ISSN 0035-8878

THE ROYAL ENGINEERS JOURNAL

Volume 95 SEPTEMBER 1981 No. 3

THE COUNCIL OF THE INSTITUTION OF ROYAL ENGINEERS

(Established 1875, Incorporated by Royal Charter, 1923)

Patron—HER MAJESTY THE QUEEN

President

Major-General M E Tickell, CBE, MC, MA, C Eng, FICE 1979

Vice-Presidents

Brigadier D L G Begbie, OBE, MC, BSc, C Eng, FICE 1980
Major General G B Sinclair, CBE, FIHE 1980

Elected Members

Colonel B A E Maude, MBE, MA 1965
Brigadier D J N Genet, MBIM 1979
Colonel A H W Sandes, MA, C Eng, MICE 1979
Colonel G A Leech, TD, C Eng, FIMunE, FIHE 1979
Major J W Ward, BEM, RE 1979
Captain W S Baird, RE 1979
Lieut-Colonel C C Hastings, MBE, RE 1980
Lieut-Colonel (V) P E Williams, TD 1980
Brigadier D H Bowen, OBE 1981
Colonel W M R Addison, BSc 1981
Colonel J G Evans, TD 1981

Ex-Officio Members

Brigadier R A Blomfield, MA, MBIM ..... D/E-in-C
Colonel K J Marchant, BSc, C Eng, MICE ..... AAG RE
Brigadier A C D Lloyd, MA ..... Comdt RSME
Major-General E W Barton, MBE, BSc, MBIM ..... D Mil Survey
Colonel J B Wilks ..... Regtl Colonel
Brigadier C W Beckett, BSc, MBIM ..... Comd 11 Engr Gp
Brigadier N R Sturt, MA, C Eng, FICE, MI Mech E ..... D Engr Svcs
Brigadier D J London, OBE, FAAI, FBIM ..... DPCS

Corresponding Members

Colonel J H Kemp, AM, Dip CE, MIE (Aust), RAE
Australian Military Forces 1980
Lieut-Colonel D J O'Brien, BE(H), MNZIE, ANZIM, RNZE
Royal New Zealand Engineers 1979
Major-General N S Freeman, CD
Canadian Forces 1979
Brigadier V P Yadav
Indian Engineers 1981
Brigadier-General Chen Kwee Fong, KMN, AMP, PJK
Malaysian Armed Forces 1978
Major T J Ludlam RE, BSc
BAOR 1981

Secretary and Editor RE Journal

Colonel E E Peel, BSc, C Eng, FICE 1972

Bankers

Lloyds Bank, Ltd, Cox's and King's Branch, 6 Pall Mall, SW1

ISSN 0035-8878

THE ROYAL ENGINEERS JOURNAL

Published Quarterly by The Institution of Royal Engineers, Chatham, Kent ME4 4UG. Telephone Medway (0634) 42669

Printed by Mackays of Chatham Ltd, Lordswood, Chatham, Kent ME5 8TD

Volume 95 SEPTEMBER 1981 No. 3

Contents

4,250

Editorial

AB INTERIM

THE Editor was very flattered when a number of Members complained that they missed his "page" in the last issue of the Journal. He was not quite so pleased at the suggestion that because of the March Editorial, *The Enemy Within*, he had been "warned off". Nothing could be further from the truth. The reason was quite simple—when preparing the June Journal for the printers it was realised that there was too much material and as the Editorial was the worst of the "articles" it was discarded. The Editor can recognise rubbish even when he writes it himself!

This morning, as usual, the Editor looked through the *Deaths* in *The Times* and *The Daily Telegraph*. As his name did not appear he came to the office. He was delighted. A number of unexpected articles had arrived. Nothing gives him more pleasure than a surfeit of articles as this gives the flexibility required to give some semblance of balance to each issue of the Journal. Some of the euphoria disappeared when he realised that three would have to be retyped (they were submitted in single-space typing) and that five of the sketches/graphs would have to be redrawn as they could not be reproduced as submitted. Would-be authors are requested to read the guide-lines published at regular intervals on the outside back cover. The Editor hastens to add that he would rather have an article not in accordance with the guide-lines than no article at all!!

The September issue of the Journal is always well received as it contains the Engineer-in-Chief's talk on *The State of the Corps* as presented at the June AGM. It is one of the most important and interesting articles of the year. We also welcome the first instalment on the research findings of a Member of the RE Historical Society on the *History of Steam Traction in the Corps*. This is mentioned, not to set the article above the others, but, to emphasise what can be done by a Member working on his own within the framework of the Historical Society. We also begin a new series, hopefully a long and interesting one, of short histories of Reserve Army Units. The histories are often complicated because of "mergers" and "counter-mergers", this is why it is so important that the histories be recorded and kept up to date. It is hoped that all Reserve Army Units will submit similar articles in the not too distant future. Members will also notice that the Book Review Section is longer than usual but some very interesting books have been published recently—there is something for everyone.

Without considerable research it is not easy to ascertain the origin of the endearing but unofficial title, *The Pickaxe*. The title would appear to stem from the pre-1905 days when a combined Journal and Supplement was issued *monthly*. To further complicate matters the Journal was a combination of the Journal and Supplement as we now know them, and the Supplement of those days was the RE List of today! Some Members still refer to *The Pickaxe* meaning the RE List, some mean the Supplement, a few mean the Journal and recently one Member meant the Sapper. This, to put it mildly, is confusing! It might be considered desirable to minimise the use of the title *Pickaxe* or at least agree on a generally accepted usage. Perhaps Members have some printable views!

1981 Corps Annual General Meeting

ADDRESS BY ENGINEER-IN-CHIEF

At the Annual General Meeting of the Corps, held on 24 June 1981, the Engineer-in-Chief, Major General G B Sinclair CBE FIHE spoke on Corps Affairs.

Introduction

This is my first report to the AGM and before I give you the customary resumé of the Corps' activities over the last year, I feel I must say something of the climate against which these activities should be viewed for it is in contrast to the somewhat brighter future envisaged in previous years.

We live in very frustrating and difficult times in the Ministry of Defence and for my own staff and indeed the staff of every Sapper Headquarters of one star and above, it has been a year of intense hard work, much of it unproductive and dissatisfying, and often spent defending self-evident truths and common sense against a never-ending barrage of searches for savings in defence expenditure. Yet at no time has it been suggested that we should reduce our commitments and in fact, if anything they are increasing, so that those economies that we will have to make eventually may be all the more painful. However, my aim is always to search for the least damaging solution which will leave the Corps with the maximum possible flexibility and potential for the future. Unfortunately, circumstances do not always permit me to achieve this.

Many of you will recall that in late 1978 the Army Board commissioned a study to determine how the Army should be constituted and organised to meet its current operational tasks. Obviously the solution was an ideal structure but it showed that the Army required enhancement, firstly to correct some of the anomalies of the Army Restructuring Programme of 1974/5/6, and secondly to deter or meet the new threat to Europe.

The decision to purchase the Trident missile system and at the same time cut public expenditure made it impossible to carry on with that proposal. In order to save something from that work, it was decided to have a rolling Army Long Term Plan, to improve our order of battle to meet the projected threat. This Long Term Plan (LTP) would look ten years ahead and would go hand in hand with the existing system of Long Term Costing (LTC), which also plots up to ten years ahead. This it was hoped would progress within the financial realities some way towards the ideal structure. May I say that I believe the idea of a Long Term Plan that sets the scene for Long Term Costing to be one of the major advances in recent years.

It then became apparent to the Chiefs of Staff that the Treasury's future projections would not allow us to sustain our present level of conventional forces, let alone enhance them, and as a result the Secretary of State decided to carry out a major review of our commitments and projected expenditure. That review made a number of fairly severe recommendations, and called for a series of further studies to identify savings. By way of illustration, I think it appropriate to mention some of the studies. However, it is important to bear in mind that these were designed to meet the requirements already proposed some while ago by the Secretary of State and are not part of any cuts that the Government may be about to make in the near future.

There was a Study of Engineer Resources, which has now been completed and fully confirms yet again the need for an independent RE Resources Organisation as opposed to one run by the RAOC. It nevertheless produced manpower savings, at the expense of part of the Workshops facilities and a Royal Pioneer Platoon at Long Marston.

You will also have heard of the 27% saving that is to be made in the Army Department of the Ministry of Defence. Although this affects only military personnel and not civil servants, those branches like my own Headquarters, which have a

high proportion of serving Officers, are going to suffer more, especially when we have already been trimmed by successive inspections by the Inspector of Establishments (and two previous 10% cuts). Identifying posts to cut has been made all the more difficult as it appears that in certain areas, such as Airfield Damage Repair and EOD, the Corps responsibility is actually expanding.

We have also been told to make a substantial saving of over 200 posts in our individual training organisation and it is quite clear that "Salami" slicing throughout the organisation will not be enough to achieve this. A wide ranging study is being conducted but no decisions have yet been taken.

The UKLF static chain of command has been the subject of a separate study within Headquarters UKLF itself, and we have lost a number of Royal Engineer posts at District Headquarters and more importantly, it appears possible that the Chief Engineer and his staff might be rusticated from Wilton. Two other studies have been going on in BAOR with a view to identifying manpower savings in Headquarters within 1st (British) Corps and in Headquarters BAOR itself, and a small number of Royal Engineers posts will disappear there.

I have to admit that much of this sounds very depressing and I will be mentioning other cuts affecting the Corps later on in my address. However, there is one bright spot and that concerns the manning situation. A year ago, we were still badly undermanned, which was a hangover from the days when our pay was driving many men out of the Army and discouraging them from extending their service. Since the restoration of pay comparability and because of the unemployment situation, internal and external recruiting has improved significantly and we are now fully manned in the ranks, with Officer manning rapidly improving as well. Indeed, our recruiting, like the rest of the Army, has had to be severely restricted to ensure that we do not go over the top. The Corps is therefore thoroughly well poised to take advantage of the better times which I am sure lie ahead—the only question is, when that will be.

A Review of the Year

Let me now turn to what the Corps has been doing during the last year with the customary review of our activities, starting with our various garrisons. All our units in BAOR have had a very successful year's training and commanders at all levels have worked very hard to make the training effective despite the effect of financial restrictions. The major event in 1980 for most units, both Regular and TA, in BAOR and the UK was *Exercise Crusader 80*. I do not need to say much about it, for the whole exercise provided the Army with plenty of good and well-balanced publicity and showed what a prominent and vital part is played by the Territorial Army in our Defence Plans.

Squadrons from the United Kingdom with the operational role of supporting RAF Germany have exercised in BAOR in support of the Harrier force and on the RAF Stations. The first live trial take-off and landing over a repaired simulated bomb crater was successfully completed by a Buccaneer on the 10th of this month at Bruggen. I will return to the subject of Airfield Damage Repair later.

In Northern Ireland, where our activities are much less well-publicised, we have had a very successful year with the major effort going into the construction work at Forkill and Crossmaglen. Search still remains a top priority task for the Sappers in the Province and in recent times Royal Engineer Search Teams have been having great success recovering considerable quantities of arms and explosives. The disorders of the last few months in the Province have meant that the Sappers are once again clearing barricades. For the foreseeable future the Corps will not be required to send Regiments to Northern Ireland in the infantry role and from this July it is planned to reduce the Sapper commitment to the Province to the present in-theatre units and a reinforced Field Squadron from UKLF.

In Belize UK Squadrons continue to serve six months tours as reinforcements to the garrison. The future of the British Army commitment in Belize after its Independence at the end of the year is still uncertain and is dependent upon talks currently

taking place with the Belizeans and Guatemalan Government.

Fifteen men from 38 Engineer Regiment and 9 Parachute Squadron were among members of the combined British and French force in the New Hebrides during the period leading up to Independence and the birth of the new state of Vanuatu last August.

Later in the year, back in the UK, the Corps were among a number of Arms called upon to provide MACM for the Home Office during the Prison Officers dispute, with members of 38 Engineer Regiment working in Frankland Prison near Durham and of 22 Engineer Regiment in Rollestone Camp near Larkhill.

59 Independent Commando Squadron and the Independent Field Troop AMF(L) carried out Winter Warfare training and exercises in Norway during the year. In addition, field troops from BAOR have continued to take part in battlegroup training at the British Army Training Unit at Suffield in Canada.

In Cyprus 62 Support Squadron continues to provide vital support not only to the garrison but also to visiting UK detachments who go there to support the UN Force or for overseas training.

In Hong Kong and the New Territories the Queen's Gurkha Engineers have had another busy year and when I visited them in March I found them to be in very good heart. I came back from Hong Kong with the advance party of 69 Gurkha Field Squadron which is forming up now in Kitchener Barracks at Chatham and will be complete and operational by the end of the year as part of the UKLF Order of Battle.

Projects and Assistance Overseas

Turning now to projects and assistance overseas; the tasks in support of Her Majesty's Government's foreign policy, for which the Sappers are so uniquely qualified, continue to bring us tremendous training value and a great deal of satisfaction. We have been involved in two Disaster Relief projects in the last year. The first was in the Carribean island of St Lucia which was hit by *Hurricane Allen* last August. Men from 22 Engineer Regiment with experience gained in Dominica earlier last year fresh in their minds, carried our repairs to public buildings and the electrical distribution system. The second Disaster Relief project has been in Italy in the earthquake zone where two separate teams of about twenty men each from 32 Field Squadron and 21 Army Support Squadron have recently returned from giving assistance with the erection of community buildings.

34 Field Squadron recently returned from four months in Kenya where they constructed a range and a workshop for the Kenyan Army as a *quid pro quo* for the training facilities which the Kenyans allow British Infantry Battalions to use every year. And also in Africa, we have some fourteen officers and men serving with the British Military Assistance and Training Team in Zimbabwe and a small team in the Gambia in West Africa helping to train the Field Force Pioneer Unit.

A detachment of men from 39 Engineer Regiment returned from the South Atlantic island of South Georgia in April having spent five and a half months rebuilding a jetty and constructing three dolphins for the British Antarctic Survey. Further north in Trinidad a team of one officer and three men from 49 EOD Squadron carried out the clearance of a large pond during February, recovering over 1000 live shells, which had been dumped there during the Second World War.

53 Field Squadron spent last summer building a road and making camp improvements at Gagetown in Eastern Canada.

East of Suez, our resident Management Team in Saudi Arabia continued to provide supervision over the £540 million construction project being done for the Saudi Arabian National Guard. I recently had the pleasure of visiting them and was most impressed by the sophistication and complexity of the work. It illustrates clearly the capabilities of our more technical officers and men.

In Gibraltar, a Troop of 48 Field Squadron did some work on the Nuffield Swimming Pool for the Fortress Headquarters and built a pipe range and water tanks for the PSA at the beginning of this year; and currently men from 61 Field Support Squadron from Maidstone are working on the recovery of the Spur Battery Gun from

the top of the Rock prior to its donation to the Imperial War Museum.

Our surveyors have had another busy year at home and abroad, especially in the map production field. For example, 42 Survey Engineer Regiment produced special maps for the operation in the New Hebrides last year which I mentioned earlier. Last June members of the same Regiment along with some French military surveyors carried out a joint survey in France and the Channel Islands with the aim of precisely positioning the islands in relation to the mainland. 512 Specialist Team Royal Engineers, who are based in America at Washington, continued to take part in the joint US/UK programme of satellite tracking. Teams were deployed throughout the world as far afield as Nepal, St Helena and Vanuatu.

Postal and Courier Services continue to be busy with traffic levels remaining relatively steady, but financial turnover rising. The major task recently has been the implementation of the transfer from Official Paid systems to public methods of posting. The transfer, which must be complete by 1 April next year, is currently on target and appreciable savings in expenditure are already being identified. Meanwhile the Service continues to provide support to all the overseas operations and exercises such as those in the New Hebrides and Zimbabwe.

That sounds a formidable and satisfactory list of activities but I should point out that a number of exercises have come under the financial axe during the last year. It is unfortunate that from the Corps' point of view they would have provided considerable training value. The first was to have taken place in the Oman where it was hoped that 8 Field Squadron would carry out construction work on a small harbour and buildings for a power station, as well as extending an electrical distribution system. The other three major Squadron Exercises were due to be carried out by our Construction Squadrons in Germany. These exercises provide the main in-theatre airfield damage repair training for these Squadrons and are important if the units concerned are to be fit for their role.

Corps Affairs

May I now turn to Corps affairs. Our system of running Corps Affairs has continued to work well. Last December we held a presentation in the Skinners' Hall in London at which we hosted a hundred or so top men from the City and British Industry and told them something about what the Corps does, and what it is. By all accounts it was a great success and has undoubtedly improved the Corps' standing as a professional body. This function was not an event staged in isolation but was part of our wider strategy of keeping the Corps in the "public eye" both inside and outside the Army. To illustrate this I would also like to mention the value that we have gained from our Joint Institution Meetings, both in UK and BAOR. Our links with the Military Engineering Committee too are being strengthened and we have had most useful discussions on digging, fighting in built-up areas, barriers and over-head protection. The Engineer and Railway Staff Corps has given us considerable assistance with our professional engineer training, technical publications and design work, and our relations with the Defence Scientific Advisory Board, and the professional Institutions are, I believe, better than ever. Last year we also organised a symposium on the Training for Leadership in Military Engineering at the request of a group of senior managers from the engineering industry and both sides gained much from the very useful discussions.

As well as promoting a wider understanding of the Corps both inside and outside the Army, our contacts with these august bodies are also aimed at gaining acceptance for "Military Engineering", as practiced by the Corps, to be accepted as a discrete part of the engineering profession in this country. A study group was recently commissioned by the Chief Royal Engineer' Committee to look at ways of achieving this and they concluded that it was necessarily a gradual process but would have a number of benefits. Firstly, it would lead to a clearer recognition by Sappers of what their role involves—that of making rapid changes to the environment and not simply the traditional statement of helping the Armed Forces to live, move and fight. This would lead to more imaginative forward thinking, a convergence rather than a

divergence of the combat and construction elements of the Corps and also give a clearer division between the Military Engineer and the other Engineering Corps within the Services. Lastly, it would lead to a more meaningful and long-lasting basis for civilian and military co-operation.

Moving on to domestic matters, you will recall that a year ago Her Majesty the Queen opened the new School of Military Survey at Hermitage. In addition, I recently had the honour of opening another new barracks—this time at Chattenden—where 24 Field Squadron took over their new accommodation and offices in Malta Lines. 1 and 3 Training Regiments are now well established in Gibraltar Barracks at Minley, and in spite of the cuts we are being allowed to build the final two accommodation blocks to complete the original scheme.

On 29 May the Corps were granted the Freedom of the Borough of Rushmoor, at a very impressive ceremony where the nine Regiments and Corps who had the Freedom of the old Borough of Aldershot regained their honour and privilege. The Chief Royal Engineer received the Freedom on our behalf and the parade which included representative contingents from all the Regiments and Corps concerned was commanded by the CO of 1 Training Regiment. Looking to next year, the 22 July is the Centenary of the signing of the Royal Warrant for the Postal Service and we are planning to commemorate the occasion in a suitable way.

You will be delighted to learn that 22 Engineer Regiment has been awarded the Wilkinson Sword of Peace, the first Sapper unit to be so honoured since the Award's inception in 1966. It is given to the unit that is considered to have contributed most to fostering good relations between the civil community and the Army and because the committee that selects the winner of the Award tends to regard Sappers as having a head start because of our unique role, it is all the more difficult for us to win. It is therefore a great credit to 22 Engineer Regiment that they have received the Award for all their hard work in Dominica, St Lucia, Zimbabwe, Belize and the UK.

I regret to have to tell you that during the last year our last two surviving holders of the Victoria Cross have died. Colonel Sir Arnold Waters VC DSO MC passed away in January at the age of 94 and as well as his outstanding Service career had a most distinguished professional career, being amongst other things the President of the Institution of Structural Engineers. Brigadier Cyril Martin VC CBE DSO also died at 88 years of age and the Martin family very kindly presented his VC to the RE Museum last November.

You will also be interested to know that we are planning to expand the Royal Engineers Museum at Chatham so that we can display some of our larger items of equipment. You will appreciate that with the size of such items as the AVRE we are going to need a fairly large site and we are hoping to use the Ravelin Building at Brompton. For financial reasons the expansion is going to be fairly slow but we hope to have most of the work done by the end of the decade. We are always looking for new material for the Museum and also for the Archives and the Library. And in this connection I would like to take this opportunity to encourage both Regular, TA and Retired Officers to become members of the RE Historical Society. More details are available in the latest Corps Journal.

I must mention our two Staff Bands which have continued to serve the Corps so well during the last year. It is unfortunate that as a result of the defence cuts, Army bands are yet again under review and I fear that our own bands are bound to be reduced in some way.

Sport

In our sporting activities the Corps has had a most successful year. 28 Amphibious Engineer Regiment are the Army Soccer Champions, 24 Field Squadron won the Army Minor Units Championships in Soccer and Athletics for the second consecutive year, the Junior Leaders Regiment won the Army Junior Rugby Title, 33 Independent Field Squadron won the Army Minor Units Hockey Cup and 9 Parachute Squadron the Army Minor Units Rugby and 14 Topographic Squadron the Army Minor Units Rugby for BAOR. Success has also been ours in skiing with, for

example, 35 Engineer Regiment winning the Divisional Championships for both Nordic and Alpine Skiing. We have also had notable success in cycling and shooting during the last year and Captain Mike Mumford is currently the British Pentathlon Champion and hopes to take part in the 1984 Olympic Games. Army Hang Gliding, which was set up as a Sapper initiative by Major Roddy MacDonald, is flourishing and I am glad to say that the Corps are maintaining the upper hand over the rest of the Army in this sport.

Adventurous Training

On the adventurous training side, we contributed a significant effort to *Operation Drake* which finished in February and currently Major Henry Day is leading a Sapper sponsored expedition to China where they are attempting to climb Jiazi Peak in Tibet which is over 23000ft high.

The Future

I would now like to say something about the outlook for the future. As a result of savings measures already taken or planned, B vehicles are going to have to stay in service for longer than was originally intended, as replacements will be fewer or slower coming into service. Items for the maintenance of these vehicles are also likely to be in short supply, so keeping them on the road may become a problem. The consumption of all types of fuel will have to be reduced and travel and movement will also suffer. The works programme must also bear a considerable cutback and the equipment programme for weapon systems, ammunition, bridging etc is not going to escape.

All these cuts must mean that life will become more difficult and frustrating for leaders and management. I see no sign of the Army giving up a major function or area of its operational role and therefore we must assume that we are going to be asked to do the same with less resources and increasingly outdated equipment. The problems are not insurmountable and we may have to change some hallowed practices, but if we regard these new conditions as a challenge and an opportunity to test our leaders' initiative and ingenuity, then I am sure the vital constituents of the Corps will remain healthy and robust.

I said that I would return to the subject of Airfield Damage Repair (ADR). It looks as though this is going to become increasingly important in the future. After years of neglect of ADR in the United Kingdom the Air Staff are now showing enthusiasm for the subject. It is possible that the Air Force Board will recommend the formation of the two TA ADR Squadrons in each of the four years, starting in 1982, to keep the highest priority airfields operational. We have got agreement to much of the expenditure on specialist ADR equipment being borne by the Royal Air Force in future. I feel this is a worthwhile concession for it means that provided the Air Staff give it sufficient priority in future, we shall be less liable to postponements and cuts than we have been in the past when the Army controlled the finance.

Going hand in hand with ADR and possible weapon development in the future, I see an increasing requirement for our Explosive Ordnance Disposal skills both in UK and BAOR in operations.

Lastly in my look forward I should tell you about the future organisation of combat development, tactical doctrine and training policy. At the beginning of this year a new three star appointment was created known as the Director General of Army Training (DGAT). His responsibilities not only include the old Directorate of Army Training, which remains, but also encompasses the co-ordination of combat development, tactical doctine and the first input into the operational requirement process. One of DGAT's first moves was to propose a new joint Arms Executive to carry out this task. The Arms Executive, to be known as ARMEX, has been approved and will open on 1 October this year at Old Sarum near Salisbury and is to be fully staffed by 1 April 1982. The staff will be largely drawn from the staffs of the Directors of Infantry, Armoured Corps, Artillery and Army Air Corps who are sitting now around the Salisbury area. It is vital that we should have a Sapper input

into all their deliberations and I plan to be represented permanently there by a Colonel GS and GSO2 who will have to be taken from existing RE establishments.

