troop of 59 Squadron has remained to support the commando brigade.

In Kenya and Thailand management teams have been working on well drilling and water development schemes.

In the Congo another small team has been planning the rebuilding of bridges destroyed in the civil war. You may remember that a number of these small management teams have been operating in the past three years in the Congo. I am delighted to be able to say that the Congolese Government and Army have been extremely impressed and grateful for what the teams have achieved. At the end of the year, in response to a request from the President, General Mobutu, we will establish another training team there, comprising three officers and five NCOs, to set up a complete engineer training organization for the Congolese Army.

In the Solomons airfields have now been constructed on three islands and a fourth is under construction. It looks as if we will be there for some years.

In Malta the Specialist Team is continuing its supervision of contract work for the PWD, in the building of a motorway, flyover and an industrial estate.

Lastly, I want to mention the projects and exercises which are in the firmer stages

of planning, and which should take place either later this year or next. We have road construction projects in view in Guyana, Canada, Norway, Ethiopia, Malawi and Hong Kong. Airfield and Airfield Installation projects in Barbuda in the West Indies, Ascension Island, Rodrigues Island near Mauritius and the Solomons and well drilling in Oman and Kenya. We are also thinking about an airfield in the Falk-land Islands.

Now I want to say something about some of our current activities starting with BAOR. Sappers have been kept as busy as ever in training with other arms, and the new organization which we have adopted has continued to be extremely successful in providing Sapper support to Brigade Groups. The final moves of units resulting from our re-organization, and the return of 6 Brigade to BAOR were completed at the end of March this year. 28 Amphibious Engineer Regiment, equipped with the M2B amphibious bridge, is now located in Hameln. One squadron has been operational since April, a second will be operational later this year, and the remainder of the Regiment by 1 April next year.

From 1 and 4 Divisional Engineers we are at present supplying a regimental HQ and four field squadrons to operate in the infantry role in Northern Ireland. This is a single four month commitment, although in view of the shortage of infantry, we must be prepared to help by providing more sapper units to work as infantry in the future if they are required.

On the equipment side, much encouraging progress is being achieved. Last summer, which was their first training season, our M2B amphibious bridge rigs naturally gave us some worries but this is only to be expected in a brand-new equipment. M2B will, I am sure, do very well this year and in the future. The first sets of Medium Girder Bridge—MGB—are reaching BAOR this summer, and at the end of this year the first bar mine-laying system and I hope we shall be able to earn some much-needed foreign exchange from sales of these equipments. We have just sold ten sets of MGB to Denmark. We continue to be grateful for the excellent support which the Corps unfailingly receives from our friends at the Military Vehicles Experimental Establishment at Christchurch in the production of new engineer equipment.

In Strategic Command it has been another year of considerable activity. Of those field and field support squadrons in UK eight have been to Northern Ireland, where they have mainly been employed on engineer tasks, and fourteen squadrons have been overseas on training exercises to Gibraltar, the Gulf, Kenya, Malaysia, Hong Kong, the Caribbean, Canada or Norway. The three squadrons which have *not* been abroad have been involved in training and project work in the UK.

To control engineer operations in Northern Ireland, a CRE was established last September. The main tasks have included maintenance of the peace line, barrier clearance, construction of OPs and sangars, security of operational bases, assistance with search operations and combat engineer support to EOD (Bomb Disposal) operations. A team of an officer and four NCOs has been sent to Northern Ireland to help organize an employment relief scheme called 'Project Young Ulster' aimed at finding constructive employment for sixteen to twenty-two year olds. One squadron is currently engaged in building a hutted Camp for a battalion at Long Kesh just west of Belfast.

In April this year, 59 Field Squadron became 59 Independent Commando Squadron, which will be permanently affiliated to the Royal Marine Commandos. This will be the first time that a Sapper unit, wearing green berets, will have been affiliated to the Royal Marine Commandos. The squadron will have troops based in Scotland and Malta to support commando groups with particular responsibility for operations on the flank of NATO. The balance of the unit will remain at Plymouth.

Now a word about assistance to the Royal Navy and Royal Air Force. Everyone will be aware of the increasing support that the Corps provides for the RAF and in particular for the Harrier. The last year has seen the start of the final trials on a new nylon and aluminium surfacing for forward airstrips, helicopter and Harrier pads.

This will be a great improvement on the old pierced steel plank. To date we have installed the new Rotary Hydraulic Arrester Gear on 27 RAF stations throughout the world. A great deal of effort is going into Rapid Runway Repair techniques, which involves stockpiling aggregate, stores and plant at an operational airfield. In this way a squadron can repair a crater 70 feet in diameter and 15 feet deep in four hoursabout the size of the average cricket table. We are all very much bound up in trying to work out BAORs requirement for Harrier Support. There is a need for about twelve training sites initially, rising to fifty later on, in addition to operational ones. We have been doing a certain number of tasks for the Royal Navy, and I intend to increase our support to the Senior Service. We have been doing some plant work in HMS Daedelus and HMS Dryad. The former is in connection with the installation of an Instrument Landing system on the Royal Naval Air Station and the latter on landscaping, building a sport track and other sporting facilities. These have provided us with some useful plant operator experience. Last month a detachment of 39 Regiment and an RN Diving team successfully recovered an old Barracuda aircraft which crashed in a bog near Londonderry in 1944. The members of the crew were identified and given military funerals.

Survey

Survey units have carried out operations in fourteen countries in the past year. They have worked in conjunction with Australian Survey and in Indonesia in mapping West Kalimantan in South Borneo. They are involved in satellite survey. They have been helping to settle a possible territorial dispute by doing a border survey between Abu Dhabi and Dubai in the Trucial States.

Postal and Courier

During the postal strike the Postal and Courier Communications Service operated an official mail service between MOD, UK Commands and Overseas Commands. They also handled some private mail for separated families, but, for political reasons, were not allowed to handle all private mail. The operation was an unqualified success, and virtually the only complaint was from certain staff officers who suggested that replies to their letters were returning to their desks too quickly. Mill Hill Depot reported that close on 100,000 items passed through in a typical twenty-four hour period. And in the 3 Division area alone more than 6,000 bags were handled during the final week of the strike.

T&AVR

T & AVR Units have undertaken a comprehensive and imaginative programme of infantry and engineer training during the year, both in the UK and abroad—in BAOR, Cyprus and Malta. They have shown great enthusiasm for a scheme which we are examining, whereby individuals might be attached to regular units which are going abroad for particularly interesting projects.

EOD

Two tasks of particular interest are worth mentioning. Last August a detachment cleared four 200 pound bombs from an old German Dornier Aircraft which had crashed near Caterham in Surrey. Each bomb contained about 50 lb of explosive. Members of the Society for the Investigation of Crashed Aircraft were also present and were most helpful. One of the bombs is now on exhibit at the Society Museum at Halstead near Sevenoaks. In September a detachment went to Sardinia and did a detailed search of about thirty acres of ground on the European Space Research Organisation test range, where a rocket had disintegrated during a test firing. Many important pieces were recovered to assist in the analysis of the failure. The Director of ESRO was most grateful for the assistance of the EOD team.

Training Organisation

The RSME has had a singularly busy and successful year as anyone on the staff there will tell you. Quite apart from a full course programme, the Commandant entertains a large number of visitors of all nationalities. In May we held a NATO

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Senior Officers Study Period which attracted a large number of Allied Officers, the Military Engineering Committee met at Chatham last month, and the Defence Scientific Advisory Council will do so next month. And many of you will have been to the excellent biennial demonstration last week.

The Training Programme has been at full stretch in coping admirably with training the splendid flow of material obtained for us by the recruiting organisation. Brigade HQ is now happily established at Minley Manor.

MACC

The Corps has undertaken a large number of tasks under the scheme for military aid to the Civil Community both at home and abroad. Many have been located in Scotland. The tasks have included an airfield on Skye, roads, tracks, sporting facilities, bridges, jetties, and a number of interesting demolition tasks. All these jobs help units to train in the sort of civil engineering tasks which could be their war role, and they help our image for recruiting.

Disaster Relief

In the East Pakistan flood disaster, 59 Squadron helped with provision of water, establishing craft bases for distribution of food, and with assessing damage to tracks, bridges and jetties. In the United Kingdom 8 Field Squadron helped with repairs to the Menai Bridge for British Rail, and 34 Field Squadron overbridged the Yarty River at Axminster for Devon County Council. Our reputation as a disaster relief agency seems to be firmly established.

Engineer Support Group

Before I go on to speak about manning, I should like to say a word about the Engineer Support Group. It is patently clear that money for Army equipment is getting increasingly short, therefore we must manage the equipment we already have to get the best use from it at minimum cost. To this end we have installed management accounting and budgetary control in the Support Group which, together with other management improvements, are estimated to have saved this year some £200,000 or 10 per cent of the total operating costs. We have installed a productivity agreement in the Central Engineer Park at Long Marston which has increased output considerably and are now negotiating its extension into the UK Engineer Parks. We hope to introduce similar improvements into BAOR. As a natural development whereby the manager on the floor will have much more control over the employment of his resources. Finally, we are examining methods of reducing the capital costs of our inventory which might produce large economies. I believe that we are not drag-ging our feet in management compared with civilian industry and that we are, in fact, developing methods that will have a definite place in the Army of the future.

MANNING THE CORPS

Officer Recruiting

Like the remainder of the Army, we did not succeed in recruiting as many officers as we would have wished in 1970, which was a disappointing year both as regards quality and quantity. Ideally, we require ninety-four officers a year of all categories, and last year our total intake was eighty. Let us now have a look at our Officer Recruiting for 1971. Based on the recruiting for the first five months of the year, and the number of enquiries which are currently in the pipeline, we should get between seventy-five and eighty officers of all categories in 1971. The total number of officers from Sandhurst is down. However, I am particularly encouraged by the number of conversions to permanent commission among the SRC and SSC and the very large increase in the number of direct entrants from Universities and Cadetships. This shows that we are getting our message into the Universities and also that our internal recruiting is going well. I believe we must continue to concentrate our attention on attracting more graduates direct from the Universities from whence we have received many of our best officers in the past. Many graduate engineers are finding difficulty in obtaining good jobs in industry, and the Department of Employment is forecasting that this situation will get worse. It is therefore most important that we use our informal contacts with all our Sapper-connected friends in the Universities to get the message clearly across that the Corps has a great deal to offer to the right sort of graduate. A new officer Recruiting brochure is being produced, and I shall see that it is given a very wide distribution so that everyone is briefed.

Soldier Recruiting

1970 has been a highly successful year for our soldier recruiting. In the Regular Army we recruited a total of 1,620 men against a target of 1,500, and in the first four months of 1971 we are already 15 per cent ahead of 1970 figures. Our recruit wastage rate, which has caused us much concern in the past, has fallen from 29 per cent, or almost 1 in 3, in 1969, to 20 per cent, or 1 in 5, last year. The army average recruit wastage over these two years was about 16 per cent. Our trained soldier wastage has been consistently just below the Army average at 6.6 per cent.

We now no longer have absolute control over our recruiting, however, because a Central Recruit Selection Centre opened at Sutton Coldfield earlier this year. By July the centre will be processing all recruits except those enlisting in Scotland. As the Corps is well up to strength, we are low on the priority list for uncommitted recruits, but, based on the satisfactory number of recruits which we have received during the pilot scheme from the Recruit Selection Centre at Corsham, we are hopeful that we shall receive enough of the uncommitted men to meet our manpower target. Meanwhile naturally no one can afford to be complacent about any aspect of the subject and we are continuing displays and publicity to increase the number of committed men who arrive at the Recruit Selection Centre.

Boys

The recruiting of all categories of boys continues to be satisfactory. In 1970 a total of 797 were recruited, which is eighty fewer than in 1969. In the first five months of 1971 we have recruited 210 junior soldiers, this is thirty-eight more than in the equivalent period last year. Boys amount to a total of 40 per cent of our total intake and on average they serve just over twice as long as the normal adult recruit. It is, therefore, most important that we do everything in our power to maintain the level of junior recruiting after the raising of the school leaving age, in September 1972.

T & AVR

T & AVR recruiting has been most encouraging, and units are well up to strength.

THE FUTURE

Now for a look at the future. First, I want to talk about the immediate future and then look at some of the longer term developments.

Next year, the present Geographical Commands in the UK will disappear, and in their place we shall have a single HQ United Kingdom Land Forces (UKLF) which will be at Wilton near Salisbury, with under command 3 Division, the Amphibious Force and 10 independent Districts. I am determined to ensure that the Chief Engineer at UKLF, who will be a Brigadier initially, is properly staffed and that Districts have nominated Sapper representatives. The really important thing is to ensure that we do not lose the country-wide influence which Command Chief Engineers have exercised over the years in so many important ways.

Commonwealth and Foreign Connexions.

I am convinced that we run one of the best military engineer organizations in the world, and I would like to see us continue as the hub of military engineer thinking. To do this we must continue to keep our Commonwealth and Foreign contacts despite the withdrawal from bases overseas. I have been very pleased to see the Italian, German, Belgian, and Dutch and Norwegian Chief Engineers as well as the Chief Engineer of the French Forces in Germany in this country recently. I shall be travelling to USA and Canada this autumn. I hope to go to Australia and New Zealand early in 1972. New Zealand have asked us to provide the Director of Engineers for their Army. I have also had contact with senior military engineers from Turkey and Iran and we have recently been discussing with both India and Pakistan the question of exchanges with the RSME.

Forward Thinking

We have redesignated the RECDC the "Way Ahead Committee" because I don't want it to be tied to Combat Development subjects only. It will cover all aspects of Corps policy. We have had one good meeting and are now very much engaged in looking at the organizational and equipment problems of the future. It is important to think out and justify the organization, trade structures, etc, to match new equipments which will be coming into service in five to ten years' time.

I now want to say a word about our position in relation to the three services. As many of you know, we are becoming increasingly involved with support for the Royal Air Force. This is not a new task when one remembers what we did in World War II. It lapsed during the last few years, but with the passing of the nuclear era will arise again. I believe also that during the next few years we may find ourselves more involved with the Royal Navy. The point I really want to make is that we shall, I believe, become increasingly the Defence Services military engineers and, coupled with our support for the Foreign and Commonwealth office, an important agency of the Government's. This will strengthen our position immeasurably.

We also need firm contacts with the professional engineering world both in the commercial world and in the Universities. To this end, I have in mind a widening of the scope of the Institution to include branches at suitable centres throughout the country. These branches would organize meetings, gatherings and dinners to appeal to regular, T & AVR and retired officers and perhaps some suitable youngsters who contemplate joining us. Lastly I want to speak about communications. Wherever I go I am aware of an enormous fund of goodwill towards the Corps—particularly among ex-Sappers and yet they are very much unaware of what we do. This is because there is at present really no means of telling them. They are not members of the Institution and even if they were, the *Journal* does not tell them very much. The *Sapper* is much more informative, but does not really meet the requirement. I feel the whole question of communicating with those outside the Corps who are interested in our affairs needs examining.

In conclusion I should say that we are at a period when our national policies are changing, particularly in relation to Europe. Within the Services both money and manpower are short and this is likely to continue. We must, therefore, be realistic about how we want the Corps to develop in the future. However, I can see a bright future ahead in which I hope we shall be increasingly regarded not only as the construction engineers for the three Services but also as a valuable instrument of government policy both in this country and overseas.

* * * * *

The 1971 Royal Engineers Demonstration

INTRODUCTION

THE Royal Engineers Demonstration is a biennial display of Royal Engineer techniques and equipments ordered by the Engineer-in-Chief. The demonstration is given to members of all three services and many associated civilians. Having in the past twenty-five years taken place at Hawley, Tidworth, Gillingham and Upnor, it now appears that the 1969 and 1971 demonstrations by the RSME at Chattenden will remain the pattern.

The demonstration is now more specifically oriented than hitherto and consists of an indoor presentation of current practice and future trends followed by a practical demonstration of techniques and equipment displays.

The 1971 Demonstration was held at Chattenden on 15 and 16 June. Two hours in the morning were spent in the Study Centre where spectators were briefed. After lunch there followed seventy minutes of demonstration of equipments and a static display.

Aim

The aim of the 1971 Demonstration was to examine the role of the Royal Engineers in the 1970s, the means by which they carry out this role and their effectiveness. The Commandant RSME, Brigadier S. E. M. Goodall, OBE, MC, introduced the subject.

Role

The role of the Royal Engineers is to provide support to all three services. Over the past 100 years the emphasis on how much support we have given to each has changed. At one time about one-third of the Corps was in direct support of the Royal Navy on submarine mining defences.

The earliest days of military flying from 1871 until the formation of the Royal Flying Corps in 1912 were in the hands of the Royal Engineers.



Plate 1. Submarine minelayer.



Plate 1a. Early military aircraft.

Today our support for the Royal Navy is more limited, but we have Sappers in support of the Commando Brigade and we have also carried out specialist survey work for Polaris submarines. As far as the Royal Air Force are concerned we now have responsibility for the construction and repair of airfields and airfield services in certain theatres and also airfield support for Harrier.

Today the role of the Corps can be examined under three distinct tasks.

Tactical Engineer Support

The first is tactical engineer support to the Army in the field, and this is our primary raison d'être. It is largely concerned with preparing the battlefield to enable the Armour, Infantry and Artillery to destroy the enemy more effectively. This we do by impeding the mobility of the enemy and improving that of our own forces.

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The 1971 RE Demostration 1,1a.





Plate 2. Polaris submarine.

Plate 2a. Harrier.

Strategic Support

Our second task can conveniently be termed strategic support. We provide engineering services both to the Army and the Royal Air Force in Germany in the event of war, in Joint Operations overseas including a NATO Flank, and in situations where the Department of Environment are unable to operate in peace, such as in Salalah at the present time.

Ancillary Engineer Support

Thirdly, the Corps provides what may best be described as ancillary support to all three services, and the most important of these are:

Survey—in which the Royal Engineers have the responsibility of providing maps, aeronautical charts and geodetic and survey data required in peace and war by all three services and Civil Aviation.

Explosive Ordnance Disposal—This covers a wider field than bomb disposal and includes the disposal of terrorist devices, guided missiles and NBC weapons as well as bombs and mines. All three services have their own EOD units and specialists, and the Royal Army Ordnance Corps also operates in this field. Much of the training is common to all and there is a Joint Services Ordnance Disposal School at Chattenden. The Royal Engineers are mainly concerned with enemy aircraft bombs where earth moving is a big feature, and the systematic search of large areas of ground such as minefields.

Finally, the Royal Engineers provide a Postal and Courier Service for the Royal Navy, Royal Air Force and Army overseas, Her Majesty's ships in home waters, and sponsored civilian organizations.

Additional Tasks

By virtue of its existence for the three tasks already outlined, the Corps can and does provide the Government with a disciplined force of engineers which has specialist characteristics and skills in terms of mobility, rapid communications, quick reaction and versatility. This has, therefore, brought additional tasks to the Royal Engineers. Where the training benefits are obvious we can and do undertake operations in support of overseas aid schemes such as the bridge built by a Field Squadron in Ethiopia two years ago, and the airfield built on Beef Island in the West Indies.



Plate 3. Ethiopia.



Plate 3a. West Indies.

The 1971 RE Demostration 2, 2a,3,3a

General engineer support can be provided in cases of natural disaster both at home and overseas. As someone once cynically said: "There is nothing like a good disaster to raise the morale of the Royal Engineers." An example of this was the replacement of bridges washed away during the floods in England in 1968.



Plate 4. Flood relief.

We also participate in the military aid to the civil community scheme in this country with the purpose of keeping the Army in the public eye. A typical project is the airstrip which is being built on the Isle of Skye at Broadford in order to improve island communications. These projects are not only good training for us, but they enable the customers, who are carefully chosen, to pay considerably less for the project than if they went to a normal contractor.

Royal Engineers can, of course, also be used in support of Government policy in moments of crisis such as industrial disputes. Specialist skills are available, and should it be necessary we can help run power stations, pumping stations, and other utilities and man standby generators for hospitals, etc.

EFFECTIVENESS

The underlying theme for the examination of our role is effectiveness. In terms of military engineering this is a difficult word to define; in essence it is an ability to provide the engineer support required by the three services within the rigid time factors they lay down and within the increasingly stringent limits of manpower and logistics. In addition it is possible to comment on the cost effectiveness aspects of having a force for military purposes which can be used on other Government business. Effectiveness requires close examination as it is fundamental to all we do. *Time*

Clearly the most important factor for all strictly military tasks is time. Unless we do our work within the tactical or strategic time limits set, not only is our part of the operation a failure, but the whole outcome may be prejudiced. In every sphere of engineer activity there is an ever-growing demand as years go by to reduce the time a job takes. An examination of the problems of tactical military bridging makes it quite clear that in World War II, without the Bailey Bridge, the Engineers would have been unable to compete under the exacting conditions imposed by mobile armoured



Plate 5. Amphibious bridge. 100 m in one hour.

The 1971 RE Demostration 4 & 5

forces and increasingly heavy and responsive firepower. Now in its turn, the Bailey Bridge has been outdated by modern battlefield conditions, and we have been forced to provide a replacement to meet much more stringent time limits.

Manpower

The next factor is manpower and this becomes more critical as each year goes by. As the overall availability of manpower decreases we have to reduce the number of men required for any individual task. We must also look critically at the degree of special skills or training required by the men themselves. Although we can and do achieve high standards of training in all Regular Army, the need for specialists in any particular operation is an adverse factor as it reduces the overall flexibility of engineer support.



Plate 6. 100 ft Class 60, 720 man hours.



Plate 6a. 30 m Class 60, 36 man hours.

Logistics

Related to manpower is the need to keep to a minimum the amount of equipment and transport support needed for an operation. This applies equally both in tactical and strategic tasks. In the tactical field it is something we have to keep in mind continuously since Engineers tend to use a large amount of stores, particularly in the early stages of any defensive war. From a strategic point of view the limitations may



Plate 7. 14-8 tonnes

es Equivalent to

Plate 7a. 8-4 tonnes

be even more severe due to a shortage of shipping and air lift and they have in part contributed to the British Government insisting on maximum host nation facilities before considering operations overseas. We have paid too little attention to research and development in the field of strategic support and are, perhaps, pricing ourselves out of this market.

Cost

Cost is the final factor and the one which tends to outweigh all others. Given unlimited money, modern technology can overcome most problems and meet the military requirements of the day. But effectiveness means value for the money that can be spared, and here we have to take our turn in priorities not only in the Army but across the whole field of Government expenditure. It is not easy to get a true

The 1971 RE Demostration 6, 6a, 7, 7a

measure of cost effectiveness when talking about military engineering equipment or techniques, but there are two indicators which can be used as a guide. Firstly, we can relate the cost of a new item to the savings which it achieves compared with obsolete equipment in terms of manpower and logistic support as well as the cost of the equipment itself.

Secondly, we can relate the cost of the item to that of any related store or equipment which it serves or helps. For instance the cost of 30 m of Medium Girder bridge is about £100,000, quite a lot of money, but if related to the cost of one of the Chieftain tanks it can carry, the bridge appears to justify its existence.



Plate 8. Chieftain on MGB.

ENVIRONMENTAL FACTORS

Before any examination of techniques and equipment which the Royal Engineers use to carry out their tasks it is necessary to see how the conditions under which they work are changing.

THE TACTICAL SCENE

Surveillance

If we look at the tactical scene first, it is in the field of surveillance in which some of the more significant changes are taking place. We as military engineers, are always extremely conscious of enemy surveillance, firstly because our work of necessity ties us to a fixed area for an appreciable period of time, and secondly because our preparations to a certain extent provide a framework for our own commander's plan, and this could be prejudiced if the signature of our work were seen by the enemy too early. Formerly, and still to a large extent today, we have relied very much on the cover of darkness for our more sensitive activities. We can, however, no longer rely upon having the whole night to conceal our intentions and we must in the future be prepared for the enemy to discover our activities in an ever decreasing space of time. This means, that for instance, we are now very limited in the amount of time we can afford to spend on obstacle crossing operations, or for instance on certain defensive activities such as minefields whose exact location we do not wish to give away, and on forward operating strips for VTOL aircraft. This surveillance



Plate 9. Camouflage APC.



Plate 9a. Deception tank.