FINALE

After such a wide review with so many unknowns in the future it would be inappropriate to summarise but I wish to give you my personal view on how we should proceed. I have visited 90% of the Regular Units, and talked to many TA Sappers in my first year, and I can assure you that at unit level the Corps is in good heart. Senior Officers and their Headquarters are and must continue to protect units from the frustrations of cuts, restrictions and change, and I applaud what they are doing now. We have got super soldiers, and leaders at all levels must be inventive and ingenious in providing stimulating training for operations which will satisfy them. When soldiers do have to endure cuts or frustrations we must explain to them why and what the more unpleasant alternatives would be, and I have made a point of doing exactly that to all Officers wherever I have visited.

This business of communication is vital to the Corps, not only from the point of view of keeping our own people informed about what is happening, but also for the promotion of the Corps' standing both inside and outside the Services. The standard of public knowledge and debate about defence matters in this country has not been good for some time and I believe there are two main reasons for this. With no National Service and much of our defence effort operating outside the UK, we have isolated the Services from the community at large. Secondly, Whitehall tends to be a very secretive place. We in the Services should have nothing to fear from well-informed public debate and indeed we should welcome it. The Trident issue and the resignation of Mr Keith Speed are stimulating the Defence Debate but we serving soldiers are severely constrained from contributing to it. However, I have already mentioned the large number of civilian contracts that we have and it is for the more senior and retired members of the Corps to cultivate these contacts and encourage debate. Those of us serving in the Regular Army or the TA must wherever possible promote the image of the Corps by giving all our activities a high profile, but especially with those who may be able to influence our financial slice of the Defence Budget. We are uniquely qualified in the Sappers to do this; we have the equipment, the role, the training and the opportunities to do the kind of interesting and worthwhile things that other Arms cannot hope to match. We must make the most of them, and our future cannot be anything other than a bright one.

The Destruction of the Asopos Viaduct

IN ENEMY OCCUPIED GREECE IN 1943

Brigadier E C W Myers CBE, DSO, BA, C Eng, MICE

On passing out of "The Shop" in 1926, the Author persuaded the Cadet one above him that he would be far better off as top Signaller of his term than bottom Sapper. "Neither", he says, "ever had any regrets". In 1940 he went to the Middle East Staff College, having got a nomination to Camberley, again according to him, "as a result of his name appearing in the frame at Point-to-Points and Military Steeplechases in the early thirties". His Corps appointments in war included CRE of an Armd, A/B and Inf Div; in peacetime CO of an Asslt Engr Regt and a CE. He held a number of staff appointments outside the Corps. On his ("forcible") retirement in 1959 he became a civil engineer and built bridges instead of destroying them. He now "grows cabbages in the Cotswolds".

Foreword

So far as I am aware the full story of the Asopos Operation has never been previously published. As a result of the sad and untimely death last January of Harry McIntyre, one of the handful of brave participants and whose Memoir appears in this Journal, (page 204), I thought it would be appropriate for the Corps to learn a bit more about this epic event, with which I am proud to have been associated.

Here is the story.

* * * * *

When our original party of twelve was dropped into the mountains of enemy occupied Greece in the autumn of 1942 to cut the railway line to Piraeus, one of Rommel's supply routes to North Africa, it included three other Sapper Officers. These were Captains (both later Lieut Colonels) Tom Barnes and Arthur Edmonds, both RNZE and Lieutenant (later, in Greece, Captain) Inder Gill[1]. Helped by 150 *Andartes* (partisans) to overpower the Italian guards, they all played key parts in the demolition of three spans of the Gorgopotamos Viaduct on the night of 25 November 1942. But, by the time we had decided to attack the Asopos Viaduct, another of the three large bridges on the railway line through southern Greece, all except Arthur Edmonds, in whose area the Asopos was located, were scattered elsewhere over the mainland of Greece. They were by then engaged on other work as members of the British Mission to the Greek Resistance Forces, which our original party was being rapidly expanded to become, with the task of encouraging and co-ordinating the development of Resistance Forces throughout Greece.

Towards the end of January 1943, trains were once again passing over the Gorgopotamos, re-erected on rapidly constructed piers of steel cribwork, and a fortnight later I learnt that the Germans were slowly but systematically taking over guard duties on the railway. This led me to decide to try to destroy the Asopos Viaduct whilst still guarded by lower grade Italian troops. SOE[2] Cairo approved and said they would send us three specially selected Sapper Officers for the task. I gave

Brigadier ECW Myers CBE DSO BA C Eng MICE

Arthur Edmonds the job of making all the preparations for the operation.

This viaduct was situated at the lower, eastern, end of a 1,300 yards long, almost impassable, torrent filled gorge, only two to ten feet wide, between 1,000 feet higher, almost vertical, mountain faces. (See Sketch No 1). Below it further to the east, the gorge opened out into a broad valley. The viaduct, within a few feet of a tunnel exit at its northern end, carried the main and only single line railway towards Athens up a gradient and on a curve over the mouth of this almost precipitous gorge. Within a few feet of its southern end the line disappeared into another tunnel.

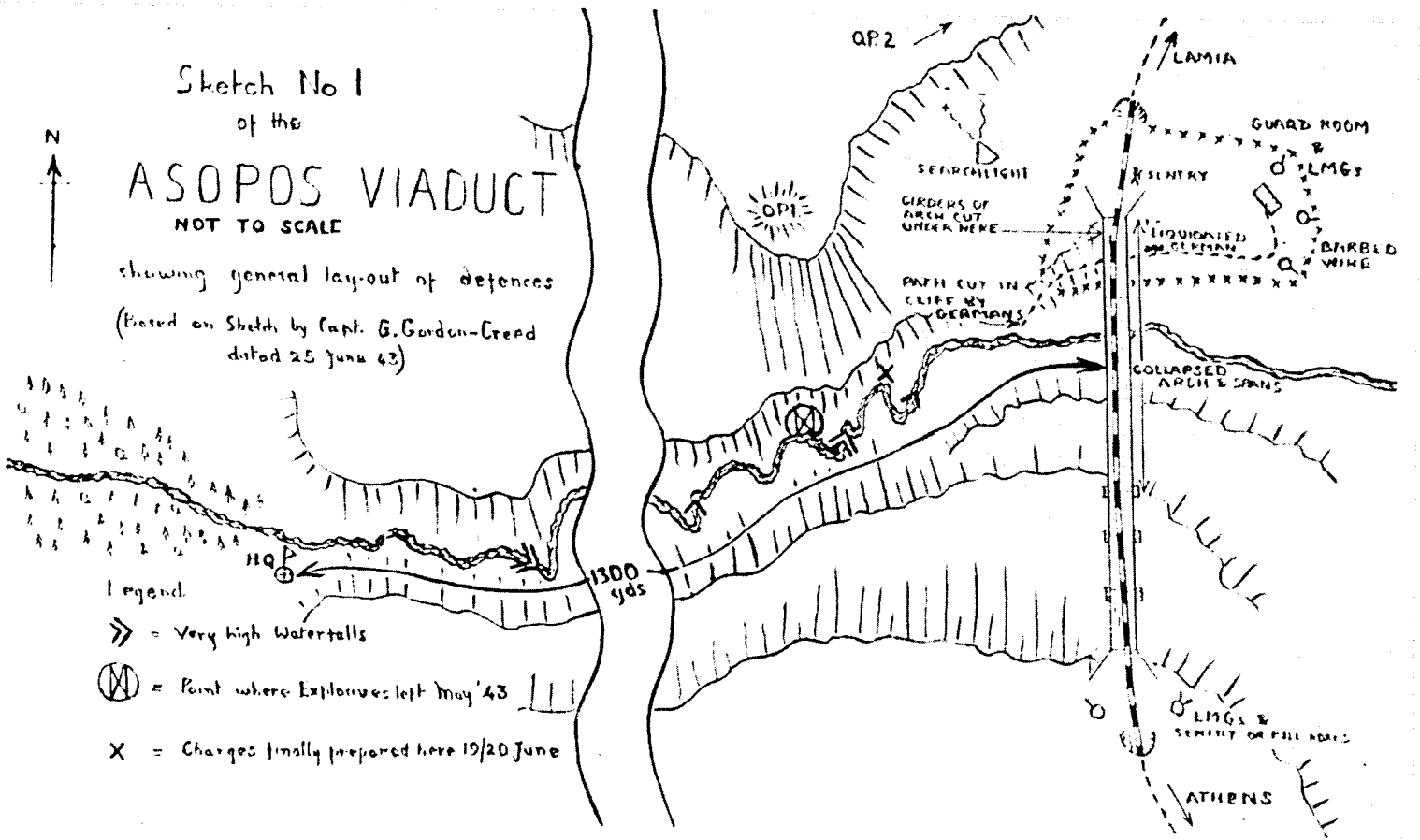
Two of the four steel spans, each of approximately eighty-two feet, which straddled the gorge proper (See Sketch No 2 and Photo No 1) were integral with a three-pin arch of composite steelwork, their outer ends resting respectively, to the north on firm ground, and to the south on a high masonry pier. There were three further steel spans supported on masonry piers at the south end.

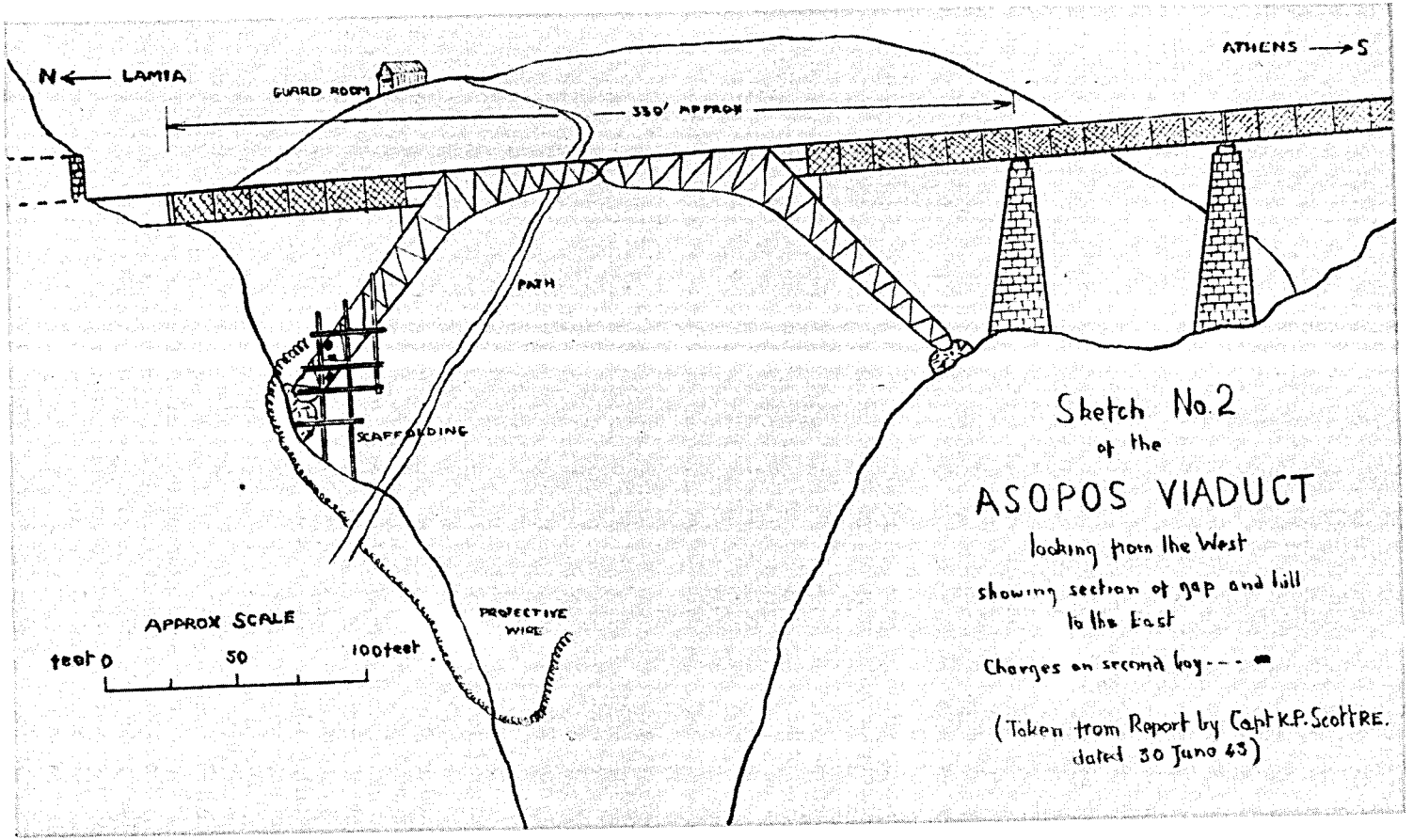
Shortly after our arrival in Greece, whilst we were still seeking Andarte support, I had carried out a careful reconnaissance of all three of the large railway viaducts in southern Greece, in order to decide which we should attack. The Papadia Viaduct, which the British Army had demolished during their withdrawal from Greece in 1941, appeared to be extremely heavily guarded and therefore unsuitable for our attentions then. I had had a good look at the western end of the gorge leading down to the Asopos and had quickly decided that this approach was quite impassible for any attacking force strong enough to overpower the enemy garrison and far too chancy for any smaller force. There seemed to me to be only three practicable approaches to the viaduct, two of them being through the tunnels at each end of it. The third was from below, from the east, where the gorge opened out into a wide plain. All these approaches would necessitate a larger force of Andartes than I then anticipated being able to find. But, by late January 1943, when Arthur Edmonds set out from my HQ in the Pindus Mountains of western Greece to return to the Giona Range, about a hundred miles north west of Athens, in order to establish his area HQ there, our successful destruction of the Gorgopotamos Viaduct was already resulting in a rapid increase in Andarte strength.

Before Arthur had left me we studied together accurate drawings of the Asopos and evolved a tentative plan, which would require a considerable force of Andartes. We decided to seize a train by night a short distance north of the viaduct as, invariably headed by two engines when travelling south, it climbed slowly uphill. The train guard would be quickly overpowered, the train boarded and driven on by us to the viaduct, where the bridge garrison would be overwhelmed and the main steel arch destroyed by British Sappers with previously prepared plastic charges.

After several reconnaissances Arthur decided that this plan was too chancy, because, although the guards on the viaduct numbered less than fifty, there was a battalion of enemy in a camp only about half an hour's travelling time away, and he did not think that a train could be seized noiselessly, and therefore without alerting the battalion, in time to reach the viaduct before we could complete its destruction. As his local Andarte Commander agreed to provide a force of up to a thousand Andartes if required, he eventually decided that the surest way of success would be by means of a mass attack by night with an overwhelming force over the more level ground from the east. Subject to a satisfactory reconnaissance I was prepared to agree with him.

It had taken SOE Cairo several weeks to select three suitable Sapper Officer volunteers and to complete their parachute training. These were Major (later Lieut Colonel) P J F Wingate, and Captain (later Lieut Colonel) H N McIntyre, both Regular Army, and Captain (later Lieut Colonel) K F Scott, who held a wartime Commission. They were eventually dropped close to Arthur Edmonds' HQ, a small mountain village, a day's journey from the railway, on the night of 11 May. I arrived there from western Greece the following day, ready to accompany Arthur and the Andarte leaders on a final recce of the approaches to the viaduct. But at the last minute, the trio of newly appointed Communist Andarte "Commanders-in-Chief"


Sketch No 1
of the
ASOPOS VIADUCT
NOT TO SCALE
showing general lay-out of defences
(Based on Sketch by Capt. G. Gordon-Creed dated 25 June 43)
N
HQ
1300 yds
OP1
OP2
SEARCHLIGHT
GIRDERS OF ARCH CUT UNDER HERE
PATH CUT IN CLIFF BY GERMANS
LAMIA
GUARD ROOM
SENTRY
LMGs
LIQUIDATED GERMANS
BARBED WIRE
COLLAPSED ARCH & SPANS
LMGs & SEMINT OR FULL ARMS
ATHENS
Legend
= Very high Waterfalls
= Point where Explosives left May '43
X = Charges finally prepared here 19/20 June


N ← LAMIA
GUARD ROOM
330' APPROX
ATHENS → S
PATH
SCAFFOLDING
APPROX SCALE
feet 0
50
100 feet
PROJECTIVE WIRE
Sketch No. 2
of the
ASOPOS VIADUCT
looking from the West
showing section of gap and hill to the East
Charges on second bay - - -
(Taken from Report by Capt K.P. Scott RE. dated 30 June 43)

got cold feet about the operation and refused to allow their local Commander to risk such a large force on what they regarded as too hazardous an operation. On top of this they got news of the threat of a big German sweep through the Giona Range and they told me that they would have to move all their local Andartes across into western Greece without delay, far away from our main communications targets.

In spite of all the persuasive arguments I could muster, although I prevented the premature dispersal of the local Andartes, I failed to obtain their support for the operation as then planned. And so it had to be entirely recast to one of a stealthy attack by the smallest possible hand-picked force. I instructed Arthur Edmonds to send off Major Geoffrey Gordon-Creed, a resourceful Rhodesian Cavalryman, and Captain Donald Stott, a brilliant New Zealand Commando, to see if it was possible to get all the way down the gorge with a handful of men.

Two days later Gordon-Creed returned and reported that he thought it would be possible. He left a few days afterwards with a party of six and all the rope we had, the charges having been prepared according to the accurately known dimensions of the bridge. His party consisted of himself and Stott, the three Sapper Officers, Major Wingate and Captains Scott and McIntyre, a Greek Officer called George Karadjopoulos as interpreter, and a Lance Corporal Chester Lockwood, a British Army NCO captured by the Germans in 1941 who had subsequently escaped and eventually joined up with us. At the end of six days, four of which they had spent struggling in the gorge sometimes with water up to their necks, completely cut off from the outside world, sometimes only with the greatest difficulty overcoming symptoms of claustrophobia brought on by the enclosed nature of the gorge, they returned, having left their explosives a little over 300 yards from the bridge. They had run out of rope. Two of the party were completely exhausted; all of them had their knees badly cut about.

The following is an extract from Captain Scott's Engineer Report to me on this part of the operation. It should be read in conjunction with Sketch No 1, which shows the general layout of the surrounding country.

"The charges for the operation were made up early in the month of May. On 21 May they were transported on mules to a place near the western mouth of the gorge. Late on 28 May all of us, with the exception of L Cpl Chester Lockwood, went down the gorge with ropes to make paths for the explosives over obstacles, eg waterfalls, deep pools, etc. On the morning of 23 May the detonators, safety fuse and time pencils were prepared and made waterproof with adhesive tape. The explosives were made up into five bundles; four of them each of one 18lb charge for a main girder, two sausages for wrapping round adjacent horizontal and diagonal bracing and two magnets for assisting to attach the charges; the fifth bundle contained accessories, primacord, made-up detonators, adhesive tape, string, a tin of primers and, in addition, two 3lb cubes of explosives. The four main bundles were wrapped in groundsheets and the accessory bundle in two gas capes. On completion of the above work the whole party, with the exception of L Cpl Chester Lockwood took the five bundles approximately one third the way down the gorge and left them on a dry spot. Great difficulty was experienced in keeping the charges dry owing to waterfalls up to 40ft high with a considerable volume of water, and owing to deep pools and stretches of water up to 10ft deep.

"These difficulties were overcome either by lowering the charges to one side of the waterfall clear of the water, or by making an aerial ropeway and attaching the charge to the rope and allowing it to slide down, the ropeway being held at an angle of 30 to 45 degrees, or by walking through the water with the charges held above our heads.

"On 24 May we carried the charges further on, to a point approximately two-thirds the way down the gorge, where we again left them on a dry spot. Operations were then temporarily postponed because of a particularly tricky waterfall, approximately 20ft high which required either rope ladders or a tree to negotiate it, and because of lack of moon".

The party returned to their base in the mountains and Cairo was asked to drop

more rope.

We will now turn to an extract from Major Gordon-Creed's report on the second attempt to carry out the operation.

"The following made up the party for the attack; Major Gordon-Creed, Captains Stott, Scott RE and McIntyre RE (all of whom had taken part in the first attempt) L Cpl Charlie Mutch, a New Zealander, another escaped POW whom we had picked up in Greece, and Sgt Michael Khuri MM, a Palestinian Arab, yet another escaped POW who had already earned the MM with us in the Gorgopotamos operation. A preliminary recce was made on 16 June by Stott, L Cpl Mutch and Sgt Khuri. For the first time, using the extra stores, the party succeeded in passing right through the

Photo 1. Pre-war view of the Asopos Viaduct from the South East.

gorge and up to the last bend above the bridge in daylight. It was discovered that workmen were very busy rivetting, apparently strengthening the main arch, and that scaffolding had been erected.

"The remainder of the party, Gordon-Creed, Scott and McIntyre arrived on 19 June and the following day the whole party proceeded down the gorge. Whilst the explosives were being repaired and altered at point "X" shown on Sketch No 1, another daylight recce was made by Gordon-Creed and Stott. A point almost underneath the bridge itself was reached. A path was noticed, which appeared to lead up to the scaffolding on the left, northern, bank. It was decided to attack that night.

"The party set off at 6.30 that evening, 20 June, to cover the remaining distance, about 350 yards, to the bridge. At about 8pm the whole party reached the foot of the path. A final recce was then made of the bridge and scaffolding by Gordon-Creed and Stott. By great good fortune is was found that neat gaps had been cut through the barbed wire (see Sketch No 2), also that the enemy had been kind enough to leave a ladder leading up through the scaffolding to a platform about 100 feet up, from which point it was possible to reach the main girders. At this point L Cpl Mutch and Sgt Khuri were sent back up the gorge to prepare something hot and to strike camp ready for a hasty exit. The four remaining members then hauled up the explosives and placed them in position. Shortly after this work had begun, a German guard on his round approached. The party remained motionless and, as the German passed, Gordon-Creed, who had been hiding behind a bush, banged him on the head with his "cosh" and the German silently dropped over the cliff".

Scott and McIntyre fixed the charges to the four main girders first of all; then the eight sausages to the horizontal and diagonal bracing. The charges were then connected with primacord and the made-up detonators taped to the main lead. The whole operation of fixing and connecting took about an hour and a half. There were times when no work could be done for some minutes owing to the brightness of the moon or to the searchlight which periodically illuminated each pier and the arch.

Scott told the story of how, on the wooden platform from which he and McIntyre worked to fix the charges, the workmen repairing the bridge had left what appeared in the darkness to be odd nuts and bolts strewn about over the decking. After having knocked one bolt over the side, with no little noise as it clattered down the gorge, they moved systematically over the decking to pick up the others, only to discover that all the rest were dark knots in the wooden planks.

Approximately half an hour before everything was finished, Stott the New Zealander left, in order to make his way up the gorge to a point above the bridge to observe the results. Grave anxiety was felt as to whether the explosive was still serviceable as, owing to the depth of water in places, it had had to be dragged through it.

Time pencils with one and a half hours delay fuses were started shortly after midnight. The three remaining members then left. At that moment a searchlight turned right on them, apparently as a routine performance by the guard. But, again quoting from Gordon-Creed's report, "they were apparently unsuspicious in spite of the appalling noise made by everyone falling over and dropping things" and the guard's curiosity was not aroused. When the party was still only half way up the gorge, at 2.15 in the morning, the charges went off. With one complete cut in the curved sections, the whole central arch collapsed into the gorge below, dragging with it both cantilever spans, where it lay, a jumbled mass of steelwork. The operation had been a complete success.

The bridge had been guarded by about forty Germans with six heavy machine guns and more light automatics. The whole defence had been laid out in every direction except up the gorge. In order to facilitate their movement and their work, we had given permission for the party to go completely unarmed except for rubber "coshes". They were lightly clad in shorts and gym shoes. If they had been spotted by the enemy whilst in the gorge, everything would have been up for them.

The destruction of the Asopos Viaduct was only one of many achievements in the

war behind the enemy lines in the Balkans. But, although I was over a hundred miles away when the final attempt was made, I have no hesitation in saying that, in my opinion, for sheer endurance, determination to succeed and pluck, which the success of this operation demanded of all those who took part, combined with almost incredible good luck, there was probably no more audacious achievement of its type during the whole war.