The 1971 RE Demostration 8, 9, 9a

threat is becoming more and more difficult to defeat in spite of improvements in camouflage systems, and we are forced to go more for deception as well as speedy completion of tasks. Since we are approaching the limits to the speed at which we can complete some operations, the time has also come when we must look at the Engineer work more in the context of the operation as a whole and devise a matching tactical deception system at the same time as we develop new equipment. This may, require more equipment and more manpower to operate it, and so immediately affects adversely our overall effectiveness, but it would seem to be something which we can no longer afford to ignore.

Response Time

Another tactical factor of extreme significance to Engineers is the response time of both conventional and nuclear artillery once our activities and intentions have been discovered. This response time is steadily decreasing and, therefore, demands that we should shorten the time we spend on any particular task in any particular area, and that we should reduce the number of men for any one task to a minimum.

Enemy Numerical Superiority

The numerical superiority of the Warsaw Pact Forces over those of NATO, particularly in armour, is a fact of life which has been with us for many years and it is nothing new, but it does underline the fact that the Engineers have to provide all the assistance they can so that our direct and indirect fire weapons can be used to maximum effect. To sum up, the trend in the tactical environment is always towards more stringent conditions under which the Engineer must operate. Although we have much excellent equipment coming into service, we cannot afford to be complacent. The future will clearly pose many difficult situations which we must solve if we are to retain a degree of effectiveness comparable with that which we shall have with our new equipment.

THE STRATEGIC SCENE

Let us now look for a moment at the strategic scene. A forward defence strategy allows Engineers little time to creat obstacles and therefore as much advantage as possible must be taken of the strategic warning period before General Alert. The Czechoslovak crisis of 1968 underlined the difficulty of interpreting correctly the warning indicators and therefore Engineers must improve their techniques in case we do not get the amount of warning we expect.

Concentration of British forces in the United Kingdom places more reliance on strategic mobility for all defence tasks outside Central Europe. This in turn demands efficient airfield engineer techniques to ensure full operability of airheads. Furthermore, the Engineers require a number of general capabilities in construction engineering so that they can meet any unforeseen demands when a force is sent overseas. Time will always be vitally important and we must be continually looking for new techniques which can enable us to meet the very strict time limits which will prevail.



Plate 10. Airfield pavement.



Plate 10a. Bulk fuel.

The 1971 RE Demostration 10, 10a

THE ROYAL ENGINEERS JOURNAL

The threat of enemy damage to our permanent airfields is serious. Techniques are required both for the rapid repair of runways so that they can be kept in service when subjected to bombardment, and also for the support of the Harrier aircraft force which gives the RAF the capability of operating away from its more vulnerable airfields.

THE POLITICAL SCENE

On the political scene the gap between rich and poor countries seems to widen as the years go by, and therefore the requirement for overseas aid to continue. It is highly desirable that the money available should go as far as possible and there is, therefore, an advantage in employing Royal Engineers on engineering works when the task is suitable. Traditional political ties have in the past tended to direct Royal Engineers towards Commonwealth countries, but this pattern has recently been changing and we have been employed in the last two years in Thailand, Ethiopia, Tunisia and in the Congo.



Plate 11. Thailand.

Plate 11a. Malta.

Peace has not yet broken out and the British Army therefore seems likely to be involved in peace keeping operations in the future. The value of using troops who can contribute materially to the local economy by doing engineering projects as well as providing a stabilizing presence was shown in Anguilla, and there may well be scope for this in other countries in the future. There are, therefore, circumstances in



Plate 12. Anguilla.

which Royal Engineers can be used in peaceful support of foreign policy provided the situation is right and the task is of value for military training.

THE INDUSTRIAL SCENE

In the industrial and technological scene the introduction of modern management techniques and the use of computers for engineer design, stock control, storage of information, etc, is beginning to make an impact. We have a long way to go as yet,

The 1971 RE Demostration 11,11a,12

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but the future holds promise for sharpening our reaction time and effectiveness. In recent years there have been great improvements in the materials available for engineering, and this has brought significant advances to our engineering equipment, particularly in the bridging field. There is good reason to expect that this trend will continue and there are still many types of equipments and engineering techniques for which we would welcome a break through.



Plate 13. AVLB 23 m span. New steels for modern bridging.

On the other hand, the enormous escalation of costs for equipment and stores means inevitably that with each generation we tend to get a smaller quantity for our money. We have, therefore, always to make significant improvements in terms of effectiveness, and must look for more international collaboration in Engineer equipment.

One final aspect of the changing industrial scene is the increasingly serious impact of disasters as civilization becomes more complex. It seems to us that there will be a continuing need for Engineers who can react quickly to a wide range of disasters, both natural and man-made, and in particular that there will be a requirement for the Government to have at their call Engineers who can manage, repair or temporarily replace public utilities of all kinds and effect temporary civil engineering works.

CONCLUSION

In conclusion there is one final point. Being an all Regular force we can achieve high standards of training. We believe that it is the very quality of our soldiers, both Regular and T & AVR, which probably does more than anything else to contribute to our effectiveness as a Corps today.

Engineer Operations in Northern Ireland August 1969 - February 1971

LIEUT-COLONEL J. F. M. GREAR, RE, AMBIM

BACKGROUND

THE root causes of the present disturbances in Northern Ireland are difficult to understand without a deep study of Irish history. These Notes offer no explanation, but for those who wish to be better informed a short list of books is included at the end of this text. Suffice it to say that civil and sectarian unrest, so often an unfortunate feature of life in Northern Ireland, became such a serious threat to the well-being of the community during 1969 that the Army was called upon to assist the civil authorities in maintaining law and order.

In mid August 1969 a formidable build up of troops began. By the end of the month the garrison had increased from 3 to 9 Infantry Battalions. 3 Field Squadron arrived on 18 August and was based at the Antrim Bridging Camp.

AIM

The aim of these notes is to publicize the scope of engineer support given to the Security Forces in Northern Ireland since August 1969.

No attempt has been made to present a chronological list of engineer activities. Rather, the work of the Sappers is highlighted under several generic headings namely:

- (a) Accommodation
- (b) Security of Tactical Bases
- (c) The Peace Line
- (d) Border Activities
- (e) Operational Support
- (f) Miscellancous Engineer Tasks
- (g) MACC and Community Relations
- (*h*) Training Assistance
- (j) Stores
- (k) The Infantry Role

ACCOMMODATION

The building, refurbishing and maintenance of emergency troop accommodation is the responsibility of the Department of the Environment. However, in the everchanging situation in Northern Ireland, the Sappers deploy a considerable effort in this field. Our relationship with DOE is cordial and helpful. We act in any one of the following roles and circumstances:

(a) As a sub-contractor for the DOE.

(b) As the principal contractor, with DOE coping with public services only.

(c) In the refurbishing of existing structures where speed is the essence.

(d) In construction, to specific military requirements, where location or security aspects rule out DOE participation.

SECURITY OF TACTICAL BASES

Units in Northern Ireland are provided with tactical bases in their areas of influence from which their HQs and sub-units can observe and operate. They are also provided with firm bases for their echelons. A wide variety of premises are used for this purpose: RUC stations, factories, bakeries, schools, halls and shops are examples. They have one thing in common—the need for them to be made secure. Included in the means adopted to achieve security are:

(a) Perimeter fences, perimeter lighting and area lighting.

(b) Sealing or protection of windows and doors by brickwork, sheet steel or XPM as appropriate.

(c) Construction of sentry posts, sangars, roof-tops OPs and elevated watch-towers.

(d) Installation of alarm systems.

Sappers are involved in all the above tasks with the exception of perimeter fencing and lighting of long term firm bases, and even at these it is sometimes necessary to precede the DOE permanent fence with a temporary fence. Many sandbags are used and experience has shown that infantry working parties require the closest RE supervision if a reasonable standard is to be achieved. Sandbags, even of the proofed variety, have a short life, and it has been found desirable to cover all but the most temporary constructions with a skin of CGI. Locations change frequently with the altering situations making security work a continuous commitment. The maintenance commitment is also considerable.

THE PEACE LINE

The Peace Line is a barrier which runs across about one and a half miles of the city of Belfast between the Shankill and Falls Roads. Its purpose is to assist the Army in its task of keeping the opposing factions apart. It was built in September 1969, when every foot of its route had to be haggled over. The negotiators included the Deputy Director of Operations, local MPs, priests, representatives of the City Corporation and on each side large, vociferous crowds. The accuracy of the frequently displayed slogan "NOT AN INCH" was amply demonstrated.

Initially it was proposed to use Type 1 catwire fences with the pickets concreted into the road surfaces but in many places stronger construction had to be substituted, such as a double 9 ft high CGI fence on steel uprights with the space between the skins filled with rubble. The Peace Line is covered by watchtowers and other OPs of engineer construction. Since its inception it has required constant maintenance, modification and repair.

In July 1970 a subsidiary peace line was built further to the North in the Ardoyne area to seal off the side streets giving access to about half a mile of the Crumlin Road. A rapid swoop by the whole of 9 Indep Para Sqn RE, timed to begin after the local menfolk had left for work, enabled the task to be completed in less than a day and without opposition or argument as the locals did not have time to react.

BORDER OPERATIONS

The border between Northern Ireland and Eire is about 330 miles long and is crossed by 193 roads and tracks. Only 19 of these roads are officially approved crossing places; a further 12 roads are permitted to be used as a concession to people living in the area. The border follows the old county boundaries and is very poorly defined.

One of the first tasks of 3 Field Squadron RE on arrival in August 1969 was to recee the entire border and to plan how it might be closed. The plan produced included the use of both cratering charges and metal spikes. A modified plan was later produced using spikes only.

In August 1970 it was decided to implement this plan in part, and fifty three crossings were spiked. The 'Mark 1' spike consisted of assymetric tripods welded up from 4[‡] in by 1[‡] in BSB and concreted into the road. Local reaction in some places was promptly to remove these, and they were replaced by blocks of steadily increasing size:

Mark 2-40 gallon drums filled with concrete, with steel tubes running through the centre extending 5 ft below the road surface.

Mark 3-15 cwt concrete blocks, fixed as for Mark 2.

Mark 4—15 cwt concrete blocks with SWR strop cast in, the strop fixed to a steel beam concreted into a trench across the road.

All these were removed in turn, the opposition deploying earth moving plant where necessary. The requirement to avoid a confrontation which might result in a pitched battle prevented the use of standing guards, and visiting patrols were insufficient to prevent interference. Concrete rarely had time to harden.

A change in political thinking in October 1970 lead to the subsequent despiking of the border. The lesson from these activities is already well known to military engineers—an obstacle is only effective when covered by fire. We have now amply demonstrated this to a large section of the Army.

OPERATION SUPPORT

In addition to those operational support tasks, dealt with in more detail elsewhere in these notes, Sappers also carry out the following:

- (a) Barricade clearance, using plant.
- (b) Assistance with searches.
- (c) Combat engineer support to RAOC EOD teams.
- (d) Operation of searchlights.
- (e) Emergency repair of damage using military equipment.

The Allis Chalmers MWT, with its great manoeuverability and versatile 4 in 1 bucket, has proved ideal for barricade clearance. In the situations in which it is often deployed it is essential for the supporting infantry to have contact with the operator and for this purpose tank telephones have been fitted. The operator requires protection by means of XPM and/or Makrolon (a transparent industrial polycarbonate sheeting), and protection must also be provided for the vulnerable hydraulics. Vehicle protection kits have been evolved for all common user vehicles.

MISCELLANEOUS ENGINEER TASKS

Included in a variety of tasks which cannot be discussed in detail have been:

- (a) Installation of remote controlled barriers at border crossings.
- (b) Laying of trackway and assistance with unloading of LCTs across beaches.
- (c) Installation of alarm devices at certain public utilities.

MACC AND COMMUNITY RELATIONS

RE participation in Community Relations activities is under three headings:

- (a) Military Aid to the Civil Community.
- (b) Assistance to unit sponsored schemes.
- (c) Assistance to Stormont with youth activities.

MACC tasks have not been numerous in the past, and those that have been carried out have mainly been concerned with the use of military equipment, such as bridging and trackway, to meet some temporary requirement. Both regular sappers and T & AVR have been used on these tasks.

The only major MACC task recently undertaken was the building of a community centre in Brooke Park, Londonderry. For this a Romney and a Nissen hut were used as a basic shell. One field troop completed the task in four months, including making good the damage caused by a serious fire which occurred when the project was half completed. Detailed planning for this project was done by 62 CRE Construction. The task provided valuable experience for the troop officers and NCO's and for individual tradesmen. The total cost to the sponsor was approximately £10,000, of which £2,300 was the Army bill for extra costs and the remainder was for materials. The main lesson learned was the need to ensure that the materials specified are in fact supplied and used; had the specified flame resistant lining been used the consequences of the fire would have been much less severe.

Unfortunately during the night 2/3 June a bomb attack on the Centre caused very serious damage which put this valuable and well used amenity out of commission for some time. The repair of the damage was undertaken by the local authorities.

Three main problems arise in dealing with MACC applications:

(a) The difficulty in obtaining the required insurance cover and indemnity, particularly in respect of demolition tasks.

(b) The difficulty in fulfilling all five conditions which must be met before MOD will agree to work being undertaken for a private concern.

(c) The existence in Northern Ireland of various unemployment relief schemes, whereby grants of up to 100% of materials costs are made to projects which will provide extra employment. This makes Army assistance uneconomic for sponsors.

The first of these difficulties has led to the ending of applications from the National Trust, for whom many worthwhile tasks might have been done. The second has caused the loss of valuable training tasks because they could not be shown to have social value. This is particularly unfortunate when the potential sponsor is only nominally profit-making, as in the case of Northern Ireland Railways.

Unit Schemes

We have been able to assist in numerous unit sponsored schemes under the Community Relations banner. These range from adventure playgrounds to discotheques. The help provided is generally in the form of a few tradesmen or plant. We do not as a rule take on schemes of our own as this would tend to defeat the object of sponsorship by the unit intimately concerned with the area and its populace. However, RE technical staff can and do help with the planning of such schemes.

Enterprise Young Ulster

Under the sponsorship of the Northern Ireland Government an extension of the regular unemployment relief schemes was launched in April 1971. It is called Enterprise Young Ulster. Its aims are to offer paid employment to youths between the ages of 16 and 22 recruited from all sections of the community whilst at the same time instilling some degree of civic responsibility into the participants.

On the grounds that the scheme is to be wholly bi-sectarian the Army has agreed to provide background technical assistance during the life of the scheme. This year, to support a work force of 100, the Sappers are providing one officer and four NCOs for 6 months, engaged under the extra costs provisions of MACC. CRE Northern Ireland is charged with the overall technical planning and supervision. Two schemes, one in the Lagan Valley on the southern outskirts of Belfast and the other near Bangor, have been selected for this year. Stormont hope to increase greatly the scope next year, although no decision can be made until the pilot scheme is under way.

TRAINING

RE provide the following training assistance:

- (a) Search team training courses.
- (b) Watermanship training, including operation of outboard motors.
- (c) Mine detector training.

Four day courses are run to train unit search teams on the minimum basis of one team per sub-unit for all units in Northern Ireland. The RUC also sends students to each course. The course includes elementary building construction, use of mine detectors and tools, booby traps, legal aspects, recognition of explosives and the methods of conducting a systematic search.

The following equipment has been found to meet most requirements of a unit search team (NCO plus 6) and standard packs have been made up for issue to all units in Northern Ireland:

- 2 Mine detectors
- 6 Mine prodders
- 4 Flashlights
- 2 Mirror attachments (fitted to prodders)
- 1 Magnet
- I Demolition ladder (less top section)
- I Lashing
- 1 50 ft pulling cord with hook

- 2 Jemmies
- 1 Claw hammer
- 2 Screwdrivers
- 1 Cold chisel $\frac{1}{2}$ in cut
- 1 Mash hammer
- 1 Pliers sidecutting
- 1 Linesman belt
- 12 Clearance certificates
- 50 Tie on labels

STORES

Local engineer stores support is provided by 325 Engineer Park. This unit is normally entirely civilian staffed apart from the OC and one WO I, but it has been reinforced by an emergency increment of up to seven military to enable it to operate round the clock. Apart from handling large quantities of defence stores and building materials the Park has also undertaken manufacturing tasks within its limited capability. With assistance from the resident field squadron it has made knife rests (about 3,500), sign boards for road blocks and road spikes.

Larger manufacturing tasks have been passed to Central Engineer Park, who have responded quickly to requests for a wide variety of items, often in considerable quantity, including crush barriers, 'cow-catchers' for vehicles, signs, caltrop chains,¹ sentry boxes and picquet huts. The latter are useful prefabricated, two-man shelters which may well have applications elsewhere.

The Park's normal holdings of plant and mechanical equipment have more than doubled to meet the emergency.

THE INFANTRY ROLE

33 Field Squadron, and now 21 Engineer Regiment (1, 4, 5, and 42 Field Squadrons), have been deployed in Northern Ireland in the infantry role. This has been necessary to help to relieve the pressure upon the available infantry battalions, some of whom are returning for their second emergency tour. The RAC and Gunners also take their turn. Their performance has been noteworthy, but experiences and the lessons learnt are not properly within the scope of these notes.

The resident field squadron has had on occasion to adopt the infantry role. Whilst it is always ready to do so when ordered, the commitment is not readily accepted for two main reasons:

(a) Equipment, particularly radios compare unfavourably with infantry units.

(b) The dislocation to normal works is severe.

It should not need stressing that the Sappers must always be prepared to provide their own protection parties. In practice, however, it is the custom for protection of Sapper working parties within the urban areas to be provided by the local infantry units. This clearly increases the work output of a troop.

CONCLUSION

The established Sapper strength in Northern Ireland is one field squadron which rotates at four month intervals. This compares most unfavourably with the usual Sapper support and recently it has been found necessary to reinforce with a second squadron (on a two troop basis).² Despite this, the volume of work that has been done is impressive and there is no chance of it becoming less.

Most tasks are at section level or less. Indeed, a troop task is a rarity. The training value to the young NCO and officer is obvious and unlikely to be met elsewhere. There is considerable variety in the jobs undertaken and it has been heartening to see

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² These are spiked devices for puncturing vehicle tyres.

² Since this article was written a second field squadron has been added. This squadron also rotates at four month intervals. 20 and 23 Fd Sqns have as a result also served in Northern Ireland.

tradesmen consistently employed in their trades as well as in the combat engineer role.

The situation has given the Corps the unique opportunity of impressing upon a very large section of the Army its skill and versatility. The Squadrons who have served here (3, 8, 9, 60 and 34 Sqns) have made full use of this chance and have proved again that a busy Sapper is a happy Sapper.

List of books recommended for background reading:

Divided Ulster, Liam de Paor. Drums and Guns, Martin Wallace. Holy War in Belfast, Andrew Boyd. Ulster 1969, Max Hastings. Fires over Ulster, Patrick Riddell. The Importance of Being Irish, Alan Bestic.

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Polex 70

LIEUT-COLONEL M. G. L. ROBERTS, MBE, RE

INTRODUCTION

POLEX 70 was an exercise to try out the partially new Emergency Fuel Handling Equipment which the Corps has had under development for some time, but which had not previously been used to convey aviation fuel from a tanker offshore to an airfield where aircraft were actually to fly with it. The object of the exercise therefore was to prove to the RAF, and to everyone else concerned, that this equipment could deliver fuel in the quantities and of the quality required, and to demonstrate this beyond any doubt by fuelling operational aircraft directly from the system.

The exercise took place during September and October 1970 in the Tayport area of Fife where the equipment was used to carry some 270,000 gallons of aviation turbine fuel from the RFA tanker Green Rover through fourteen miles of pipeline to Lightning aircraft operating from RAF Leuchars. All three Services and several different cap badges were involved; in outline those who took part were as follows:

KN		KFA Green Rover
ARMY	RE	RHQ 38 Engineer Regiment
		516 Specialist Team RE (Bulk Petroleum)
		11 Field Squadron and troop 48 Field Squadron
		Detachment 15 Field Support Squadron
	RCT	Transport from 27 Regiment and 17 Squadron
		Marine Craft from 17 Port Regiment
	RAOC	180 Petroleum Bulk Operating Platoon
		Detachment Army Fire Service
	REME	Detachment 38 Engineer Regiment Workshop
	AAC	One Alouette helicopter
RAF		RAF Leuchars
	38	One Wessex helicopter
	Group	•

In all from the Army there was a total of some 450 men, 82 vehicles, 16 items of plant and 15 marine craft, although not all were present all of the time.

DESCRIPTION OF THE EQUIPMENT

The layout used in the exercise is shown at Plate 1. The tortuous course pursued by the pipeline was dictated by the need to achieve a sufficient length to test the equipment adequately. Very briefly it can be thought of as having three constituent parts, each of which could be employed independently if required.



The Ship to Shore Line

This is an 8 inch internal diameter flexible hose which is laid on the sea bottom. It is floated into position and sunk by filling it with water. The word flexible is to some extent misleading because it comes in 25 ft long sections which are bolted together and weigh half a ton, so that they are not easy to handle. Fuel is pumped by the tanker through the ship to shore line and through a length of aluminium piping to the shore storage area, where it is stored in 30,000-gallon flexible tanks. An alternative method of getting fuel ashore is provided by a beach discharge system employing dracones.

The Pipeline Proper

From the shore storage area the fuel is carried by 6 in victaulic aluminium piping to storage areas on and near the airfield. It is pumped by Morrison Dorman pumps, which are designed to deliver 450 gallons a minute at a pressure of 200 lb per sq in, and are normally operated in pairs. These are located at the shore storage area and at a booster station if required.

The Hydrant System

This is a complex system located on the airfield which provides final filtration and delivers the fuel at an automatically controlled pressure and rate of flow through any of four dispensers.

The whole system is designed to deliver 450 tons, or 135,000 gallons a day.

THE CONSTRUCTION PHASE

A great deal of the construction phase went like clockwork, partly due to the excellent planning carried out by the special planning team which had been set up at Barton Stacey six months previously, but in order to keep this article to a reasonable length I will largely gloss over those aspects which went well in order to concentrate on those where difficulties were encountered. These were almost all concerned with the ship to shore line. Unloading of the some 600 tons of stores from seven trains and unpackaging them and distributing them to the site, although at times the stores control organization was strained almost to the limit, went virtually without a hitch, as did construction of the whole of the shoreward part of the system. This part of the exercise, from the time of arrival of the first train, was completed in three weeks, exactly according to plan.

It was known from the start that the ship to shore line might present problems. The Tay Estuary is notoriously difficult for shipping and the weather at the beginning of October was not expected to be good, so that although a trial had been carried out it was by no means certain that the tanker would be able to anchor successfully. The tidal current to be expected of 3 to 4 knots, which in the event proved to be even greater (up to 5 knots), was close to the limit considered tolerable for construction. A further hazard was that there was not room to launch the ship to shore line in the normal way off the beach. Instead it had to be constructed and launched from a slipway in the harbour and the shoreward end then floated round to its proper position outside the harbour. Since the harbour dried out at about half tide this meant launching at high water, holding the 2,500 ft length of submarine line in the tideway for some three to four hours until the next slack water at low water and then extending it to its proper position, anchoring it and sinking it by flooding it with water from the shoreward end.

In the event conditions for construction and launching on 18 September proved almost ideal and thanks to good previous training the whole operation went better than anyone had dared hope, although it was found that the two RCT workboats, which were intended for the purpose, were only just able to maintain control of the floating submarine line in the tideway with both of them towing together. However a few days later the Dundee Harbour Board complained that the end of the pipeline, which was marked with a yellow buoy, extended too far into the shipping lane, although the Board had not previously expressed any anxiety when it was explained



Plate 3. Divers attaching anti-roll bars to the ship to shore line.

Polex 2 & 3



Plate 4. Launching the ship to shore line.

to them that it could not be precisely positioned. However it was agreed to move it and decided that this would be done by refloating it by filling it with compressed air and sinking it again after repositioning it. It was from this moment that our difficulties began. The weather by now (28 September) had deteriorated; fog came down during the operation and there was also a temporary failure of communications to the marine craft, which hampered control, but the main problem was that it proved much more difficult than anticipated to raise the pipeline anchors. The absence of a satisfactory lifting device in any of the craft was crucial. In addition, due to a shortage of SWR, cordage had been used for some buoy lines and these frequently broke; this meant sending down divers to disconnect the anchor chains from the pipeline and rebuoy the anchors so that they could be recovered later, a hazardous operation, which could not be done at all when the tide was running strongly, because of the risk to the divers created by the current. In consequence of all this it proved impossible to complete the operation in time before the full flow of the flood tide and it was necessary to sink the pipeline quickly while it was still under some degree of control. Although the end finished up well clear of the shipping lane, it was not in the planned position. None the less the position appeared to be a satisfactory one and it was decided not to attempt to move the pipeline again until the tanker arrived, when it could if necessary be moved, an operation which should prove easier, because the ship could be used to maintain control of the seaward end.