Every one of the six who took part received an award; Gordon-Creed and Stott each the DSO, the two RE Officers each the MC, and the two Other Ranks the MM. I asked if Stott, who had been such an inspiration to the rest of the team throughout the

Photo 2. A small party of the British Military Mission on the move through typical Greek mountain scenery.

operation, could be considered for the VC. But he was apparently not qualified as no shot had been fired! Not only were congratulations sent by wireless to those who took part by the C-in-C, Middle East, General (later Field Marshal) Wilson, but Prime Minister Churchill himself, when he learnt of the operation, sent his personal congratulations. A few days after the event the RAF flew over the area to photograph the damage done, and a stereoscopic pair of photos was ultimately prepared for SOE London. Some months later, when on a visit to Chequers. I was asked to show them to (then) Mr Churchill. I still remember his gleeful chuckle.[3]

The story is not quite finished. We were told that the Germans were so convinced that the bridge had been blown up as a result of treachery, that they later shot the entire garrison. Quoting from my own report, written in August 1943, "the bridge was blown up on 21 June and since then the Germans have been hurriedly rebuilding it with concrete piers. But with delight we learnt a week ago that one of these piers had collapsed, causing the demise of several Germans and retarding the re-opening of the line". As a result of this gallant operation the railway line to Athens was cut for four months.

Although I had orginally intended that the Asopos Viaduct should be blown up in the early spring of 1943, before Germans replaced the Italian guards, the eventual date could not have been more opportunely timed. For it fitted in almost exactly with the beginning of widespread destruction of communications of all sorts, ordered by GHQ Middle East, throughout Greece by the Greek Resistance and members of the British Military Mission, concentrated over a period of three weeks immediately prior to the invasion of Sicily. We had been carefully preparing for this for several months. It was all part of an Allied cover plan to help mislead the Germans into thinking that Greece, not Sicily, was about to be invaded.

During the preparations for the destruction of the Asopos Viaduct every ill wind seemed ultimately to have been transformed into a favourable one. Good fortune had indeed been on our side all the way.

Postscript

Since completing the above article I have received the following unsolicited contribution from Colonel the Hon C M Woodhouse DSO, OBE, my Second-in-Command at the time of the Asopos Operation and my successor as Commander of the Mission. Apparently, some months after the operation, Don Stott the New Zealander told Monty Woodhouse that he was not absolutely certain about what he believed he had momentarily seen in the moonlight as a result of the explosion of the charges, and on returning to their mountain HQ, a young Greek who had training as a draughtsman was sent down to look at the bridge from the open ground to the east, disguised as a peasant. He brought back a drawing which they unfolded with trembling hands. Aghast, they saw an exact picture of the viaduct as it had been before the operation. "Was that really what he had seen"? they asked in despair. "Oh, no"! he replied: "the bridge is at the bottom of the gorge, but I remembered what it used to look like!"

[1] Tom Barnes was tragically killed in Tasmania, the result of a car accident shortly after the end of the war. Arthur Edmonds thrives as a farmer in New Zealand. Inder Gill has recently retired from the Indian Army, to which he transferred at the end of the war, with the rank of Lieut General.

[2] SOE, Special Operations Executive, the wartime organisation responsible for encouraging, organising and supporting resistance and sabotage in enemy overrun countries.

[3] I have lost touch with Geoffrey Gordon-Creed and both the "Other Ranks". Don Stott, having earned a Bar to his DSO, was killed in the Far East whilst on a Special Operation shortly before the end of the war. Ken Scott, with a Bar to his MC, is Senior Partner to Sir Alexander Gibb and Partners, but still finds time to be a most active supporter of the Corps, including being a Member of the Institution (he has recently been elected Hon Member of the Institution), the REYC, a TA Lieut Colonel in the Engineer and Railway Staff Corps, a Member of the Military Technology Board and Chairman of the Military Engineering Committee.

Solar Preheat for Domestic Hot Water

LIEUT COLONEL J M GUYON MA

THE planet Earth circles our star, the sun, at a radius of about 93M miles at which distance the radiant energy is worth 1·36 units (kilowatt-hours (kWh)) a square metre an hour. A satellite in a shadow-free orbit above the air, taken as ten miles thick, could collect 33 units a day. A cloudless bright June day on the surface at Kew (Lat 51°) might give 1·02kW a square metre at noon under an imaginary vertical sun, 0·95 at actual midsummer noon (sun alt 62°) when the rays must traverse eleven miles of air, but only 0·25 at midwinter noon (sun alt 15°) when the rays must traverse 35 miles of air before reaching the surface. Our axis of rotation is inclined 23·5° to the vertical to the plane of our orbit, so causing the sun's apparent track across the sky to change day by day and hour by hour, giving sixteen hours of daylight in summer but only eight in winter. The radiation consists of infra-red, visible light, and ultra-violet, of which visible light carries only half the energy. All three degrade to heat when they fall on a dark coloured surface. Less than half comes from the direct rays of the sun, more than half from the sky. If there is enough light to take a photo with an ordinary camera without flash, then some energy can be collected. Our radiation climate is better than most people would expect, providing over half as much in a year as California, Australia, Israel and South Africa.

A flat plate collector consists (Fig 1) of a thin matt black copper plate which collects the radiant energy from the sun and sky and turns it into heat, covered with a sheet of glass in front and insulated back and sides. The glass admits short wavelength incident radiation, but blocks the re-radiation of heat from the collector plate at long wavelength (the greenhouse effect). The heat is carried away from the plate by a grid of waterways through which is pumped a mixture of water and anti-freeze. The array of collector panels is usually put on the roof of the house as probably the best shadow-free site available, and also to keep the glass out of harm's way, so that aspect and tilt are usually dictated by available roofing. Any aspect between SE and SW will

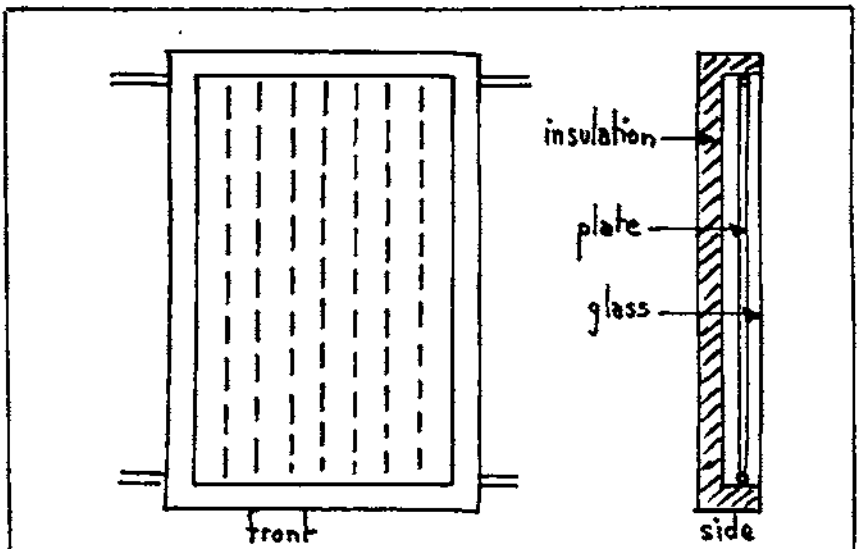


figure 1. collector

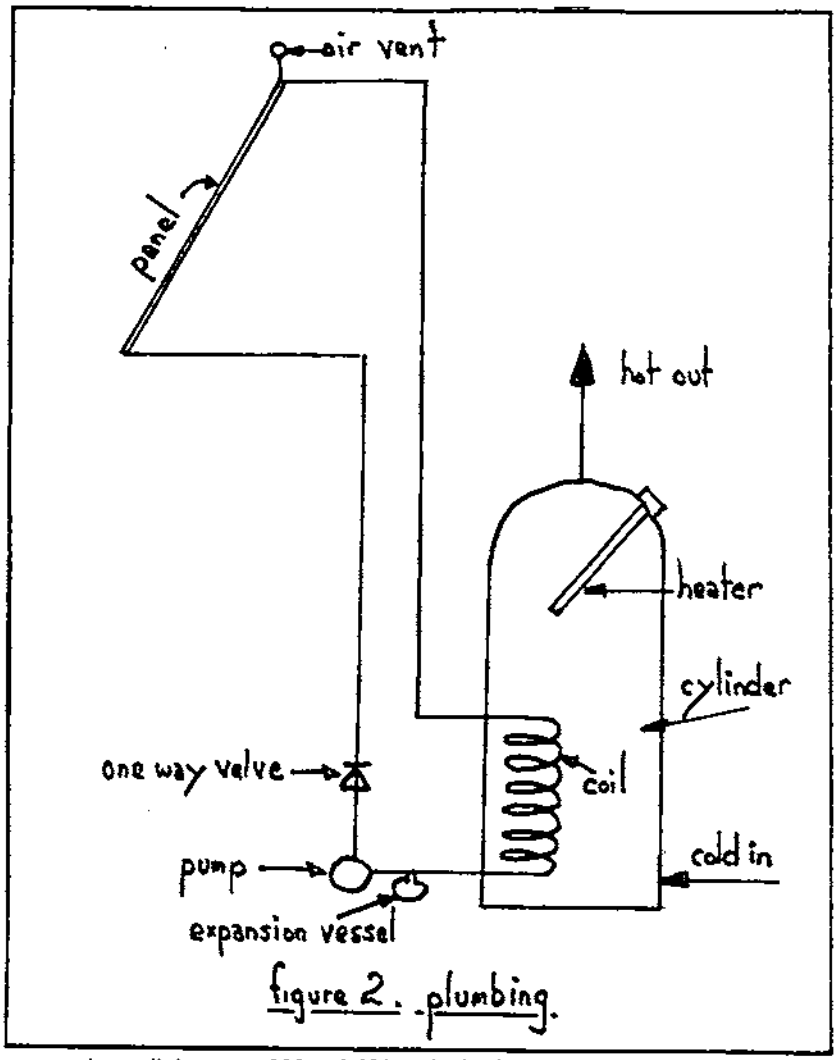


figure 2. plumbing.

serve, and any tilt between 30° and 60° to the horizon. The flatter tilt will produce a surplus of hot water in summer and little in winter, the steeper rather more in winter but rather less overall.

The plumbing required (Fig 2) consists of flow and return pipes feeding the panel through a pump and heat exchanger coil at the bottom of the solar store, which heats the contents. Hot water is drawn from the top and cold replacement water flows in from the mains or attic cistern at the bottom. A booster—usually an electric immersion heater—is fitted to heat enough hot water for one bath at a time: for best results, this should have its own thermostat and timeswitch.

A solar heater will turn cold water to lukewarm whenever there is enough radiation, but is less good at turning lukewarm to hot because of the inevitable losses from the relatively large flat area of the collectors under increasing temperature difference. For this reason it pays to lower the thermostat setting on the immersion heater to the minimum acceptable figure so that the largest possible proportion of the heat needed is supplied "free" by the sun, and the smallest possible proportion by expensive electricity. Using a setting of 120°F/49°C we achieved 57% "free" from

the sun in Lat 52°30′.

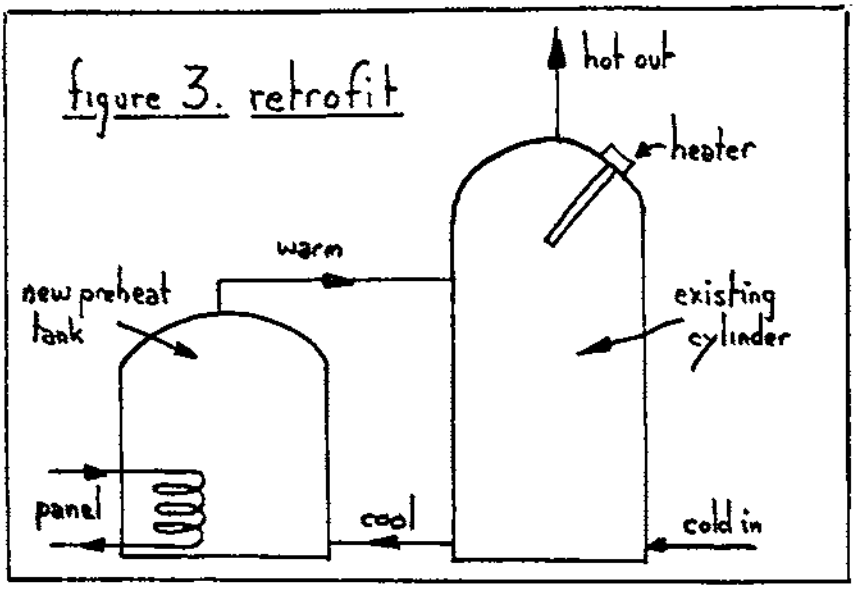
If the household now uses 50gal/227litre of hot water a day at 140°F/60°C it will need 60gal/273litre if the temperature is reduced to 120°F/49°C as recommended above. Since the solar boiler is only "on" for six hours a day, the energy collected during this time must heat enough water for twenty four hours, and the insulation on the store must keep it hot enough to be useful for the whole of this period. This dictates a 60gal/273litre solar store, and nothing smaller is adequate to secure a reasonable return in useful heat for a fairly heavy investment. We use one factory-fitted layer of insulation plus two commercial jackets on top, and lose 0·5°F per hour from 120°F/49°C. Collection ceases about tea-time with the store at perhaps 130°F/55°C; by next morning, about fourteen hours later, it will have cooled to 123°F/50°C—still plenty hot enough for a comfortable bath, which most people prefer at about 105°F/40°C.

To heat 60gal/273litre requires about five square metres of collector plate in these latitudes. A larger panel will cost more, give slightly higher temperatures, but waste much more heat. A smaller panel will cost less and give lower temperatures with higher boost bills. Too small a solar store means that all the rest of the hot water needed must be paid for as at present.

Control of the pump is by an electronic black box called a differential controller connected to temperature sensors in the panel and store. When the collector is hotter than the store, it starts the pump, stopping it again when the store becomes warmer than the collector in late afternoon or thick cloud. A non-return valve in the primary solar loop ensures that heat from store is not re-radiated by reverse gravity circulation at night or in cloud.

So far we have been describing a new installation in a new house where we have a fairly free choice and it is possible to sink the collectors between the rafters, and to use the cover glass as an integral part of the roof. The problem of adapting an existing house is more difficult. The Americans call it a "retrofit". The panels can be fixed on top of the existing roof covering, but must be securely anchored against storms. Their pipes can be taken through the roof covering, but great care must be taken that no leaks result. The existing hot water system might typically consist of a 30gal/136litre cylinder with a calorifier coil run off the house central heating boiler in winter plus an electric immersion heater for summer. The solar installation salesman will probably suggest merely adding a 30gal/136litre solar preheat store which draws cold water from the mains or attic cistern and feeds sun-warmed water to the domestic cylinder instead of cold. This shortcut suffers from two main disadvantages. The first is that most households use most of their hot water when the solar boiler is off. If the household uses 60gal/273litre of hot water a day, only 30gal/136litre in the solar preheat tank will get heated by the sun, and the remaining 30gal/136litre will have to be heated from cold as at present—and paid for. The second is that when running a bath, the pipe connecting the two tanks quickly gets hot and stays hot; but over half of all the hot water used is used in sink and basin, not bath, therefore drawn off in dribs and drabs: the pipe connecting the two tanks cools down when the hot tap is turned off, and delivers cold water, not hot, from the cold pipe when the next hot tap is turned on. The effect is that only half the hot water drawn from the taps is sun-warmed; the other half is lukewarm, cold, or stone-cold when it reaches the domestic cylinder, although it started quite warm in the solar preheat tank. If the solar preheat tank is put in the attic (often easier and cheaper) with the existing domestic cylinder on the first floor (or ground floor of a bungalow) then the connecting pipe is likely to be a long one and the amount of nominally hot but actually cold water in it that much greater.

If your existing cylinder is old and furred up in a hard water area, then take the chance of changing it for a single new cylinder large enough to act as an efficient solar store, with boosters acting only on the top 20gal/91litre or so—enough for one bath with a little over. If your existing cylinder is still perfectly good, and you are able to find the space for a second alongside or very near it on the same level, then add a



second and connect the two in parallel, not series as shown in Fig 3. Hot water from the top of the solar preheat tank will then flow by gravity (being lighter) into the top of the domestic cylinder, while the cold water at the bottom of the domestic cylinder will run back into the bottom of the solar preheat tank, and at the end of the day the whole contents of both tanks will have been warmed by the sun. The two pipes connecting the two tanks should be given at least 1·5in/40mm of armaflex or similar preformed pipe insulation to keep the heat in.

To get full benefit from sun and sky you need to switch the booster off when the solar boiler is on. Since the sun does not shine to order, the easiest way to achieve this automatically is to have a timeswitch on the immersion heater which turns it on in time to heat the morning bath if yesterday's sun has not already done so, turns it off for the day before the morning bath is run, and on again when the solar boiler has switched off in late afternoon; off again before the last bath of the day is run, in order to keep down overnight losses. There will be enough hot water left over from the morning bath to carry right through a day of heavy cloud up to the time the booster switches on again in late afternoon, provided your solar store is big enough and kept warm enough by insulation. If you are using the central heat boiler as booster in winter, fit a manual or motorised valve in the primary circuit—provided your boiler, if solid fuel, has a heat emitter in the primary circuit, otherwise it will overheat when relieved of the domestic hot water load—so that you can turn the booster off when the solar boiler is on and possibly at night also. Most combined boiler systems have a cyltrol or similar valve on the return from the domestic hot water calorifier to the boiler to keep the domestic hot water temperature below the scalding temperatures needed for efficient central heating. If you have a solar heater, it pays to adjust this control to take all the heat the sun will give, and add only the minimum needed from fuel which has to be paid for.

If you really want the last drop out of your solar heater, you may have to think of changing your domestic hot water habits slightly. The more hot water you can arrange to use usefully while the solar boiler is on, the more free energy you will collect. This is because the colder the water you feed to your collector, the higher its efficiency and the less sun heat it wastes. If you draw no hot water while the solar boiler is on, the store gets hotter and hotter and eventually, towards panel sunset, the waning radiation is not strong enough to force in any more heat, so the pump switches off although the sun is still shining brightly. If, on a hot day, you took all the

household baths around noon, the cold replacement water would be reheated with high efficiency during the afternoon and the pump would continue to run long past the time at which it would have switched off if no hot water had been drawn off. Most house occupiers will refuse to do their laundry at noon on the grounds that it will not usually dry the same day: but if you live in a clean area, consider leaving it on the line overnight to dry next morning, or use a tumble drier. Dishwashers or hand washup can usually be done after lunch: even if everyone is out all day during the working week, the former at least can be loaded and left ready to go on a timeswitch. Since the first degree of heat above cold water temperature costs just as much as the last before the water is hot enough for a bath, this problem merits the expenditure of some ingenuity to solve it without too much domestic upheaval.

In May 1979 we installed 4·8 square metres of collector in three panels driving a 48gal/218litre store: collector aspect 168° (12°E of true South), tilt 58°. Total incident radiation for the year to April 1980 was 4454 units, of which we collected and used 1544. The heat was measured at the domestic cylinder at 7am each morning, hence included all system losses and overnight loss from store. The year to year variation in global radiation (sun + sky) does not exceed about 10%, although the variation in bright sunshine hours is greater. Land's End might expect to get 15% more, John-o-Groats 15% less, and roughly in proportion for places between.

Such a system professionally installed might cost about £1500 (1980)—or £750 for components if you were able to do the work yourself. In return you might expect 1500 units of "free" heat for your bathwater, or £75 tax-free income if a unit cost 5p, equivalent to £107 for a standard rate taxpayer. It is the policy of the present government to ensure that gas prices rise 10% faster than inflation and electricity 5%. A 25% increase in gas prices has already been announced for this year (1981). Other fuels are likely to follow suit. This prospect makes solar heat more attractive. Sophisticated calculations can be made assuming some arbitrary future course for inflation, interest rates, and energy costs, but the result is only as good as the assumptions made. Most people expect energy costs to go on rising faster than inflation. If they do, then a solar heater now is likely to look like a wise decision within five years, provided a durable weatherproof system is chosen.

Enlightened Building Societies, led by Abbey National, are beginning to recognise that an approved solar system adds to the value of a property as security for a mortgage. If you already have a mortgage, it is therefore worth asking for a further advance to finance the installation of a solar heater. If granted, you qualify for tax relief on the interest content of the repayments as for the main mortgage, which makes the transaction an attractive proposition since it is partly government subsidised.

Unfortunately the British Standards Institution, although it has produced a *Code of Practice for Solar Heaters—BS 5918/1980*—is not yet ready to prescribe an agreed procedure for testing flat plate collectors in this country. Until it does so, and the test facility is set up, it is hard for the layman to judge between one collector on the market and another. Some help may be available from The Solar Trade Association Ltd, 26 Store Street, London WC1E 7BT, whose members are bound by a Code of Practice which came into effect on 1 July 1979.

Use of Reflectors

Expensive parabolic reflectors are useless in UK since only about 40% of the global radiation comes from the sun as a reflectable beam, the rest from all parts of the sky. However, given suitable roof angles, a fixed flat reflector may be used to increase the total radiation falling on the collector panel in winter.

The house in the photograph is known to the trade as a chalet bungalow. The front South roof has an aspect of 168° true and a tilt of 58°. The three collector panels sit just under the ridge, above the dormer windows and the array is 12ft long by 5ft high (3·65m × 1·5m). The flat roof over the dormer windows was covered in November 1979 with shiny aluminium roofing foil 22ft long by 4ft wide (6·7m × 1·2m) at a cost, professionally fixed, of £35. The noon geometrical efficiency of the resulting collec-

tor/reflector combination is given in Table 1. By coincidence, on 7 March/7 October the noon direct rays strike the panel at 90° in altitude, and the ray reflected from the outer edge of the reflector just hits the top of the panel, meaning that the whole width of the reflector is effective on those two days. On 21 May, 21 June and 21 July the noon altitude of the sun in Lat 52° is greater than the panel tilt, so that the noon reflected rays never hit the panel at all. Morning and afternoon rays, however, reflected from a lower sun by the wings of the reflector will give some help.

A panel tilted 58° only sees about two thirds of the hemisphere of sky which produces 60% of the radiation, so only receives 40% from the sky and another 40% from the sun (if it faces South). Since only sunbeams are usefully reflectable, and the diffuse omni-directional sky radiation is not, the noon geometrical efficiency of the reflector applies only to half the total incidence radiation. Allowing the roofing foil to reflect 80% of the incident sunbeams produces an estimate of the reflector bonus as a percentage of the direct radiation reaching the panel at noon when the rays are hottest and the sun azimuth favourable. To calculate morning and afternoon bonus would need a computer, or many man-months of manual calculation, and has not been attempted.

Fig 4 shows at:

A—Global radiation (sun + sky) on a horizontal surface of 4·8 square metres recorded by the Meteorological Office at Cardington near Bedford in 1979 totalling 4579kWh for the 12 months. The average for Cambridge, nearer than Cardington, 1957–71 was 4584. Cambridge stopped taking readings in 1972.

B—Global radiation on 4·8 square metres tilted 60° calculated by the Building Research Establishment from Met Office data for Kew for a horizontal surface, and applied to A above, totalling 4732.

C—Total radiation (sky + sun direct + sun reflected) on 4·8 square metres tilted 60° derived from B by applying the estimated reflector bonus from Table 1 totalling 5463.

D—Estimated heat collected and used totalling 1639kWh. June, July and December are "actuals" with the foil reflector in place, remaining months estimated from previous actuals without the foil reflector.