The tanker arrived on the evening of 1 October and the following day anchored up in readiness to connect up to the ship to shore line, which it was intended to refloat and bring alongside the ship with the aid of the ship's winches. However the weather now deteriorated sharply and as a result of gale force winds during the night of 2 October the tanker dragged all four of her anchors and went hard aground on a bank up river. She was clear again by dawn with the aid of tugs, but had had to cut loose both her stern anchors, her stern capstans having been damaged by the load placed on them. Attempts were now made to reposition the ship using her bow

Polex 4

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anchors only, but it was a forlorn hope. It proved virtually impossible to position her sufficiently accurately and once in position she could only remain there whilst the tide was on the ebb. This meant that there would barely be more than an hour or two left for pumping fuel, before the pipeline would have to be disconnected until the next tide. In the early stages of attempting to position, the ship had dragged her anchors certainly close to, if not actually across the pipeline. Whether from this cause or some other is not known, but when a connection was finally made it was found that the pipeline had been severed some 900 ft from its seaward end.

The weather now became worse again and with some difficulty the two severed parts of the pipeline were sunk before conditions became impossible for the workboats. Gales were forecast and the tanker moved off out to sea, which at least gave a breathing space in which to decide what to do next. Somewhat unhappily this moment (6 and 7 October) coincided with the two principal visitors' days; these had been planned a long way in advance, there was no possibility of changing them and it was felt undesirable to cancel them. However the coincidence of the visitors' days did have one great advantage, the senior visitors from Headquarters Engineer in Chief and Engineer Support Group were able to help in finding a solution to the problems of the ship to shore line. A further 1,000 ft of the submarine line was ordered up from Long Marston and by dint of driving continuously all day and night, trucks carrying it arrived on 8 October. At the same time agreement was obtained for the tanker to moor up to two port emergency buoys, 3,100 ft off Tayport harbour, and to remain for longer than originally planned.

Meanwhile great difficulty had been experienced in recovering the two severed sections of submarine line, partly because of the weather, which continued to provide conditions which varied from difficult to impossible, and partly because of the problems of freeing them from entangled anchor chains and other obstructions and of finding a means of bringing them to the surface. In the case of the seaward end the main problem was how to inflate it with compressed air in order to float it. Various solutions were considered, including running a very long length of airline from the



Plate 5. Main line pumps at the shore storage area. The 30,000-gallon storage tanks can be seen behind the pumps.

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Plate 6. An improvised crossing for the 6 in aluminium piping over a footpath.

tanker, which entailed borrowing an incredible number of lengths of air hose from the Naval Dockyard at Rosyth. Eventually someone had the bright idea, which proved highly successful, of loading a compressor into a DUKW. However all of this took a long time, partly because it was not safe for the divers to work at anything but times of relative slack water, during daylight and when weather conditions were at least fair, if not good. The shoreward end proved very much more difficult to recover than expected for a reason that did not become apparent for some time; when the line had broken a section of very tough steel wire lining had been dragged out from inside it and this snagged on the bottom when the pipeline was afloat in shallow water. However by keeping it continuously afloat by blowing air through it for some hours it eventually drifted onto the mud on the ebb tide. It was then possible to remove the severed end and substitute a blank flange with a non return valve in it. After this no difficulty was experienced in refloating it, towing it round into the harbour and delaunching it.

Finally on 9 October 3,000 ft of 8 in submarine pipeline, with 400 ft of a 6 in more flexible pipeline (known as Admiralty hose) borrowed from the tanker and fitted to the seaward end of it, was successfully launched and connected up. The decision to use the Admiralty hose was made for two reasons. Firstly because it gave much greater flexibility in the positioning of the end of the 8 in submarine pipeline and secondly because it had been found that the latter was extremely cumbersome and awkward to lift up from the sea bottom and connect to the tanker's manifolds. One problem was encountered which was instructive. Once the pipeline had been connected it was tested with water up to about 60 lb per sq in; it was held at that pressure for several minutes without any sign of a drop in pressure. None the less as soon as fuel was pumped through it from the seaward end a leak appeared. This was found to be due to a coupling on the Admiralty hose having become partially opened. These couplings are different from the 8 in pipeline couplings and close by a twisting action; it seems almost certain that the hose having been previously twisted had un

Polex 6

twisted under the pressure of the fuel, undoing the coupling. When the pressure from the shoreward end was applied the effect of course would have been to place pressure on the twisted hose in the opposite direction, closing the twists so as to prevent any flow and holding the couplings closed. The original twisting of the hose must have occurred when the pipeline was being towed by the workboats, the simple solution to which would have been to have towed with a swivel, a common naval practice, but one which regrettably did not occur to anyone until after the event.

LESSONS LEARNT FROM THE EXERCISE

Perhaps the most important single lesson, though it may seem obvious, is the necessity for prior liaison and thorough training where more than one Corps or Service is involved. This is not to say that this particular aspect was neglected, only that what had been done proved barely adequate in certain respects to meet some of the very difficult conditions found on the exercise, partly because in some cases the facilities were not available. The Master of the tanker obviously did not expect such very serious problems as those with which he was faced, involving as they did a potential hazard to the safety of his ship. Because of this it very quickly became apparent that liaison with the Master was of overriding importance, since the whole success of the exercise depended upon being able to connect the tanker up to the ship to shore line. The Exercise Commander accordingly spent virtually the whole of the time when the tanker was endeavouring to manoeuvre into position and connect up, on the bridge with the Master. This enabled decisions to be taken quickly on the spot and conveyed to all concerned by radio. Communication with the ship was not as easy as might be thought and this was one reason for the importance of having a senior liaison officer on board. Communication from Exercise HQ to the ship's radio room could only be made at pre-arranged times. Army radio sets positioned on the ship had to be located, very inconveniently, on the open deck above the bridge, to avoid both fire hazards and interference with the ship's electronic equipment, Radios were not permitted on the tank deck, so that communication with the men working on connecting the pipeline to the ship's manifold was not simple. As far as physical liaison was concerned, small craft for the purpose could not always be made available from other tasks nor was the weather or tide always suitable, whilst if a helicopter was used it entailed telling off crash and fire crews on the ship, members of the ship's complement, including the First Officer, who could not always easily be spared from other duties. Many of these liaison difficulties could have been discussed and resolved in advance if it had been possible to get the Master and desirably his First Officer as well to see both the equipment and the area of the exercise beforehand, although there are obvious problems in separating them from their ship. In the event neither was able to come ashore until shortly before their departure. In the longer term the proper solution is clearly to redesign the equipment in such a way as to provide for a simpler and more flexible connection between the ship to shore line and the tanker, perhaps on the lines of the solution eventually arrived at on this exercise.

Another area in which more preliminary training would have been helpful was that of the beach discharge system. The dracones used are discharged through an 800 ft length of floating beach hose from a pump raft offshore. Because of the delays caused by the problems with the ship to shore line, there was little time to practise this, but any decision to try out the system was further inhibited by the knowledge that the RCT workboat crews had had no previous opportunity to train with the dracones. The larger of these carried 300 tons of fuel and would have presented a considerable pollution and fire hazard if it had been punctured. In the event use was made of only a small dracone, carrying 35 tons. There seems no reason why training should not be carried out with dracones filled with water.

The RAOC personnel equally had had very little previous opportunity to acquaint themselves with the equipment and entirely due to inexperience a coupling burst in the 6 in aluminium pipeline just South of the booster station during the operating phase, causing a considerable loss of fuel. This was due to an NCO at the booster



Plate 7. An overhead crossing in the forest.



Plate 8. The booster station. The flexible tank on the left contains water for foam making for fire fighting.

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station allowing the pressure to rise too high before opening a main valve, causing a shock loading on the pipeline at the first bend after the booster station. It is understood that work is going on now to improve the training installation for this equipment at the RAOC School of Petroleum.

Although much effort went into planning the dismantling and backloading phase, it presented unexpected problems, partly because the equipment was not designed or laid out with this in mind. One relatively minor point was that it proved extremely difficult to pump the flexible storage tanks dry. In general there was too much scope for misunderstanding over both the disposal of slops and final accounting for the fuel. Slops are understood in the oil trade to mean fuel contaminated with water or other impurities. On the exercise the pipeline was finally cleared with water and since it is not possible to locate the interface between the fuel and water precisely, much of the slops consisted of water contaminated with relatively small quantities of fuel. The disposal contractor was unwilling to accept this and it had in the end to be disposed of by pouring it away, but there were then problems in accounting for such fuel as it contained. Other accounting problems were created by the absence of any means of accurately measuring quantities of fuel either on the tanker or in the flexible storage tanks. A meter installed ashore to measure the quantity discharged from the tanker was damaged early on, probably by a small pebble which had got into the ship to shore line during construction.

The acquisition of land for the exercise and the obtaining of agreement from the local authorities to the exercise being held at all had been major issues during the planning stage, which had affected the choice of site. This had some repercussions on the conduct of the exercise. Much of the pipeline was laid on land belonging to the Forestry Commission and the latter placed considerable restrictions on what could be done; other landowners also imposed restrictions, so that a tactical layout and any serious attempt at camouflage and concealment became impossible. One section of the pipeline went through a field in which there were rare fungi and special care had to be taken to avoid damage to them. It had not been at all easy to obtain a suitable site for the exercise camp, which finally was located in a field rented for the year from a farmer. It was clear from the start that this field was liable to become boggy, but it was the only site available. Sure enough a very heavy rainstorm whilst the advance party were setting up camp converted sections of the traffic circuit into a quagmire, and it was decided to move as many vehicles as possible down to an area on the shore where the stores and workshops were located. Neither the CO's nor the RSM's temper improved when some bright spark, who seemed to think that he was making good a boggy area with some solid material, dumped a load of earth which smelt like pig manure outside RHQ. Some of these problems over land might have been eased if the planning team could have been set up rather earlier allowing more time for negotiation.

Finally to give a proper balance to this account of lessons learned on the exercise here are some of the aspects to which the lessons of the past were very successfully applied:

Co-operation between the Field Squadron, the Specialist Team and the RAOC and RCT elements, none of whom had ever worked together before, went quite splendidly and the whole exercise force very quickly became a well-knit team. This involved a considerable degree of tolerance and understanding, particularly between the OCs of the Field Squadron, the Specialist Team, the RCT marine element and the RAOC Bulk Operating Platoon, but an important factor also was that responsibilities were defined in detail in the operation order issued at the start of the exercise. Any subsequent problems were ironed out at an evening conference held every day by the Exercise Commander. Co-operation with the tanker and with RAF Leuchars required a continual exercise of initiative and forebearance, primarily because of a much great mutual lack of understanding of one another's problems. Co-operation with most of the local authorities proved easiest of all, since the Tayport Council went out of their



Plate 9. The main manifold at off-station storage.



Plate 10. On station storage. The units at bottom left are the final filter-water separators.

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way to make the Army welcome; no doubt economics had something to do with this, but there was much very genuine goodwill as well, which it was a pleasure to find.

Control and Distribution of Stores. This was very carefully planned and the secret of success lay in this good planning and in the maintenance of close control during the unloading and distribution. All stores, except for the 6 in aluminium piping, were taken first to the stores area, where they were unpackaged and checked. The aluminium piping was unpackaged at the railhead, delivered direcfly to where it was required, and strung out. This avoided double handling of a major item; in the case of other items because of their range and complexity, it was essential to unpackage them first in an area where they could be recognized and properly checked. A short section of pipe was delivered packaged, by helicopter to an inaccessible area, but this method is not recommended for accessible areas, because unpackaging on the spot and stringing by hand is time consuming.

Standards of Construction. High standards of construction were insisted upon, if necessary at the expense of speed. As a result only a few minor leaks occurred and very little dirt found its way into the system, with which the incorporated traps and filters were more than adequate to cope.

Quality Control of Fuel. This was exhaustively discussed and agreed with the RAF before the exercise began and in consequence never became a problem. The RAOC tests were scrutinized by the senior expert from the MOD, who, it turned out, worked for both the Army and the RAF, so that his clearance of the fuel for use was accepted as final without any argument.

Fire Precautions. The Strategic Command Fire Adviser made a comprehensive fire plan and a most efficient Army Fire Service detachment was deployed to the exercise. All storage tanks were bunded with earth, or in cases where earthworks were not permitted by the landower, by using sections of Braithwaite tank.

Communications. These are absolutely vital at all stages and for the most part worked well. Communications for the commissioning and operating phases, which are



Plate 11. A Lightning being refuelled

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respectively the responsibility of the Specialist Team and the Bulk Operating Platoon, require careful thought because the former has no communications and the latter an inadequate scale. Furthermore fire precautions prevent the use of radios close to the pipeline during pumping operations, which must therefore be controlled by telephone; and very close control is required, particularly to deal with emergencies.

CONCLUSIONS

In spite of the tribulations with the ship to shore line the exercise was a great success. Nine hundred and fifty tons of aviation turbine fuel were delivered to RAF Leuchars and used by the Lightnings based there. This was more than enough to prove the system and kept the station going for about a week. Nor should it be thought that because there were so many problems with the ship to shore line this part of the equipment is necessarily unsatisfactory. The tide and weather conditions on the exercise were certainly as bad if not worse than the very worst for which the equipment is designed. Almost all of the difficulties encountered stemmed from the central problem of positioning the tanker very precisely and then holding it sufficiently rigidly in one position throughout the changes of the tide to permit connection to the ship to shore line to be made and maintained whilst the tanker discharged. This could largely be overcome if a more flexible connection were used between the end of the ship to shore line and the tanker, probably on the lines of the solution adopted on the exercise, with which the 6 in Admiralty hose employed provided both the flexibility required and the ease of connection to the tanker's manifold.

This cannot possibly be regarded as a comprehensive account of the exercise, which is impossible of achievement in an article of this length. Those who are interested are referred to the official report to which this article can be regarded as in the nature of a supplement. It seems fitting to end by paying a tribute to some of those responsible for making the exercise the success it undoubtedly was, even if this is not usual within the pages of this Journal.

Those that particularly deserve mention are:

RN Army	Captain J. Gould RNR RD Lieut-Colonel H. J. Goodson RE	Master of the Green Rover who headed the Planning
	Major T. S. Sneyd RE	OC 11 Field Squadron, who was responsible, with his Squadron, for construction and dismantling
	Major W. H. Donaldson MBE RE	OC 516 Specialist Team RE (Bulk Petroleum) who, with his team, covered all the technical planning and supervision
	Captain R. H. Dadswell RCT	OC Detachment 17 Port Regiment RCT, whose workboat crews in particular worked long hours under more difficult conditions than they had encountered before
	Captain A. Norman-Baillie RAOC	OC 180 Petroleum Bulk Operating Platoon, who, with his platoon, was responsible for all pumping operations

RAF Group Captain N. S. Howlett RAF

Tayport H. G. Wilson Esq Town Council Station Commander RAF Leuchars, whose station assisted in many ways, including using the fuel provided by the exercise Town Clerk, a man of unfailing good humour and helpfulness

The Ninth British Commonwealth Games Heavy Girder Footbridge

Part I by CAPTAIN (GE) D. J. MILLINGTON, RE Part II by MAJOR D. N. HALL, RE

PART I: DESIGN

THE Ninth British Commonwealth Games were held in Edinburgh from 16 to 25 July 1970. The main venue for the Games was the Meadowbank Sports Centre; a magnificent new complex of athletic stadium, games halls, cycling track, and practice area situated in the centre of the city on the north side of the main A1 trunk road.

Permanent car parking facilities at Meadowbank are limited, and it was decided that for the period of the Games the Kings Park, to the south of the A1, would be used for the temporary parking of up to three thousand cars. This meant that up to ten thousand people would have to cross the busy road four times a day, for eight days, and would create an unacceptable traffic congestion. Overbridging the A1 seemed the obvious solution, and in June 1968 the City Engineer asked the Chief Engineer, Scotland, for RE assistance with the overbridge and car park.

The reconnaissance showed that overbridging was feasible, and the Chief Engineer decided to seek expert advice. So in early 1969 the Bridging Wing at the RSME was asked to look at the proposed site to produce a design for the bridge and piers. The design was to be based, as far as possible, on standard bridging equipment. They were also asked to recommend a method of construction.

In this heavily built up area only one site, opposite the eastern end of the stadium, was acceptable. At this point there is a layby on the northern side of the road, and the overall width of the road is 59 ft 6 in. The pavement on the north side is 25 ft wide, and on the south side 7 ft (Fig 1). The ground to the north of the road is owned by the Edinburgh Corporation who agreed to lease the privately owned yard on the south side. Several vertical obstructions including telegraph poles, street lighting standards, fences, and a large hoarding were on the site of the south pier. Some of these could be removed, but others had to be avoided. The area to the north was landscaped and formed part of the Sports Centre.

Discussions were held with the City Engineer's Staff, and planning was finalized in March 1970. During the planning the following became clear:

(a.) Site restrictions

(1) The restricted space at both ends of the bridge meant that ramped approach spans could not be considered. It would therefore be necessary to use some form of stairway construction.



(2) No centre support was possible as this would restrict the flow of traffic, and constitute a dangerous hazard.

(3) The minimum span across the road and footpaths was 82 ft.

(4) The normal method of building and launching an equipment bridge could not be used.

(b.) Client's requirements

(1) The structure as a whole was to be capable of taking the maximum estimated flow of ten thousand persons in one hour, with, in the worst case, the bridge and stairway packed to capacity. This condition did in fact arise, and gave a live load of 1,400 lb per ft run.

(2) The bridge was to have a minimum underside clearance over the centre of the road of 16 ft 6 in. At this height no bridge limiting signs are necessary.

(3) The stairways were to be the same width as the bridge deck, to avoid a bottleneck effect.

(4) Steps were to have a minimum 12 in going, and a 6 in maximum rise, with not more than sixteen treads in any one flight.

(5) Any stairways over 6 ft wide were to have a centre dividing handrail.

(6) Outside handrails were to be 4 ft high, and centre handrails 3 ft 6 in high, measured vertically. All handrails to be capable of withstanding the thrust of a densely packed crowd.

(c.) Resources

(1) The structure was to be designed using the available standard RE bridging equipment stocks and other readily obtainable materials. As will be seen in the succeeding paragraphs, this factor was to have a considerable influence on the final design.

(2) Equipment held in the Engineer Park, Scotland was to be fully used to avoid high transportation costs.

The RSME design consisted of an 87 ft 6 in (six intermediate and two end bays) single single, reinforced standard width, HGB supported on 20 ton crib piers. Bailey was considered unsuitable because of the difficulty involved in building a multi-truss bridge on high piers.

Each pier was to be 34 ft wide, 14 ft deep, and 16 ft high with timber cap and ground sills. Two hundred cribs were required for each pier. This scheme was fully accepted, and work started on the outline design for the stairways and landings. This was based on bridging cribs with Bailey chess decking for the landing structures and all timber stairways. By late Autumn 1969 a provisional stores list for the bridge and piers, including the landings, had been prepared. This included 700 cribs! Initial enquiries at Engineer Support Group, Woolwich, revealed that less than 200 cribs were available, not even enough for one pier! It therefore became necessary to abandon this design for the piers and landings, and to make a completely new approach.

Standard Bailey, and HGB piers were considered in turn, but neither proved suitable, and they were rejected. The standard pier arrangements did not give the deck area required to form a landing, nor were the pier heights suitable for the bridge oblique road clearance of 16 ft 6 in. The larger number of special fittings which would have been required were not available. At this stage no simple answer to the pier problem could be thought of, so in February 1970 MEXE (now MVEE) were asked for advice. A visit was made to Christchurch and the problem was put to Mr Longbottom of the Briding Staff. The use of a composite leaf pier was suggested, and an outline design based on EWBB components was produced. This consisted of two sections; a front face or leaf of triple triple construction two panels wide, backed up by two wings or one bay of double triple construction at right angles to the leaf. The leaf section was to act as the bridge abutment, and the wings were to provide stability to the structure, and a platform for the landing. The overall width of the pier

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Fig 2. Close up of 'block and bolt' used to secure two sections of piers, taken at erection trials at Longmoor. Bolt diameter was later increased to 11 in.



Fig 3. Bridge erection trials at Engineer Park. Mills scaffold tower proved invaluable.

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thus produced was 20 ft, and therefore not wide enough to take the standard HGB, which is 21 ft 3 in between bearings. The little used narrow version of the HGB, however, has a width between bearings of only 17 ft 11 in, and fitted the pier. It therefore became necessary to change the bridge design from standard to narrow HGB. The overall height of the basic pier structure was 15 ft. By the addition of grillage of crib bearing beams at the top corners of the leaf section this was increased to 16 ft 6 in. With the normal HGB grillage beam, short, fixed on top, the distance between the top of the bridge bearing and the underside of the pier was now 17 ft 2 in. It was estimated that this would give a clearance, over the road, in excess of 16 ft 6 in. The exact clearance could not be calculated as the bridge sag was unknown.

Certain measures were specified by MEXE to give stability to the piers:

(a.) The double triple "wings" were to be tied to the triple triple "leaf" at each truss level. With the entire bridge load being imposed on the inherently unstable narrow leaf section of the pier, a solid mechanical bond to the wings was vital. It was suggested that some block and bolt method could be used. The Central Engineer Park was asked to design and manufacture the necessary parts, and this was done by 31 Base Workshop Squadron.

(b.) The ends of the wings remote from the leaf pier were to be held down either by rag bolts, by pull lift jacks between panels and dead-weighted on the ground or by dead weight (kentledge). This was necessary to counteract the considerable overturning force that might be applied to the front of the pier during bridge construction. The latter method was best suited to the site conditions and kentledge, comprising EWBB stringers (3 tons dead weight) was loaded onto the base of the piers.

(c.) The HGB bearings were to be set immovably over the centre of the leaf pier, and their loads were to be applied to the leaf pier chords at their point of intersection with the panel verticals and diagonals.

The MEXE solution to the pier problem and the consequent change to narrow HGB proved ideal, and had several side benefits. The width of the stairways could be reduced by more than 3 ft with a corresponding reduction in the considerable quantity of timber required for their construction. The dead load of the bridge was reduced by some $2\frac{1}{2}$ tons and the possible live load by approximately one-sixth. A small saving might also be possible on the construction time. Finally it provided the answer to the problem of finding a suitable surface for the bridge deck, since HGB decking units are quite unsuitable for pedestrians, and some form of covering or overdecking would have to be incorporated. Several methods had been considered, including plywood, timber boarding, and asphalt over a roofing felt skin. All were feasible, but would be expensive in money and construction time. With the change to the narrow bridge, EWBB chesses could be used. The further reduction in width of the deck, and consequently the stairways, from 15 ft 6 in to 13 ft 9 in was accepted by the City Engineer.

To get from the bridge deck to ground level, a vertical distance of 19 ft plus, at least thirty-eight steps were required. The City Engineer ruled that there should not be more than sixteen steps in any one flight, so it became necessary to introduce at least two landings, and therefore three flights of stairs on each side of the bridge. Site restrictions on the south side necessitated the use of three landings and four flights of stairs.

When it became known that bridging cribs were not available in the required numbers, it was decided that the intermediate landing stages should be constructed of EWBB on a base of cribs. This consisted, on the south side, of two bays of double single construction to give a quarter space landing; and, on the north side, of four bays of double single construction to give a half space landing. The problem of decking on the top (part of the pier structure) and intermediate landings was overcome by adapting the normal EWBB deck system. Transoms were placed across the top of the trusses and fixed to the top chord with riband bolts and large washers.



Fig 4. North pier base-chesses on gravel bed. Enclosing boards were cut to conform to sloping pavement.



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Stringers, chesses, and ribands followed in the usual way. The third and lower landing, on the south side, was constructed simply of one layer of cribs on a light grillage with Bailey chess decking. The stairs and handrails were of massive construction, but designed to be built easily with the minimum of complicated joints and the maximum prefabrication, and able to be dismantled quickly. Chain link fencing was fitted as a safety measure to the bridge and stairways.