Note that global radiation on a tilted area facing South is greater than that on a horizontal plane—4732 against 4579—the summer loss being more than made up by

Reflector Bonus % — Table 1

Month	J	F	M	A	M	J	J	A	S	O	N	D	21st day
Noon η	35	64	71	25	0	0	0	25	71	64	35	28	geometrical
Reflectable	17·5	32	35·5	12·5	0	0	0	12·5	35·5	32	17·5	14	sunbeams only
Reflected	14	25·6	28·4	10	0	0	0	10	28·4	25·6	14	11·2	20% reflector loss

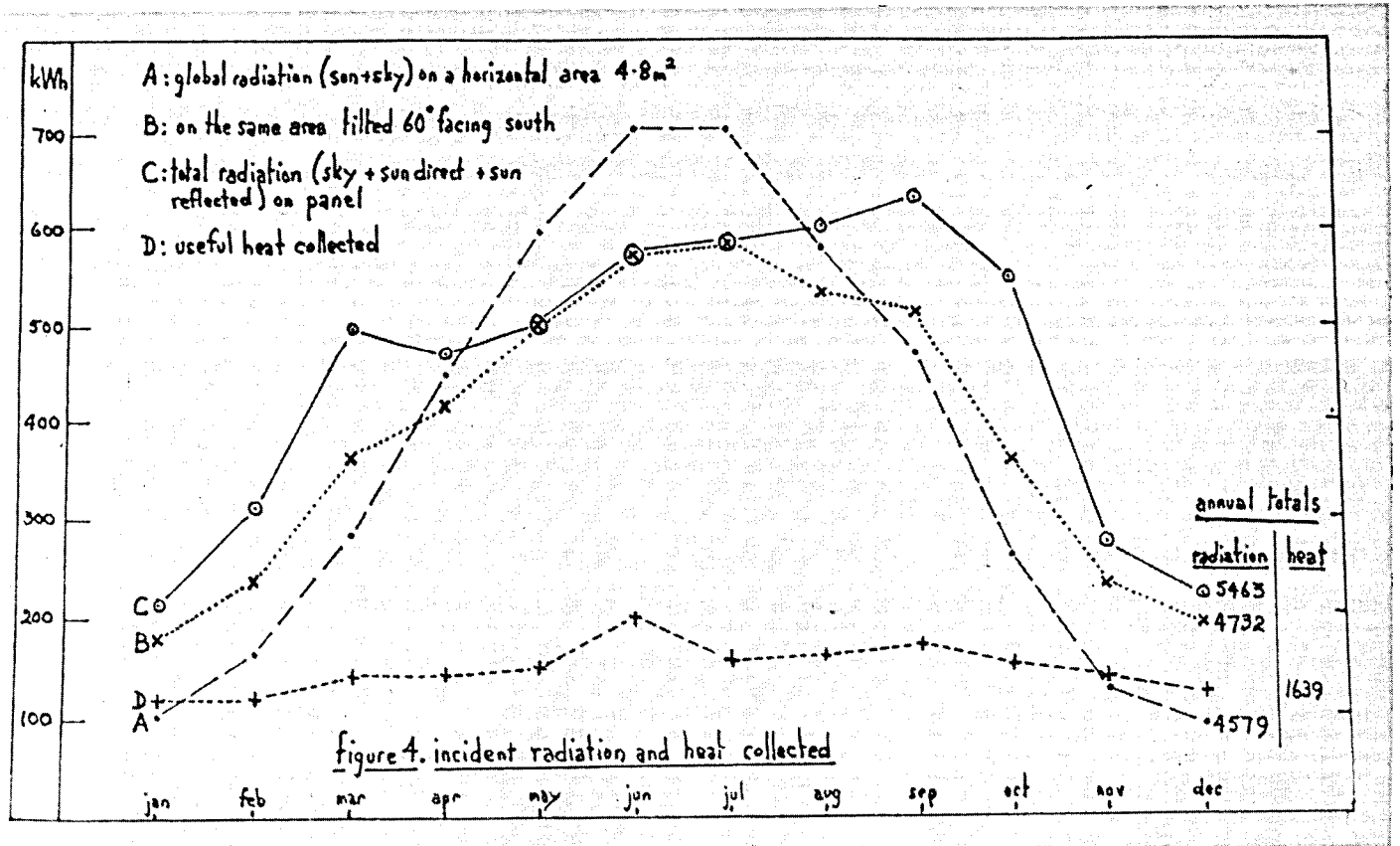


figure 4. incident radiation and heat collected

the gain in autumn, winter and spring (curve B *cf* curve A). Maximum radiation is received on a plane tilted at 34° by making best use of the high midsummer sun: but this either produces too little heat in winter or, with a larger collector, high temperatures and high losses in midsummer. It is the writer's opinion that the less peaky curve B produces a greater annual total of heat actually collected, stored and used than would a tilt of 34° instead of 60°, though this has yet to be proved.

The overall efficiency showed only a small improvement from 35% to 36%. This is the useful heat collected against global radiation on a horizontal plane. A fixed flat plate collector can only have the sun's rays normal to its surface for two instants in a year, and has to struggle for the rest of the time, so not much more than 40% can be expected as a maximum, using first class collectors.

The solar fraction went up from 57% to 70% due to more radiation being available over the reference period—4579 against 4454—increased by tilt and reflector bonus to 5463 (curve C), without any increase in hot water demand or temperature of use. Better use can be made of the extra reflected radiation in March and October, with the cold water at 50°F/10°C, than would be the case in midsummer with the cold water at 70°F/21°C from the attic cistern, since higher temperatures inevitably mean higher losses with the present design of collector. So we only had to pay to heat less than a third of our hot water.

62% as much heat was collected in December as in June (123 against 201kWh). We got "free" hot baths from the sun (no boost needed) on clear sunny days in every month of the year except January, an achievement which gave us great satisfaction. Any fool can boil a kettle in June, but it takes hard thought and some ingenuity to wring heat from an English winter sky. It can be done.

All the curves are "humped" to the right, curve A because there is usually actually more global radiation to be collected in the second half of the year, B because tilting the collector emphasizes the sun component and while January–April has only 37·5% of the total as sunshine, August–November has 41·3%; and C because the extra radiation over B comes only from the sun. Consequently more heat is collected in September/October than in February/March although sun altitudes are comparable.

The heat curve D is very much flatter than the radiation curves ABC. One kWh (3410 btu) applied to 10gal (100lbs) of water will raise its temperature 34°F/19°C: in midwinter with cold feed at 45°F/7°C the water will be warmed to 79°F/26°C at which temperature collector losses are low. In midsummer with cold feed at 70°F/21°C the water will be heated to 104°F/40°C, almost hot enough for a bath, and at these temperatures collector losses start to become alarming—hence the flat shape of the heat curve. This emphasizes the fact that a solar heater should always be regarded as a preheater, never as a boiler, and also that a larger collector panel results mainly in increased loss of heat.

A vertical collector with a horizontal reflector in front of sufficient width for full efficiency 21 November/21 January, and splayed outwards in plan @ 45° to reflect from 9am to 3pm is calculated to give a steady monthly intake of heat all year round within 10% excluding December, and also to collect more radiation certainly and more heat probably than a collector tilted at 34° without a reflector, which is reckoned to give a maximum annual incident radiation in UK latitudes.

If you have a vertical South wall which is shadow free all year, add a verandah, carport, sunroom or what you will in front of it. Cover the flat roof with metallic-faced felt (recently available—aluminium or stainless steel), mount a collector panel on the wall above, and enjoy (nearly) free bath water all year round!

* * * *

On Being a Troop Commander in BAOR

CHALLENGED by the publication of an article on being a UK Construction Troop Commander (*RE Journal*, Volume 94/1, March 1980) the CO of a Regiment set his Subalterns the task of writing on being a Troop Commander in BAOR. The three short articles which follow are a selection of those submitted. They were selected to indicate the different faces of Regimental life as well as both the serious and light-hearted attitudes held by all Subalterns at some time or another.

Life of a Troop Commander or The Support Troop Paradox

LIEUTENANT M W WHITCHURCH RE

After three years service with 73 Indep Fd Sqn the Author went to Sandhurst and was commissioned in 1979. He attended 70 YO Course at Chatham and now serves as a Support Troop Commander in BAOR.

SECOND Lieutenant Sticky Holdfast RE has been given a Support Troop.

"No! God, what have I done!" cries Sticky. "My visions of thrusting, BATUS, Battle Groups, sports car, Spartans, all gone; I'm in the second eleven. Passed over. A Support Troop". Sticky retires to his room to consult a bottle of Scotch.

But wait Sticky, all is not lost. Wouldn't you like to be a Lieutenant Holdfast? Or even Captain Holdfast? Of course you would! Well drink not—for this is your chance. Your life as a Troop Commander can be a success quite easily. Remember the golden rule is not to do anything by half measures. You can do this by:

Making an impressive arrival.
Keep'em talking,
Being a tactical eccentric, and
Being a BAOR Champion.

MAKING AN IMPRESSIVE ARRIVAL

You don't have a car? Get one. Hire it. Borrow it, get one. It must be really vintage or really big. Porsche, Bentley, Jaguar, these are all ideal. Remember that on arrival deliberately go around the barracks of your new Regiment asking for the whereabouts of the Officers' Mess, announcing that you are Sticky Holdfast reporting in. Of course your preparation will pay off; that film star suntan you've got by borrowing a sunlamp will support you when you mention at tea to your new fellow Mess members that after thrashing the car from St Moritz to your Greek Island yacht

Lieutenant MW Whitchurch RE

marina, you really must put it in for servicing. For example, you return the car to the owner.

In addition, before leaving Barnsley you will remember to write a few lines on expensive stationery and post them from Mayfair and Knightsbridge with sender's addresses such as "From Lord Rodney Wellbred Boring", and "Major General Sir Freddie Foxhound MC psc, Director of Infantry". It is amazing who looks at your letters. Well, Sticky you've arrived; your next stage is to:

KEEP THEM TALKING

You'll be under the magnifying glass of the whole Regiment. So show a bit of style and keep them talking. Having swung from the chandeliers at a Regimental Guest Night and you are writing out the cheque for damage, make sure to mutter something like, "Only three hundred pounds Mess Sarn't? Is that all!" You may then write a woeful letter to your bank manager and explain he is banking with you rather than you are banking with him!

No doubt the Adjutant will punish you for your deed. Remember Sticky, this man is a flyer and is bound to crush you before you can say "Carver". So remember to take your extras without qualm and when told that your beret has dust on it reply with something like, "Standards are really slipping these days" and "I really must replace my Batman".

Surely the Battle Group Cocktail Party will emerge on the calendar, so grab your chance Sticky and keep 'em talking! That's right, arrive in style, get your driver to drive you to the party in a Combat Engineer Tractor. The sight of a Subaltern clad in his dinner jacket arriving in his charger CET in full view of the Battle Group Cocktail Party must be a Royal Engineer arriving and will certainly keep 'em talking! Why not go all the way and have the Squadron flag flying from the antenna?

Don't forget the umbrella for exercises either Sticky, for on exercise as a Support Troop Commander your charger will be a Ferret. It is a fact, a standard English umbrella will cover the open part of your turret, not only does this give your vehicle that certain something, it is also very practical.

Why not hold a pukka Pimm's Party when on Soltau in you Command Spartan? Send out proper invitation cards with RSVP E35 written on them. Now is the chance to spring from the Officers' Mess your centrally employed soldier-cum-waiter, who, sporting silver tray and black tie will present your OC with a refreshing glass of Pimms, and your soldier will recharge your guest's glasses during the occasion. As it is an exercise, it would be befitting to sport DPM (Disruptive Pattern Material) tie for the occasion. So far so good, now they're talking. Let's go one stage further and:

BE A TACTICAL ECCENTRIC

When giving your radio orders do give them a British Empire flavour. On being ordered to withdraw by the Battle Group Commander exclaim on the radio, "The Sappers never retreat dammit!" and then go on and fight your battle against the Orange Forces with cries over the radio like, "Remember Rorkes Drift!" and "Don't fire your anchors and Ranger Mines until you see the whites of their call-signs!" Such inspiration will drive your CETs' crews onwards. This style of leadership will probably induce the men to follow you out of curiosity rather than respect. No matter. It works.

This will invariably be true when you lead the counter-attack single handed with your CETs following. Standing on you leading CET pointing your brolly at the enemy sabre fashion and exhorting the Troop to greater things.

Notice whatever happens, the tactics don't matter, for if you can give the impression of being a tactical eccentric with oodles of binge and capable of taking out the Kremlin with your CETs, you will be reproached in a sympathetic manner for upsetting the Battle Group Exercise. Well done Sticky! Such dash! So much for the exercises, now for your *pièce de résistance*, being:

BAOR SPORTS CHAMPION

So you're not a Gladiator. No matter, not for you the mundane sports of ski-ing

shooting, hockey, cross-country and so on. Before coming to the Regiment buy some silver cups and inscribe on them such titles as:
SHEEP SHEARING CHAMPION 1979,
PLOUGHING CHAMPION 1980,
BOWLS CHAMPION 1978, and so on.
Form teams, and challenge all newcomers. There won't be any? That's right: so you become the BAOR Champion; more power to your elbow.

So Sticky my boy, there is much you can do to be a success. The Support Troop paradoxically can be much better than you think. Success will be your bearer and your Colonel will hold you high.

Life as a Troop Commander in BAOR

LIEUTENANT J W SAGE RE B Sc (H)

The Author was educated at Hatfield Grammar School and Birmingham University where, in 1978, he attained an Honours Degree in Minerals Engineering. He attended DE13 course at Sandhurst and 68 YO at Chatham. Lt Sage now serves as a Troop Commander in Osnabruck.

ALMOST a year now since I joined the Regiment straight from Sandhurst and Chatham and how time has flown. Hardly a chance to get bored and certainly no time to sit around. Nobody told us on the YO Course that every single moment is taken up or that everything takes so much time.

Originally, I was posted to the Regiment on 7 January 1980 but as a result of several phone calls late in December, "Can you come skiing?", I arrived in Osnabruck on New Year's Day. Nothing stirred, nobody knew I was arriving or indeed anything about me. Eventually, stones thrown at a lighted window in the Mess produced results and within three hours I'd pointed the car south and headed for Bavaria, and the Regimental Snow Queen Hut. The next three weeks were taken up the Langlauf training and the Div Championships. Individually I was well pleased but regrettably the team was too novice for any prizes—but there's always next year.

Straight from the Langlauf racing and back to the Snow Queen Hut to see how the system worked—in order to gain experience should I be called upon to run the hut for the next winter.

February was spent with a Field Squadron. This Squadron was largely made up from the Regimental Rear Party from the Northern Ireland tour so I joined them for a month prior to my "nominated" squadron returning from post-NI leave. Well, rather than entrust me with a Troop for just a month they made me OIC of the Escape and Evasion fortnight they were running. This was really great fun although I couldn't understand why so few of them wanted the live chickens! Possibly, they'd all managed to smuggle enough money through our initial search to live off *bratwurst mit pomme frittes* for the two days. Still, we didn't lose anybody and the weather was

Lieutenant JW Sage RE B Sc

fine but cold. Afterwards they all admitted they'd enjoyed it—even though most of them seemed to have walked considerably further than the fifty miles planned. Map-reading works in weird and wonderful ways!

Finally, the great day arrived at the beginning of March—my own Troop—and I thought I'd been busy before! March passed in a brief flash of training, interviews, GDP recces and the like. Getting to know the soldiers in the Troop was high on the list of priorities and a photo "mug shot" of each one was a great help, but it still took a long time to put so many names to faces.

High on my agenda was to take the Troop away for a long weekend to the Harz Mountains. A special recce and the plan was laid. In those far off days of plentiful fuel, it was too easy to borrow two landrovers, fill them up with compo, fresh food and sports gear and a dozen of us were off to the Harz. Four days of freedom, great! We climbed, canoed, discoed, walked, ice-skated and even had the odd beer here and there. What a great weekend—all voted to go back again as and when time permitted.

However, Spring brings with it the beginning of the Exercise season and the first was a weeks CPX. Following close on its heels were a couple of two-day Squadron exercises. Great fun, the first time I had really been able to get out with my Troop on exercise. No problems though, the Sections all rose to the task and all went smoothly. The bridge didn't drop in the gap and all the vehicles were returned safely.

Spring began to creep towards summer and plans were laid for what was to be Bridge Camp. However, fate took a hand and we ended up driving west, instead of east, to the Dutch border around the towns of Meppen and Lingen. A very flat part of the country, as one would expect bordering on to Holland, but beautiful in its own right. The weather was kind to us, although bitterly cold at times, but mostly the sun shone as we went about our business.

The first week was a Squadron exercise building up to the week-long Regimental exercise. Certainly never a dull moment, always something to do and a vast amount of track mileage put away. Many amusing incidents spring to mind: one was 2 Troop almost losing a crane which sank in what turned out to be a floating bog, closely followed by the recovery effort of 2 AVREs and an ARV! But somehow they were all got out and eventually we arrived back in Osnabruck thick with mud but having learnt a lot.

Once these two exercises were over it was on to the real jolly?—the Inter-Troop competition. In all, five Troops were taking part and rivalry was intense to say the least. Probably, at least from my point of view, this was the most tiring exercise of all. No Staff Sergeant—he was away swimming for the Regiment—so the Recce Sergeant was promoted to fill his place and the senior Corporal took over as Recce Sergeant. Need I have worried? Not a bit of it. Everybody worked extremely hard and came out shining. Especially when we found out we had come second, losing by only five points out of a possible eleven hundred—so close and yet . . .? No matter, probably the best weeks exercise of the whole year. Certainly nobody had time on it to get bored or to say they had not done anything.

Almost before that week was over it was off to Sennelager and BGT (Battle Group Trainer). My Troop supported the "Skins" Battle Group and October/November was due to be spent on exercise over at Suffield in Canada. As part of the pre-BATUS training we were to spend nearly two weeks on Soltau and Hohne ranges but prior to this, the commanders spent one week at BGT. What a marvellous concept—a large scale map was laid out to represent both NATO and Warsaw Pact equipments. Two days were spent recceing on the ground, siting the various combat team positions, and then two battles were fought on the map board as if for real. As the Sapper Troop Commander, I had to accompany the BG Commander and his Artillery adviser during these recces and put forward the Sapper point of view. It was very enlightening to work with the other Arms and it reinforced my views about the importance of all-arms co-operation.

Straight after BGT the weather appeared to be set fair so it was off to the Harz for

another long weekend. Ten soldiers from the Troop went in one landrover and a couple of cars. We stayed at the hut at Torfhaus overlooking the East-West border. Unfortunately, the weather broke on the Monday but no matter if one is canoeing anyway, and several new rock faces were found and explored by the climbers.

By now Soltau training was getting close (pre-BATUS work-up with the BG) and trains had to be booked for the APCs, and large-scale maps found of the area. Thrown in for good measure at this time was my PQS 1 exam which necessitated a litttle pre-exam work and a recce of the RV to try and gain a clue as to what the questions could be. It worked. I passed, and before the new exam is brought in too; much to my relief.

"SOLTAU"—a map-readers horror they said. "MTT"—Multiple tank tracks marked on the map; a polite way of saying a sea of mud with 1001 tracks everywhere. Still by the end of ten days and 800 miles driven across it there was no real problem. It is not nearly as difficult as people make out. This exercise really brought home the all-arms co-operation. Not only does one get to know other tactics and methods but also the personalities within the battle group which makes for much easier and more efficient relationships.

Everyone thoroughly enjoyed Soltau. It must be the most realistic training that one can expect out in BAOR although as far as the Sappers are concerned we are limited by what is required at BATUS. There is no MGB but there are armoured engineers which, for a lot of the Troop, including myself, was the first time we have ever been involved with them. Very few minefields are laid at BATUS and in fact we didn't lay any at Soltau at all, which is unusual. However, minefield breaching, both by hand and with GV (Giant Viper) was used several times.

Straight back from Soltau it was about turn, clean up the vehicles and off on adventure training. I ran two trips this year. The smaller was for two weeks to Berchtesgaden in Bavaria (actually just about as far away as one can get from Osnabruck and still remain in Germany). Ten of us went down, in two landrovers and two cars, whilst the rest of the Troop was on leave. Although we were flooded out on the first night at the campsite, we walked and climbed all over the area—culminating in a two day ascent of Watzmann, the second highest peak in Germany. Whilst down there I managed to borrow four canoes and two days were spent on the River Saalach which is Grade II–III water in places. Here I taught basic and a little advanced canoeing under superb conditions. Whilst down there full use was made of the American Forces facilities which they kindly made available to us and I can thoroughly recommend the steak and chips at their General Walker Hotel.

The second two-week trip followed straight on and was much larger with up to thirty-five staying in a large wooden hut in Torfhaus in the Harz Mountains. Torfhaus itself overlooks the East-West Border and with binoculars one could easily see the guards, dogs and other paraphernalia less than 3km away. Whereas in Bavaria we had concentrated mainly on walking and climbing, the Harz saw us also sailing, canoeing and windsurfing, although climbing was still carried out every day by a small band of stalwarts. Undoubtedly, the greatest success of the trip was the hiring of two windsurfers. Originally planned for just two days, they proved so popular and such good fun that in all we had them for about ten days and they were a laugh a minute! During the course of the two weeks everybody tried all the activities and several became quite competent sailors and intend to carry on the sport. The canoeing in the Harz tends to be a bit tame due to the lack of large rivers but one, the River Oker, turns into a grade III—IV torrent for almost four hours a day when the Hydro Electric Station opens it sluices.

The other canoeing instructor and myself had several descents, both managing to capsize once before we decided it was far too dangerous for students. For experienced canoeists, however, it's a must. Unfortunately, all good things must come to an end and it was back to Osnabruck for another weeks CPS directly prior to *Exercise Crusader*. Enough has already been written about *Crusader* I feel to last a lifetime. However, it was a valuable exercise and enjoyable.

Upon returning from *Crusader* we found that the BATUS trip had finally been cancelled, much to our disappointment—due to the cutbacks on spending. For a while it looked as if the Troop would still go out to Canada for 2–3 weeks just to clear up the range, but this too was finally cancelled.

Well, as everything seems to be getting into tighter and tighter straits it becomes increasingly difficult to find things to do to keep the soldiers motivated without using anything, especially fuel or vehicles.

Quickly, to sum up then; the year has flown by far too fast but I feel I have done, and learned, a tremendous lot. For the winter months it is off to Austria and Bavaria as captain of the Regimental Alpine Ski Team at the Divisional and, hopefully, the Army Ski Championships.

My First Impressions as a Troop Commander in BAOR

LIEUTENANT W F WAWRYCHUK CME, B Eng

Will Wawrychuk attended Canadian Military College for two years at Royal Roads in Victoria and then two years at Royal Military College in Kingston. He graduated with a degree in Civil Engineering and was commissioned in May 1979. After completing his final six months of military engineering training he was posted to 1 Combat Engineer Regiment in Chilliwack, British Columbia. In Aug 80 Lieut Wawrychuk joined an Engr Regt in Osnabruck, BAOR on a two year exchange programme.

RESPONDING to a shortage of RE Officers at the Captain and Lieutenant level, five Canadian Military Engineer Officers were posted to spend two years on exchange with the Royal Engineers. As one of those five Officers, I have been serving for the past couple of months with an Engineer Regiment in Osnabruck. Three of the other four Canadians are also serving within BAOR in Regiments

Having completed my military engineering training only last February, I have really only spent five months with a Canadian Combat Engineer unit before coming overseas. That was 1 Combat Engineer Regiment (1 CER) located in Chilliwack, British Columbia. As you can see I have very little experience in working with either the British or Canadian Engineers, I would, however, like very briefly to pass on some of my first impressions of troop commanding in BAOR and Canadian Engineer units.

First of all there is a considerable size difference between a Canadian and a British Engineer Regiment. A Canadian Combat Engineer Regiment, commanded by a Major, consists of two Squadrons: a Field Squadron comprised of three Field Troops

Lieutenant WF Wawrychuk CME B Eng

and a Support Squadron. In time of war an additional Field Squadron would be formed but the overall peacetime strength is roughly 230 all ranks. The role of the Regiment is to support a Brigade Group.

A British Engineer Regiment is designed to support a Division. With its three Field Squadrons, a Field Support Squadron, and a strength of roughly 900 all ranks it is considerably larger than its Canadian counterpart. In the end, however, the British and Canadian Brigades each receive roughly the same amount of engineer support.

Keeping in mind the above comparison, it is easy to see why on my arrival in my Engineer Regiment I was so impressed by its size in terms of both men and equipment. As if this first shock wasn't enough, we then headed out on to *Ex Spearpoint.*

In Canada, 1 CER is separated from the Brigade that it supports by roughly 600 miles. It is all too easy to forget where the Sappers fit into the overall combined arms effort if you don't often get the chance to see it happen. *Ex Spearpoint* was extremely valuable to me since it showed me exactly how Engineers do fit in with the other combat arms. It was also a real eye-opener since up until then I had very little contact with armoured vehicles. Although operations on the scale of *Ex Spearpoint* are rare in BAOR they never happen in Canada. I consider myself very fortunate to have arrived here at the time that I did.

With regard to combat engineering itself, I found the scope of the minefield operations to be far larger than I had seen before. In addition I found working with the Armoured Engineers very interesting. Although we do have the Leopard AVLB in Canada it is fairly rare as are the opportunities to work with it.

The Troop I was attached to for *Ex Spearpoint* was involved in a bridging operation on an oxbow on the River Leine. Our Troop built a 12-bay DS MGB across the river. The crossing site was then completed by a No 9 and a No 8 Armoured Bridge launched across the oxbow, a No 9 Armoured Bridge across the river and a further No 8 Bridge used to upgrade the load class of an existing bridge. With the defile marking as well, this was a very sizeable task indeed for a Troop to co-ordinate.

Also very apparent during *Spearpoint* was the concern over exercise damage and the inconveniencing of the local German people. The dense population and high degree of land use by the German people means that suitable engineer training areas are difficult to come by in BAOR. Specifically the amount of actual demolition and route denial training that the Sapper can do is quite restricted. Thus during an exercise the Sappers must do a large portion of the tasks notionally and it becomes difficult to represent a wartime situation.

In Canada, we are blessed with areas and ranges that allow a high degree of realism. In some areas we can carry out route denial and demolition operations virtually unrestricted. There is also the freedom to do considerable earthwork with our engineer plant, and tasks like anti-tank ditches or blowing and replacing culverts can be done.

Something else that I have gained by coming to BAOR as a Troop Commander is the opportunity to work with different equipment. Much of the kit is in fact different, from webbing to APCs to minelayers, etc. To be able to work with both the Canadian and British kit has certainly broadened my horizons and allowed me to draw comparisons between the two. In particular I have enjoyed getting the chance to work with (and actually cabby!) the Combat Engineer Tractor.

I have found there to be a considerable difference on the attitudes between the Canadian and British Regiments by virtue of their role and location. In the British Regiment, as part of the Western world's front-line defence, there is certainly an awareness of the threat of war. The Eastern Bloc countries are not far away and even among the German civilians there is a wide acceptance of military activity. In comparison, thousands of miles away in Western Canada at 1 CER, it is difficult to get the idea across to the Sappers that there is indeed a very serious threat. Thus the Sappers of my present Regiment have a definite advantage in terms of mental preparation and this leads to them perhaps taking their jobs a little more seriously. One area on which there is far more emphasis in BAOR than in Canada is that of

NBC readiness. As is required, in BAOR we are equipped with all of the kit necessary for conducting operations in an NBC environment. On exercise the kit is used and the drills practised. In Canadian Engineer units the required equipment and training is sadly lacking.

I was a bit concerned before arriving at this Regiment that I would have difficulty in relating to the Sappers in my Troop simply due to my different background. To my relief I have discovered that there is no problem at all. The Sappers here are the same as in 1 CER: good, down-to-earth, enthusiastic, hard-working lads motivated by booze and women, although not necessarily in that order. Of course there is the odd case when communicating has been difficult purely due to language.

In Canada, with our bi-cultural heritage, we have the challenge of communicating in both English and French. As a Troop Commander you invariably have Sappers of French-Canadian background and achieving a mutual understanding becomes a bit interesting. Since I've been in BAOR I've run up against quite a different language situation. First off, there is the obvious problem of communicating with the local people, and a capability in German is certainly something worth working for. The other language problem I've discovered is that of conversing in my Canadian English with Sappers from every corner of the United Kingdom! They all seem to have different accents and subtle differences in word meanings. Say what?!

One thing with which I must credit the Sappers here is that they are in a better state of physical fitness than are their Canadian counterparts. Although morning PT was conducted at 1 CER it was far less demanding that it is here. In addition shorts and running shoes are worn for runs instead of denims and boots. Under the Canadian system each individual has two physical tests a year: a 2 × 10 mile march and 1.5 mile aerobics test. Since these each only come once a year there is a tendency to let them slip and try to train up to the test, instead of maintaining a high continuing level of fitness. In the BAOR Regiment it is policy that each man pass a Basic Fitness Test each month. Thus he is required to maintain a certain level continually. With the current emphasis that is being placed on these BFTs a man will soon find that career action will be taken if he fails to meet the standard.

A major difference I have found between working with a Canadian and a British Engineer Regiment is in terms of how the support services required by the Regiment fit in. Under the British Regimental system the Regiment itself provides the manpower for all the necessary support facilities such as the guardroom, clothing stores, ration stores, the various messes, etc.

In Canada we work on a Base concept whereby the support staff of the Base (Garrison) provide the required service for all the units on the Base. Some of the jobs are handled by civilians while the others have military personnel trained specifically for that role. While there are many advantages and disadvantages of each of the two systems I believe the major controversy to be as follows. Under the Regimental system the people in the support roles are members of the Regiment themselves, and thus they are familiar with the Regiment and attuned to its needs. In addition the Regiment has closer contact with, and tighter control over the people who provide the services. On the other hand the frequent turnover of people in these jobs results in a lack of continuity and a lower skill level. In addition, the Regiment must provide these people to the detriment of fulfilling its primary role. As a Troop Commander I find that one-sixth of my Troop is detached to central employment at any given time. I also believe that many of these jobs represent mis-employment for the Sappers in them. It is, however, argued that by performing these Regimental tasks a Sapper broadens his horizon.

Much to my satisfaction, I have found that there is a lot more money and backing available here in BAOR for adventure-training and sporting activities than there is in Canada. The proximity of many other military units allows a highly competitive league to be set-up in almost every type of sporting activity. Although in Canada inter-unit competitions do exist, the greater distance between bases and the money and travelling time therefore required, often preclude a very active schedule. I have also

found that with the British enough emphasis is generally placed on sports to allow the various teams to concentrate fully on their particular training. I sincerely hope that the present financial situation in the British Forces will not too greatly affect the present attitude.

During this article I have given you an idea of what my first impressions of serving with a British Engineer Regiment have been, both from the point of view of a new Troop Commander and of a Canadian Military Engineer. I must say that the experience I've had so far has been extremely interesting and enjoyable and I'm looking forward eagerly to the rest of my exchange tour. CHIMO!

The Code of Practice for Site Investigations

BRITISH STANDARD 5930:1981

MAJOR J COTTINGTON C Eng, FICE, MI Mun E, F Inst HE, FGS, FCI Arb, M Cons E

Enlisted as Apprentice Tradesman at Chepstow 1933; Mechanist S Sgt 1940; commissioned 1942; War service with 50th Div, SME Middle East; DCRE Kuala Lumpur and Johore 1947; ITRRE 1950; Long Civil Course 1951; MEXE 1953; DCRE BAOR 1957; War Office E2 and DGW(C&S) 1959. Joined Dorset County Council 1961. Formed own Consulting Practice 1970; joined by K A Phillips DIC, C Eng, FICE in 1979 to practice as Cottington Phillips and Associates.

Appointed I Mun E representative on CP 2001 Drafting Ctee 1965 to date, ICE Drafting Ctee for Conditions of Contract for Ground Investigation 1979 to date.

INTRODUCTION

The urgent necessity for this revised Code has been strongly indicated by the number of papers and technical advisory literature on Site Investigation emanating in the past decade from leading Establishments and Advisory bodies including the Building Research Establishment, the NHBC and C&CA and by others who are more directly concerned with the execution of site investigation. The revision commenced in 1965, the Draft Document was issued for Public Comment on April 1976 arising from which the Steering Sub-Committee dealt with seventy-four pages of comments and completed their final submission to the British Standards Institute in November 1979. The completed Code, now known as British Standard 5930 (1981), was published on 1 May 1981.

It will probably be some time before the relevant volume of Military Engineering is re-written or revised to incorporate material from the new Code and unlikely that it, as published, will be made available as "Unit Issue". This article is therefore a review to emphasise those Sections which have particular relevance to Military Engineering and for those of the Corps now serving and fortunate enough to be appointed to practice the art of Site Investigation. The Sapper Officer is fully trained in the wide scope of Engineer Reconnaissance, an art, the application of which is seldom required in the current training of his civilian counterpart, which is now happily

Major J Cottington C Eng FICE MI

emphasised by the Code. The author recalls a discussion with a Committee colleague during the early days of drafting in which the colleague, with some feeling, said "We should write this in the style of a Military Manual then everyone will be able to understand it". Well, we did our best and under the Chairmanship from 1974 of Dr Alan Meigh OBE, FICE, MASCE, FGS, (Lieut Colonel (V) Engineer & Railway Staff Corps) achieved something in which we have some pride.

GENERAL APPLICATION

In most cases users of a Code of Practice of this type refer immediately to the particular Section applying to the problem which they have in hand at the time. In this method of use much of importance is lost, the lack of which may lead to misapplication of the information presented by the Section. The Reader, particularly at Staff level, is therefore advised to pay particular attention to the opening sections of the Code which explain the reasons for its production, the staged sequence of investigation and the general procedure which is to be found in the body of the Code.

A necessary division is now made between the terms "Site Investigation" and "Ground Investigation". Site Investigation covers investigation not only of the ground conditions peculiar to the site but includes the immediate geological and geographical area within which the site is contained. It therefore incorporates information on communications in terms of roads and services applicable to the site, the geology and the indicated problems arising therefrom. The history of the site in terms of archaeology and more recent use are investigated in detail, in other words a full Sapper reconnaissance with detailed attention to the overall geology. The geological exploration and testing of the subsoil is now termed Ground Investigation and this is dealt with in detail in the particular Sections.

Site Investigation in the minds of many of the professions concerned with the results, has been rather tainted by two opposing aspects. The first of these being an investigation to the utmost degree with a consequent wealth of superfluous information often culminating in lengthy reports somewhat divorced from the particular problem, lacking positive opinions or with advice somewhat devoid of practicality in execution or economics. At the other end of the scale it was visualised that the execution of a few trial pits or borings, devoid of engineering data, gave sufficient information on which to design the various forms of construction intended. These ranged from extensive road works or major civil and structural complexes down to the foundations of a simple bridge. This lack of understanding has been maintained in the first case by the absence at Staff level of a specific statement of the requirements and in the second by insufficient time allowed without regard to the skill and expertise of the personnel or equipment available to execute it, thus resulting in inadequate and frequently erroneous tactical or design data.

In these matters the Code is explicit on the required experience and qualifications of personnel involved at each stage of the work. Guidance is given on the several methods of execution and type of sampling and tests to be made, the detailed classification and engineering properties of the soils encountered and finally the style and detail of presentation of the report. The Code is shortly to be supplemented by "Conditions of Contract for Ground Engineering" currently being drafted by a Committee sponsored by the Institution of Civil Engineers, the Association of Consulting Engineers and the Federation of Civil Engineering Contractors, thus ensuring as far as possible that its recommendations are put under effective contractual control.

CONTENT

The Code contains eight Sections, supported by eight Appendices to which reference is made throughout the text. Although not intended as a text book several of the Sections, particularly those relating to operational methods, do approach this form in terms of detail requirements. It is therefore essentially a guide to good practice and could in the future be incorporated in a Training Synopsis. The individual sections may be conveniently regarded for classification into four Groups, the content of which is summarised hereafter.

DISCUSSION

Group 1:Sections 1 & 2

The scope of the Code given by Section 1 does not perhaps sufficiently emphasise that its application is to the widest concept of investigation. As in a military requirement this involves large areas of countryside, allocating selected areas for operations, transportation, development, mineral working, and Base areas. Although it considers primarily the selection of construction sites, some minor regard has been paid to the wider environmental and economic considerations which could affect a tactical situation generally.

A general consideration presented by Section 2 could be extended beyond the statement that appears to limit it to an essential preliminary to civil engineering construction. The extension inferred includes the spheres of study previously mentioned which intent is covered in detail in terms of "Suitability" and although the stated limitation is basically that of the sphere of operations of the Engineer there is no such limitation in practice. With change of emphasis the logical approach to any problem involving the use of land is given in such form that any profession concerned with land-use may adapt its particular requirement from the approach which the Code presents.

For the first time the term "Desk Study" is used. This is conveniently chosen to define the preliminary studies made in assessment of the situation in terms of geology, topography and communications attaching to the area. From this study a discussion can be made and presented in the form of a Preliminary Report, giving the assessment of the situation and probably making recommendations for further investigation in specific terms. These could be the investigation of salient features contained within the area, the need for patterned investigation or a sequence of regularly spread investigation points such as where road alignment is concerned and in the zoning of areas for particular use.

Reference is made throughout these Sections to published works and to particular Appendices within the Code for sources of additional information, including the earlier uses of the site and the use of air photographs as in Terrain Evaluation.

Group 2:Sections 3, 4 & 5

Section 3 on Ground Investigation gives further detail on sequence and refers to previous comments that an understanding of the geology of the site is a fundamental requirement in the planning and interpretation of the ground investigation. It continues with discussion on the extent of the Ground Investigation, the selection of methods and tools applicable and relating to particular geological conditions and their effect. The Section is specific in its requirements that debasement of this vital art should cease to be a potential of disastrous consequences to the work which follows. For this reason Clause 15 dealing with Personnel for Ground Investigation is firmly presented in terms of the qualifications and experience of those concerned at all stages of the work in order to achieve an end result upon which full reliance can be placed. In so doing the Code goes as far as it can to ensure that those who require the results of site investigation are reassured that at each stage the right man has been applied to the right job.

Section 4 dealing with Excavation, Boring, Sampling, Probing and Tests in Boreholes is a refreshing and explicit guide both to those who are concerned with the end result of the investigation and in particular the personnel engaged in the investigation. It enables assessment of the detail of work required in ground investigation and gives an indication of the reasons for what may still be regarded as an expensive undertaking. In this connection it may be noted by those familiar with the previous (1957) Code that no specific indication of cost is presented. It follows that the time spent in investigation is always related both to the extent of the proposals and to the complexity of the ground in terms of the variations within it. It is clearly demonstrated that no cost indication of a full investigation can be made until completion of the Preliminary Study.

It will be seen by the detail given under the Clauses dealing with Groundwater that

over the intervening years between the 1957 and the new Code considerable advances have been made in this sphere of investigation and in the related testing. The several methods of investigation and tests are discussed in detail and although, as previously stated, this approaches a text book presentation it is nevertheless essential to this difficult and necessarily complex part of ground investigation.

Clause 22 dealing with the frequency of Sampling and Testing in Boreholes is a guide to the general principles of sampling in determination of the character and structure of the strata. As will be appreciated from the foregoing details the frequency of sampling is to a large extent dependent upon the purposes of the report. For example, although limited sampling can apply to the study of large areas of ground it is necessary that frequent and in many cases continuous sampling may be needed for the more detailed application. The latter is not necessarily applicable only for major structures but to particular problems where considerable variation in stratigraphic pattern can be anticipated or forensic investigation is involved.

It has of course been necessary to use diagrams of apparatus of particular manufacture in order to demonstrate more accurately the application of the method of in-situ testing than could be achieved by sketches of "typical apparatus". However since this Code was completed in draft it is probable that these in themselves have been modified and improved.

Section 5 on Pumping Tests follows from the preceding Clauses on Groundwater It is presented in detail and is again a text book presentation but the Code allows both the Operator and those who would receive the final report to appreciate the necessity for complexity and adherence to what is almost laboratory control of an in-situ test. In contrast the section of Geophysical Surveying which follows is of a general nature but nevertheless will undoubtedly clear up current misunderstanding as to the limitations and types of this method of survey which lack of understanding may in the past have led to inadequate results.

Group 3: Sections 6 & 7

Section 6 dealing with Tests on Samples, although in general principles, includes valuable guidance relating to sample storage and facilities for visual inspection. It relates in turn to Section 8 being the Identification and Classification of soils. This details the tests by name and, what is particularly important for those not fully versed in the art, describes the purpose of the test. The Section refers back to a previous table in Statement of Sample Quality at Clause 19 and again demonstrates the necessity to ensure suitability of samples for testing. The tests which are listed and their application extends beyond that of the previous Code and includes those relating to determination of bacteriological and gaseous content.

In sequence of presentation it may have been expected that Section 7 on Reports should be the last to appear in the Code.

However it is in logical sequence from the previous section dealing firstly with Field Reports. These are of extreme importance in the preparation of Boring Logs, for guidance in selection of specimens and the tests which require to be applied to them and interpretation leading to problems which may be encountered during construction. It includes standard pro-formae for use with Permeability Tests, Vane Tests, Lugeon Tests and Cone Penetrometer Tests.

The sub-section dealing with the Report should be studied in detail by those responsible at all stages for a site investigation. The report will embody all of the studies, tests, interpretation, conclusions, opinions and recommendations upon which major decisions at all levels will rest. This requirement is of course summarised in the Code but in hindsight there is perhaps one important omission, briefly mentioned in a previous paragraph, which is the style of report related to the degree of understanding of its user. It may be necessary to prepare two or three reports on the same investigation, or at least summaries, which allow its content and implications to be understood by all those concerned with the undertaking.

There is excellent guidance on the preparation of Boring Logs which is supported by examples relating to light cable percussion rigs and rotary drilling. These are

followed by combined logs knows as Summary Logs. Brief reference is made to Borehole Sections, which are known by many as "Sub-surface Profiles". These form a valuable part of a report particularly when relating to highway construction and tunnelling. Undoubtedly when Borehole Sections are used it is essential that a clear statement regarding their accuracy in terms of level and possible variation in soil type must be considered in interpretation and that the Section is to be used solely as a guide. The diagrams and layout could well be adapted as standard Army Forms.

Group 4: Section 8

Here a single Section is presented as a Group. It would be an oversimplification to regard the presentation merely as an extension to the Casagrande System. Although based upon it, the British Standard Classification of Soils (BSCS) system presented by the Road Research Laboratory is chosen as the best applicable but, in consideration of other systems, its use is stated to be discretionary. On first reading it may appear to be complex and a little bewildering. However, casting prejudice and previous use of other systems aside, it will be found to be one of the most simple and comprehensive systems so far devised.

The classification is made in two stages, the first being the Field Identification and Description of Soils in the form of a comprehensive Table containing guidance on visual identification. This is followed by important detail relating to the description and tests to be applied to "Made Ground". The latter is particularly applicable nowadays when much use is made of old tipping sites and "reclaimed land". The system proceeds under the heading of "Classification of Soils" to the detail required for determining the classification and continues through to the Coding applicable. This is also presented in tabular form and supported by examples illustrated by a Grading Chart.

The Section proceeds to the Description and Classification of Rocks for Engineering Purposes and the content is invaluable to those whose frail knowledge of engineering geology may require some support. The text includes graphic symbols for use in Boring Logs and Borehole Sections which are inter-related with those of the soils for which they are the parents.

Appendices

As previously stated, the appendices are complementary to the several sections of the Code and provide immediate guidance on the structure of the Desk Study, sources of information of published material in Ordnance Survey maps, Geological Survey and Soils Survey maps and Memoirs, Admiralty Charts and hydrographic publications together with meteorological and hydrological information.

There is some guidance for the production of a further check list for those engaged on Site Reconnaissance, proceeding to the detailed information required for design and construction.

Continuing to more recent requirements arising from the need to extend development and construction into what previously could have been regarded as "dead land" there is an Appendix on the investigation of points to consider in areas of mining, quarrying and waste disposal, including open cast mining and quarrying. This is supported by details of sources of information relating to the Appendix.

It follows that enthusiasm and concentration on the job in hand frequently involves forgetfulness in terms of Safety Precautions and a strong reminder is given on this requirement by a separate Appendix.

Lastly, users of the previous Code will notice that the discussion and nomenclature on The Nature and Occurrence of Soils and Rocks has been removed from the body of the Code and included as a complete Appendix together with supporting diagrams. This includes a graphical presentation relating to the Pedalogical interpretation of the upper zones of soils and is directly related to the Soil Survey of England and Wales on which continuing survey and publication of Area Memoirs is being made on a National basis. It may be worthy of note that the Author has found the Soil Survey publications to be extremely useful when dealing with shallow investigations and those of a forensic nature.

A History of Steam Road Traction in the Royal Engineers

LIEUT COLONEL J E NOWERS RE, B Sc (Econ)

The Author joined the Corps having obtained a B Sc (Econ) degree at London University. He served as a Fd Tp Comd with 7 Fd Sqn in Osnabruck, as a Tp Comd in the Junior Leaders Regt and as 2IC 2 Armd Engr Sqn in Hohne. After Staff College he went as GS02 (W) to the Armour School at RAC Centre Bovington. It was in Neinburg, when he was OC 45 Fd Sp Sqn, that his interest in steam traction was first kindled. After a tour as GS02(W) HQ BAOR he was appointed 2IC 28 Amph Engr Regt followed by a short tour as GS02(W) at HQ E-in-C. He is presently attending a language training course before becoming BLO to the German Engineers at Munich. A keen fresh water angler he formed the BAOR Angling Association and ran it for 6 years.

This fascinating article is too long to be published in a single issue of the Journal. With the Author's agreement it has been serialised. The Sections and Photographs have been numbered to follow on throughout the article as a whole.

Contents

1. Foreword

I first became interested in this subject when I commanded 45 Field Support Squadron RE in 1973–75. During my tour in command, the unit celebrated the 75th Anniversary of its formation and I began to research its history.

The circumstances of its formation are well-documented. It was certainly the first mechanised unit in the British Army, if not in the world. However I was surprised to find no published record of the part played by the Corps in the development of mechanical transport. Yet MT became one of our largest offspring!

Lieut Colonel JE Nowers RE B Sc

My first project was to assemble a collection of photographs illustrating steam road transport in the Corps. The next step was to write the story. The bibliography will give an indication of the wide field for research. I found correspondents as far afield as South Africa and Australia.

I cannot claim that this history is complete. For example the Royal Artillery and the Army Service Corps both played a part in the early development but I have found few details. However I believe the story contains all the main events.

So many other developments were going on at the same time that it was difficult to decide what to include and what to omit. I have omitted the later career of REB Crompton but I have included details of the end of the career of Colonel J L B Templer, a relative of Field Marshall Sir Gerald Templer, because it does seem that he received little recognition from the Army in general and the Corps in particular. Even the more recently published books in the bibliography fail to give a correct account of the part he played.

Should any reader have more details to contribute to the story I would be glad to correspond.

2. The Early Days

As early as 1845 the Inspector General of Fortifications drew attention to the potential of steam power for military use. However at that time the Army could only visualise steam being used for railways and for static power plants. Meanwhile steam power and steam engines came into increasing use in agriculture. In 1858, John Fowler's ploughing engine won a prize of £500. By 1867 over 250 of these engines were in private use.

Steam engines had several disadvantages. The jolting of unsprung machines on hard uneven roads ruined the engines and exhausted the drivers. The noise and smoke disrupted horse traffic, especially on narrow roads. Under the *Red Flag Act of 1865*, speed was limited to 4mph in open country and 2mph in towns. All road locomotives were to be attended by at least three people, one of whom was to walk sixty yards ahead of the locomotive with a red flag by day and a red lantern by night to warn of the vehicle's approach. This repressive legislation was not rescinded until 1896.

One of the first practical traction engines to interest the British military authorities was the Burrell-Boydell machine using Boydell's Patent Railway or Endless Wheel. James Boydell filed his first patent, No 11357 in 1845. "My invention consists of a mode of applying moveable detached parts of a railway to the wheels of carriages, whereby each part is successively placed by its wheel in the road or land over which the carriage is to pass, each piece of the railway, when down, allowing its wheel to roll over it, and the wheel lifts the pieces of railway successively and holds each piece in such position as to deposit it correctly when that part of the wheel which carries a part of the railway again comes near the earth, which means a railway will be continuously formed and broken up as the carriage is drawn along on a road or over land, by which the power required to draw a given load will be reduced".

Originally Boydell considered applying his invention to the wheels of carriages and wagons only. Comparative trials were held in Woolwich Arsenal in 1855, under Lieut Colonel Tulloch RA, Superintendent of the Royal Carriage Department, to establish the value of these wheels for soft cross-country going. A 68pdr gun weighing 8ton was tested with ordinary and Boydell wheels. These trials were so promising that the War Office sent a number of these patent wheels to the Crimea to be fitted to guns and animal-drawn trench carts. Further trials were carried out at Aldershot, the wheels being supplied by Messrs Morton and Foster. Some old books state that traction engines fitted with Boydell wheels were actually sent out to the Crimean War, but there is no evidence of this.