By the first week in March 1970 a full set of working drawings had been prepared and passed to the City Engineer for his approval and signature. This was expected to be a mere formality as close contact had been maintained with the City Engineers' staff at each stage of the design. The City Architect and Police had also been consulted at various times. At this late date, however, the City Architect, who was responsible for the design of the Meadowbank Centre, requested a change in the layout of the stairways on the north side. This entailed moving the lower flight of stairs so that they would exit onto the pavement on the west side of the bridge rather than the east as previously agreed, which meant that the lower landing had to be moved. Only a small amendment to the timber stores list was required. The amended drawings were approved and signed by the City Engineer on 12 March 1970. The final structure was neat, and it satisfied all functional requirements. The pier design was original, and proved once again the versatility of Bailey bridging equipment.

PART II: THE BUILD

At midnight on 4 July Edinburgh's sky was partially overcast with a steady, but familiarly cold breeze from the west. There was an air of excitement and expectancy on the A1 road at Meadowbank as 1 Troop of 10 Field Squadron, with four Coles cranes and one special high lift crane, stood in their parties waiting for the Police to close the main road. This was to put to test all the planning in Headquarters Scotland, and the Troop's training during recent weeks.

It started for that Troop over three months previously with a trial build at Longmoor of the special piers when two main points emerged. It was felt that added stability was needed to prevent possible overturning or movement during construction of the bridge, and that the special bolts holding the two side wings to the front of each pier should be increased from $\frac{1}{3}$ in to $1\frac{1}{4}$ in diameter. The stability was found by adding three tons of kentledge in the form of Bailey stringers placed across the Iowest transoms in the piers.

The Squadron had arrived at the Royal Scots Greys' barracks in Edinburgh some four weeks before the actual build was to take place. The first priority was to decide on a method of building the bridge and hoisting it up onto the piers within six hours using up to four Coles cranes and one civilian high lift crane, the site allowing little preconstruction of the bridge. The number and types of cranes limited the weight of bridge which could be raised onto the piers in one lift, and it was thought prudent to keep the weight per crane as low as possible, in any case aiming at below half the rating of the crane at minimum radius. The Troop Commander, who was away for the practices, had arrived at the following possibilities for the build:

	Method	Weight per crane (tons)	Number of cranes
Α.	Whole bridge to be lifted with every other cross girder in position	5	4
В.	As in A, but without reinforcing cords	4.3	4
C.	Whole bridge with nose girders instead of cross girders for construction only	4.7	4
D.	As in C, but without reinforcing cords	4	4
E.	Half a bridge at a time over a temporary centre pier	2·8 (5·6	4
F.	Each truss built and lifted separately, and cross girders inserted by high lift crane	3.9	2



Fig 7. View, looking south, of nearly completed bridge and stairway. Chain link fencing was used along the sides of the bridge to prevent children falling on to the road below.

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The method chosen had to be a certainty. It was tempting to lift the lightest skeleton bridge up, but the sag when it was supported at both ends on the piers would make reinforcing and bracing extremely tricky, and changing all the nose girders for cross girders would be a lengthy operation. 87 ft 6 in of HGB, reinforced or not, looked a cumbersome load to lift on to the piers which could so easily be knocked out of true. This method also relied upon all four cranes being serviceable, which, as we learned later, was over optimistic. Building a temporary pier in the centre of the road, and lifting the two halves of the bridge was discarded as being too complicated, particularly on such a restricted site. Finally adopted was the single truss method (F) which required only two cranes to lift and move at once, and there were only two touch down points to control at once. It had the advantage of being simple.

61 Engineer Park at Livingstone had allotted a large portion of its real estate for the troop to try out and practise the builds; and the troop arrived to find the site already laid out with bridging materials as on the A1 site. The excellent facilities there ran to a troop store, a site office, and the use of a canteen. Building started at once with a sense of urgency, for a quick answer was needed as to whether the single truss system was possible, and whether it could be done within the many limitations. It was probably for this reason that the two piers shot up quickly. The interesting part then started, and of course the pace slowed down to a more cautious one. The trusses were built; and, lifting them one at a time with Heavy Floating Bridge lifting gear, they were raised onto the piers. The cross girders were then inserted by the high lift crane. There were no major problems, though many lessons came out of that first build. It was clear, for example, that unless the levels were dead right and the trusses positioned accurately, bracing would be tortuously slow. So now it was purely a matter of practising, first by day, and then by night, before starting to strip the piers and move them for construction at the Meadowbank site. Meanwhile a team of some of the Squadron's carpenters was busy at Livingstone with a Clerk of Works prefabricating the stairways and landings for the footbridge. This part proved to be excellent trade training.

As soon as preparations were under way at Livingstone the Chief Engineer called a meeting with representatives of the Police, the City Engineers, the Meadowbank architect, the Military Police, and the Commonwealth Games Co-ordinating staff. The Squadron was then invited to explain the plan for building the bridge, and present its problems and requests. That meeting was invaluable in getting the best possible working conditions on a restricted site across a busy main road near the centre of the city. It was agreed to move bus stops, form areas of no parking or waiting, to divert pedestrians when necessary; and the City Engineers agreed to lend road signs, barriers, and also calor gas lighting for the night build. These were only a few of the many problems thrashed out during those useful two hours.

All these preparations had an enourmous effect on the night of the build. The trusses went up successfully, but progress on the rest was slow at first while the bracing was steadily easing the two trusses into true alignment; then suddenly, when half the girders were in, building accelerated, and the road was open three quarters of an hour early. The next week was a hectic one, decking down, completing the stairs, cleaning, painting, and generally making the bridge into something 10 Field Squadron could be proud of. On 13 July Edinburgh's Councillor Bateman came to a small handover ceremony and declared the bridge open for the Ninth Commonwealth Games. It was Edinburgh's first footbridge.

Two weeks later the site was clear again, but it was estimated that well over 40,000 people had used the bridge while traffic flowed safely beneath it along the AI road.

The Sappers now build many temporary footbridges for the civil community; but it is thought that this is the first of its kind based on HGB. It provided a challenging design and some excellent training in organization and bridging for the field troop who returned to 37 Engineer Regiment with their tails high having satisfied their customers. The knowledge that the construction raised no insurmountable problems must have given much satisfaction to all those who had had a hand in the various designs.



Minley Manor

MINLEY MANOR was built for the Currie family in the 1860s, with considerable alterations in the 1880s. The house, which is a reproduction at slightly reduced size of the Louis XII Chateau de Blois on the Loire, stands in grounds of about 2500 acres, all of which were bought by the War Office as a training area in 1936. In January 1939 HRH The Duke of Gloucester opened the house as the Senior Division of the Staff College. Subsequently "C" Division were housed there until the completion of the extensions to the Staff College, Camberley, in 1968.

When it became known that it was planned to replace Southwood Camp by a new barracks for 1 and 3 Training Regiments at Minley, negotiations were begun to acquire Minley Manor for the Corps. These negotiations resulted in the decision to house Headquarters Training Brigade, Central Volunteer Headquarters, and the RE Officers' Mess (Aldershot) in the House. Brigade Headquarters moved at the end of April, and the Mess opened on Monday 3 May 1971. The opening Mess entertainment was to be a Beating Retreat and Cocktail Party on Tuesday 25 May 1971.

On a dull but dry evening the hosts headed by the Commander. Training Brigade, Brigadier A. G. C. Jones, MC, and nearly 250 guests, including our senior serving Sapper Officer, General Sir Noel Thomas, KCB, DSO, MC, assembled at the foot of Minley's magnificent avenue of Wellingtonia and lime trees. Here they witnessed an impeccable performance of the ceremony of Beating Retreat by the Royal Engineers Band, Aldershot, and the Bands of the Army Apprentices College, Chepstow, and the Junior Leaders' Regiment, Dover, directed by Captain S. W. Patch, RE, Director of Music RE Band, Aldershot.

The Royal Engineer Officers' Mess (Aldershot) has settled very comfortably into its new home, and there is a growing conviction among the members that Minley Manor is one of the best things that has happened to the Corps for many years. The building itself, although having no really large rooms, has already proved that it can

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Minley Manor

be adapted for many different types of entertainment and function. The pleasure gardens are truly splendid and extend to many acres, in which members of the Mess, their families and friends may often be viewed taking in the beauty of the scene. The Mess boasts two squash courts, four grass and two hard tennis courts, and a disused swimming pool which may yet be re-commissioned.

Minley Manor has certainly had a very propitious re-birth after being empty for over two years, and it is confidently expected that it will quickly become well known and well loved throughout the Corps. Officers of the Corps and Members of the Institution who find themselves passing near by will always be welcome to call, to look around the house and grounds, and to sign the visitors' book.

1815 from the Engineer Angle

LIEUT-COLONEL J. G. O. WHITEHEAD, MC, RE, Rtd

WATERLOO having been won on the playing fields of Eton, it comes as a surprise to find that one of the clearest accounts of what took place was not written by a member of the team but by a junior groundsman, whose perspective might have been expected to belong more naturally to the pages of *Gardening Illustrated*; yet it has been a chance look at some remarks from a man brought up to the pickaxe, which has helped materially to confirm what was really in the captain's mind during the days leading up to 18 June 1815. It has led to more else besides, for the resultant study of how the Engineers prepared the field for the big match has shown that their work may conceivably have contributed to the result; and it has brought to light the pleasing evidence that Royal Engineers sometimes get a wider view of affairs than do the more impetuous arms of the Service.

The work in point is *Remarks on the 1815 Campaign*, written by Captain J. W. Pringle, RE, in about 1825. It is a little-known account, having been made for Sir Walter Scott who printed it as an appendix to his nine-volume *Life of Napoleon*, where it has remained in consequence largely unread; it was noticed though by John Curling some thirty-five years later, who reprinted it in 1861 as a pamphiet for private circulation, and that too became overlooked. Yet it is an unusually observant account, and contains a certain amount of information not found elsewhere. It enables the material in *Wellington's Despatches* to be read with an occasional view of what more lay between their lines.

The need for looking between the lines exists, unfortunately, because although there is adequate evidence in the *Despatches*' bare text, it none the less is consistently glossed over by "popular" criticism, which seems to get some peculiar gratification from belittling Wellington's conduct of the campaign, despite his accomplishment of a superlative victory.¹ Certainly no man is infallible, and certainly historical criticism is invaluable when constructive; but a particular fallacy, Wellington's supposed anxiety for his communications with Ostend, said to have made him late over keeping his promise to join the Prussians, is dangerous. It is serious because the operation was an inter-allied one, and this country's reputation will not be helped in any future undertaking of the kind if it is supposed we are not to be depended upon; whereas, on the contrary, these four days showed such a complete subordination of national interests to the common cause that it ought to be a matter for deep national pride. Pringle experienced the same in his day, and his dissection of the ill-grace deserves a thought—

"The talents and honour of the British commanders are rated at a low state, their success attributed more to chance than military skill . . . What are now termed liberal ideas seem to have made it a fashion to assert and give credence to these

¹ A conspicaous offender is the 1970 Encyclopaedia Britannica.

accounts; and it is no uncommon occurrence to meet with Englishmen who doubt the glory and success of their countrymen on that eventful day. A wounded spirit of faction has contributed to this feeling, and in the indulgence of its own gratification, and under the mask of patriotism, endeavoured to throw a doubt over the military achievements of our countrymen . . . There does appear in this a decay of that national feeling (which is) the mainspring of all great actions."

Blucher had a more expressive term for persons holding those so-called liberal ideas —"trouble-squirts".

The Campaign opened with an abnormal interim period, between Napoleon's arrival in Paris on 20 March and his crossing the Belgian frontier on 15 June, during which the Allies regarded themselves neither at war nor at peace; they were in the anomalous position of being on the defensive against any possible French incursion, yet disallowed for political reasons to cross the frontier and reconnoitre; at the same time their forces were being built up for an offensive into France, expected to start early in July. In the meantime therefore, the British had the problem of defending a stretch of borderland rendered awkward by several circumstances. Firstly, the country now called Belgium had recently been made an unwilling province of the Dutch kingdom; its people were quite largely French in sympathy and many of the soldiers had served under Napoleon and admired him; accordingly the security of Brussels was of the first importance, because if that city fell the whole country could be expected to turn to the French. Next, the proximity of Brussels to the blind spot of the frontier was only forty miles, six hours on horseback; nothing could be known of what was happening behind that frontier, while less than ten miles beyond it were the French fortresses of Lille and Valenciennes, under cover of which the enemy could assemble in strength and then cross the border before any steps to meet them could be taken. Thirdly, the Belgian frontier fortresses had been dismantled by the French after the 1794 campaign, when the land was incorporated into France; there were no artificial defences to cover the Allied cantonments, which had to be dispersed widely, partly in order to watch the whole length of the frontier and partly for subsistence on local supplies; a mathematical calculation will show the depth to which a surprise attack could penetrate before enough troops could be assembled to meet itthe advantage lay wholly with the French. Fourthly, magazines were being stocked in readiness for the coming advance into France; these had to be protected against any incursion.

Hasty engineer defences were needed at once; these though could only delay the enemy temporarily, by denying him use of the main roads, for at the same time enemy cavalry and small bodies of infantry could cross the frontier anywhere, nor would the small rivers offer any problem to the French engineers. The first measures after Napoleon's return consequently were the immediate renovation of the border fortresses of Ypres, Tournai and Mons, also Nieuport, Ostend and Oudenarde, while Ath was added later; coupled with which was a system for flooding low-lying country, as an obstacle to free movement.¹

Sketch 1 shows the theatre of war, and has been oriented south-westwards to face the enemy,² with its axis the line Paris-Brussels. Its main features embody the following. The fortifications of Ostend and Antwerp had been left intact by the French in 1795 because of their being seaports; Ostend provided the shortest crossing from England, and was valuable for speeding up the turn-round of shipping, but it was distinctly exposed, being barely twenty miles from the frontier; Antwerp and other Dutch ports, however, offered practicable alternatives for military communications. The principal rivers ran more or less from front to rear, they provided

³ Although looking at the map "upside down" may at first seem puzzling, past omission to do so has resulted in the exposed relation of the Ostend communications to the British front not being appreciated.

¹ See Inspector Lys Department's April *Renseignmens sur les Inondations* (SUPP DESP, p 194); also the interesting point that even after Waterloo, when the Army was on the outskirts of Paris, Wellington disallowed the frontier inundations to be drained, to guard against possible marauding. (SUPP DESP, 1 July).



little in the way of lateral lines of defence. On the Prussian left, the hilly and wooded terrain of the Ardennes precluded operations beyond the Meuse. The Allied front thus ran approximately from Nieuport through Ypres-Menin-Tournai-Mons-Charleroi to Dinant, the Anglo-Netherlands army being responsible for eighty-five miles of it, to Binche, the Prussians for thirty-five miles. The Anglo-Netherlands forces were cantoned mainly east of the Scheldt, spread over an area forty miles wide; the Prussians were in depth from Charleroi to Liege, a distance of about fifty-five miles; the length of time needed for orders to reach the scattered formations and units, and for these to assemble, will be apparent. The Prussian communications ran through Liege to Cologne.

The defence problem is made clearer by the history of the preceding war. In 1794 (only twenty years earlier) the Austrians, Dutch, and British were fighting the French revolutionary armies, who operated from Lille, Cambrai, Maubeuge and Philippeville. By the end of June an Austrian corps was at Ghent, facing south-west; on its left were the British, behind the Scheldt facing west; Ostend was isolated, held by a British brigade and eventually evacuated, about which more will be said later; from near Avelghem the line bent to the south and west of Mons, where was the Dutch army, and thence it ran eastwards to the Austrians at Ligny. In advance of this line, Tournai and Valenciennes fortresses were held by the Dutch, and Charleroi by the Austrians. The Austrian communications ran from Wavre to Maestricht, the British communications were through Antwerp. Ostend had been cut off from the line of the Scheldt by a French force from Lille; Lord Moira was in command there when Wellington landed with his battalion, the 33rd Foot, and he had no illusions about the valuelessness of the place, regarding it as of importance only to the Secretary of State and not to any military eye. Moira consulted Wellington over its evacuation, who recommended passage by sea to Antwerp; so the impracticability of relying upon it as a base will have been imprinted on his memory.

The Belgian fortresses having been taken over by the French, the next stage in their history was the siege of Antwerp by the British in 1814. Pringle compares 1815 with the experience of a French diversion made at that period—

"Buonaparte might have made demonstrations in front (of Brussels), and sent 20,000 men from his garrisons to ravage Ghent and the country beyond the Scheldt, and cut off our communication with Ostend. In 1814, when the Prussians were concentrated near Brussels, this had been done with effect from Lille. Though little advantage might have resulted to the enemy from such a measure, much blame would have been attached for not taking precautions against it."

Antwerp capitulated after Napoleon's fall, but some of the British troops remained in the Netherlands; and it was then that the CRE, Lieut-Colonel James Carmichael-Smith, had the southern half of the "Waterloo Map"¹ sketched, presumably in anticipation of permanent fortifications being built south of Brussels to guard the new capital. This accounts for the date 12 June 1814 on the right-hand bottom sheet of the Map. In September 1814 Wellington himself reconnoitred the re-established frontier between France and the Netherlands, and on the 22nd he wrote a Defence Memorandum which will be quoted at some length for ready reference—

"The Netherlands having been joined with Holland . . , it is probable that the disposable (iefield) armies of Great Britain and Hanover would co-operate in the defence of these provinces. Secure communication then with England and the north of Germany is an essential object in any system of defence to be adopted, and, above all, that with Breda and Berg op Zoom, and with the Dutch places in the Lower Meuse and Lower Rhine.

"The operations of the revolutionary war have tended in some degree to put strong places out of fashion; and an opinion prevails . . . that strong places are but little useful, and at all events are not worth the expense which they cost. . . . (Nevertheless, in 1794, when) very imperfect field works only having been thrown

¹ This map is now in the RE Museum, Brompton Barracks, Chatham.

up at some points during the period of their possession by the Allies, the enemy did not find it so easy as they had before, and it required much more time to get possession of the country . . . notwithstanding that (their) superiority was much more commanding than it had been in November 1792.

"It cannot be expected that, in the event of the commencement of hostilities, the French should not be superior to the Allies in the Netherlands in the first instance; and, unless the country should be in some manner strengthened, the same misfortune as occurred in 1792 must be the consequence....

"I could find no situation which, (being strongly fortified, might cover the country, and which the enemy would not venture to pass.) . . . It is obvious then that the country must be fortified upon the old principle; and, considering by whom it was fortified formerly, the local advantages of the sites of some of the old fortifications, and that in many instances they present the means of inundating the country, upon which it must in a great degree depend for its defence, and the expense to be saved by adhering to the old plans in almost all, I am inclined to recommend that the old situations should in every instance be adhered to, and the old sites, with the modern improvements in the flanks, should in almost every instance be followed.

"By the adoption of the system above recommended it will be observed that all the principal objects to be attended to are secured. The right of the line from the Scheldt to the sca will be made so strong as, with the aid of inundation, to be quite secure even though left entirely to its garrisons; and it must be observed that, owing to the great command of water in this part, the expense of the works to be constructed, and the time they will take, will be much diminished. The disposable army, then, having its communications with Holland secured by the strength of the right of the line and by Antwerp, will be applicable entirely to the defence of the left."

This Memorandum makes perfectly clear what was in Wellington's mind in the following year, during the period when the initiative lay with Napoleon: his army's primary concern was the country east of the Scheldt, that west of it could be ignored, and his communications with England could, if necessary, be through Holland or even through Hanover across the Lower Meuse.

The Memorandum continues that, in so cursory a view as he had taken, he could not point out what positions the field forces might take up, nor similarly what might be fortified beforehand; and he advised that a proper engineer report should be made,¹ with—"a mémoire raisonné upon each fortification, pointing out the garrison required for its defence, and their reasons for thinking such garrison 'necessary'". None the less he remarked that good positions existed: behind Tournai, between Tournai and Mons, around Mons itself, and along the line of the Haine stream towards Binche, also about Nivelles; and he added that—"the entrance of the forêr de Soignes by the high road which leads to Brussels from Binche, Charleroi, and Namur, would, if worked upon, afford others". But, he observed—"The fortification of these positions cannot be a secret, and, in a country such as these provinces, no position can be taken with an army which is not liable to be turned, and which would not be turned if the works on it were to be previously constructed".

This Memorandum anticipates Wellington's 1815 plan, the entrance to the Forêt de Soignes being the position termed "beyond Waterloo" during that campaign; the expression, though, does not mean the Mont St Jean position only, but includes the Belle Alliance ridge, as well as (presumably) the ground further forward sketched in 1814. He was accompanied on the reconnaissance by Lieut-Colonel Carmichael-Smyth and other Royal Engineers, so it can be appreciated that in the course of it the CRE must have learned something of Wellington's method for conducting a defensive operation. When the area "beyond Waterloo" is noted in relation to the Paris-

¹ In the Despatches of 18 Ian 1815 he expresses surprise at its not having been done, and remarks--"(The French) now think they can march into Belgium, as they could into Alsace, or any other of their own provinces. If the Netherlands were fortified, they would know the conquest would take time, and occasion some broken heads, which they do not like better than others." It was made eventually in 1816, and its contents are set out on page 388 of Volume 1 of Corps History; from them the places' relative importance in 1815 can be gauged.

Brussels axis, on Sketch 1, its conformity with his views about dependence upon communication with Holland, or if needs be with the Lower Meuse, is plain.

The following spring, news of Napoleon's return reached Brussels on 9 March, and soon afterwards work was put in hand on restoring the old frontier fortresses' defences; while such British troops as were in Flanders, together with the Netherlands army, concentrated round Tournai, Ath, and Mons, to cover Brussels from any light incursion. Their numbers were however insufficient to resist the full weight the French were capable of bringing against them. The defences of Ypres, Tournai, Mons, Oudenarde, and Ghent required considerable renewal, those of Nieuport, Ostend, and Antwerp only slight repair. At about the end of March a threat developed from between Lille and Bergues, causing provisional orders to be given that the troops cantoned near Menin, if unable to resist, should fall back on Courtrai, destroying the bridge over the Lys; from there they were to delay the enemy as long as possible, to gain time for the Allies' assembly, and endeavour to ascertain his object, but without compromising their own safety. Thence, if obliged to, they were to fall back on Oudenarde and Ghent, flooding the country. No attack however materialized.

Shortiy afterwards, on 4 April, Wellington arrived and took over command of the Anglo-Dutch forces; his request to advance straight away into France and make contact with the enemy was disallowed, so he was obliged to remain on the defensive behind a sealed frontier, dispersed and without (in the first place) adequate defence works to cover his dishabille. He quartered his troops east of the Scheidt, roughly in the area Avelghem-Mons-Nivelles-Brussels-Ghent, with cavalry watching the frontier; between 6 and 15 April he dissuaded Gneisenau from the plan that the two armies should join east of Brussels, expressing the firm opinion that Brussels ought not to be allowed to fall into the enemy's hands "even for a moment", and the Prussians accordingly came forward to Charleroi. Eventually it was agreed that the two armies should unite at Ligny-Nivelles if the French attacked the Allied left; but in Wellington's opinion that position was too far advanced to be practicable under the conditions he anticipated, and he would have preferred their concentration to have been near Waterloo.

On 11 April Flag Officer the Scheldt enquired his wishes over Naval cooperation, and Wellington asked him to examine the possibility of helping in the defence of Ostend; the Rear-Admiral replied four days later suggesting gun-fire covering the western approaches, with which Wellington concurred though remarking that no present attack threatened.

At the same time he gave his plan for the defence of the Netherlands (his base area) after the field army had advanced into France; his letter to the Prince of Orange sums it up, italicized here for clarity—

"It must be expected that the enemy will keep his fortresses on the frontier well garrisoned. If these garrisons should collect to the amount of only 15,000 men, after the Allies shall have passed them, and should make an irruption into (the Netherlands)—an event by no means improbable¹—will His Majesty (Netherlands), under existing circumstances, have in his power the means of stopping them at least short of Brussels? In my opinion, certainly not, unless he should occupy Ghent, Tournay, Ath, and Mons. There is no danger of any of these points being *seriously* attacked; and they will be so strong that, unless *seriously* attacked, they cannot be carried; and there is no chance that an enemy, (such as) I have supposed may make an irruption into the country, will venture to pass them."