A more complete specification, Patent No 431, was filed in 1854. The invention consisted of a stout wheel carrying six wooden floats or paddles, attached to the rim by slotted links and pins, allowing each paddle in turn to lie on the ground whilst the

wheel passed over and then raising and replacing it on the ground in front of the wheel. Boydell formed the Boydell Endless Railway Company to exploit his invention and approached several engine builders inviting them to use his wheel. Mr Richard Bach of Birmingham produced the first such engine in 1855, and Richard Garrett and Sons of Leiston, Suffolk, built one in 1856. Both were adaptations of existing machines. Clayton and Shuttleworth of Lincoln and William Tuxford of Boston each built an engine in 1858. Charles Burrell of Thetford built over twenty such engines. The first left the erecting shops in 1856. The driving wheels were of wrought iron, forged in one piece and 5ft 6in in diameter. The 6½in tyres were shrunk on and the paddles were 14in wide.

The Burrell-Boydell engine aroused the interest of the Government and in June 1856 a Select Committee was appointed by Lord Panmure to test one of these engines at Woolwich in the presence of an audience of Army Officers. These trials were sufficiently successful for the Government to order an engine in 1857. Mr W Lamerton, the Machinery Superintendent at Woolwich Arsenal, and Sergeant Squires RHA accompanied the engine on its journey from Thetford to the Arsenal. They kept a log of the journey which started on Tuesday 8 September 1857 with a team of five men to look after the train, consisting of the engine, four carriages loaded with oak timbers and one living van, weighing over 43ton in all. After several adventures the train arrived at the Arsenal on Thursday 17 September having covered the 99½mile at an average speed of 3.1mph, actual travelling time. Mr Lamerton remarked that if the carriages had been stronger he could have averaged 4½mph.

Later this engine was vigorously tested at the Arsenal. In 1858 the Ordnance Select Committee arranged a trial in which the engine towed a train of four 8in guns, with a total weight of 43ton, on the level at 3mph and up a gradient of 1 in 13 at 2½mph. As a result the Government ordered a second train. Colonel Sir Frederick Abbott of the Military College, Addiscombe, and Colonel Sir Proby T Cantley KCB also attended this trial on behalf of the East India Company and were very favourably impressed, Sir Frederick reporting that such trains would enable the Government to dispense with half the ordinary military force in India since the troops could be concentrated more quickly. It was recommended that two engines be sent to Calcutta and two to Bombay and at least one was delivered in 1859 although no details of work in India have survived. Two engines were also presented to the Pasha of Egypt.

James Cowan, a military writer of the time, suggested that the Boydell engine should be fitted with scythes on the wheels, an armoured cover, and carry guns. However the idea was rejected as barbaric!

Boydell's invention was subsequently refined, notably by Burrell, but in spite of personal expenditure of some £10,000 it had little success and Boydell died, a disappointed man, in June 1862. The War Department sold off its engines in 1858.

Although the Boydell wheel reduced the ground bearing pressure of the vehicle, it was very noisy, often broke on hard surfaces, and the slots and pins wore out very quickly. However, it anticipated the crawler track later used for the tank.

William Bray of Folkestone developed another kind of wheel which was patented on 31 December 1856 under Patent No 3102. The wheel boss was fixed eccentrically to the axle. Attached to the boss was a series of rods, each terminating in a blade which slid in and out of the wheel rim as the eccentric boss rotated on the axle. The eccentric could be moved by a worm gear operated from the driver's platform. Moving across country the worm would be adjusted to allow the blades to protrude at the bottom of the wheel thus increasing its grip. On roads the blades would protrude at the top of the wheel. The in-and-out movement would keep the blades clean. The maximum protrusion was three inches. An attractive feature of the engine was the boiler lagging of mahogany strips, neatly finished off and highly polished.

The Bray engine was designed by D K Clark, Bray's consulting engineer from 1856–1864. It is not certain if William Bray served a proper apprenticeship but he

first worked for the South Eastern Railway at Folkestone as an engineer on one of their Channel steamers. The first mention of his engine appears in the *Folkestone Chronicle* of Saturday 18 July 1857. The patterns were made by John Dunk and the castings by Mr Barrett who had a small foundry in Tontine Street, Folkestone.

The War Department, having rejected the Burrell-Boydell, tested the Bray at Woolwich Arsenal. The engine weighed 8ton and was rated at 8nhp. (Nominal Horse Power, see Notes). "A 68pdr gun on a sling wagon, with ropes, levers and tools of different kinds, was attached to the engine. The engine started with this load of 7ton on the 11 May from the Royal Arsenal, Woolwich, up Burrage Road to Plumstead Common. The road is pretty steep, in several places the gradient being 1 in 10. On the return journey to the Arsenal the engine and train were taken through Nightingale Valley with a fall of 1 in 8. The pace downhill averaged 2.272mph and appeared to be not less uphill. The coke consumption was 59lb. (Photo 1). On May 25 a second experiment was made, this time drawing three 68pdr guns and wagons; again steep roads with sharp turns were met with, but all went well."

The trials were not sufficiently extensive to compare the cost of steam traction with animal transport. However the Trials Committee recommended that the engine should be employed in the Royal Arsenal to gain useful experience for improved construction of such engines.

The engine met with a mishap in 1859. "An accident to the Bray's Traction Engine occurred the 9 April in Nelson Street, Greenwich, owing to the sudden embedment in the roadway of the wheels of this ponderous machine, itself 5ton in weight and laden with a mainshaft weighing 22ton 8cwt, proceeding from Penn's Factory to HMS *Howe* lying in Woolwich Dockyard. The engine was steaming up the road at about 3mph when, in order to avoid some newly put down macadamised stones, it was turned towards the kerb; but that part of the road being over some cellars, suddenly gave way, and it required the efforts of a number of labouring men, aided by powerful jacks, iron levers and plates, with enormous steam power to extricate the engine and raise the immense weight upon the sound earth: an operation which was accomplished without further accident after a little over an hour's delay, and consequent interruption of the roadway traffic".

In 1860 the Admiralty purchased at least two Bray engines for use at Woolwich and Keyham Dockyards. These were built by Messrs F & J Hughes at their New Cross Works and when near completion were seen by Mr Vianson, the Inspector of Steam Machinery in the service of HM the King of Sardinia, who was also Duke of Savoy. However His Majesty did not apparently order any machines.

Photo 1. Bray's engine on WD trials

In October 1861 one of these Admiralty engines weighing 13ton moved most of the heavy parts for the engines of HMS *Arethusa* from Messrs John Penn & Son's Works in the Lewisham Road to Deptford, a distance of two miles, in ½hr. The load totalled 45ton.

Bray's engine was also adapted as a mobile crane and one was built in 1862 for use in Woolwich Dockyard. The winding drum was placed over the motion and was gear driven from the crankshaft. To counter the overturning moment from the crane load, a large belly water tank was added and a more robust forecarriage. Similar engines were built for John Penn & Son of Greenwich, Humphreys and Tennant of Deptford, and Maudsley, Sons & Field of Lambeth.

3 The Steam Sappers

In December 1868 the Royal Engineers obtained their first traction engine. It was named *Prince Arthur* in honour of HRH The Duke of Connaught who began his commissioned service in the Corps as Lieutenant RE in June 1868.

The engine was built by Aveling and Porter of Rochester and had Works Number 437. It was required to power a 36in circular saw, grindstone, lathe and general joiner, and should draw 5ton up a slope of 1 in 12. Its weight with water and coals was not to exceed 5ton. The engine was finished and tried in January 1869 and was found to answer all requirements save weight, being some 6½cwt over. Since the weight on the driving wheels did not exceed the weight on the hind wheels of the 64pdr gun with limber, it was accepted.

No 437 was of 6nhp with a single steam-jacketed cylinder, with 7¾in diameter bore, placed upon the forward part of the boiler. It had single-speed chain drive to the rear axle. The hind wheels were loose upon the axle, driven by pins passing through the bosses into drums on the axle. One pin had to be withdrawn when turning a sharp corner. The driving wheels had tyres of rubber segments sheathed in steel plates. It was used by the *School of Military Engineering* (SME) as a traction engine and by the RE Park as a stationary engine to drive machinery. It easily hauled a train of 16¾ton up Star Hill, Rochester, and maintained 5mph on a level road. The indicated steam pressure was 113psi.

In 1869 there was a quickening of interest in the military application of steam power. The *Illustrated London News* of 10 April reported "During the Eastern Volunteer Review a combined assault by land and sea was made on Dover Castle. An outstanding event of the Review was the operation which was performed on the Saturday of drawing a battery of guns from the railway station up the Castle Hill by means of two of the patent traction engines of Messrs Aveling and Porter, Rochester, who were about to send them across to France in the way of business and having them ready at Dover lent them for the purpose as a trial of their power".

In 1871 the Ordnance Select Committee investigated the merits of the traction engine. They reported that they could not improve on the trials carried out by the Royal Agricultural Society at the Wolverhampton Show in July and recommended that two Aveling and Porter engines be purchased. The engines were not to weigh more than 95cwt, the weight of the 64pdr Armstrong breech-loading gun, in order that the pontoon bridging should not be overloaded. The Committee also decided that traction engines were to be a Royal Engineer responsibility.

In the event only one engine was purchased. It was delivered to the Royal Engineers at Chatham in September 1871 and was named *Steam Sapper Number 2*, thus clearly indicating its ownership. *Prince Arthur* was rechristened *Steam Sapper Number 1*.

Number 2 was an improvement on Number 1, being lighter and having the drive transmitted by spur gears rather than a chain and rated at 7hp. Its general layout later became the standard design for traction engines. It embodied Thomas Aveling's patent hornplate system where the firebox outer side casing plates were extended upwards to form hornplates. With tubular bracing between them, these carried the 3-shaft motion, the crankshaft, counter-shaft and rear axle. This gave a rigid frame to

carry the gearing and shafts, and avoided the inevitable bolt holes caused by mounting cast-iron brackets on the top of the boiler. The whole structure was stiffened by a spectacle or motion plate in front and a plain plate across the footplate and carrying the stop valve or regulator handle, and pressure gauge. The driving wheels were 7in wide and 5ft in diameter, made of wrought iron, and fitted with a simple compensating motion which allowed the engine to take the sharpest corners without disconnecting the drive from either wheel. The front wheels were of wood, 3½ft in diameter and 6in wide. The single cylinder was carried over the smoke box. It was steam-jacketed with 7in bore and 10in stroke. It carried four slide bars with Stephenson link valve gear and eccentric reversing gear. The crank shaft carried a fly wheel, 4ft diameter and 5in wide, able to provide belt drive to static machinery. The locomotive-type boiler was 2ft 6in diameter and 7ft 7in long. Worm and chain steering was controlled by a hand wheel on the footplate. Thus one man could both drive and steer.

The Royal Engineer Committee, consisting of Colonel T J L Gallwey, Commandant SME, Lieut Colonel H Wray, Instr in Constr SME, Captain W O Lennox VC CB, Supt Fd Wks SME, and a full-time paid secretary, Captain R Home, tested the engine. Various experiments were tried such as burning wood fuel, the addition of a winding drum and of a governor to drive machinery at a fixed speed.

The Engineer of 22 September 1871, reporting the trials stated that: "It was the lightest engine of its power yet constructed and although of only six nominal horse-power it drew a test load of 15½ton up the 1 in 11 gradient of Star Hill, Rochester under 115lb head of steam". (Photo 2)

In the Autumn manoeuvres of 1872 this engine went from Chatham to Blandford and drove a pump supplying water through one mile of pipe with a rise of 150ft.

At the end of 1871 the Inspector General of Fortifications told the RE Committee that Steam Sappers were to be procured for several stations and asked which manufacturers should be invited to tender and what modifications were required. The Committee recommended that only Aveling and Porter had a suitable design of

Photo 2. Steam Sapper No 2 drawing a 68pdr gun up Star Hill, Rochester. Note the man with the red flag at the bend of the road ahead of the engine. (Photo of drawing from *Illustrated London News*.)

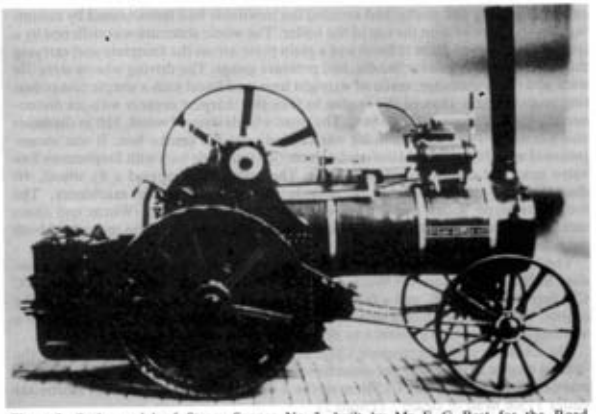


Photo 3. Scale model of Steam Sapper No 3, built by Mr E G Best for the Road Locomotive Society, and presented to the RE Museum

engine. A specification was drawn up and five more tractions were ordered in 1872. (Photo 3).

Shortly after this a curious episode occurred which almost killed the military traction engine. The new engines were designed for a working steam pressure of 115psi. The boilers were designed with a high factor of safety. Yet the Inspector of Machinery at Woolwich Arsenal gave his opinion that the engines could only be operated safely at up to 60psi. This aroused considerable controversy. The RE Committee felt that the engines would be so inefficient at such a low pressure they should be scrapped. Thirty years earlier, engines had operated on 200psi and in 1871 the normal pressure was 115–180psi. The Inspector of Machinery's opinion was supported by the Steam Users' Association. After consultation with John Penn and Sons of Greenwich, the well-known shipbuilders, the pressure was raised to 80psi but the controversy continued until 1875.

In 1873, Steam Sapper No 9 was fitted with flanged wheels to run on a railway. Presumably the trial was satisfactory since in 1877, No 12 was purchased with a set of tramway gear. These engines had wheels of 4ft 8½in gauge and were used on the 2½mile military railway running from the powder magazines at Upnor to the River Medway. Steam Sapper No 6 was sent to Cork Harbour for use on the defence works and there is a report of an accident to it when it fell into a ditch at Fort Camden.

Eventually over twenty such engines were delivered to the Royal Engineers. At least one was fitted with a 5ton crane jib and wide wheels were available for road rolling. Aveling and Porter also built the wagons to go with the engines.

By 1875 the Steam Sapper was available with 6, 7 and 8nhp ratings, with 8in × 10in, 8½in × 12in and 9in × 12in cylinders respectively. Later two speeds were provided. Fast and slow pinions on the end of the crankshaft could be slid in and out of mesh with the double speed wheel on the counter shaft. A locking device prevented both speeds being engaged at once. Later, in 1873, Aveling and Porter were asked to consider a double cylinder engine. However, they were entirely against it arguing that the extra fuel consumption involved would make the engine uneconomical.

The first engine to see active service with the British Army went with the Sapper

contingent to the Ashanti Campaign in 1873. (Photo 4). General Sir Garnet Wolseley was to sieze Kumasi and put down the Ashanti. Major R Home, the first paid Secretary of the RE Committee who had dealt with the trials of Steam Sapper No 2, was appointed CRE for the campaign, and resolved to try steam traction. Three traction engines were prepared for the expedition with a selection of Aveling and Porter wagons including ten ambulance wagons. However only one engine was shipped out in pieces to Cape Coast Castle. The boiler came ashore in a small lighter which was beached and then tipped to detsant it. The engine was erected and started work within 9 days.

Its performance was not entirely satisfactory and in the absence of roads it had to remain in the coastal plain. Captain Buckle RE, who commanded the RE Company, reported in his journal:

"*31st October*. Steamed up the hill and through the town with the Steam Sapper to the intense astonishment of the natives. Got the saw bench to work. In the afternoon was ordered to take an Ashanti prisoner on the engine some two miles out of town. The engine did not work well at all, her boiler primed she got short of water and refused to go up a hill. Altogether it was not a successful trip".

"*3rd November*. The traction engine hauled up two of Crease's filters weighing each two tons from the beach. It also sawed a good deal of timber and hauled water from the condenser".

"*4th November*. Wished her to haul in the afternoon but found two of her tubes leaking and had to desist. The behaviour of the engine has caused much disappointment".

Later the engine overturned after a two-mile run. It was taken back to Cape Coast Castle and used as a stationery boiler.

Captain Buckle was killed in action later in the campaign and was mentioned in Sir Garnet's despatches as being one of the most accomplished and practical engineer Officers of his rank. Portions of Captain Buckle's journal were reproduced in Lord Wolseley's depatches.

The CREs final report was as follows: "The traction engine did not come up to expectation. On good roads it would be valuable: but on the very narrow roads on the

Photo 4. Steam Sapper No 8 and crew from 28 Company RE at SME Chatham before joining the Ashanti Campaign of 1873

West Coast where the bridges are of a flimsy description it was unsuitable as a traction engine. As a stationary engine it worked very well".

It is of interest to note that stores were taken from Upnor to lay a railway track to support the expedition.

In 1874 the SME carried out trials with Steam Sappers used as stationary engines, road engines and railway locomotives. The results were reported to the RE Committee by the Commandant SME, saying that as stationary engines they gave good results with some drawbacks. He added: "As road engines they leave little to be desired". As locomotives, tested on the hilly Upnor line, "for a military railway I should much prefer putting my trust in a light line worked by a Steam Sapper than in any narrow gauge railway with other locomotives of the same weight".

Late in 1873 two traction engines were reported to be working in Woolwich Arsenal. They were described as Steam Sappers for the Engineer Siege Train. They proved to be two Thompson engines, *Steam Gunner No 1* and *No 2*, weighing 12 and 8ton respectively. Both were reported to be too heavy to work with the siege train.

Further trials were held at Chatham in 1877 as part of the siege operations. *The Times* of 30 July reported, "Great interest was shown in the traction engines, which with their loaded trains took part in the march past at the close of the manoeuvres. On this occasion one 8 horse power engine drew three 32 pounders on trucks, and another engine of 6 horse power drew two 12 pounders". The train of three guns, weighting 12ton in all, travelled at 4mph on the level and at a steady speed up an incline of 1 in 10. An engine fitted with a rope drum was used as a winding station at the steepest points. Another was fitted with a 5ton crane jib and unloaded the guns from the railway and placed them on their carriages.

Aveling and Porter Steam Sappers, having proved themselves with the British Army, were sold to Italy, France and Russia for military use.

Immediate Response

MAJOR D S HAY TD RE(V)

The Author joined the Post Office in 1945 and did two years National Service in 1948–49. On returning to the PO in 1949 spent the next six years as an engineer before transferring to the telephone traffic side in 1955. The years 1955–1963 were spent mainly dealing with telephonist staff and exchange equipment duties. In 1964 he passed the RCB and was granted a SSC in the Royal Engineers Postal and Courier Communications until 1967; during which time he served in Borneo with 51 Gurkha Brigade during the Confrontation. Joined T&AVR (PCC) in 1968. On rejoining the PO in 1967 he returned to telephone traffic work until 1969 when he joined the then PO Data Processing Service. He is now Head of Group responsible for Microprocessor Development System Support in the British Telecom research and development environment.

This article was first published in *The Royal Engineers (PC) Annual Magazine 1979* and is republished by kind permission of the Director Postal and Courier Services and the Author.

Immediate Responce Major DS Hay TD RE

At 0900hrs on a grey October morning in 1979 I had just started to rewrite some Courier Movement Orders (I was in HQ FCS for my Annual training) when a cheerful voice said "Are you on for a trip to San Diego?" Thinking that Captain Bill Whiting RE was joking, I replied that I was ready to go immediately. It was no joke! An hour later I was on the tube to Heathrow to RV with RN representatives.

I can remember wondering if it was all a dream! My mission was to take some very urgent spare parts to a stricken submarine which was at San Diego Naval base.

When I arrived at Terminal 3 I found my ticket waiting for me at the BA desk. Shortly after that the Royal Navy appeared with the packages. When I saw them I knew they were somewhat larger than the usual cabin hand luggage! This fact was confirmed by the girl at check-in who said "No way . . ."

It was at this point, following my insistence that one way or another these parcels were going on the plane with me, that a charming BA Supervisor (Mrs Heyes) appeared on the scene. The problem was solved with the purchase of a second one-way ticket for the packages. Mrs Heyes also cleared my path through to be first on the plane—a DC10 hired from New Zealand Airlines. The packages were duly tied down in place by a BA ground loader.

During the flight the Captain invited me on the flightdeck and following our conversation the Captain said he would arrange for me to be met by a BA representative at Los Angeles (LA).

Some ten hours flying time, two big meals and a film later we arrived at LA. It would be true to say that the plane was firmly planted onto the runway at LA!!! I was met, not only by a BA rep, but also a porter. I was first off the plane and was whizzed through US Customs, Emigration and Medical authorities. It was a relief to find that *F MOV 220* (NATO travel document) was instantly recognised. I had no passport with me, only my *F MOD 90.*

It was at this point that I found myself outside the BA Terminal, alone with two large parcels, in the middle of LA Airport in the dark (it was about 2100hrs). The Airport tram (bus) took me and my baggage round to the United Airways building, a moment of panic here as I had no US currency to pay the fare! However, the trip was free, which also gladdened my Scottish heart! It was during this journey that I became acutely aware of the bulk and awkwardness respectively, of my two "diplomatic bags". As I struggled to enter the secure area, I was referred back to the security desk, where I was advised that I had no diplomatic immunity (which was correct as I was not carrying a diplomatic passport annex) but the bags had, and were allowed to bypass the all-seeing X-ray machine.

Again I was first on the plane (Boeing 727). The flight to San Diego took but thirty five minutes—hardly time to sink the free cup of coffee. When I enquired about leaving the plane first the head of the cabin staff suggested that I should sit tight and wait until the "rush" subsided. True enough the plane had hardly rolled to a halt (with the "fasten seatbelts" light still on), and there was a rush for the door. So this time I was last off!

I was never so glad to see a British Sailor—I'd been travelling for some fourteen hours and I was suffering from "jet lag". I was escorted to the US Navy Sperry Dock Submarine Facility. After a few minutes walk along the quay, through a US Navy submarine supply ship, over a US submarine, I arrived at my final destination, HMS *Conqueror*—one of our Valiant Class nuclear powered giants of the underwater world. These submarines are some 285 feet long, with a beam of 32 feet and they displace 3500 tons (more than a Leander Class frigate). *Conqueror* is a silent hunter/killer. Having arrived on board there was one last slight difficulty—one of the packages was too big to pass through the hatch currently open. This hiatus lasted for about one hour until another, larger, hatch was opened. Having finally disposed of my charges to the Duty Officer, I was pleased to hear those immortal words—"What'll you have to drink?"

Shortly afterwards I was taken/carried to the Shelter Island Inn where Conqueror's Captain also lodged. The room provided was complete with loo and shower.

Lack of sleep was beginning to catch up on me and in true Naval style I "crashed" on the bed. After breakfast I met Commander Roger Trussell RN, Commander of *Conqueror*, who took me to San Diego Old Town (two years old!). "Old Town" is mainly a pedestrian precinct of Mexican/Portuguese buildings moved bodily to the area to form a tourist attraction. This was on the way to the "boat" (not ship—you may call *Conqueror* a "submarine" or a "boat" never a "sub"). The weather was marvellous, bright and sunny—temperature 70°F with 60% humidity.

During the morning Commander Trussell arranged for me to be shown over *Conqueror* (for which privilege I am very grateful) and in the afternoon I was taken to Sea World—forty acres of park containing all manner of marine creatures and birds (feathered). On my way past the dolphin pen some over enthusiastic tail wagging soaked me to the skin. Just as well it was a lovely warm day. Shamu, a killer whale, is the star attraction of Sea World. It is an unforgettable sight to see a 4 ton, 21 feet long mammal some 5–6 feet clear of the water as he sailed over a rope. I spoke to one of the Department of Health Avian Authority keepers who was quick to point out that their park was second only to Slimbridge for varieties of sea birds on view. The keeper took me round the hospital, one of the patients was a Pacific Brown Pelican, recovering from an operation. Its pouch was stitched up after some fishermen had cut it. He also showed me the indoor penguin pen where there were Adele, King and Emperors walking around with great solemnity. I also met "Oogli" a charming salmon crested cockatoo who immediately stepped onto my arm when I went to stroke her. She was happiest when being petted by anyone (no comment). I was collected and returned to my hotel by RN transport.

The following morning I reported back to HMS *Conqueror* which was making ready to sail. I collected a despatch for UK and started on my journey home.

After a short trip to LA I joined the homeward flight in the same plane that I had come out on, with the same crew—it was like meeting old friends. I have nothing but the highest praise for BA cabin staff and air crew. The journey back was much enlivened by the presence of the All Blacks Rugby team on their way to England. I remember thinking that they would provide formidable opposition if they played rugby with the same enthusiasm and efficiency as they consumed beer. At the time of writing (Wales 12 All Blacks 13) it seems that I was right! Perhaps they train on beer? The DC10 landed at Heathrow, this time it was so gentle that the cabin staff gave a rousing cheer—the "driver" had become more skilful since the hard landing at LA!

I was duly collected from Heathrow by FCS transport and handed in my bag to the FCT and returned to Mill Hill, still hardly believing that I'd been to San Diego. For once in my life, I was in the right place at the right time! A truly valuable and unforgettable experience.

* * * *

The Royal Monmouthshire Royal Engineers (Militia)

A SHORT HISTORY

CAPTAIN I M THOMPSON RE

* *The Author was commissioned from RMAS in 1971. On completing his YO Course he joined 32 Engr Regt for a tour as a Tp Comd with 7 Fd Sqn, followed by a tour at AAC Chepstow as a Wing Captain. More recently, from 1977–79, he was loaned to the Sultan of Oman's Land Forces where he served as a Coy Comd in the Desert Regt. On return to UK he took up his present appointment as Adjutant of R Mon RE (M).*

Introduction

The Royal Monmouthshire Royal Engineers (Militia) is the Senior Reserve Regiment of the British Army and takes precedence immediately after the Regular and before the Honourable Artillery Company and all other units of the Territorial Army. It is in fact the sole survivor of the Militia Regiments which have their origins in the Trained Bands and General Levies of Medieval and Tudor Times.

The Origins

The Act of Union of 1536 brought Wales under the Crown as a "very member and joynte of the same". The County of Monmouth was formed as part of the process and so became responsible for raising the *Posse Comitatus*. This was a body of men over the age of fifteen, (excluding peers, the clergy and the infirm), which could be mobilised in an emergency by the Sheriff of the County.

The earliest Monmouthshire muster of such "harnessed and furnished men and others fit for Warre" is dated 1539 and appears to include all the able-bodied men then liable for service. They were at first untrained, and it was not until 1573 that the Council of the Marches made provision for training by selecting one hundred men, the County's first Trained Band. They were to be men "able for soldiers . . . and to be furnished and kept in readiness".

The order was not too efficiently obeyed and the Council complained. More detailed instructions were issued in 1577 recommending that the Bands should consist of men armed with "Callivers, Flasks, Touch Boxes, Morions, Swords, Daggers and such other furniture as appertains". On the selection of recruits it favoured "meet and able husbandmen and farmers' sons" as "more likely to stay on the spot rather than such Artificers as are often moving about".

Archers were encouraged to practice their skill and were not to be given shot; Companies should consist of at least fifty men ("no man to be drawn further from his home than is necessary"); and training was to be given by gentlemen "of skill and

The Royal Monmouthshire Royal Engineers Captain IM Thompson RE

experience in martial affairs". Mustering was to be done for four days at Easter, four at Whitsun and two at Michaelmas, while 8d a day was to be paid to each man. There was to be no profiteering over provisions, armour was to be kept scoured and ready for use, and bullets and powder were not to be wasted unnecessarily. The Commissioners were advised to control prices near the places of muster "so that the levies have victual and lodgings at reasonable rates" and were urged to set a good example by taxing themselves "and shewing forwardness in this service, to provoke others of ability to do the like".

Monmouthshire seems to have been slow in making its returns and got away with it because the Council of the Marches frequently failed to include it in the list of Welsh Counties when issuing proclamations. Nevertheless, a letter of 21 March 1577 ordered the County to raise and train one hundred men. Again there was delay, the Commissioners of Muster blaming the loss of their returns on "the negligence of the bearer"; but eventually training was under way and was fairly swiftly followed by the inevitable complaints of the rate-payers who asked to be "eased of such paymentes and intertainmentes as are landed upon the countrie and allowed unto the Muster masters and trayners of the souldiers".

With the passing of the threat from Spain, interest in the Militia lapsed until 1616 when the Privy Council issued new directives to remedy the defects in the Trained Bands. Ten years later Charles I tried to revitalise affairs by sending experienced soldiers from Regiments in the Low Countries to spend three months teaching the reluctant Militiamen how to bear arms. The move had little effect and in 1635 the Privy Council accused the Deputy Lieutenants with "Connivance and remisness of late yeares". Something of the administrative chaos into which the Militia had lapsed can be gathered from the fact that the Marquess of Worcester was ordered to muster the Monmouth Mounted Troop in 1627 for inspection at Cardiff.

As the break between King and Parliament drew near, the control of the Militia became an issue on which there could be no compromise, especially as the London Trained Bands were firmly under the control of Parliament. Parliament had forseen this and introduced a *Militia Ordinance* embracing most of the powers already exercised by the Lord Lieutenant. The King replied with a *Commission of Array* which had the advantage (for him) that soldiers raised by array could be moved from one part of the country to another. The arrival of two contradictory commissions forced most prominent men to take sides and split each county into factions.

Here in Monmouthshire the issue was complicated by many of the county families being Catholic and the divided loyalties were quickly shown when war broke out and Parliament tried to move the Militia Magazine from Monmouth to Newport. The Mayor refused to hand over the keys, was arrested and taken to London. His Deputy, equally determined, reinforced the door with stronger locks, and followed the Mayor to London. Three Magistrates who had refused to help in the removal were dismissed and Parliament was petitioned. But the magazine remained where it was and as a result the Commissioners of Array were ordered under arrest to London as delinquents "for disarming the well-affected Party of the County of Monmouth".

But although Monmouth was Royalist to begin with, and Raglan Castle remained so throughout, there were many who disliked both sides and wished only for a quiet life. This gave rise to the Clubmen, associations of armed neutrals, banded together to defend their territories against the disruptions of war from either side. The Militia thus became neglected but the arrival of the Scottish Army led the Commissioners to order its embodiment, while from 1650 onwards there became available a Training Manual, produced by a professional soldier, Sergeant-Major Richard Elton. *The Compleat Body of the Art Military* set out in detail drill exercises and the duties of all soldiers "from Sentinell to Collonel".

A new *Militia Bill* was introduced in 1657 but after the Restoration of Charles II, Parliament annulled all bills passed since 1636 and all Trained Bands except those of London were discontinued. It did however provide for a Militia consisting of 20,000 foot and 2,000 horse. It made the Militia the prerogative of the King, placed it in each

County under the Lord Lieutenant who was to appoint Officers, and allowed for fourteen days annual training, paid for by the local authority. Offences could be dealt with by local Magistrates, though Officers had power to fine or imprison in default. This was the form the Militia was to retain until the reorganisation of 1757.

In 1684 the 1st Duke of Beaufort, Lord President of the Council of the Marches in Wales, went on a *Progress* through Wales, accompanied by the diarist, Thomas Dinely. When he reached Monmouth the Duke "took a view of the Militia Regiment of this County of Monmouth, when the Earl of Worcester at the head thereof on foot as Colonell with his leading Staff, saluted his Grace, severall of the principal gentry . . . placing themselves in ye Front of the stand of pikes; Doublings, Countermarches, Wheelings, variety of exercise and good and close fireings were made, whence the Mayor and ye rest of the Magistracy of Monmouth Town in their formalities invited his Grace to accept the Freedome of the place . . . That done his Grace with all the Gentlemen that accompanied him to Monmouth Town-Hall were collationed there with a cold treat, during which the militia horse then led by Sir Charles Kemis gave several vollies and the troopers were treated as they were mounted with syder and ye noted Monmouth ale, Drums beating, Trumpets sounding and Bells ringing".

On the following day the Duke returned to Badminton, "extremely satisfied with the good order in which his Grace found the Militia, not only of the Principality of Wales but also of the County of Monmouth . . . the Gentry everywhere . . . expressing a Loyal Zeale and most Dutifull Affeccon to his Majesty and the Established Government".

The reign of James II and the Revolution of 1688 led to the embodiment of the Militia, as did the threatened French invasion of 1690. At the end of the century the Monmouth Militia consisted of 523 men, of whom 40 were mounted. The Officers included Sir John Williams as Colonel, Henry Probert, Lieut Colonel, John Arnold, Major, and Charles Price, George Lewis, Edward Perkins, Henry Morgan and Nicholas Arnold, Captains.

After the flight of James II, the threat of a Jacobite rising increased and the Militia was embodied in 1715 and 1745, and it was the inefficiency displayed in this embodiment which led to the reforms of the *Militia Act* of 1757. Previously men, horses and arms had been provided by individuals. From 1757 the whole liability fell on the county and parish. Monmouthshire was given a quota of 240 men which was in turn apportioned amongst the parishes. Men were to serve for three years and were to be chosen by lot or find a substitute. (It is of some interest that in 1803, of 45,492 men raised by ballot, 40,998 were substitutes). Men from eighteen to forty-five were eligible, annual training was compulsory, and during embodiment the *Mutiny Act* applied. Officers required a property qualification and until 1802 the force was exclusively Protestant.

Embodied men were usually billeted in inns, where they were provided with "diet and small beer". Wise travellers avoided such places and when Viscount Torrington stayed at the Beaufort Arms during his visit to Monmouth in 1781 he wrote: "I slept very ill last night. It is a plague to be in an inn with troops, for the Officers employ and occupy the whole house". He watched the Militia parade in the evening, "and a stout body of men they are", and decided that the amount of venison in the Beaufort larder was entirely due to the Militia carrying out their training in private parks.

At the same time, the Militia Officers provided an important element in the social season of plays, concerts, balls and races which accompanied the Monmouth Assizes. Indeed, when the American War of Independence broke out, Monmouth Races were abandoned because the embodiment meant that all the principal gentry were away from home.

Life in the Militia could also be harsh, as the Court Martial records for 1793 show. William Willot, for instance, was sentenced to 500 lashes for being drunk and behaving in a riotous manner. Although the sentence was approved by the Duke of Beaufort, it was eventually remitted to 450. Similarly, another man, for absenting himself from his quarters and theft, was sentenced, with the Duke's approval to 500

lashes, but this was reduced to 700.

At the outbreak of the French Wars in 1793, the Monmouth and Brecon Militias were amalgamated into one Regiment. Although the strength varied from year to year, the earliest Parade Statement which has survived, (March 1799), records 28 Officers, 50 Sergeants and 652 Other Ranks. This included a band, which, thereafter, played an important part in Monmouth's social activities; sometimes giving concerts, sometimes leading political demonstrations, occasionally welcoming distinguished visitors. It was present on the Quay to welcome Lord Nelson in 1802, greeting him with "Rule Britannia" and "See the Conquering Hero comes".

In 1794 Pitt had introduced many reforms to strengthen the Regular Army. The Militia was supplemented by Volunteer Companies, a locally raised Home Guard to oppose invasion. The Monmouth Volunteers were presented with Colours by the Duchess of Beaufort in 1799. Similarly, Yeomanry and Volunteer Cavalry were to be raised. The Loyal Monmouthshire Troop of Yeomanry, under Captain Lewis of Llantilio, assembled for training in Monmouth in December 1798 and received their Standard at Abergavenny on 24 February 1800.

During the Nineteenth and Twentieth Centuries the Monmouth and Brecon Militia suffered several transformations. In 1804 the Regiment was given the prefix "Royal". In 1820 Brecon was detached and the Regiment became The Royal Monmouthshire Militia and in 1832 The Royal Monmouthshire (Light Infantry) Militia. At that time the whole of the Militia in England was inactive but in 1852 the *Militia Act* became law and the Regiment was again formed. The Regiment was the first to volunteer for active service during the Crimean War embodiment, the Officers offering £5,000 to equip it for that purpose. The offer was rejected but many Officers and men served as Volunteers with the 23rd Royal Welsh Fusiliers.

The following notice appeared in the Army and Navy Gazette in 1877: "This Militia Regiment (Royal Monmouthshire) we hear on account of its great efficiency has been selected by the Authorities as one to be converted into an Engineer Corps and is likely soon to change its Light Infantry character". On 27 March of that year, the *London Gazette* recorded—"The Queen has been graciously pleased to approve the conversion of the undermentioned Militia Regiment as follows—the 'Royal Monmouth' from 'Light Infantry' to "Engineers". Later that year the *London Gazette* recorded—"Her Majesty has been graciously pleased to approve of the Royal Monmouth Engineer Militia being in future designated Royal Monmouthshire Engineer Militia". The Regiment thus became part of the Corps of Royal Engineers. A further change in the title was made in 1896 and the Regiment became The Royal Monmouthshire Royal Engineers (Militia). At this time it shared the distinction of the double Royal with the Royal Anglesey Royal Engineers, but, with the passing of the latter as an active unit, the Regiment became unique in this respect.

The conversion from "Light Infantry" to "Engineers" was obviously the cause of some great feeling within the Regiment as shown by the anonymous offering penned by an Officer of the day and shown below:

"BLESS THEE, BOTTOM, THOU ART TRANSLATED!"

Oh! take me away, and sit me down, and give me a breath of air,
I've heard the most astounding news, and it's more than I can bear;
Sometimes I wonder if I'm asleep and having a horrid dream,
Like what comes after a big mess night and I wake with a choky scream.
But this is a stern reality 'tis only too plain to see,
And why this grief should have come about is a desperate puzzle to me,
For I must have done something or other most horribly wrong I fear,
To find myself, at my time of life, turned into an Engineer.
It isn't the coat I mind so much, and the busby I don't mind that,
Though there are some faces that don't look well from under a tall fur hat;
Nor the broad red stripe on my trousers that gives me a martial air,
Nor even the brown morocco belt with the pouch I shall have to wear.
I've always been used to different things, and couldn't without a sigh

Take leave of the silver bugle of the old Light Infantry—
But though I know the change would be great, I flatter myself it's queer
If I don't make, as far as appearance goes, a respectable Engineer.

It's the thought of the things I shall have to learn which fills my soul with dread,
I know I shall never be able to get one tenth of them into my head;
There's fortification and bridges, and mines, and going about in a trap
With a nightmare sort of a compass to make an impossible map—
And lots of stiff books full of x's and y's; I must say I think it is cool
To expect me to go and learn them now, when I never could learn them at school;
And sketching and drawing—I put it fairly to any of you that are here—
Would you trust me to draw anything—if I were an Engineer?

They say our men would be good at the trade, for they're used to work underground,
And in Field rank for the officers a recompense would be found;
But I don't want to see our good old Corps, the smartest Corps near Wales,
Made up of "Majors and Miners" like a school-girl's book of scales.
I daresay I am behind the times and I don't much care if I be,
For most of my brother officers will be just as bothered as me,
They're an excellent lot of fellows, but a little too fond of good cheer
To come quite up to Von Moltke's mark of an ideal Engineer.
I sit and sigh for the days that are past and wish they were with us still,
A kindly meeting of kind old friends, and a pleasant amount of drill;
Most part of the year we hunted and shot, and then when spring was at hand,
It was quite a relief to wear a red coat and listen once more to the band.
But what with their mobilisation schemes, and depot brigades and all,
The good old fashioned Militia-man has got to go to the wall.
Well I suppose the plans are right, but one thing seems pretty clear,
I shall have no peace of my life when I'm turned into an Engineer.
Oh dear!
What were the Horse Guards thinking about to make me an Engineer.

At the outbreak of the South African War the Regiment volunteered to send a Section. The offer was accepted and a Section consisting of an Officer, a Sergeant, a Corporal, a Second Corporal and 22 Sappers served with the Bridging Battalion RE. A further complete Company was sent in the same year and was employed initially in road building and later under the Director of Railways.

The year 1908 brought about a far reaching change, for the old Militia became the Special Reserve and this involved the new liability of service abroad in time of emergency, probably with a regular unit. When mobilisation came in 1914 no men were in fact, sent to regular units. The Regiment mobilised one Siege, two Railway and one Depot Company. Throughout the war it maintained its own units from its own depot and, in addition, raised five further Companies, three Siege and two Army Troops. It trained and sent to the war a total of 76 Officers and 2,113 Other Ranks.

The end of hostilities saw the virtual demise of the Special Reserve; the Companies were disbanded and the Regiment reduced to a cadre of one Officer and five Other Ranks. In 1925, under the scheme of the new Supplementary Reserve, permission was granted from the War Office to raise two Army Troops Companies, RE, SR, "to take over the title and traditions of the Royal Monmouthshire Royal Engineers (Militia)". This was indeed a proud occasion; as events turned out the Regiment was the only descendent of the old Militia and Special Reserve to be re-incarnated. Training was performed under the same conditions as the Territorial Army.

Early in 1939 the two Army Troops Companies became 100 and 101 Army Field Companies, and, as such went to war in September of that year. They sailed to France from Newport as part of the BEF and were first employed as GHQ Troops near Arras. Their tasks included preparing the C-in-C's residence for the entertainment of His Majesty King George VI on his visit to the BEF. During the campaign of 1940

the two Companies greatly distinguished themselves and received a special word of commendation from the C-in-C the late Lord Gort VC. 100 Field Company, commanded by Major George Whitehead, was captured while holding part of the line as Infantry: 101 Field Company was more fortunate and was eventually evacuated from Dunkirk. After reforming, 101 Company was stationed in London and a cadre was removed to form a new 100 Company. Both Companies were employed on the London defence lines. In 1941 they moved to Devon as part of 77 Division and not long after became Corps Troops of 8 Corps, a role they filled until the end of the war. They crossed to Normandy in 1944 and were in the van of the fighting until VE Day; they were amongst the first Sappers across each of the major obstacles, the Seine, the Rhine and the Weser.

When demobilisation started the original members were rapidly lost and new numbers were given to the two Companies in Germany so that the original ones could be used in England when the Regiment was reformed. Permission to reform as an Army Engineer Regiment was granted in 1948 and thus the R Mon RE (M), in addition to being a Regiment in its own right, was able to conform to the regimental formation within the Corps of Royal Engineers.

The Present

The Regiment was reformed in 1948, and in 1953 given the Freedom of the Borough of Monmouth. In 1967 the Territorial Army was completely reorganised and the Royal Monmouthshire Royal Engineers (Militia) now consists of 100 Field Squadron at Newport, 108 (Welsh) Field Squadron in Swansea and 225 (Birmingham) Field Squadron, with the Regimental Headquarters in Monmouth and the REME Workshops at Newport.

108 (Welsh) Field Squadron is the direct successor to 53 Welsh Divisional Engineers. 108 (Welsh) Field Squadron have undertaken considerable work on community projects in the Lower Swansea Valley. These tasks have been of great military training value as well as helping to improve the environmental aspects and facilities of the local community.

The Regiment was honoured with the Prince of Wales Award in 1971. The Plaque, personally presented by the Prince, now hangs in a place of honour at the Castle. In April 1974 when, under local government reorganisation, Monmouthshire reverted to the ancient title of Gwent, the regiment continued to provide the sole reminder of the County name which existed through so many centuries.

On 2 April 1977 a parade was held in Monmouth to celebrate two important dates: 21 March which was the 400th Anniversary since formation of the Regiment, and 1 April which was the First Centenary since the Regiment joined the Corps of Royal Engineers.

During 1978, two major events highlighted the year. The Regiment had been further honoured by Swansea City Council conferring the Freedom of the City. The parade was held in Swansea on 15 April and the Regiment was inspected by the Mayor of Swansea and the Chief Royal Engineer. After the presentation of the Freedom Scroll and Casket, the right to march through the streets of Swansea was exercised. The salute was taken at the Guildhall.

During Annual Camp which was held near Hameln in late June, Regimental Headquarters, 108 (Welsh) Field Squadron and 225 (Birmingham) Field Squadron were visited on 20 June by the Honorary Colonel His Royal Highness, the Duke of Gloucester. This was the first visit to the Regiment since his appointment was announced in the Queens Birthday Honours List in 1977. His Royal Highness has visited the Regiment regularly since taking up his appointment.

It is with great pride that the Regiment looks back on over 400 years' loyal service to twenty-two Crowns and more than 100 years as Royal Engineers. We confidently look forward to the future knowing that we are able to fulfil our role should we ever be mobilised.

Engineer Support for the Royal Artillery

SOME THOUGHTS ON AN ANCIENT AND HONOURABLE TASK

LIEUT COLONEL R D GARNETT MBE RE

BACKGROUND

One of the oldest of all military engineering tasks has been the preparation of gun positions. The improved mobility of field artillery in the 19th Century and the recent, in historical terms, abandonment of fixed fortifications has taken this task out of the range of "normal" RE tasks. Recent considerations in the Royal Regiment have led to the conclusion that, even with armoured artillery it will be necessary to dig in the guns. Without getting involved into why this has come about, it is perhaps worth considering the implications from a military engineering point of view.

THE REQUIREMENT

What the Royal Regiment wants is earthwork protection against counter-battery fire, and this includes air attacks.

The usual gun position will be a slot about 1.5m deep surrounded by an earth bund 1.2m high. A possible design for an Abbot along with its supporting ammunition truck is shown in Sketch A. Where the water table is high it may be necessary to produce a higher bund. In addition to the main slot, flanking dugouts will be required for crew and ammunition protection, but this is a second priority.

Battery command posts will also require protection but in this case the slot is smaller since only an FV432 requires protection. If time allows a MEXE shelter will also be required for each Command Post; see Sketch B.

Within the Divisional area the RA may require up to sixty large holes of one sort or another. In terms of excavation this is over 5,500m^3. This is quite a plant task and equates to more than 1km of anti-tank ditch. For a number of reasons, however, it will require considerably more planning and supervision than one long ditch.

TASK DEFINITION

The design of pit shown in Sketch A has a volume of about 121m^3. Trials have shown that this excavation requires one hour's work for a CET (Combat Engineer Tractor) and a similar time for a TEREX (Medium Wheeled Tractor).

Excavation is only part of the problem since the spoil has to be carefully and accurately placed. Allowing for an angle of repose of 1:1.5, the base of the bund will be 3.6m wide. To allow for some spillage this means that the centre line of the bund must be about 2m from the edge of the excavation. To get the best results from the equipment operator, the task must be set out properly to show not only the limits of the excavation and the centre lines of the bund but also the point at which the ramp starts to rise from the bottom of the pit. The usual system of pegging is adequate for this purpose.

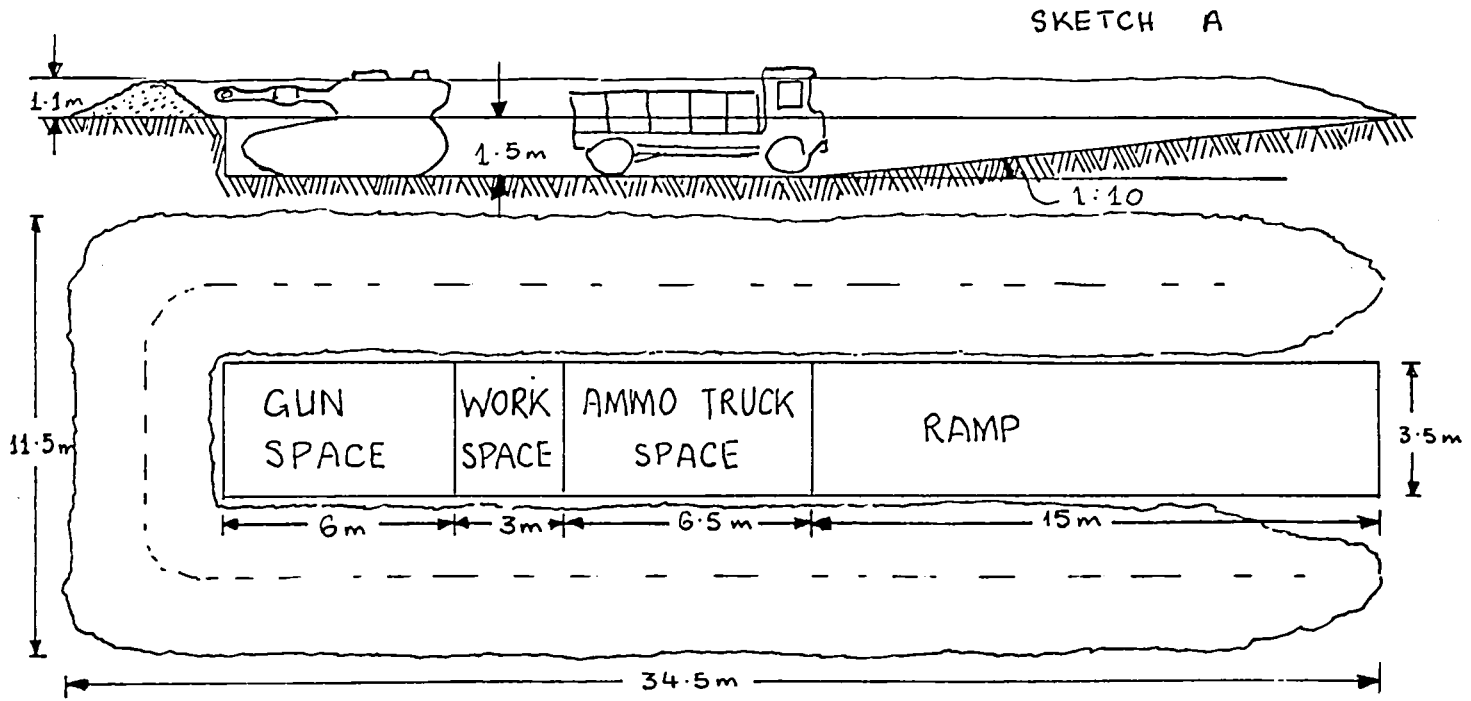
There is no doubt that operator training is a key factor. Those who train hard will undoubtedly produce better productivity from their machines.