At the end of April, however, rumours of a French attack were again rife; so Wellington wrote a Secret Memorandum on the 30th, giving his intentions if it should develop. He foresaw three possible lines it might take—west of the Scheldt, or be-

¹ This actually occurred, see SUPP DESP, 28 June, from Prince Frederick: the garrison of Mons was employed in stopping continual "excursions" from Condé.

tween the Scheldt and Sambre, or along both-and he gave provisional instructions accordingly. These included inundations and the removal of the bridge at Avelghem; the garrisons of Tournai and Mons were to stand fast, but that of Ath was to be withdrawn if the works had not reached a stage of being tenable against coup de main, Ghent though was to be held at all costs. The bare text of the Memorandum does not disclose the underlying intention which now can be recognized as implicit, that in the event of the French advancing west of the Scheldt the whole of that area would be abandoned, leaving Ostend to hold out under its own resources, protected by flooding, and with the army's communications transferred to Antwerp. The reason for the abandonment not being stated will have been to avoid causing alarm amongst the Netherlanders; none the less the Engineers were aware of its implication, for Pringle remarks that the situation was now more satisfactory than it had been in March, as the state of our defence works now enabled us to "command" the Scheldt and assume the offensive, thus visualizing a front facing west, while Wellington in his covering letter to Uxbridge says: "If the attack should be made between the Lys and the Scheldt, I shall, if strong enough, cross the latter and attack the enemy."

The expression "if strong enough" is noticeable: he had not yet had his 3 May meeting with Blucher at Tirelemont, so he could not judge what aid to expect, and the reverse possibility existed of his being outnumbered and driven back from Brussels before the Prussians could arrive. The seriousness of the apparent situation, and the uncertainties with which he had to contend, are reflected in his letters of the period. On 3 May he orders the country to be flooded round Ostend, Nieuport, Ypres, Tournai (as far as practicable), Mons, and Ghent; and on 6th he thinks it expedient—

"to lodge in the fortress of Maestricht 1,000,000 rounds of musket ammunition, in order to provide for any possible occurrence which might take part of the army in that direction".

By the 11th, though, the threat had eased and the French appeared to be on the defensive, and he writes to the Prince of Orange—

"In the situation in which we are placed at present, neither at war nor at peace, unable on that account to patrol up to the enemy and ascertain his position by view, or to act offensively upon any part of his line, it is difficult, if not impossible, to combine an operation, because there are no data on which to found any combination. All we can do is to put our troops in such a situation, as, in case of a sudden attack by the enemy, to render it easy to assemble, and to provide against the chance of any being cut off from the rest."

In the meantime some false alarm had started flooding without his orders, at Antwerp on the 4th, and at Oudenarde on the 5th. As points of interest, the Mons inundations were completed by the 19th, but did not prove as extensive as hoped; while at Ostend and Nieuport local obstruction to the flooding was encountered, drawing a severe reproof from Wellington on the 30th, here quoted to illustrate his handling of the people's half-hearted will—

"No country can make an exertion for its defence against a foreign enemy without individual inconvenience and injury. . . The order for forming the inundations was given at the moment it was expected, from the intelligence received, that the enemy was about to attack this country; and the order was given the sooner, because it was known that time would be required to form the inundations of fresh water, and it was determined not to do the country the permanent injury of letting in the salt water."

At this juncture Wellington's satisfaction at having some sort of fortified screen can be surmised, for he was now experiencing the situation he had forecast to the Prince of Orange on 17 April, with the difference that now all the weight of the French might be launched suddenly against any point on a fifty-mile front, and his works might be carried by serious assault. Which explains his brevity over a manufacturer's offer, on 6 May, of a new kind of howitzer—

"Compliments; and I do not consider this to be a proper period to alter the equipments of the army or to try experiments."

Against this background of events the northern half of the "Waterloo Map" will have been sketched, during the latter half of April and the first part of May; it was called in before it had been finished, presumably because of the likelihood of its being needed at short notice, and its bottom right-hand sheet bears the date 21 May. Seen in conjunction with the 6 May order for an ammunition reserve at Maestricht, the slight projection to include the Louvain road from Mont St Jean is surely significant? It would seem as though Wellington took the CRE into his confidence and gave him special instructions to have that done; this would account for Pringle's remark—"The intention of the allied marshals to remain together, whatever might be the issue, is known . . . and had the events of the 16th (June) been such as to necessitate a retreat, and give up Brussels, Maestricht is probably the point on which both armies would have retired." Whether Pringle learned this from the CRE after the war, or whether (as conjecture) an engineer reconnaissance of the roads was also ordered, as would seem a natural proceeding, and he was aware of it at the time, can only be guessed; certainly in 1825 he was interested in the Prussian communications, and familiar with their condition.

Wellington's deep personal interest in the terrain covered by the Map is on record in Mercer's Journal—

"To meet the threatened invasion, it was generally understood in the army that the Duke had made choice of two positions in the neighbourhood of Brussels—the one a little beyond Waterloo, the other at Hal, the point where the roads from Ath and Mons unite. In one or other of these, it was said, he intended to await the attack, according as the enemy might advance. Frequently, attended only by an orderly dragoon, he would visit these positions, studying them deeply, and most probably forming plans for their occupation and defence."

The Map reflects this plainly, in its five-mile arc round the west of Hal; for, despite his fortifications he considered Napoleon's most dangerous course (and so most probable one) would be to throw his weight against the Allies' right and manoeuvre them away from Brussels, thus gaining an initial political success which would consolidate his own position in France, and enable him to set about the hard business of head-on fighting, with his army's morale higher than ever and his opponents' correspondingly shaken. No steps were taken by Wellington to strengthen these positions with earthworks, however, for several probable reasons: firstly his agreement with the Prussians to fight further forward, this would look insincere if he promptly started to entrench his own preference in rear; secondly there were several alternative positions "beyond Waterloo", and he would rather leave the choice until the occasion (an open matter which actually occurred); while thirdly, as he had said, fortification would encourage the enemy to turn any position, whereas as soon as he and the Prussians had joined one another he wanted a straight fight.

The incompleted areas of the Map afford an interesting insight into the priorities he ordered: of first importance evidently were the Louvain road projection and the arc west of Hal, round which latter he will have expected a cavalry turning movement; lowest priority was given to the ground between Hal and Mont St Jean, a wooded area of intricate paths and water-courses, to which, as his supposed anxiously preserved line of potential retreat, he is seen to have paid marked indifference!

For roughly another month, from mid-May to mid-June, the strengthening of the fortifications and the build-up of the Allied forces continued; so, daily it became more problematic as to whether Napoleon would venture an attack, or whether he would

await an invasion of France defensively near Paris. Wellington's attitude during the period has best been pictured by Lady Longford, who quotes Caroline Capel's crystallization of his silent normality—"Nobody can guess Lord Wellington's intentions, and I dare say nobody will know he is going till he is actually gone." Indeed, his thoughts may well have amounted to, "Anything can happen". And for that he was prepared.

His orders to the Governors of defended towns were sent out on 7 June; they applied both to while the field army was still in Belgium, and when it had advanced into France, and they were to take effect—"the moment the enemy sets foot on Netherlands territory", whereupon the places were to be declared "in a state of siege". The orders are too lengthy to be repeated, since some are individual to specific towns, but briefly: Antwerp, Ostend, Nieuport, Ypres, Tournai *citadel*, Ath, and Ghent *citadel* were to be regarded as fortresses; though Mons, Tournai *town*, and Ghent *town* were rated as entrenched camps. For the fortresses the extreme was ruled, that they were to be held until not only had the enemy made a practicable breach, but until that breach had been retrenched and had fallen to an assault; also, that any surrender prior to this, except by decision of the Defence Council,¹ would be treated as treason. Following them, on 11 June, a further order forbade any of the public to enter Tournai and Ghent citadels and the Mons redoubts, as well as a general instruction against the public being allowed access to to the works and outworks anywhere.

Treason spelt death; and Wellington's short shrift with offenders was known; consequently the immediate reaction was for the Netherlands Governor of Ath to represent that his works had not reached a fit stage to be considered a fortress. Wellington replied on the 14th that he was aware of this, but that all he was requiring of the Governor was that he should do his duty as a brave man, and that if he did not like the prospect then another governor would be posted in his place. The sequel came two days after Waterloo, on the 20th: the Governor reported to Wellington direct, that he had done as he was told and had put Ath in a state of siege, flattening out all houses, trees, and hedges within 200-500 yards of the place, in order to give a clear field of fire; and he signs himself "Your very humble and very obedient servant". His pungent postscript was left to be inferred—"The bill will follow".

The defence system is shown on Sketch 2. Inundation, though, was a slow process, taking two to three weeks to complete with fresh water; when sea water was used the result was almost immediate, but the effect was drastic and could only be carried out as a last resort, as it damaged the soil for years. Sea water too enabled wider flooding; for example, at Bruges the Grande Place could be covered to a depth of five feet. Inundations also depended upon the redoubts covering the sluices remaining in the garrisons' hands; while in May civilian obstruction went to the extent of violence over trying to prevent or drain the flooding round Nicuport and Ostend.

The pertinent question arises as to how much this defence system, as a whole, exercised any effect on the subsequent operations? Wellington, as is well known, always held that Napoleon's most dangerous line of attack would have been against his own right, he knew the nature of his fortifications, and he did not regard them as an adequate deterrent. Pringle, whose account must reflect other contemporary opinion as well, comments correspondingly—

"It is, indeed, a matter of surprise that Buonaparte did not make a more important demonstration on the side of Lille and Mons, [because] a false movement of the English general to his right, at that period, could not have been easily remedied in time to have fought in front of Brussels, and to have effected his junction with the Prussians."

From the French side, Ney declared after the war that opinion in France beforehand had expected Napoleon to attack the British first; and Henri Lachouque states that demonstrations against the Allied right were ordered. History however does not

¹ Governor (President), OC Troops, OC Artillery, and OC Engineers.



record anything more than rumours to have been set afoot, round about 9 June, that Napoleon was on his way to, or at, Lille; the absence of any concrete action is noticeable. So, one is obliged to contemplate, Why? Napoleon, for his part, will have been fully informed about the works' comparative lack of strength; though on the other hand he will have known of Wellington's assiduity over them, and it may have been that an echo of Torres Vedras rang in his ears, together with the shrewd— "occasion some broken heads, which they do not like better than others". At any rate, for some reason only to be guessed at, he did nothing against the British right.

In the present writer's opinion the fortifications cannot have been the deciding factor which led Napoleon to attack the Prussians first; according to what Hobhouse was told in Paris on 29 May,¹ he had already decided to do so, hence the decision was not based on the circumstances of the moment but was predetermined policy, relating to some factor other than physical. But as regards no feint being attempted against the right, there would seem no other explanation than the defence system's apparent capability to—"occasion some broken heads". Exactly what was in Napoleon's mind about them is hard to determine, in view of his enigmatic order to Ney (near Quatre Bras) on 16 June—

"You will realize the importance I attach to the capture of Brussels. It could, moreover, give rise to far-reaching events, for such a rapid and unexpected movement will isolate the English army from Mons, Ostend, etc.. I wish your arrangements to be well made, so that the moment the order is given your light divisions can march rapidly and without obstacles on Brussels."

He was certainly seeing Mons in a different light from Wellington;² but his "without obstacles" sounds significant. Consequently, with every endeavour not to claim too much, it seems justifiable to suggest that the unspectacular engineer work before the actual fighting began contributed conceivably to the final result. As an illustration: Quatre Bras hinged on the arrival of the 3rd and 1st Divisions, and an hour's delay could have brought defeat; Weller's judgement over this is being quoted—

"Had Ney's army defeated Wellington, driven even a mile north and then swept east on the flank and rear of the Prussians, Blucher would have been disastrously defeated."

Surely, therefore, it can be contended that the slightest French threat from the direction of Mons or Tournai would have brought about delay, and altered the course of the war completely? Hence it is suggested that perhaps (and the idea can only be conjectural) it may have been an element of thoroughness in the engineer work, coupled with the tenacity enjoined by Wellington, which made the defence system appear more formidable than its actual nature warranted, and thereby deterred any feint, enabling Wellington to bring his scattered divisions to Quatre Bras just in time.

After Quatre Bras, on the following morning, when Wellington gave de Lancy the Waterloo Map and sent him back to set the army in position, it is sometimes supposed that he marked in pencil beforehand the line he wished occupied; this though is incorrect. He gave de Lancy open instructions to choose according to the circumstances at the time of the troops' arrival; for when de Lancy left, little was known about the Prussian situation and news of any kind could be expected to arrive during the course of the day, although in the event it did not. Wellington himself would have preferred the Belle Alliance ridge;³ but de Lancy chose that of Mont St Jean, probably on account of the prospect of the Anglo-Netherlands army being temporarily outnumbered and unsupported. The pencil marks on the Map scem likely to have

¹ "We can beat Blucher first, and then we shall try your Wellington." Spoken by one of Napoleon's aides. (Quoted, E. Saunders, *The Hundred Days*, p 89.)

^{*} Mons was not well fortified; it was classed by Wellington as an entrenched camp, the gatrison of which was to retire, if necessary.

² Fitzroy Somerset, quoted by Lady Longford in Wellington p. 441; and cf Vivian in Siborne's Waterloo Letters, No. 71.

been made by Wellington for Muffling's benefit, after Blucher's message reached him the next day at about 6 am,¹ to show him where he would like the Prussians to come in on the left of his line.

The magnitude of the risk Wellington took, when he decided to stand at Waterloo, has not yet been fully appreciated. He appears to have received an advance message of assistance between two and three in the morning, sent presumably by his liaison officer at Prussian headquarters, on which he decided to stand at all costs. Realizing that for a time he would be outnumbered, and that he might be manoeuvred out of his position covering Brussels before their forces reached the field, he promptly abandoned his normal communications with England through Ostend and Antwerp, leaving open only the rough track to Louvain by which he might retreat and join Blucher. Antwerp he ordered to be put into a state of siege, with its inundations made "to their utmost extent". Oudenarde and Ghent countrysides he ordered to be flooded, while Ostend, if not already flooded (perhaps drained after the May complaint), he will presumably have ordered to be re-inundated.

In order to present the situation as it will have appeared in his eyes on 18 June, which incidentally will also have been in the Prussians' eyes, Sketch 3 has been drawn. To repeat the metaphor, it is the groundsman's plan of the field on which the match was going to be played; and it is the one that had been in Wellington's mind's eye ever since 10 April, when he wrote to Gneisenau—

"En cas de revers, je crois que toute l'armée doit se replier sur Liège et Maestricht, et, s'il est nécessaire, sur Juliers."

It was for this contingency, coupled with the double purpose of covering the Netherlands after the field army had advanced (Sketch 2), that his engineer works were designed.

In Sketch 3 all the fortified places are to be visualized as in "a state of siege". Mons has been shown as unfortified because it was being treated as an entrenched camp, not due to hold out to the last, but whose garrison were to retire to Ath if hard pressed; and the Tournai and Courtrai inundations are omitted because their sluices could fall into enemy hands and the waters be drained off, nor was Courtrai fortified. West Flanders, it will be noticed, takes on the character of an island, separated from the field army and connected with England through its coastal fortresses Antwerp and Ostend. The nakedness of Brussels becomes apparent; and the prospect faced by Wellington at 3 am on 18 June stands out vividiy—"II se peut que l'ennemi nous tourne par Hal, quoique le temps est terrible et les chemins détestables."

Napoleon originally intended to attack soon after daybreak; then the time was postponed to 9 am and finally the guns opened fire at 11.25. Blucher's leading corps could not arrive until 11 am² at the earliest; so during that period Wellington had to bear the risk of his left being smashed and of his being cut off from the Prussians; and from 1.30 to 4.30 that is what Napoleon applied himself to doing, for it was not until 4.0 that Prussian contact began to be made effectually. Consequently it must have been during the early afternoon that Wellington was forced to consider the possibility of being cut off from Blucher and having to retire to his right; and it will have been this crisis (amongst the many in the battle), which caused him to say ten years afterwards that had he been forced from his position he would have retired towards the coast. As seen here, that means that Sketch 3 has to be looked at the other way up. He used to make light of the predicament, saying-"Could Napoleon" have ventured to follow me? The Prussians, already on his flank, would have been in his rear." Doubtless this is what flashed through his mind at the time; but he could not then have been aware of Grouchy's 33,000 on the Prussian left tear, who under those circumstances must have brought Blucher to a standstill, nor will he have reckoned on Blucher's lieutenants being less resolute than the Marshal himself.

¹ See Lady Longford, p. 444.

* See Pringle, p. 17, and a note on the subject in the Extracts from his Remarks in the RE Corps Library.



Indirectly, the pencil marks on the Waterloo Map form a personal memento of that precarious situation, and of the magnitude of what had been staked: for, if as has been concluded here, they were made by Wellington to impress upon Muffling his anxious desire as to where the Prussians should come in on his flank, then the sequel is told by Muffling himself, which happened at seven in the evening. He (Muffling) had been watching with the utmost "impatience" for Ziethen's advanced guard, when he saw it suddenly turn round and move off to its left, towards the other Prussian corps. Dismayed, he galloped over to it immediately. A staff officer whom Ziethen had sent ahead had mistaken the numbers of wounded who were being taken to the rear, as well as not a few deserters, for a retreat; and he had told Ziethen that the British were beaten, so the Prussian turned to join his own main body. Muffling managed to convince him of the truth, whereupon without hesitation Ziethen came in on Wellington's left. Such, it would seem, is the sequel to the marks on the Map, and a reminder of one of the most unselfishly conceived battles ever fought.

A quantity of unsavoury criticism about national interests having been given precedence over allied ones thus disappears, leaving behind it only the nasty smell sensed by Pringle-decay of national feeling. All the material quoted here has been available for the last 150 years; there is no excuse for its not having been noticed, the cause has lain in some perverted intellectualism which has not wanted to notice it. One can remark caustically that if Wellington really had been anxious about the route to Hal, the Map would not have left it unsurveyed, nor would Sperling have found it wiser to ride there by way of Brussels rather than through the woods; while surely some expert "nitpicker" ought to have found fault with Wellington for having flooded Ghent and Oudenarde, and not countermanded the order until a fortnight after the battle? There must be something wrong when so-to-speak historical fans throw bottles at the captain of the winning team, and it falls to a groundsman to have to point out to them that they are looking at the pitch the wrong way up! Not only a deodorant is needed but cerebral surgery.

Hygiene apart however, engineer lessons from the campaign seem to exist and to be applicable to the present day. In the first place, flexibility being the key-note to Wellington's methods, his Engineers' function was to adapt the ground for it. As has been seen, the 1815 fortifications had to cover the wide variations of his taking his army south into France, or east to the Lower Meuse, or west to the coast. Also (if there is validity in what has been suggested here), he took his Chief Engineer into his confidence about the communications, secrecy over his plans being essential. Today, though, there is no single architect to design construction in a theatre of war, but a plethora of departments: will secrecy and flexibility be attainable? In 1944, despite the strict secrecy imposed over "D"-Day intentions, three months beforehand the predetermined plan was divulged unwittingly to a large works conference of a multitude of departments, by a staff unversed in military implications. May not something nearer to the 1815 Chief Engineer's role be called for?

Secondly Sir John Burgoyne's comments, on how earthworks might have strengthened the field of Waterloo, lead to a material consideration. Sappers were not available presumably because they were unarmed and unsuited for withdrawals; for an advance there were pontoon companies and men for fortress assault, but for retreat Wellington seems to have been content to leave the infantry to their own resources. The attitude reflects the character of the day, when men were left largely to their own resources over everything, in civilian life no less than in military operations; nor was it lack of humanity so much as lack of imagination. Accordingly Major Tylden's words serve as a useful reminder for this defect, relating to 18 June at Malines, when his companies—"assumed a posture of defence, but the attitude, from want of arms, was necessarily impotent and embarrassing". The word "embarrassing" is pertinent: it well describes the feeling of being unsuitably armed in the presence of an enemy; and it raises the question of whether current imagination (in Defence at large) meets the conditions of which 1815 may have been a forerunner?

Wellington's care to prevent Brussels from falling into French hands was on account of the acute internal security problem which would have arisen in his rear, besides other repercussions; and Napoleon's prepared poster, dated for issue at Brussels on 17 June, confirms the threat. Today, internal security in rear areas may become extremely acute, on account of the kind of war to be anticipated, and the vast depots and installations to be protected, exposed to the risk of trained and organized sabotage; engineer defence work is bound to be demanded on a large scale. Reflection therefore might be opportune as to whether the Army as a whole is really familiar with anti-guerilla defence, such as used to be experienced in "colonial" warfare, and whether the administrative tail can produce enough men for it, and whether all personnel are suitably armed? If not, more than "embarrassment" is likely to be felt. As a single example, an automatic pistol in an equipment table may give an entirely false sense of security. Wellington's 1814 Defence Memorandum, recommending an engineer report with a mémoire raisonné upon each place to be defended, pointing out the garrison required for its defence, and reasons for thinking such garrison necessary, could well apply to rear area security in future plans. If, in 1815, the thoroughness of the engineer work conceivably helped deter the enemy from his most dangerous line of attack, might there not be scope for such an engineer mémoire raisonné on rear area defence today?

Wellington's clearness of vision and resolution were phenomenal; hence the last word has not yet been said about Waterloo. The present writer, with recollections of once having been a temporary undergraduate, has no hesitation in offering the last word but one—Napoleon, before he left Paris, remarked, "I go to measure myself against Wellington." The result proved beyond controversy the shortcomings in the metric system.

* * * * *

A Hundred Years Ago

МАТА КАСНА

THE RE Journals for July, August and September 1871 bring no rich load of grist to the reviewer's mill; due chiefly to the high proportion of space devoted in them to subject-matter of which this Series has already taken note. Thus, fifteen columns of "Submarine Mining Warfare" from Major Stotherd (to be continued), somewhat tedious notes on the damage sustained by the ironclad *Agincourt* when she grounded on the Pearl Rock, lengthy dissertations on "Experiments against armour-plates at Shoeburyness", and further commentary on the Siege of Paris do no more than reflect once again the pre-occupation of the period with the defensive aspects of the sapper's role. Alone, the Shoeburyness article is, perhaps, noteworthy for one almost unintelligible sentence of 131 words, punctuated at random by one semi-colon, five commas and two parentheses.

A prevalent interest, previously remarked upon, in cost evaluation is here instanced by an estimate of not more than £1,800 for the provision of 100 yards of the new pontoon bridge, exclusive of the wagons, which were priced separately at £54 apiece. The estimate was, however, to be considered as "somewhat vague", since it had tardily been discovered that no factory existed for the production of "Mr Clarkson's material", of which it had so confidently been recommended the flotation units should be made. Captain Lambert, who had enjoyed a period of attachment to the Pioneers of the Prussian Army at Lauenberg, on the Lower Elbe, in 1869, records his impressions, observing that "no long boots were provided, and the building-squad of the trestle bridge must sometimes have suffered severely from the cold. Even in the Schleswig-Holstein War in winter, the men had to enter the water with bare feet and legs".

It appears that a number of RE officers had, over the preceding years, been most

hospitably received and entertained by the Prussians in their homeland as well as on service during the Franco-Prussian war. In acknowledgement of the great civility shewn to them, a Cup had been presented to the Prussian Engineers' mess at Coblenz in 1868, and, on 14 July 1871, the following telegram was delivered at Wouldham from Baron von Kittlitz, Lieutenant of the Royal Prussian Engineers and Adjutant of the 8th, or Rhine, Pioneer Battalion:

"Returned from the glorious French war, the Royal Prussian Engineers drink with your present the very good health of the Royal English Engineers."

A suitable reply was sent, reciprocating the kindly feelings and wishing all prosperity to their "brothers-in-arms". Does the Cup still dress the table of some engineer mess of the Bundeswehr in the West German Republic?

An article in the September number, on "Promotion in the Royal Engineers", concerns itself with the hypothetical structure by ranks of the Corps necessary to provide a satisfactory career pyramid, but holds little of relevance in the present age. For one reason, Colonels Commandant and Colonels then counted against the establishment of the Corps, while officers on the staff and otherwise employed ERE did not. The current scales allowed 35-5 second-captains and lieutenants to every six lieutenant-colonels. Oh! to have been -1 of a second-captain! Strange, indeed, were the workings of the Adjutant-General's Department in those days, as can be seen from the curious happenings following the death of General Sir Charles Ellicombe notified in the London Gazette of 27 June 1871. A chain reaction seems to have set in, at the tail-end of which lucky Lieut-Colonel William Faris "who retired from the Royal Engineers on full-pay prior to 3rd November, 1854", over sixteen years before, suddenly found himself a full General.

Of the forty RE companies in existence a hundred years ago, twelve were located abroad and twenty-eight at home, of which ten were stationed at Chatham. Of those overseas, three were at this date in Bermuda, three in Gibraltar, two in Malta and one each at Quebec, Halifax, St Helena and Mauritius. The "History" of the Corps is irritatingly silent as to what they were all doing, but we know that Colonel Jervois, Deputy Director of Works and Fortifications and master-spirit behind the great defence works approved under the National Defence Act of 1860, visited Halifax and Bermuda in 1869 "in order to inspect the works in progress at these naval bases", and later went on to Gilbraltar and Malta. With the introduction of steam into the Royal Navy all these places gained in importance as "coaling-stations" and required fixed defences on a modern scale. Of St Helena we are reminded that the 7th Company Royal Sappers and Miners followed Napoleon to that island in 1816 and, among other works there, built for him a residence at Longwood, which he never occupied. When "Boney" died on 5 May 1821 a stone vault was built for his corpse, and his body was lowered into it, by men of the Company, which, "the necessity for it no longer remaining", was then withdrawn. When they returned is not recorded, but in 1871 7th Company RE was once again in garrison on the island. Of Mauritius we are told a little more, in that the first sappers, a party of "seven masons and bricklayers under Corporal John Reed", arrived there in 1832 "for the purpose of teaching and instructing the native artificers". Reinforced in the following year, they were responsible among other things for the building of the citadel on the Petite Montagne. On completion of this work this half-company was withdrawn, but in 1848, a full company of 100 men was again sent to the island and remained there for many years. In 1871, this was the 24th Company RE and both St Helena and Mauritius became important coaling-stations on the Cape route to India and the Antipodes. Strangely enough, no RE company was at this date stationed at the Cape, though there was a CRE, with five other RE officers, in the colony. The formal opening of the Suez Canal took place in November 1869, when Aden assumed greater importance, though it was at that time administered from India. In 1935, a sapper of 41st (Fortress) Company, in Singapore, asked in his Education examination to set down a few lines on Aden, wrote "It is one of the forty-five ports on the sea-route from

England to the East"—a misinterpretation of the word "fortified", of course, and a quaint reflection on the hazards of oral teaching.

As for the officers, India accounted for 272 and the other "foreign" stations 100. The remaining 462 (including a number shewn as on sick-leave) were at home stations. The lists include, among the "old retainers", three paymasters, four quartermasters, three surgeons (and five assistant do.) and two veterinary surgeons. Ôddly, it seems, three of the surgeons were at Chatham, two at Aldershot, and one each at Gibraltar, Bermuda (then a notorious fever-spot) and Malta. A genealogist might find an interesting field for enquiry in this List, which contains a remarkable number of names to be repeated in the rolls of following generations. The historian will take note of the early strivings of men destined to achieve fame; while the idle reviewer, browsing through these pages, ponders some idiosyncrasy of posting or phraseology. Here we find no less than seven VCs serving in September 1871, two of them, Lieut-Colonel Sir H. C. Elphinstone and Captain G. Graham, earned on the same day in the Crimea, when the latter led the ladder-party to the assault of the Redan, Lieut-Colonel H. N. D. Prendergast, Captain C. A. Goodfellow and Captain E. T. Thackeray had gained theirs in the black days of the Indian Mutiny; and Captain W. S. Trevor and Lieutenant J. Dundas achieved the distinction simultaneously in the Bhutan war of 1865, leading the way into a blockhouse occupied by 200 desperate men. To do this Dundas had to scale a 14 ft wall and affect an entry "headfirst through an opening not more than 2-feet wide between the top of the wall and the roof of the building". The Victoria Cross was introduced by the Queen in 1856 to reward just such "conspicuous acts of bravery in the presence of the enemy". The other distinction at this time available to reward officers of the Navy and Army was a Military Companionship of the Order of the Bath, reconstituted in 1815 to commemorate "the auspicious termination of the long and arduous contest" against Napoleon. The List under secrutiny contains twenty-nine of these CBs, to say nothing of three Gs and five Ks among the generals. The high proportion of VCs and CBs were never again to be reached, and their individual significances were by degrees rarified with the successive introduction of new awards, the DSO in 1886, the MC in 1915, and the Order of the British Empire, with its many grades, in 1917, at the height of the Great War.

The Corps List of September 1871 tells us that the CRE at Aldershot was Colonel R. M. Laffan, engaged no doubt in telling "chalk from cheese" on the Plain to which posterity was to give his name. Two distinguished chroniclers of the Corps, Lieut-Colonel Whitworth Porter and Lieutenant C. M. Watson, were then serving inconspicuously respectively in Malta and at Cork; Captain F. E. B. Beaumont, MP, evidently took time off from his duties at Sheerness to represent his constituency at Westminster; and Lieut-Colonel H. Y. D. Scott, having completed the building of the Albert Hall, rested from his labours in the chair of the Director of Building at South Kensington. The future and controversial hero of Spion Kop, Captain Charles Warren, commanded 10th Company at Dover; Licutenant Bindon Blood, the Corps' first Chief Royal Engineer, was stationed in Bombay; and Lieut-Colonel ("Chinese") Gordon, enjoying "the happiest years of his life" in a humble post at Gravesend, stood under orders to proceed to the Danube. There, as British member of the European Commission with an annual salary of £2,000, he was to be engaged on the improvement of the Salina mouth of the Danube to such good effect that vessels of large burden were soon to be able to load at the Galatz and Braila wharves.

Over these yellowing pages the imagination pierces the frail structure of fact. Did Lieut-Colonel E. M. Grain, with the romantic title of "CRE China", really roam the vast and diverse expanses of the Mandarin Empire from the Great Wall to the Gulf of Tonkin? What was Lieutenant F. G. Oldham doing in Japan, when his Company was stationed in Mauritius? Is there some drama behind the curt ambiguous phrasing of "Second-Captain P. Phelps—to leave Europe"? And, was it more than the lure of alliteration which allowed the proof-reader to pass the rankless, initial-less "Barklie has embarked for Barbadoes"? The published records of the cricket season of 1871 contain nothing of spectacular interest, nor is it easy to draw much inspiration from a lengthy account of the RE ν RA 4-oared boat race rowed on 17 June over a long course on the Medway above Rochester Bridge. Steamers, special trains and all, testify to the importance of an event long since abandoned; but, they could not prevent the torrential rain from spoiling the subsequent "al fresco" lunch in the Castle grounds. We can sympathize with the organizers, with the bands of the Corps and of the Royal Marines, and with the "large company which had assembled", but all was not lost. "Merry groups of ladies" (Bless them!) "were seen to be thoroughly enjoying themselves in nooks and corners . . . judging from the laughter and merriment which proceeded from some of these parties, it may be doubted whether many people did not enjoy the crouching under the old arches, or in some groined corner, nearly as much as if they had been able to walk about in the grounds of the castle."

Thin gruel, this Quarter. But, take courage; the puffing of the "Steam Sapper" can be heard making its way up Barrack Hill.

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Correspondence

Brigadier E. M. Hall, CB, MBE, Treworgey Manor, Liskeard Cornwall.

15 June 1971

BRIGADIER H. P. CAVENDISH

Sir,—It was terribly sad for us to see that "Cav" had died, but even sadder to see that his Memoir in your June issue covered only his official history and barely mentioned the man he was. I write as the last survivor of the Officers' Mess of that 18 Field Company Royal Bombay Sappers & Miners that left India in late July 1939 with 11 Indian Infantry Brigade, with no knowledge at that time that we were to be founder members of the 4th Indian Division. The war was only on the horizon. I served under "Cav" directly or indirectly for six out of eleven years, between 1939 and 1950.

It is no surprise to me that many tributes have been received from India. "Cav" was above all a professional soldier and a dedicated one-dedicated both to the Corps and to India. He did not suffer fools gladly and I still record with joy the two occasions when he said to me, "Hall, I didn't know a Sapper officer could be so ignorant." I was, but I learnt from him. He was however tremendously shy in personal relationship, with the result I feel that few who had not had the privilege of serving with or under him would have had the chance of knowing the real "Cav".

Once this was achieved, "Cav" was joy—he was totally honest in the best sense, but full of compassion allied to a wonderful, although sometimes hidden, sense of humour. His man management was humane and balanced. His manners were superb—and, indeed, to the fair sex (once he accepted them) his charm immense.

A great chap, "Cav", in every sense of that inadequate phrase—many of us will miss him. I learnt so much from him, professionally and as a person, that I would be most grateful, Sir, if you could find room for this additional tribute.—Yours truly, E. M. Hall.

> Colonel A. J. Kerry, OBE, MEIC, late RCE, Church Close, Rectory Lane, Woodstock, Oxford.

> > 14 June 1971

1944 45 BULK SUPPLY OF PETROL TO 21 ARMY GROUP

Sir,--I have just read Major-General Sir Eustace Tickell's very interesting article in the June Journal. I would like to add one or two points from the purely Canadian point-of-view.

From war diary entries it appears that the Chief Engineer First Canadian Army was

given more than a little responsibility for pipeline construction on 4 September 1944, as all the terminals lay in that Army's area. There seem to have been three major tasks:

(i) On 4 October 1944 the 3rd Battalion, Royal Canadian Engineers (about 750 all ranks, mainly French-speaking), supported by one company (about 200 all ranks) from the 2nd Battalion and the 2nd Canadian Drilling Company (some 250 plus all ranks, specially trained in oil installations) and detachments from other arms, started work on the sector from Ostend to Aeltre, completing the task in 3½ weeks. Simultaneously two companies (oil installation trained) of the US Corps of Engineers dealt with the sector from Aeltre to Ghent.

(ii) From there the Drilling Company went direct on to the Boulogne-Calais sector, to work with 106 CRE Works (No 1 Oil Construction Group). The first of the three lines built here came into use on 20 November 1944. Incidently a BEM for gallantry was won on this job.

(iii) On 13 February 1945 two companies (about 400 all ranks) from the 3rd Battalion started on the link from Ghent to Antwerp, soon being joined by 2nd Canadian Drilling Company, RCE. Petrol was flowing by 28 March, although General Sir Thomas Riddell-Webster did not officially couple in the last link until 10 April 1945.

I would also like to stress that we were all "Canadian Sappers", whether French or English-speaking by birth, and all RCE units contained both, although for administrative reasons it proved easier to post the bulk of French-speaking personnel to particular units. In actual practice, the unit with which I came overseas in 1940 contained speakers of every language known in Europe and on more than one occasion we supplied personnel for use by the BBC.—Yours faithfully, A. J. Kerry.

> Lieut-Colonel J. H. Fyson, MBE, MC, CEng, MICE, MNZIE, 43 Military Road, Northland, Wellington 5, New Zealand. 17 July 1971

Sir,—"Mata Kacha" in his article "A Hundred Years Ago" in the March 1971 *Journal* refers to a monorail system advanced by a certain Mr Fell, and admits to not being able to discover who Mr Fell was.

I wonder if your author was thinking of the originator of the Fell system for allowing locomotives to climb steep gradients and turn tight curves? There were three known examples of this system in use, all described in various papers of the Institution of Civil Engineers. One in the Swiss Alps, one in Brazil, and the third in New Zealand.

The system had a central rail which was gripped by horizontally placed driving wheels. Gradients as steep as one in twelve could be climbed. The New Zealand example was over the Rimutaka Range in the North Island, and lasted until quite recent years when it was replaced by a five mile long tunnel at much lower elevation.

The Fell engines were spaced out along the train, as many as five. Once a train was blown off the line but held from dropping far below by the grip of one of these engines.— Yours faithfully, J. H. Fyson.



From portrait by Oswald Birley

FRANCIS POITIERS NOSWORTHY, the senior Colonel Commandant Royal Engineers (retired), died peacefully at Lansdowne Nursing Home, Bath, on 9 July 1971 in his eighty-fourth year.

The son of Richard Nosworthy, CMG, of Kingston, Jamaica, he was educated at Exeter School and the Royal Military Academy, Woolwich, and was commissioned into the Royal Engineers in 1907.

After leaving Chatham he was posted to India and joined the Military Works 200

Lieut-General Sir Francis P Nosworthy KCB DSO MC Colonel Commandant RE

Services at Secunderabad. In 1911 he moved to Delhi for work in connexion with the King George V Durbar, after which he was transferred to Mardan as Garrison Engineer and took part in the excavation of the old Buddhist Monastery of Takht-I-Bhai. The following year he became a Company Officer in the 1st (KGO) Bengal Sappers and Miners at Roorkee and almost immediately afterwards he accompanied 6 Company to the Abor Mishmi country, where the unit became part of a column, commanded by Lieut-Colonel E. C. Tylden-Pattenson, RE, whose aim was to drive a road through, and open up, the country as far as the Indo-Chinese frontier. The task took a year to complete under active service conditions and the company suffered many casualties. On returning to Roorkee, Nosworthy was transferred to the Survey of India. However, on the outbreak of war in 1914 he was recalled, to join 20 Company of the 3rd Royal Bombay Sappers and Miners and sailed with the 3rd (Lahore) Division for France.

The Division landed at Marseilles towards the end of September and moved northwards by stages. It was eventually thrown into battle in the Festubert Sector. On 28 October 1914, 20, together with 21, Company took a prominent part in the capture of Neuve Chapelle. Used as infantry in a frontal assault, led by their officers sword in hand, the companies acquitted themselves with conspicuous gallantry, but at grievous cost. R. S. Rait-Kerr and Nosworthy were the only two surviving officers and they both were wounded. After rejoining 20 Company in January 1915, he was again seriously wounded in the Second Battle of Ypres. During his convalescence the Indian Corps was transferred from France to Mesopotamia, and Nosworthy's World War I service with Indian Troops came to an end.

On his return to France in January 1916 he was appointed a GSO III on the Headquarters of II Corps, and in January 1918 was transferred to 66 Division as GSO I, which appointment he held until the Armistice in November 1918. For his services in the early part of the war he was awarded the MC and Bar, the DSO, and a brevet majority, followed later by an immediate bar to his DSO, and the French Croix de Guerre during the final German offensive of March 1918. In the last Honours List of the War he was promoted to brevet Lieut-Colonel.

In January 1919 he was posted as an Instructor at the Staff College, Quetta. Shortly afterwards, however, he was made GSO I 4 (Chaman) Division, then operating in the Chaman/Kandahar region in what came to be termed the 3rd Afghan War. Returning to the Staff College when hostilities ceased in September, he had as one of his 'pupils' the future Field-Marshal Sir Claude Auchinlech. In the field of sport he distinguished himself by winning the Staff College Point-to-Point Cup three years in succession.

Returning to the home establishment in 1922 he was appointed to the Intelligence Directorate of the War Office as GSO I, and in 1926 he was appointed Chief of Staff and Assistant Kaid of the newly-formed Sudan Defence Force, created a Pasha by the Khedive and given the rank of Lewa, equivalent to Major-General. The Kaid was Major-General H. J. Huddleston, who later became Governor-General of the Sudan. The Defence Force was set up after the murder of the Sirdar of the Egyptian Army— Sir Lee Stack—when it was decided to divorce completely military units in the Sudan from the Egyptian Army. The Defence Force created by Huddleston and Nosworthy consisted basically of a number of small, mobile, self-contained units and they were in advance of any other Force at that time as far as mechanization was concerned.

On completing a four-year tour of duty in the Sudan, Nosworthy became a student at the Imperial Defence College, after which he was employed for a short period in a Works appointment, in his substantive rank of major, as DCRE Hounslow. In September 1932 he was appointed GSO I China Command, where his chief preoccupation was the preparation of plans for the modernization of the defences of Hong Kong. A detailed plan and estimate of costs were eventually prepared and accepted but, due to lack of funds, only very few of the major works were put in hand before the outbreak of war.

In 1935 he was given command of 5 Infantry Brigade at Aldershot. It was a period

of mechanization. When he took over the Brigade it was completely horsed: when he left in 1938 not a single charger nor horse-drawn vehicle remained. With 6 (Experimental) Brigade, 5 Brigade formed part of 2 Division then commanded by Major-General (later Field-Marshal Sir Archibald) Wavell and, under his inspired leadership, a new technique of mechanized warfare was evolved which became the model for the remainder of the British Army.

In 1938 he was promoted substantive Major-General and, returning once more to India, he became DCGS at Army Headquarters. Owing to the lack of funds the Indian Army was at that period woefully deficient of all types of modern weapons and equipment, being in practically the same state as it was at the end of the First World War. Nosworthy was made Chairman of a Modernization Committee. A detailed five-year programme was quickly drawn up which, among other features, made provision for the complete mechanization of the Indian Cavalry. The programme was accepted by the Government of India but, as it involved an expenditure beyond the resources of that country, it was referred to the Home Government. The result was the despatch of the Chatfield Committee later in the year. With a few minor modifications, the programme was approved by the Committee and submitted to Parliament, where £20,000,000 for its inception was voted. Executive work was immediately put in hand, but the outbreak of war in September 1939 found the Indian Army still far from being a modernized fighting force.

In May 1940 Nosworthy was recalled to command 18 Division in England. He returned by air, but meanwhile the Dunkirk evacuation had taken place and all was in confusion. On arriving home he was ordered to resuscitate IV Corps with whatever mobile formations and units there were available in England. The role of the Corps was to form a GHQ General Reserve, prepared to counter-attack in any section between the Wash and Southampton and, if necessary, in the direction of Liverpool. Meanwhile three formations, which had returned from France, and which were completely immobile due to lack of transport, were allotted various defensive sectors on the coast. This precarious situation lasted throughout the remainder of the year. Matters gradually improved, however, and in June 1941 it was decided that a full Corps in GHQ Mobile Reserve was no longer needed. IV Corps then took over responsibility for the Sussex coast, where it remained until relieved by the Canadian Corps, when it was disbanded, to be re-formed later in India. During the time the Corps was in Sussex, Nosworthy was slightly wounded at a demonstration by a premature explosion of a Blacker Bombard. He was subsequently given command of IX Corps in the North of England. This Corps was however, in its turn, reconstituted in preparation for the 1st Army's North African landings and Nosworthy, although now over the retiring age, was appointed GOC-in-C West Africa.

His principal work in West Africa was the organization, despatch and maintenance of an Expeditionary Force to India consisting of two Divisions, one of them commanded by a Sapper officer, Major-General G. C. Woolner, an AA Brigade and an adequate complement of ancilliary services. The entire Force was successfully transferred to India in nine convoys during 1943 and 1944 and gave valuable service on the Arakan Front. The work involved the expansion of the Royal West African Frontier Force from a pre-war strength of some 6,500 to approximately 176,000. The total cost was in the region of £100,000,000.

Lieut-General Sir Francis Nosworthy finally retired in February 1945 after almost forty years of active soldiering.

Nosworthy was an accomplished athlete and sportsman. When at the RMA Woolwich he represented the Shop against Sandhurst at gymnastics and at boxing. As a young officer at Chatham he played both cricket and Rugby for the Corps. In India his chief recreations were polo, point-to-point racing, pig sticking and shikar. The skin of a large tiger, shot by him, hangs to this day in the hall of the Headquarters Mess, Chatham.

He was appointed Colonel of the 3rd Royal Bombay Sappers and Miners and in 1945 he was appointed Colonel of the Royal Indian Engineers. He became a Colonel Commandant RE in 1940 and was Representative Colonel Commandant in 1947. His tenure as a serving Colonel Commandant expired in 1950.

After retirement he took a keen interest in various ex-service Associations, including the British Legion and the Old Contemptibles, of which he was the President of the Hereford Branch. He was also for some years Vice-President of the National Association for Employment of Regular Soldiers, Sailors and Airmen. He obtained two Directorships, one in the Chinese Engineering and Mining Company Ltd and the other in the Lake Copais Company Ltd, of which he became Chairman. He retired from these commitments in 1955 and, at the age of 68, he took up farming in Herefordshire. He recently lived in Bath.

On 31 December 1925 he married Audrey Davey, daughter of T. R. Davey, Esq, JP, of Wraxall Court, Somerset. They had a son, born in 1927, and a daughter, born in 1930. To his family our deepest sympathies are extended. A Memorial Service will be held in Bath Abbey at 3 pm on 25 September 1971.

C.A.B. writes:

Frank Nosworthy was the last survivor of the gallant band of RE officers serving with the 20th and 21st Companies of the (later Royal) Bombay Sappers and Miners, who displayed such outstanding bravery and devotion at Neuve Chapelle and Ypres during the winter of 1914–15. The description of these epic events is dramatically told in "The Indian Sappers and Miners" (Chapter XVI) by Lieut-Colonel E. W. C. Sandes, DSO, OBE, MC; to these, the awards to Nosworthy himself, earned over a brief period, bear eloquent testimony.

At Neuve Chapelle a bullet passed through his map-case, and punctured that place name on the map inside! After being severely wounded, shot through the heart, at Ypres, he disagreed with the Medical Officer at the Casualty Clearing Station, when the latter expressed doubt on the likelihood of his recovery!

His staunchness of character pervaded his whole life, and helped to sustain him aided by the devoted care of his wife, in his recent years of ill-health.

Those of us who enjoyed the privilege of his friendship, and admired his courage, in my case over fifty years—will cherish his memory. "Un vrai soldat, sans peur, et sans reproche".

* * * * *



From the 1939-45 War Portrait Gallery in the RE HQ Mess, Chatham

MAJOR-GENERAL "GINGER" WATKINSON, an intrepid yachtsman, the original Commander of the 1st Assault Bridge RE was one of the first ashore during the Normandy Landings, Chief Engineer XXX Corps during the Rhine crossing operations and Chief Engineer BAOR, died at Plymouth after a short illness on 7 May 1971.

Geoffrey Lionel Watkinson was born on 20 July 1899, the younger son of Professor and Mrs. W. H. Watkinson of Liverpool. He was educated at Clifton and the Royal Military Academy, Woolwich. He was originally commissioned into the Gunners in 1919 but transferred to the Sappers four years later, spending two years at Chatham. In 1925 he sailed as one of the crew of the REYC 14-ton cutter *Fulmar* which was second in the first Fastnet Race ever sailed, a very creditable feat as *Fulmar* was the smallest yacht in the race. Watkinson qualified as an REYC "skipper" whilst still a subaltern and sailing was his lifelong joy. He was a founder member of the Royal Ocean Racing Club and later a member of both the Royal Thames and the Royal Western Yacht Clubs.

Major-General GL Watkinson DSO DL

In April 1927 he was posted to the 5th (Field) Company RE at Aldershot, but a few months later he was transferred to the Military Intelligence Directorate at the War Office and until October 1930 he was "specially employed" in certain cloak and dagger operations in Turkey and the Levante and became a First Class interpreter in Turkish.

On 10 June 1929 he married Phyllis, younger daughter of Mr and Mrs Charles Pauli of Stoke Bishop, Bristol, at All Saints, Margaret Street, London. They had two sons.

From October 1930 to January 1934 he served with the 56th (Field) Company RE at Bulford and then held Works appointments at Hounslow and Feitham. In July 1935 he was again attached to the Intelligence Directorate at the War Office and spent a short while specially employed on intelligence duties before being posted to the Bengal Sappers and Miners at Roorkee. He did not stay long in India and in July 1936 he became an Assistant Instructor at the Gas and Fieldworks and Bridging School at Chatham. Two years later he was posted to the Training Directorate at the War Office.

He served in India, the Middle East, at home and in North West Europe during the Second World War. Soon after the withdrawal of our armies from France and Beigium in 1940 the German Todt organization started to build the formidable -Atlantic Wall defences which it was claimed would be impregnable against any possible sea-borne attack. The abortive raids on Dieppe and other places tended to confirm this. The Sapper "forlorn hope" stood no chance of breaching the beach defences unless they could be carried forward in thick-skinned vehicles. From this sprang the concept of a special RE assault force, carried in modified Churchill Tanks, which could be used in the forefront of the battle for tasks that other engineer units could only execute at high cost, if at all. In April 1943 Major-General Sir Percy Hobart, an armoured warfare expert who had started his military career in the Sappers, was given command of the newly-formed 79 Armoured Division whose role was the development of special armoured assault equipment and techniques. The Division initially contained two Assault Engineer Regiments. In July, Watkinson was appointed Commander Assault Engineers. These soon became the 1st Assault Brigade RE comprising three Assault Regiments, each of four Assault Squadrons, and an Assault Park Squadron, an Ordnance Field Park and a REME Brigade Workshops. The standard sapper vehicle was the Churchill AVRE armed with two Besa machine guns and a petard capable of firing a 40 lb concrete block-busting demolition charge, known as a flying dustbin, up to an effective range of 80 yards. In addition special shaped charges, the Bechive and the General Wade, were carried. These had to be placed by hand but could be fired from within the AVRE. Further assault engineer devices, based on the AVRE, were a huge fascine, an assault bridge of 30 ft span for tanks, a skid Bailey of 80 ft span which could be launched without the Sappers exposing themselves to enemy fire. Other equipments developed were the Ark, with a trackway on top of the AVRE, which could be driven into a small gap and the trackway released to form a bridge. Tank dozers and armoured bull dozers were other developments. For explosive minefield clearance the Snake and the Conger, which consisted of a rocket propelled hose later filled with a highly dangerous liquid explosive, were also developed, and for "carpet laying" the Roly-Poly and the Bobbin were both designed to lay reinforced matting over soft patches on an invasion beach. These were the basic equipments developed, and rapidly put into production, by the drive and insistence of Ginger Watkinson. A host of other devices were tried by him and found operationally wanting. When D Day came his three Assault Regiments were placed respectively under command of 50 British Infantry Division, 3 Canadian Infantry Division and 3 British Infantry Division. The Brigade Headquarters had no operational part to play but the first LCT to reach the Berniers-Sur-Mer beaches in the Canadian sector carried Brigadier G. L. Watkinson, as a passenger, and the Commander of 8 Assault Squadron RE, Major R. T. Wiltshire, RE. He remained in command of the 1st Assault Brigade RE until the spring of 1945 when
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he became Chief Engineer of Lieut-General Sir Brian Horrock's XXX Corps, then embarking upon Operation Veritable, the clearance of the West bank of the River Rhine, and later with XII Corps to take part in the great Rhine crossing operation on 23/24 March. When hostilities in NW Europe ceased he became Chief Engineer BAOR and retired on 12 September 1946. For his services in NW Europe he was awarded the DSO in 1945 and the Belgian Croix de Guerre with Palm and was made a Commander of the Belgian Order of Leopold II with Palm in 1946.

After his retirement he preserved his connexion with the Corps and was for nine years the Honorary Colonel of 110 Field Engineer Regiment, TA, whose headquarters were at Bath. He was appointed Deputy Lieutenant for Somerset in 1958 and became President of the West of England Engineering Employers Association. He also became a Director of Stothert & Pitt Ltd, Torrance and Sons Ltd, W. F. Willis Ltd, and Avalon Garages Ltd, and, of course, he continued his yachting activities.

J.C.W. writes:

My recollections of Ginger Watkinson start as a YO when he was a gas instructor —in fact the Gas School—at the SME. His instruction was much more original than the formal academic teaching then in vogue, and included lots of entertaining demonstrations which have since become common practice. In those days YOs "called" on their instructors, which usually meant slipping cards in at the door unnoticed. With Ginger we all stayed to tea and had an entertaining hour at their house near Chattenden.

He later owned a Thames barge, *Plinlimmon*, once owned by A. P. Herbert, and converted it to a yacht. In this he lived with his family, moored in the Medway in winter and cruising in the summer. In the autumn of 1938 she was on the south coast, and it was not until well into October, after the Czech crisis had died down, that he was able to get away. With two other REYC volunteers I joined *Plinlimmon* on a Friday night at Portsmouth. Shortly afterwards Ginger arrived and we set off.

Cutting across the Horse Sand we ran through a line of buoys that the Navy had assembled for the boom defences, and lost a dinghy which was towing aft in the process. Ginger was quite unperturbed, and we pressed on up channel before a rising westerly gale. It was soon blowing very hard indeed, and because *Plinlimmon*'s heavy iron barge wheel had been replaced by a smart wooden yacht pattern it took two to hold her in the heavy following seas. It came on to blow very hard indeed, and the gale backed to the south and visibility was obscured. We hit another buoy in the Downs and at dawn on Sunday crept round the North Foreland to anchor in Margate roads. There were seven ships sheltering there, including a destroyer.

As Commander 1st Assault Brigade RE he had a most exacting task. In the autumn of 1943, when the brigade formed up not only were the Sappers new to this specialist role, but most of the equipment was undeveloped, and certainly not in production. The successful raising and training of the brigade was due to his originality, organization and drive. On joining the brigade new units were completely dismembered. My squadron lost all its officers, lance-sergeants and corporals who went on a six week's driving and maintenance course. The sergeants went to the Brigade School to learn about the assault engineer equipment and weapons. Some RAC instructors taught crews to drive on old Churchill tanks, and radio operator courses began. The SSM and myself ran the squadron on our own, and put everyone through a range course, and mines and demolition. Then the others returned, I went to an intensive course at the Churchill tank manufacturers and finally the whole team came together to work up in the Orford battle area. We were fully operational in three months.

The Divisional Commander, Sir Percy Hobart, was not an easy man to serve; he had originally been a Sapper, before making his reputation with the Royal Tank Corps, and he expected a lot from his old Corps! One night at Divisional Headquarters a proposed new mine-clearing device was discussed by Ginger Watkinson and the Brigade Commander. The following morning the latter arrived at the training area and asked to see it. On being told that it was not yet ready he replied: "What have you been doing all night?"

For the invasion there was no operational role for 1st Assault Brigade Headquarters as the Regiments were all under command of the attacking divisions. In spite of strict orders to the contrary, Ginger embarked as a crew member of the Armoured Recovery Vehicle and was on the beach with his Sappers on D-Day. On returning to England he was ordered to report to Divisional Headquarters at once, and an officer who travelled with him told me that that was the only time he had ever seen Ginger look a little worried. On arrival General Hobart demanded a first-hand account of events and nothing was said about disobeying orders. In many ways they were similar characters.

Later in the campaign he organized the 79 Armoured Division troops for the invasion of Walcheren, which included changing AVRE Regiments to Buffalos (Amphibious lightly armoured load carriers) in a week or two. For the Rhine crossing their role was changed again to 50/60 rafing. Ginger was never worried by difficulties, and had no time for anyone else who was. He was always approachable and ready to listen to other people's ideas, discuss them and often improve them. Once accepted as a member of his team you had his full backing. We were mostly very young for our responsbilities and got into some dreadful administrative muddles at times, which a lesser man would not have tolerated, but we could always count on his support.



J.M.R. writes:

Ginger Watkinson was an enthusiastic sailor and a well-known member of the Royal Engineer Yacht Club; a highly competent seaman of the "press on regardless" school, almost immune to the vagaries of the weather and as tough as they were made even in those days. He was a founder member of the Royal Ocean Racing Club in 1925 and crewed in that year in the first Fastnet Race in the REYC yacht *Fulmar*, when she gained second place. He was a mate in the 1927 Fastnet in *Ilex* when she was almost the last of thirteen yachts to give up, out of a field of fifteen, after three headsails had been blown out in twelve hours and she had sprung a serious leak. He was always the first out on the bowsprit and the last to agree to abandon the race. He skippered *Ilex* in the 1931 Fastnet and in numerous other races in the British Army of the Rhine just after three was instrumental in obtaining the windfall yachts *Overlord, Avalanche* and *Torch* for the club.

The story is told of a memorable passage which Watkinson undertook in 1924 from Oban to Chatham in the old gaff cutter *Twilight* (still owned today by a member of the club) with a crew of brother officers. Allegedly ready for sea, he found *Twilight* propped up in a field on two tree trunks. Within thirty hours, under his leadership, she had had two coats of paint, the mast had been stepped, gear put aboard and they were under way. After ten days, during which she was pumped for twenty minutes in every hour, they reached Chatham at midnight on the last day of the crew's leave, having passed Beachy Head at 3.30 that morning. A hard-driving skipper of the old school indeed.

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SHOLTO PEMBERTON died after a long illness on 2 April 1971, aged 87 years. He was born in 1883. In 1900 he entered the RMA Woolwich, where he got his colours for Gymnastics. In 1902 he passed into the Royal Engineers. Lord Roberts was the Inspecting Officer at the Passing Out Parade. After YO Training at the SME Chatham he was posted to India and travelled out on the Transport Assaye. This could be considered a portent for the future for he was to spend the best years of his

Colonel S Pemberton DSO MC

life with the Madras Sappers and to add further laurels to that famous Corps which bears "Assaye" (one of Wellington's early victories in India) as a Battle Honour.

On arrival at Bombay he was posted to the 2nd Queen's Own Sappers and Miners and he joined the Corps at Bangalore on 12 December 1904. His first posting was to 13 Company, then stationed at Secunderabad. The following extract from Sholto's personal papers refers to this period: "That the Madras Sapper of earlier days was no mean shot with a rifle was proved when in 1905 13 Company won the RERA Shield which was at that time open for competition annually by teams of 8 from all RE and S and M units in UK or abroad. It was fitting that Subadar Devasahayem made the highest score and won 2nd prize in Class I for Officers. This was the first time on record that this coveted shield had been won in India; this apparently caused some consternation at Chatham for the following year a 2nd shield was provided and the competition was therefore split into two categories, one for units in UK and the other for units abroad." What Sholto does not mention in this record is that he himself was also a member of the 13 Company winning RERA team, and in fact tied with the Subadar in obtaining the highest score. His widow treasures a cup inscribed "R.E.R.A. 1905, Class I. 2nd prize. 95 pts. Lieut. S. Pemberton".

In June 1909 Sholto was posted to 11 Company stationed at Rawalpindi. He was in command of No. 1 Section which was on outstation at Drosh in Chitral and employed on road works and bridge construction. At the end of 1911 11 Company moved to Delhi for works in preparation for the Durbar. The Company later lined the route for the State Entry on 7 December 1911 and took part in the Royal Review on 14 December.

Sholto was then transferred to 10 Company and in November 1912 he took the Right Half Company to the Abor hills in the north east of Assam to provide engineer support to the Abor Survey Party. The objects of the expedition were to prolong the survey of the country northwards on both banks of the Dihang River and to locate the true course of the Tsang Po river. During the march many tributaries had to be crossed and Sholto and his Sappers constructed a total of nineteen bridges of types varying from cane tubular and bamboo arch to crib piers and steel cable suspension, while longer rivers with spans up to 500 feet were crossed by flying rafts. The survey had to be completed before the rains set in and it was a race against time. Sholto accompanied the flying column which crossed the Doshung La (13,500 feet) into Tibet on 2 July 1913 and returned just as the rains broke. He had meanwhile contracted a severe go of Jungle Fever, and Jack Wickham had a difficult job to get his OC carried out through desperately difficult country.

Sholto, now a Captain, was then appointed OC of 12 Company at Secunderabad. R.H.D. who was then his subaltern writes: "In the spring of 1914 there were severe floods in the surrounding country and a railway bridge some hundred miles from Secunderabad was washed away. Sholto persuaded the railway authorities to get 12 Company sent up to improvise a foot bridge by which passengers detraining on one side of the break could cross and join another train on the far side. In the Abor country the natives had built suspension bridges of jungle creepers woven into ropes. Sholto substituted wire cables for the creepers and made a suspension bridge of the Abor type across the hundred foot gap. This worked though it took a stout-hearted passenger to cross the swaying foot way."

War broke out on 4 August 1914 and on 17 March 1915, 12 Company proceeded on Field Service with Indian Expeditionary Force D and disembarked at Basra on 25 March 1915, joining the newly formed 12th Indian Division in General Nixon's Corps. The IEF had occupied Qurna on the Tigris and Shaiba, but both were threatened by the Turks. Moreover the country between Basra and Shaiba was under water from abnormal flooding of the Euphrates. Stores had to be got forward and wounded brought back. Sholto was largely concerned with devising rafts from bellums and marshoofs. When the Turkish attack on Shaiba materialised Sholto's rafts were used to ferry guns and howitzers to the battle area and the attack was repulsed.

After Shaiba a force under General Gorringe with 12 Company as its engineer

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component was despatched to sweep Turkish detachments and their Arab supporters from the left bank of the Tigris. The column would have to cross the Kharka river. Sholto was told to provide the means and did so with his customary ingenuity, improvising pontoons from posts, planks and paulins and hauling them across the desert on pipe carts collected from the oilfields and drawn by mules with harness improvised from bridge lashings. His sappers worked without rest. The Kharka reported as 450 feet wide turned out to be 600 feet in full flood with banks 14 feet high, but was brilliantly crossed by Sholto's improvised pontoons and flying bridges. The advance continued on both banks to Khafajiya. On the left bank creek followed creek and 12 Company constructed seven more bridges each one being dismantled as soon as the column had crossed and the material carried forward to the next. The Arabs were completely defeated and Sholto blew up the fort at Khafajiya before the force returned.

This operation enabled Townsend's force to advance up the Tigris to Amara. 12 Company was then switched to support the advance up the Euphrates to Nasiriya. The main channel was blocked by a large dam 30 to 50 feet thick with layers of reed matting alternating with earth. Sholto demolished this by sinking forty captured Turkish mines in holes 10 feet deep, and primed with dynamite. This cleared the channel and enabled river steamers to get through on 29 June. Before the final attack across the Atabiya creek 12 Company had the task of sapping forward under fire and constructing a bridge head on the far bank. Nasariya fell on 25 July 1915.

With the capture of Amara and Nasariya the position of the IEF was strategically satisfactory, as the lines of Turkish advance down the Tigris and Euphrates were both blocked. Sholto reported that his men had shown a spirit of enthusiasm and tireless energy that was beyond praise. Sholto and three of his officers were awarded the MC and four Indian Ranks received the IDSM.

General Townsend and his 6th Division now advanced and captured Kut. He was ordered to press on towards Baghdad, but was repulsed before Ctesiphon and forced to retire. On 3 December 1915 his force entered Kut, where he was ordered to remain. The Turks soon closed round and the investment began. The next four months were spent in determined attempts to relieve Kut. They were pressed with great gallantry, but they all failed.

During the first attempt 12 Company was engaged on the Euphrates. It arrived on the Tigris on 10 February 1916 joining 13 Company (recently arrived) to form the Engineer Troops of Tigris Corps. Both Companies were heavily involved in the next two relief attempts. 12 Company formed part of General Kemball's column for the costly and unsuccessful attack on the Dujaila Redoubt, working during the night on deepening eight wells in the depression which provided water supply for the troops.

12 Company at this time was still carrying materials for Sholto's plank and paulin boats intended for crossing the Hai. A Bridging Train with pontoons had now arrived from India. The Tigris however was in flood and both 12 and 13 Companies were still fully extended on bridging the Tigris which was essential for switching the advancing troops from bank to bank in the attempts to find weak spots in the Turkish defences. While the third attempt to relieve Kut was being desperately made against the strong Turkish positions at Sannaiyat, Sholto had found a site for a bridge across the Tigris at Fallahiya. The bridge was begun at noon on 7 April, 12 and 13 Companies working from opposite banks. Anchors were laid from a steamer and pontoons were added singly owing to the strength of the current. The river was at maximum flood and work was much interfered with by stormy weather. However, the bridge was completed within twenty-four hours and successfully maintained thereafter. During the final relief attempt 12 Company was driving saps forward towards Sannaiyat until the incoming flood water made it impossible to continue. The food supplies in Kut had by now run out and the garrison was forced to surrender on 29 April 1916.

After the fall of Kut, Tigris Corps was ordered to stand fast. Thorough re-

organization was necessary, rest for the troops, more transport and drafts to replace the heavy casualties. By the end of 1916 the base at Basra had been extensively developed and railways laid from Qurna to Amara and Basra to Nasariya. Three bridging trains had been formed from the Bengal and Bombay Sappers each carrying 500 yards of bridge.

General Maude took over command in August 1916 and reorganized the Tigris Force into two Corps of two Divisions each. The Engineer Troops of 14 Division in III Corps were 12, 13 and 15 Companies of the Madras Sappers. Sholto's 12 Company was heavily involved in engineering work of all sorts, but their most important task was the maintenance of a pumping station at Maqasis 4 miles from Kut and under fire from the left bank.

By the beginning of December 1916 General Maude considered that the condition of his troops and their supporting services was satisfactory. His two Corps were in strong positions astride the Tigris and he decided that the time had come to strike. On 13 December I Corps advanced to the Khudaira Bend and HI Corps got astride the Hai. Lines of strong points connected by wire entanglements were constructed to defend the area captured and 12 Company worked (including the night approach march) for 12½ hours continuously. It is also recorded that 12 Company Officers Mess celebrated Christmas day with a dinner including fish bombed in the Hai and geese stalked and shot with a service rifle!

Now began the one instance in this campaign of protracted trench warfare. The Turks were heavily entrenched on the right bank of the Tigris and steps were taken to clear them slowly and methodically. The bitter fighting may be gauged from the fact that in the first attack on the Hai position in which two Sikh Battalions took part the losses amounted to 1,032 out of 1,227. On the following night a report was received that an enemy communication trench was filled in for a distance of 80 yards from the British front line and from there forward was open and full of Sikh sick and wounded. Sholto decided to open this up. There was a three-quarter moon and as the work went on enemy snipers were shooting from 40 yards away. In spite of rifle fire and bombs, however, 12 Company successfully accomplished this task. After further bitter fighting both the Hai position and the Dahra Bend were cleared of the enemy by 16 February.

The right bank of the Tigris was now clear of the enemy. Maude's plan was to keep the Turks occupied on the whole front and eventually to effect a surprise crossing of the river and outflank the enemy. The place selected for the crossing was the Shumran Bend and the formation selected was 14 Division. The engineer side of the operation was to be in two parts.

- (a) The ferrying of the covering party in pontoons to capture and hold a bridge head.
- (b) The construction of the Pontoon Bridge.

Brevet-Major Sholto Pemberton, OC 12 Company, was in charge of the ferrying operation, and Major Freddie Witts, OC No. 2 Bridging Train, Bengal Sappers, was in charge of the Bridge.

The whole success of the operation clearly depended on the covering party's occupation of the bridge head. This was to be Sholto's responsibility, and he prepared for it with careful reconnaissance, detailed planning, thorough organization and repeated practice. There was very close liaison between engineers and infantry.

On 23 February 1917 pontoons at all three ferries were in the water by 5.30 am. Although the Turks fought most stubbornly and there were many casualties among rowers, pontoons and assaulting infantry, the ferrying was so well controlled and gallantly executed that by 9.30 am the Royal Norfolks were holding a line 300 yards inland, and by 3 pm the whole of 37 Brigade had gained a line across the peninsula and a mile from its southern extremity. Freddy Witt's pontoon bridge 295 yards long was begun at 7.30 am and complete by 4.30 pm. The remainder of 14 Division were across by midnight, followed by 13 Division and the Cavalry Division. The successful crossing at Shumran with its menace to the Turkish communications was the signal for the evacuation of Kut and retirement on Baghdad. Immediate awards to Madras Sappers who took part included two MCs, two IOMs and two IDSMs. On 24 February whilst search was being made on the far bank for wounded men, 99 armed Turks, including six officers, surrendered to one Havildar and two Sappers of 12 Company. 12 Company then took part in the pursuit and entered Baghdad with the leading Brigade on 11 March. Sholto and Captain Dewing were awarded the DSO, Lieutenant Woakes the MC, Sergeant Conroy the DCM, Subedar Burland the IOM and two IORs the IDSM.

Shortly after the capture of Baghdad Sholto was appointed GSO II to the 7th (Mecrut) Division. Later he was transferred as Brigade Major to 162 Brigade in Palestine. He had then been 24 years in Iraq almost continually on active operations with 12 Company. He remained in Palestine till 1919, when he at last went on leave to the UK. Here on 20 January 1920 he married Winifred, daughter of Colonel Carew-Smythe, late RE, who had previously been the Agent of the Hyderabad Railway in Secunderabad. It was while stationed there in 1914 that Sholto had first met his future wife. In 1920 they both went out to Bangalore, where Sholto must have been overjoyed to be with his Madras Sappers again. Unfortunately it was not for long, for after one year only he was invalided home. On arrival he spent six years on Salisbury Plain, three years each as DCRE Bulford and DCRE Larkhill. In 1927 he attended the Senior Officers School at Sheerness, and in 1928 he was promoted Lieut-Colonel and then served from 1928 to 1932 as CRE Dover. In 1932 he was promoted Colonel and placed on half pay. Later he was appointed Liaison Officer between the War Office and NAAFI. He retired in 1937. After Munich in 1938 he was given back his job and he mobilised NAAFI on to a war footing. This took six months. When war broke out in 1939 he moved Heaven and Earth till he was recalled. He was then appointed Chief Engineer of a Corps in East Anglia with rank of Brigadier. After Dunkirk he was relieved by a serving Officer, but he continued to work on the Defences of East Anglia. This job came to an end, but he was determined to go on serving and he took over command of the Bomb Disposal Organization of East Anglia.

After the war Sholto at last settled down peacefully with his wife at Yateley after 43 years of continuous service. The Shumran Bend had long since passed into history. However, it was considered at the time as a classical river-crossing operation, and Sholto was asked to give a series of lectures about it, which he did. Sholto always remained devoted to the Madras Sappers and he wrote a remarkable tribute to their loyalty, courage and cheerfulness in a memoir which he sent to the Commandant at Bangalore in 1957. In his later years his health sadly deteriorated and he was continuously nursed by his devoted wife during a long illness. He is mourned by his many friends, all of whom extend their deepest sympathy to his widow.

H.E.M.C.

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MEMOIRS OF AN ACADEMIC OLD CONTEMPTIBLE COLONEL DONALD PORTWAY, CBE, TD, JP, MA, FICE, MIMI (Hor) (Published by Leo Cooper Ltd. Price £2-50)

(Fuonshed by Leo Cooper Lio, Price £2-50)

This splendid book should be read, not only by Royal Engineers and those serving in the Royal Corps of Signals, but by all men of action. Over a very long and wonderfully active life—he was born in 1887—which this book so entertainingly describes, the amalgam Donald Portway has formed of military, academic and human experience must surely be unique.

The book opens with some interesting observations on the Old Contemptible Society, followed by the author's vivid recollections of Victorian childhood and way of life in East Anglia. He wore the black uniform of the Essex Volunteers when a cadet in the Felstead School Cadet Corps and, after winning the Senior Science Scholarship at Downing, he became a "full-blown volunteer sapper" in the Cambridge detachment of the London Electrical Engineers RE(V) in 1906 and so began his prodigious career as a Reserve Army Royal Engineer.

The second Chapter paints with a broad brush a brief and inspiring picture of the history and achievements of the Corps of Royal Engineers, which all our YO's could well afford to read.

As a trainer of Officer Cadets, Donald Portway always emphasised that "the first essential of a good combatant officer in time of war is a keen desire to engage the enemy" and he himself has never been satisfied with merely marching to the sound of the guns. The record of his detailed experiences in command of combatant troops on active service, in both world wars, enables the reader to share his precious experience of what really goes on in battle and in the atmosphere of war, and it is here that his long-lost diary provides the very stuff of military history. He served with RE (Signals) in France in 1914 and 1915 and commanded 209 Field Company RE (T) in France in 1940.

Donald Portway has enjoyed so many years of varied military service, including eighteen in command of the Field Company RE of the Cambridge University OTC, several years in command of Officer Cadet Training Units and as President of Officer Selection Boards, both at home and in India; and has steadily built up, from his vast personal experience, such interesting and authoritative opinions on character, morale and leadership, as well as the theory and technique of officer selection, that that part of his book should be required reading for all selectors and trainers of potential leaders, both military and civilian. He mentions, for instance, "a certain craving for guidance innate in the follower, which the true leader should exploit"; that "the job of the trainer is to harness the instinct of leadership to the spirit of service"; and that "to get the best out of people we must appeal to the best in them".

After World War I, Donald Portway moved, at the invitation of Professor Inglis, from the Royal Naval College Dartmouth, where he was an experienced instructor, to Carabridge, with a fellowship, to take the class of young naval officers there who were proving rather too unruly. Before long it was felt by the University that "a former officer, not altogether unversed in the noble art of self defence, would be likely to make a good proctor". This led, in due course to his becoming a recognized authority on civil and mechanical engineering, in touch with every technological development, and Master of St Catharine's College from 1946 to 1957.

There is no room here to mention his other innumerable activities at Cambridge and elsewhere, but in the course of his career he seems to have known all the personalities of his time, including kings, archbishops, field-marshals, scholars, scientists and engineers, and his interesting observations and very frank stories of Cambridge life and Cambridge people will make the reader chuckle no less than Donald must have chuckled when he wrote them.

Standing as he does four-square behind the Victorian virtues which he learnt from his parents and his Quaker nurse, it is no surprise to learn of his concern at "student malaise", the decline of team games at universities and the effects of the "permissive society". But it is heartening to find him in sympathy with those who fear the triumph of efficiency over humanism in the substitution of science or technology for culture.

His avowed amibition is to survive till 25 November 1973 and sing his last *Nunc Dimittis* in the Chapel of his beloved St Catharine's College on the 500th anniversary of its foundation. All Sappers, and all who read this book, will wish this great and influential friend of the Corps a happy Quincentenary and many good years beyond it.

T.H.F.F,

BOOK REVIEWS

THE CURSE OF CROMWELL

A HISTORY OF THE IRONSIDE CONQUEST OF IRELAND 1649-53

D. M. R. Esson

(Published by Leo Cooper Ltd, 196 Shaftesbury Avenue, London. Price £3-15)

Few historical figures can have been more admired, or more hated, than Oliver Cromwell. To some the great-nephew of Thomas Cromwell, Henry VIII's Vicar-General who first suppressed the Monasteries, was the saviour of Parliament, democracy and the Protestant Faith, the founder of the New Model Army whose Ironsides "knew what they fought for and loved what they knew", and the great Lord Protector of the Realm. To others he was an evil regicide, a cruel military dictator, arch enemy of the True Faith and in Irish history his character is stained with "a blacker hue than the Devil himself".

The barbarians who swept across Europe on the collapse of the Roman Empire never penetrated the fastnesses of Western Ireland and there Christianity persisted. From the fifth to the eighth centuries the spiritual descendants of Columbanus, Gall, Aedan, Columba and a host of other Irish missionaries went forth to convert the Picts and Scots and later helped to re-establish the frontiers of Christendom and of learning once more across Europe. In spite of the "Night of a Thousand Years" which followed, invasion, plunder, despoilation, massacre, and deportation, dungeon, fire and sword the Irish preserved the "Faith of their Fathers" and all attempts, many of them very logical and high-minded, to suppress it failed.

Saxon England was overrun by a swarm of land-hungry Norman Knights in the eleventh century and the indigenous population was despoiled of their possessions. Since then there have happily been no further similar incursions. Few people, however, can have experienced more invasions by adventurers and alien armies than the luckless Irish. Indeed the heraldic Red Hand of Ireland, *Lamh dearg Erin*, bears token to this lust to possess Irish soil. The fable is that in an ancient expedition of adventurers to Ireland their leader declared that the first to touch the shore would possess the territory he reached. The ancestor of the O'Neills, later Princes of Ulster, bent upon gaining the award, seeing another boat beating him to the beach, cut off his hand and threw it ashore thus staking his claim.

Ireland in English eyes was historically a potentially hostile off-shore island where enemics of the State could congregate and where deep Popish plots could be hatched. Many punitive expeditions were despatched to put these down and in lieu of pay, golden bowler and pension, parcels of land were handed out to those who had taken part in them. Indeed these expeditions were often partially financed by persons buying, in advance, debentures on Irish land to be parcelled off after it had been seized from its dispossessed owners. As time passed many properties became owned by absentee landlords and managed by extortionist agents grinding the most they could from the poor Paddies whom they looked upon as an inferior breed, in the same way as were the Red Indians in the New World. Other settlers who lived on, or worked, their own land often married Irish girls and became more Irish than the Irish as each generation passed. They also often tended to become alienated with the country of their origin and a thorn in her side.

In his short history of *Empire and the Army*, Sir John Fortescue, an ardent imperalist and great admirer of the New Model Army and all it stood for, dismisses the Ironside Conquest of Ireland 1649-53 in a few words. He wrote: "After breaking down all opposition in England Cromwell was sent to Ireland where, though he dealt sternly with the Irish who still espoused the Royalist cause, he forbade all plunder and paid his way."

Major Esson in his book paints a fuller picture and highlights the stern measures meted out by Cromwell to the Irish to reduce their country to obedience. The day of battle would show God's wishes, and God's work would be done by his Ironsides. After the battle he, Cromwell, would complete the task. He had been one of the signatories of King Charles's formal Death Warrant. The King was executed on 30 January 1649, and on 10 July Cronwell, now Lord Lieutenant of Ireland, set off from London. On 15 August he was welcomed in Dublin where he proclaimed condign punishment on any of his troops found guilty of robbery or pillage—a proclamation that meant exactly what it said.

His first military operation was against the fortified town of Drogheda garrisoned by over 3,000 men of whom one half were English Royalists, both Catholic and Protestant, who had been loyal to the beheaded Monarch and who were still loyal to his son, later to become Charles II. The city refused to surrender. It was stormed by Cromwell's army and only a handful of the garrison escaped being put to fire and sword. It is said that one thousand perished in the flames of St Peter's Church, burned to death, their escape being barred in true Old Testament fashion by the Ironsides. According to the Rules of Usages of War of the day an order of *Cry Havoc* was a legitimate one, but one seldom enforced. A regicide,

however, could not spare even one Royalist who might later impeach him, and in Cromwell's view it was a righteous judgment of God. This stern measure struck terror in the hearts of the Irish. Wexford fell also to him. Over 2,000 Irish were massacred and the Ironsides systematically plundered the town. And so the story continued until, in May 1850, Cromwell returned to England for a hero's welcome and the life rent of the King's property around Whitehall. The Army displaced Parliament in December 1653 and Cromwell was declared Lord Protector.

After Cromwell's departure bitter fighting, with no quarter given on cither side, continued in Ireland with varying fortune for a further three years and in general Cromwell's directive concerning a captured garrison was followed: "Knock the officers on the head, every tenth soldier to be killed and the rest shipped to the Barbadoes." By 1653 Ireland lay helpless beneath the mailed fist of the Lord Protector and the Puritans of England. Except for parts of Connaught and Clare, the whole country was reorganized into an extended English Pale, comprising Dublin, Wicklow, Wexford, Kildare and Carlow, and the remaining Counties were divided between adventurers and soldiers. The Catholic Faith and the Irish language were proscribed so that never again would it be declared that the Mass should be said in every church in Ireland and not a single Protestant should be left alive in the country. The state was to be wiped clean by the wholesale deportation of Irish leadership and the introduction of a new middle class from England having as labourers an Irish peasantry, no longer priest ridden, subservient to their new masters. Money had also to be exacted through taxation to pay for the Ironsides' conquest of Ireland.

On 3 September 1658 Oliver Cromwell died, ironically enough from malaria originally contracted in Ireland. He was buried among the kings in Westminster Abbey. He was succeeded by his son Richard who held the office of Lord Protector until April 1659 when a Republic was re-established which continued until 8 May 1660 when Charles II was restored to the monarchy. On 30 January 1661—the twelfth anniversary of the execution of King Charles I—Cromwell's body, and the bodies of two others who had signed the Death Warrant, were exhumed, dragged on sledges to Tyburn where they were hanged and dccapitated at sunset. Their headless bodies were then cast into a pit beneath the gallows and the heads were set on poles on the highest pinnacles of Westminster Hall.

Major Esson, who served in the Corps from 1939 to 1958, was a prolific contributor to the RE Journal over the years 1955-61, and, after leaving the Army, he has held various engineering and journalistic appointments. His history of the Ironside conquest of Ireland is a most detailed and fair one and excellently written. It deserves study, particularly today with the troubles in Ulster, as it describes how deep rooted are the issues which divide the Irish people.

J.L.

TRIAL WITHOUT JURY A ROAD PROBLEM FACT, FARCE AND THE FUTURE COLONEL H. E. HEBBERT, DSO, OBE, MC, MA (Cantab), RE Rtd (Published by Carfax Publishing Company, Oxford. Price £1.25 net)

Colonel H. E. Hebbert, now in this seventy-eighth year, was elected Chairman of the A40 Protest Association in 1967. He was commissioned into the Corps in 1914. He served throughout the First World War and was awarded the DSO and MC. After the war he was in charge of the Royal Engineer officers up at Cambridge University and sat for, and obtained, an Honours Engineering degree. Later he served in the Sudan for many years first in the Public Works Department and later as Post-Master-General. During the Second World War he was re-employed and served in Civil Affairs in Italy where he was awarded the OBE. Retiring to Somerset he became involved in a protest against the alignment of a by-pass road and, on moving to Oxford in 1963, he found a similar conflict awaiting him there. The A40 Protest Association could not have chosen a more able or doughty Chairman.

Colonel Hebbert's well-documented book, with a Foreword by Professor Colin Buchanan, describes the long-drawn-out fight against "authority" not only with regard to building a road through Christ Church Meadows but also the proposed alignment of the London to Fishguard Road through a recently-developed residential area of North Oxford. The "authority" that had to be won over was first the Oxford City Council and secondly the Ministry of Transport. In the public enquiry the Minister of Transport appointed one judge, and there was no jury nor appeal. Government expenses were paid for out of public funds whereas, win or lose, the appellants had to bear their own expenses. Although the battle has

BOOK REVIEWS

not yet been won completely much has been achieved, and Colonel Hebbert has written this book to help ensure the ultimate long term solution considered correct by his Association, and to give heart to all others with similar environmental problems. Sapper officers involved on the planning of major road construction projects should study this book.

J.L.

NO MORE SOLDIERING FOR ME SPIKE MAYS

(Published by Eyre and Spottiswoode, London. Price £2)

Spike Mays, in his latest book, traces his career from the end of his first period of service in the Army to the time he completed a degree course at Edinburgh University.

He shows great tenacity of purpose in overcoming the difficulties he encounters as a lowly paid Post Office employee struggling to gain a foothold in the academic world. Ably backed by his loyal wife, who takes up full-time employment to supplement the meagre educational grants he receives, he obtains a scholarship to Newbattle Abbey College and then goes on to Edinburgh University.

His style of writing is very matter of fact and at times, especially towards the end of the book when he describes in detail his experiences in the educational establishments, tedious—although there are occasional flashes of what at best can be described as Service humour.

One gains the impression that Mr Mays is at times somewhat resentful of authority and may well have a chip on his shoulder. Only rarely in his career does he seems to have found superiors in his employment who were mindful of his welfare. That he failed WOSB during his service in the Second World War does not seem to have improved his outlook on his superiors in rank, and one senses that he feels the Army was the loser in that the examining Board was not able to recognize his innate abilities.

Nevertheless, the fact that he has struggled against all odds and gained a remarkable degree of success shows that he is a man of strong and resolute character and deserving of recognition.

Success story that it is, it is hardly a book to grip and enthrall the reader.

H.J.

WINSTON CHURCHILL'S TOYSHOP

STUART MACRAE

(Published by the Roundwood Press Ltd, Kineton, Warwick. Price £2.75)

The author was second-in-command to Sir Millis Jefferis at M.D.I, a Ministry of Supply department employed on the secret production of a wide range of anti-tank and other weapons from 1940 until the close-down of the department shortly after the end of the war. During that time the department built up from a very minor organization, employing a staff of two and operating in a small workshop in a London basement, into a large concern employing a sizeable work force of designers and technicians and housed in a country mansion in Buckinghamshire. Major M. Jefferis, MC, RE, rose to become DMD and Major-General Sir Millis Jefferis, KBE, MC, and Captain S. Macrae collected red tabs and the rank of Colonel.

The department came directly under the auspices of the Prime Minister, Mr Winston Churchill, through Professor Lindemann. Having direct access to the latter and, through him, the ear of the Prime Minister, and having also their own bag of gold, M.D.I was often able to achieve quick results by unorthodox methods. In his book *Their Finest Hour* Sir Winston Churchill described Millis Jefferis as "that brilliant officer whose ingenious, inventive mind proved fruitful during the whole war".

From "Winston Churchili's Toyshop" came many ingenious weapons-the PIAT gun, the Limpet mine, booby-trap devices, delayed-action fuses and various bombs designed for special purposes.

Stuart Macrae at times adopts a breezy style of narrative. At others, however, the detailed descriptions of some of the items developed are not unlike the information contained in user handbooks and instructional manuals. Nevertheless the book is a good record of the wartime activities of one of the less publicized backroom establishments where much thought and devoted industry produced a multiplicity of unconventional weapons that contributed in no small way to victory.

OPERATIONAL RESEARCH IN MAINTENANCE

Edited by A. K. S. JARDINE

(Published by Manchester University Press. Price £4.80)

The importance of the maintenance function is today highlighted by the Department of Trade and Industry which has established a Committee on Terotechnology. Tero-to care for hence terotechnology means the caring for in the widest sense.

This book comprises a series of individual papers, presented at a Symposium on Operational Research and Maintenance at Strathclyde University. It covers the basic maintenance problems, application of operational research, some operational research concepts, several papers on specific application and one on the measurement of maintenance effectiveness.

Many officers at some time or other are involved with maintenance policy and appreciate the many variables which are going to effect the success of the policy; be it a case of determining the frequency of the inspection, preventive maintenance necessary or when to replace (cast) equipment. Given time to observe and record a successful system can be evolved by empirical means. If we can analyse the problems accurately at the start and correctly anticipate the effect of various alternative maintenance policies, we shall be able to select a policy which will either save money--normally the ruling criteria—or have a better record of equipment availability. By applying the scientific methods used in this book, mathematical models can be constructed from records of previous maintenance of a similar nature. These can then be applied to the future to give the alternatives on which management can make policy decisions.

The book is highly technical both in its content and style. In many of the papers the prose, although easier to read than legal papers, takes nearly as much analysing before the meaning becomes clear. To get full value from this work the reader must be very fluent in the use and guises of statistical mathematics. It is doubtful if many of the mathematical approaches produced in these papers are seen outside a university or a practising operational research department. Nevertheless, anyone involved in formulating maintenance policy will be able to select something of value from this book.

J.P.

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DIFFUSION DATA

No. 1 1971

F. H. WÖHLBIER, Editor

(Published by Trans Tech Publications, Adolf-Ey-Strasse Id, D-3392 Clausthal -Z Germany)

This publication is printed periodically to present reference data compiled in the field of solid state atomic transport for scientists ranging from physicists interested in defect solid state to metallurgists dealing with such processes as precipitation, creep, oxidation or sintering.

The information summaries include what is known on atomic transport in crystalline and amorphous solids and in liquids which are solid at normal temperatures and pressures; diffusion, ionic conduction, thermotransport, electromigration, permeation, inert gas release kinetics, isotope effects for atomic transport; it covers transport within the crystal lattic, along grain-boundaries or dislocations, on surfaces or along interfaces, in thin films; it includes mechanical effects, pressure effects, magnetic field effects, and all other topics related to solid state atomic transport.

This issue, the fifth, contains a cumulative author index to Volumes 1-4.

F.T.S.

OCEANOGRAPHY FOR PRACTICING ENGINEERS Luis R. A. Capurro

(Published by Barnes & Noble Inc, New York: Distribution in Europe and the UK by Chapman & Hall Ltd, 11 New Fetter Lane, E.C.4. Price £2:25)

This soft covered book is one of the present set of ten publications comprising a Professional Engineering Career Development Series, produced by the publishers with the aid of consulting editors supported by an editorial advisory committee and an engineering profession advisory group—the author being a member of the Department of Oceanography, College of Geosciences, Texas A & M University. Its object is to acquain the reader with the tools, techniques and vocabulary of oceanography, a technological field now being rapidly developed to make effective use of the sea.

BOOK REVIEWS

The 156 pages of text, diagrams and tables, covers marine environment, characteristics of sea water, ocean circulation, the waves of the sea, the chemistry and biology of the marine environment and the earth beneath the sea—supplemented by a six-page glossary and a list of selected reading.

Present worldwide activities in marine science and its associated engineering endeavour indicate the thought and effort being given by governments and private individuals to the potential of the sea for solving some of the social problems of the day, and engineers, executives and laymen who do not wish to be left behind in the new technological race would be well advised to read this short, but factual, and well written account of its characteristics. F.T.S.

WATER QUALITY ENGINEERING

Wesley Echenfelder, Jnr

(Published by Barnes & Noble Inc, New York: Distribution in Europe and the UK by Chapman & Hall Ltd., 11 New Fetter Lane, E.C.4. Price £2.25)

This book, first published in 1970, is another of the present set of publications comprising the Professional Career Development Series—see the Oceanography review above. Its purpose is to provide non-water engineers with an introduction to the general concepts of waterquality management for the eradication of industrial waste pollution and the disposal of sewage—it does not cover the supply and treatment of drinking water.

The author who is with the Department of Environment and Water Resources Engineering, Vanderbilt University, has limited his text to 300 odd pages which includes a reasonable number of photographs, diagrams and data tables. Nevertheless, he has successfully presented a great deal of factual data and descriptive writing adequately to cover the following subjects for those belatedly interested in the preservation of our inland streams, rivers and estuaries. His subject headings are: Water-Quality Standards, Sewage and Industrial-Waste Characterization, Analysis of Pollutional Effects in Natural Waters, Characteristics of Municipal Sewage, Industrial Wastes, Waste Water Treatment Processes, Pretreatment and Primary Treatment, Oxygen Transfer and Aeration, Biological Treatment, Tertiary Treatment, Sludge Handling and Disposal, Miscellaneous Treatment Processes and the Economics of Waste Water Treatment. A ten-page list of selected reading, mostly of USA origin, is given which has been divided into chapter groups. The data given in many of the tables is naturally the results of US research, and the text qualification references are largely to US papers, but this is of no disadvantage when one realizes that interest in the preservation of the human environment is international-particularly during the current year and, we hope, the years to come.

F.T.S.

BIAXIAL BENDING SIMPLIFIED V. A. Morgan, MEng, CEng, MICE

(Published by V. A. Morgan, 13 Ellerdine Road, Hounslow, Middlesex. Price £2:00)

The subject matter in this stiff-covered Design Booklet is reprinted with revisions and additions from a series of articles which first appeared in *Concrete and Constructional Engineering* in October, November and December 1966. The six design charts contained in the articles have been supplemented to a full series of seventy charts.

The text and charts should be studied with the recent edition of CP 114—where it deals with the design by the load-factor method of short columns subjected to combined direct load and bending and states that the distribution of compressive stress in the concrete may be assumed to be "rectangular, parabolic, or such other shape as is shown by tests to be reasonable". The author claims that the design charts presented enable problems involving members subject to uniaxial or biaxial bending, with or without direct load, to be solved quickly.

The explanatory text of biaxial bending, with definitions and worked examples in SI, Metric and Imperial units, is given in the first twenty-five pages, the seventy charts with an index follow.

The text and charts are eminently suitable for the use by concrete design specialists.

F.T.S.

Technical Notes

CIVIL ENGINEERING

CIVIL ENGINEERING AND PUBLIC WORKS REVIEW, May 1971: M73 Motorway. To hit the headlines a motorway has to be of great length or amenity unless it has particularly interesting engineering features. The M73 is in the latter category, although its six-mile length will greatly benefit drivers going north from Glasgow. Earthworks total 4 m yd³ but of this some 1 m yd³ are being cut to waste as the boulder clay soil includes alluvial deposits and peat. Peat holes up to 30 ft in depth are being dug out and replaced with boulder clay, and as the water table is very close to the surface, the contractor used dewatering techniques to allow the use of the cheap fill rather than import granular material. At the north end of the contract the route passes over a peat bog and so a different technique was adopted. An undermattress of wire netting (cheaper than timber fascines) was laid on top of the peat and unburnt colliery shale tipped on top. The weight of superimposed material slowly displaced the peat until a firm stratum was reached. This section is now in use and appears satisfactory, although the possibility of greater maintenance has not been overlooked.

ERSKINE ROAD BRIDGE. In view of the bridge failures at Milford Haven and Yarra this article is especially welcome as the Erskine Bridge is also of steel box girder construction albeit with cable stays on the main span of 1,000 ft. The steelwork for the bridge weighs 11,500 tons and was prefabricated as sections 56 ft long and approximately 102 ft wide and 10 ft. deep. These weighed up to 170 tons each and were test preassembled on the ground to avoid later difficulties. There are no expansion joints in the main span and thermal movement is accommodated in the piers which rise 180 ft above water level. In this review it is not possible to detail all the construction methods, but prestressing was used to allow the closing box section to be inserted. When this box has been welded in possible of the main expansion joint was released and the final transverse weld completed.

W.G.C.

THE MILITARY ENGINEER

MAY-JUNE 1971

"Earthquake Disaster Engineering" is an article describing the action taken by the American Army after the Los Angeles earthquake of February 1971. It covers the immediate action taken to save lives, both with regard to collapsed buildings and the possible collapso of the Van Norman Reservoir Dam, the repair of public utilities and permanent restoration operations. It concludes by outlining the future role of the American Corps of Engineers should a similar disaster occur.

An interesting article on "Biodeterioration of Materials in the Sea" deals with both stone- and wood-boring marine animals. Suggestions are made on methods of control and ways to prolong the life of both wood and concrete when used in marine construction.

With the advent of the Jumbo Jet and Galaxy C-5A aircraft there is some concern about the criteria for design and evaluation of airfield pavements to support such heavy loads. Trials on pavements of varying cross-section, both flexible and rigid have been carried out by the American Army Engineer Waterways Experiment Station, and details of pavement cross-section, test loads, traffic tests are given in an article.

For the field engineer there are articles on thin walled revetments for aircraft protection against shrapnel, the construction of an emergency corduroy road and the design of a multiplate pipe arch shelter.

"Explosive Excavation" is an article dealing with current trends in both nuclear and chemical explosive excavation. Details of some major nuclear cratering events are given together with a harbour project "Tugboat" conducted with chemical explosive. This project produced a channel some 1,000 ft long by 130 ft wide with a berthing basin 300 ft square all at a design depth of 12 ft. This was achieved with twelve 10-ton charges in coral.

M.F.R.C.

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Forthcoming Events

11-12 September 17 September	RE Veterans Weekend RESA AGM	Chatham Brompton Study Centre
26 September) 10 October	REYC/RNSA Series Races	River Medway
7 October	Civil Firms Guest Night	RE HQ Mess
21 October	Engineer and Railway Staff Corps	
	(T & AVR) Dinner	RE HQ Mess
26 October	Band Concert	RE HQ Mess
2 November	47 YO Batch Night	RE HQ Mess
14 November	Remembrance Parade	Garrison Church
18 November	Corps Guest Night	RE HQ Mess
SPO	ORTS AND GAMES FIXTURE	W 1971-72
	RE RUGBY FOOTBALL CLUE	,
15 September	1st Round RE Cup	
6 October	Semi Final RE Cup	
13 October	Final RE Cup	Chatham
20 October	RE RFC Trial	Aldershot
27 October	RAOC	Bramley
3 November	RMCS	Chatham
10 November	RM	Chatham
24 November	R Signals	Blandford
1 December	RMĀ Sandhurst	Sandhurst

RE HOCKEY CLUB

1 December

8 December

12 January

RA

RCT

Chatham

Aldershot

11-12 September 15 September	RE Inter Unit Knockout Competition Staff College	Aldershot Minley
18 September	Guildford	Guildford
24-26 September	Training Weekend	Longmoor
26 September	Bournemouth 6s	Bournemouth
2 October	Trojans (L)	Southampton
10 October	Hamble Old Boys (L)	Longmoor
17 October	Dorset	Longmoor
23 October	Beckenham	Gillingham
30 October	R Signals	Blandford
3 November	Wiltshire .	Longmoor
6 November	Aldershot Services (L)	Longmoor
10 November	Oxford University	Oxford
13 November	Mid Surrey	Gillingham
20 November	Bournemouth (L)	Bournemouth
27 November	Teddington	Gillingham
4 December	Infantry	Warminster or Longmoor
8 December	RMA	Sandhurst
11 December	Hampstead	Hornsey Club
18 December	HAĊ	Gillingham

RE GOLFING SOCIETY

14-15 SeptemberAGS Autumn Meeting28-29 SeptemberAutumn Meeting14-15 OctoberRA GS16 OctoberRMCS GS20 OctoberRMA GS	Berkshire North Hants R St Georges, Sandwich Huntercombe North Hants
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This snuff box was presented to the Mess in 1844 by George Sim, Bengal Engineers. It is one of the many historical pieces of the RE HQ Mess collection. Photographs and descriptive details, written by the Late Colonel J. M. Lambert, of fifteen Mess portraits and forty-one pieces of Mess silver are included in a beautifully illustrated booklet entitled

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