RECONNAISSANCE AND PLANNING

The "customer" for this task is usually the Gun Position Officer of the RA Battery concerned. He will normally be thinking about camouflage, intervisibility, anti-tank fire plan, local defence, resupply and a host of other very important factors. He will probably try to have his guns within an area about 500m × 500m and about eight pits will have to be excavated in this area.

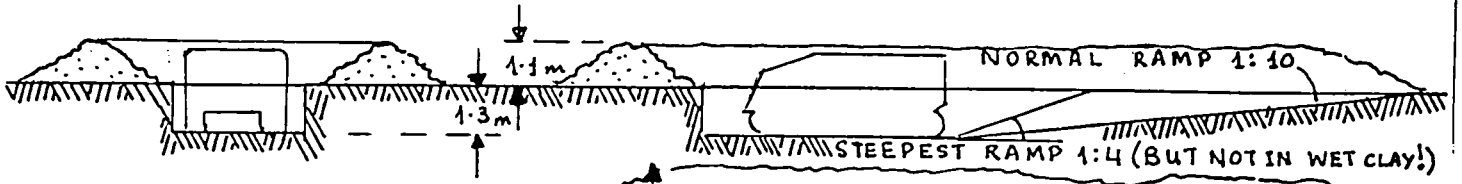
The RE adviser must not allow him to forget some equally important points when siting his gun pits: such as:

Level of the water table
Underground services (such as electricity, water and gas)
Site drainage
Soil conditions (bearing pressure, angle of repose, clay lenses, etc)
Priority and flow of work



GUN PIT DESIGN ~ 1 ARMD DIV 1980

SKETCH B

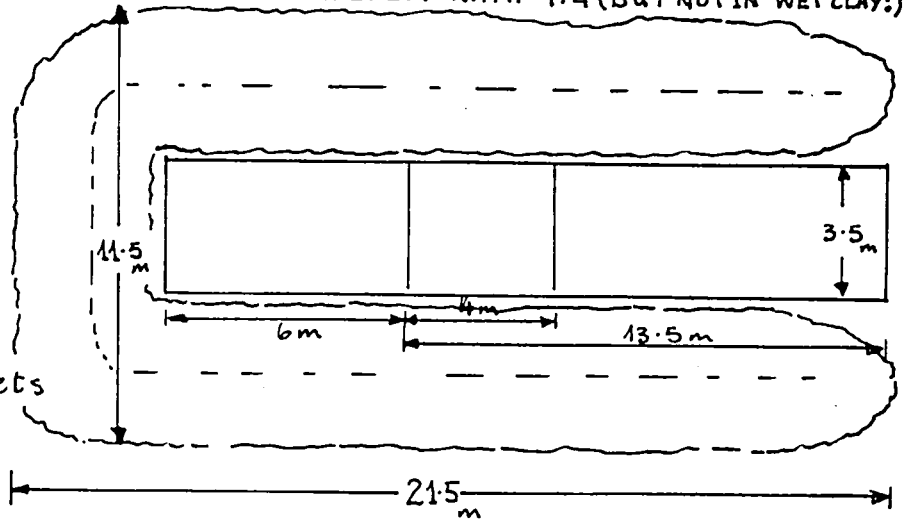


MINIMUM PIT DESIGN

ARMOURED COMMAND

VEHICLE

Note: Depth of 1·3 m allows revetting with angle iron pickets



To do this the Engineer requires tools such as an earth probe and a mine detector. He needs to gather information from maps, landmarks and the local population. Above all he needs training in evaluating the various factors, including the customer's wishes, and preparing a sensible plan. He must also set out the work, brief the operator and make sure that re-supply, servicing and maintenance are satisfactory. When the task is complete he must gather his flock together and move off to the next job.

SOME SAPPER CONCLUSIONS

Reconnaissance and planning must take place jointly with the RA Gun Position Officer. The work must be set out before the plant arrives on site.

If the Engineer equipment starts work before the RA are in location then some provision has to be made for local security. An operator cannot concentrate on his work and keep an eye open for an air or gas attack. To get the best output from the Engineer plant available, down-time must be kept to a minimum. This includes down-time from machines left idle once they have finished their task.

The task is not in support of, nor does it need, a Field Troop (who will anyway be heavily employed on other duties).

A temptation to pass the problem to the RA and give them 2 × CET per battery for twenty-four hours ensures that they will not be used to the best effect; since there will be too much down-time.

With the completion of deliveries of the CET to the Corps we have gained an enormous earthmoving capacity at Divisional level. We now do have the capability of digging in the guns and even providing reserve positions. This does not mean that we should forget that, like any other Engineer task, support for the RA will require:

The Definition Stage (by means of a Joint Reconnaissance)
A Planning Stage
The Mounting and Execution Stage comprising:
  Orders
  Deployment and Setting Out
  Site Control
A Recovery Stage

A CONTROVERSIAL CODICIL

"Sappers should not be dissipated in small parties on a large number of tasks with one or two underworked pieces of plant. It is more effective to employ them in fewer properly organised and equipped teams moving from task to task in an agreed order of priority".[1]

"The cardinal principles are that sufficient men and machines should be deployed to achieve the necessary progress in the task and conversely that no more *men* are deployed than can be effectively employed".[2]

"To maintain machines at a high level of efficiency there must be a thorough system of inspection and maintenance. If a large machine breaks down the effect is the equivalent to a considerable number of men becoming casualties . . . it may be necessary to duplicate such machines or have replacements on call".[3]

Question: Now that the earthmoving capacity of the Divisional Engineers has increased so much, have we got the right answer to the problems of its command, control and support? Should we perhaps be thinking of it being centralised into an Armoured Plant Squadron instead of three Field Squadron Support Troops and the Support Squadrons Plant Troop?

[1] *ME Vol I Part II, Command and Employment of Engineers,* para 20.
[2] *ME Vol I Part II,* para 56.
[3] *ME Vol I Part III, Engineer Planning and Organisation of Work,* para 136.

Addendum

Headquarters Engineer-in-Chief, while anxious that this topical subject be discussed

now, would like to point out that:

(a) The number of holes the Royal Artillery may require may be much greater.

(b) The introduction of the CET does not increase the capacity for earthmoving in the Division because of compensating reductions in "C" vehicles and because some CET are likely to be committed to other tasks.

These factors alter the last conclusion and the first line of the *Question* under "A Controversial Codicil".

The Official Study under the Chairmanship of Lieut-Colonel B R Rawlings RE, C Eng, FICE, FI Plant E, on wide circulation, covers this subject.

Memoirs

BRIGADIER H E HORSFIELD CBE, MC**

Born 23 August 1895, died 17 January 1981, aged 85

HERBERT ERIC HORSFIELD was educated at Bradfield College, passed in to The Shop in 1913 to be commissioned into the Corps in 1914.

In World War I he served in France and Flanders with the 154th Field Company, being awarded the Military Cross and two bars. After that War he went to India and was posted to the 3rd (later Royal Bombay) Sappers and Miners at Kirkee. There he commanded the 22nd Field Company which he eventually took to Quetta. He returned to England in 1936.

He was soon asked to go back to India to become, in 1938, Commandant of the Royal Bombay Sappers and Miners. In that post he had the responsibility for the great increase of his Corps in 1939–40 from its peace-time strength of seven fighting companies to an arm which was roughly the equivalent in strength of a division and made up of Mahrattas, Mussulmans and Sikhs as well as a minority of British personnel. Those who were there at the time talk of the wise and calm way he dealt with the considerable problems involved, skilfully and persuasively yet firmly leading and encouraging all those under him. This resulted in that enormous expansion, initially at Kirkee and then in the field, being accomplished smoothly and very rapidly.

In 1942 he was appointed Chief Engineer, Eastern Army (which eventually became Fourteenth Army under Slim). There his organising and engineering abilities bore full fruit. He had at first the planning and execution of roads and airfields for Fourteenth Army, priority being given to the Assam airfields from which the Americans flew across the Hump to supply the Chinese and later to the hilly Imphal Road which maintained IV Indian Corps during the recapture of Burma.

One of his many great achievements was the 120-mile Arakan coastal road from Chittagong to Akyab, only a small length of which could be adequately surfaced. The rest was covered with a hardcore of brick, burnt with inferior coal brought by coastal craft. There were innumerable tidal creeks which had to be bridged (5 miles in all of

Brigadier HE Horsfield CBE MC

bridging), use having to be made of local river craft with improvised decking: standard bridging equipment could not be spared then from Europe.

He was responsible for the distribution of the Engineer units of all kinds as they came forward, and it was he who organised the raising of a boat-building company to make boats from the timber growing by the rivers. These were the boats that sailed down the Chindwin and the Irrawady in 1945.

All those who served under him in the Burma campaign say he always knew exactly what he wanted and got it from them in his own quiet way. Certainly he made a great contribution to the eventual triumphant progress of Fourteenth Army, and this was recognised by his being made CBE.

He retired from the Army in 1948 and started a whole new career as a civil engineer, joining John Mowlem and Company who were then branching out into overseas work for the first time since the firm began in 1820. They had become involved in India and had formed a firm (taken over from the United Africa Company) which became the Mowlem Construction Company, based in Nairobi.

At that time the Labour Government embarked on their ill-starred attempt to grow vast areas of groundnuts in record time in Tanganyika. Horsfield took charge of a contract for the MCC to build over 100 miles of road from Port Lindl across virgin country to Natchingwea where they started a township intended as the base for those who were to undertake the clearing and planting of groundnuts. The work included well-boring and rest areas on the road for those who were to follow up the pioneering. The groundnuts plan then became a fiasco, Horsfield and his men being, after their good work, the only ones to emerge with credit from the affair.

Horsfield then returned to Nairobi, where he was a sort of "elder statesman and father confessor" to the young engineer-directors sent out from England to run the MCC. His presence added distinction and reputation to the firm as it went from strength to strength in high grade building and civil engineering all over Kenya and Uganda, as it does to this day. (Just as he arrived in Nairobi the Mau Mau emergency was at its height and Harriet (Tiny) Horsfield did fine work in helping and comforting the young wives while their husbands were away on scattered works all over the country or working after hours as special constables or fire watchers and on other duties.)

In 1954/55 Mowlems were invited to undertake the modernisation of the Iranian main roads under the new Seven Year Plan, the idea of the newly-installed and young keen Shah. Horsfield went to Tehran to organise the work of a varied assortment of talents, shipped out from Britain. He established small groups at Khoramshar, Ahwaz, Khorammabad and Hamadan to deal with the narrow and badly battered but vital road built by the Sappers in World War II. In Tehran he organised offices and established a modern Soil Mechanics Laboratory, a novelty in that country. He recruited Iranian staff, completely integrated with the British staff. (Here again Harriet was an invaluable help, organising a social club for both nationalities and sexes as well as entertaining Iranian wives in her house).

Towards the end of 1956 Horsfield's arthritic hip forced him to retire, being succeeded by another Sapper, Brigadier Cavendish. However, he refused to be idle. He became a Councillor of Bognor Regis in 1960 and was the Council's Chairman in 1965–66. He was a faithful member of the Royal Bombay Sappers and Miners Officers' Association and, in spite of very severe arthritis in his last years, regularly attended its annual dinner. Right up to 1980 he never missed the annual At Home of the Colonels Commandant RE. He was a Fellow of the Royal Society of Arts from 1948 to 1970.

He is survived by his wife and a son (known well to many officers of the Corps) and a daughter.

THF, HH (for John Mowlem), HAM, CAS, ECRS, FEWS

LIEUT COLONEL H N McINTYRE OBE MC

Born 17 May 1917, died 26 January 1981, aged 63

HARRY MCINTYRE joined SOE, Middle East, as a volunteer for Special Operations in enemy-occupied Greece. After a parachute course he was, in May 1943, dropped at night onto a reception ground in the Greek Mountains.

The story of the ensuing few weeks and of Harry's gallant part in the epic demolition of the Asopos Viaduct on the main railway line to Athens is told elsewhere in this Journal. Throughout the operation he displayed great coolness, resourcefulness, and an infectious cheerfulness which, combined with his unique powers of endurance and sheer "guts" fitted him perfectly for this hazardous Sapper task. Immediately after the Asopos operation he took part in the successful demolition of two other smaller bridges as part of carefully prepared and widespread sabotage activity designed to persuade the enemy that Greece, not Sicily, was about to be invaded.

Harry's next major job (in 1944) was concerned with arrangements for the sabotage of German aircraft on the airfields around Athens. He was then ordered to return to Cairo for another special assignment. This difficult and dangerous journey he accomplished by *caique* from the east coast via a "neutral" Turkey and reached Cairo by August 1944. A fortnight later he was off to Cyprus to join up with another Officer for re-infiltration into Greece—again by caique. He landed near Athens in September 1944 to help prepare the way for our liberating forces and was in and out of the city in *mufti* several times, often sheltered by a brave young Athenian girl called Niky Rallis, (the sister of the present Prime Minister), who was subsequently enrolled into SOE.

For his services to Greece he was recommended for a Greek medal, but for some unknown reason it was never awarded.

After the liberation of Greece on 23 December 1944 he returned to Cairo. Niky followed, and on 2 February 1945 they were married. Ten days later he was ordered to join the Staff of the Chief Engineer, Palestine.

ECWM

Harry McIntyre would have succeeded wherever the war had taken him, for after all the qualities needed are much the same in all operations. What made him ideal for our purposes was something more than these indispensable qualities. He always knew the right thing to do before he was told. His determination and good humour in doing it were inexhaustible. No one knew better how to exploit the good luck and neutralise the bad luck which both played so great a part in our operations. And he had the tact and charm to establish a relation of perfect loyalty with our Greek allies, for which I know he would have divided the credit with his future wife.

CMW

Harry McIntyre joined 10 Trades Training Regiment SME in November 1949 as a Squadron Commander, later becoming its 2IC.

The contrast between this role and his truly glamorous wartime activities could hardly have been more marked, yet he immediately threw himself into his duties with the greatest zest. He soon developed a strong Squadron spirit whilst insisting on the highest standards of drill and turnout. His equally strong Regimental spirit inspired

Lieut Colonel HN McIntyre OBE MC

all ranks—from the Commanding Officer downwards! He led the Regimental Rugger Team with tremendous enthusiasm at an age which most men would have been happy to be on the touchline.

Off-duty he was a stimulating companion and a good host. In all this he was admirably supported by his wife Niky who soon got to know the wives of all ranks in Harry's Squadron and played a valuable part in the running of the Regimental Wives' Club.

NHLC

Harry McIntyre was appointed the first CRE CROWN in 1963. This was a project to build a MRT airfield in a remote part of Thailand, to be used in SEATO Ops. Political and financial restrictions had only allowed minimal previous reconnaissance and planning, and his arrival had been delayed to the last possible moment. He had then to organize the whole of this complicated operation, not least the mounting and support logistics—virtually from scratch, in a short space of time. He had a mixed force of British, Australian and New Zealand Sappers and supporting services, but as the Corps was very overstretched at that time, the administrative grades such as clerks and cooks were quite inadequate. Moreover supply by air was drastically limited by the competing needs of operations in Borneo.

In this difficult task, Harry's great energy and ebullient nature defeated all problems and frustrations. He succeeded in setting up the large construction camp and getting the project well under way in very creditable time and in harsh climatic conditions. Many will remember the daily sight of Harry's cheerful and tubby figure leading the whole work force through a mobile bath unit at the "close of play" in the early tented camp.

By his strong character and leadership, as well as his highly developed sense of humour, he left behind a force of high morale, and was very deservedly made an OBE.

JHSB

I first met Harry on Loeng Nok Ta Airfield in NE Thailand in 1964. I arrived on my first visit to find him leading his men in the last stages of a cross-country run—later he sang songs with his guitar.

I next worked with Harry in HQ BAOR in 1966–67. He was on the Staff of the Chief Engineer, with responsibilities in the matter of Engineer Works and reorganisation. This was a period of intense activity and Harry was working extremely hard right up to the moment of his retirement.

He was very popular with his colleagues and his many contacts with all ranks in that vast organisation. I felt his retirement as a great loss, both as a friend and as an Officer of the Royal Engineers. He was a great man in a tight corner, and his favourite word—and quality—was *panache*. He did not love routine, or easy conventional ways.

AJT

Once in a lifetime—if one is fortunate—people like Harry and Niky McIntyre come into one's life. We met them in Chatham in 1950, and since then they have been our closest friends.

Harry had in full measure that over-used word *Charisma*. Always when we met we heard some new and interesting story of their wartime experiences in Greece.

Two very brave people need more skilful pens than ours to do them justice, and we hope that one day their full story will be told.

In co-ordinating this Memoir we hope we have given an indication of the worth of Harry McIntyre.

RGG, MO'BG

COLONEL SIR ARNOLD H S WATERS VC, CBE, DSO, MC, DL, JP, C Eng, FICE, FI Mech E, PP Struct E, FIWES, FGS, M Cons E

Born 23 September 1886, died 22 January 1981, aged 94

ARNOLD HORACE SANTO WATERS, the last surviving VC of the Corps, was born at Plymouth, the son of a Minister of the Methodist Church, and educated at Hoe Grammar School. For two years before WW1 he was employed as a construction engineer in South Wales.

He joined the Corps as a 2nd Lieutenant on 30 January 1915 and served in the European theatre. In 1917 he won the MC, in 1918 the DSO and the VC. On 4 November 1918 Temporary Captain (Acting Major) A H S Waters DSO MC with 218 Field Company RE was building a temporary bridge over the Oise-Sambre Canal near Ors:

"From the outset, the task was under artillery and machine-gun fire at close range, the bridge was being damaged and the building party suffering severe casualties. Major Waters, having heard that all his officers had been killed or wounded, at once went forward and personally supervised the completion of the bridge, working on cork floats while under fire at point blank range. So intense was the fire that it seemed impossible that he could escape being killed. The success of the operation was due entirely to his valour and example".

So read the citation which led to the award of the Victoria Cross.

Having relinquished his commission in 1919 he returned to civil engineering to become one of the country's leading Consulting Engineers mainly specialising in water supply and sewerage. He was twice President of the Institution of Structural Engineers, in 1933 and 1943, and an Honorary Member of the Institution of Royal Engineers. During WW2 he was Divisional Food Officer for the West Midlands.

He was tireless in his efforts to help others whenever he could, his work with Service Associations, Schools, Charities etc are too numerous to list but two instances illustrate his strength of character, his understanding of people and his impartiality.

In 1952 he became Honorary Colonel 127 Construction Regiment RE TA, serving until 1958. During this time he took great pains to keep in contact by attending every function and meeting monthly to talk over affairs with the CO. Teetotal, he maintained that the Loyal Toast should be drunk only in port or water and always insisted that a jug of water should be available at dinners—a quirk remembered by all PMCs!

Appointed JP on the Sutton Coldfield Bench in 1929 he became Chairman after WW2. He once placed two quite well-known figures on probation for a year (a remedy normally applied to naughty boys) after they had attempted to play golf in a Public Park on Sunday.

Sir Arnold lived a very full and useful life and will be sadly missed by a large number of friends and colleagues. To Lady Waters and his three sons—two of whom are working with A H Waters and Partners which Sir Arnold set up in 1920—we extend our sympathy.

EGW

Colonel Sir Arnold HS Waters VC CBE DSO MC DL JP
C Eng FICE

Correspondence

Lieut Colonel A F Toogood
Littlefold
15 Aveley Lane
Farnham Surrey

RE Officers in Command of Infantry

Sir,—I bring to your attention Colonel E N Evelegh DSO MC as he may be indeed a unique case of a Sapper Officer commanding units of other combatant arms.

I was his senior RE Staff Officer shortly after the outbreak of WW2 and I recall him telling me he thought he had a unique career in WW1 as he had commanded not only an Infantry Battalion but also a Cavalry Regiment in war. Unfortunately I cannot remember any details except I believe he said this occurred in Mesopotamia. If you are interested I suppose War Office records could confirm this or otherwise.

If he did I hope it will be recorded in memory of a gallant Officer who I thought was shabbily treated in WW2.—Yours sincerely, A F Toogood

Brigadier L O Clark OBE
The Torbay Hotel
Sidmouth EX10 8NW

Letters of Brigadier C G MARTIN VC CBE DSO

Sir,—Brigadier Martin described in his letters, (*RE Journal* June 1981), how 56 Field Company with 3rd Division fought back, in the first days of the war in 1914, from Maubeuge, through Amfroipret, to Solesmes.

It may be of interest to note that 55 Field Company, with the Guards Division, travelled precisely that same road in the reverse direction, during the last days of the same war in 1918.

On 20 October 1918, 55 Fd Coy built a bridge over the River Selle at Solesmes under a continuous bombardment of mustard gas. A few days later the Company lost several of its remaining much-valued horses in Amfroipret from a chance salvo landing in the farm stable-yard, where they were picketed.

The Company arrived in Maubeuge on the evening of 10 November. By 0900hrs on 11 November, the Company had just completed a temporary barrel-pier foot-bridge over the canal, to link the two sides of the town, all the road-bridges having been blown, when the message reached them that hostilities would cease at 1100hrs.—Yours sincerely, L O Clark

The British Historical Society of Portugal
Colegio Dos Inglesinhos
5 Rue Sao Boaventura—Lisbon 2

The Lines of Torres Vedras

Sir,—On behalf of The British Historical Society of Portugal and of the authors of our book on the Lines of Torres Vedras I wish to thank you for your courtesy in reviewing our book and in sending us a copy of the Journal (June 1981) in which your review featured.

Should any Sapper Officer visit Portugal with the intention of examining "The Lines" our Society would have much pleasure in giving him any help on which we

might be capable—Yours faithfully, Anthony Hunter, *for and on behalf of The British Historical Society of Portugal.*

PS. As an Appendix to this letter I would like to give any help I can to any Sapper who visits Portugal for any purpose! My private address and telephone number are: Lieut Colonel A D Hunter DSO, 5 Largo da Caracota, 2710 Sintra. Portugal. Tel 2930070

Book Reviews

HOW TO ORGANIZE EFFECTIVE CONFERENCES AND MEETINGS

DAVID SEEKINGS

(Published by Kogan Page Ltd London: Price £12·00)

Major D A L Seekings retired from the Corps in 1978 and is now an independent consultant and organizer of all types of event from large international conferences and displays to small company meetings and training programmes. Although conferences and meetings can be big business, this book is designed to help anyone who has to arrange a meeting large or small, public or corporate, long or short. Every aspect is dealt with, how to approach the task by considering Why? What? Who? When? and Where? It then goes on to discuss the programme, speakers, presentation and production.

The book is well written and the check lists at the end of each section are most useful. Those involved in arranging conferences and meetings will find this book a good investment.

EEP

THE WORKS OF ISAMBARD KINGDOM BRUNEL

EDITED BY ALFRED PUGSLEY

(Published by Cambridge University Press: Price £9·50)

A Group of engineers, each distinguished for work in one of the many fields covered by Brunel, have joined together to pay tribute to him by describing his major works and critically examining them in terms of the engineering knowledge of his time and today. For this purpose they have sought out relevant contemporary documents and drawings, and in particular have benefited from a study of the Brunel papers held by the University of Bristol.

It proved impracticable, in a book of this size, to consider his every engineering activity but all his major works have been treated in some detail and reference is also made to his dealings with his staff and his theoretical work.

Sir Alfred Pugsley, Emeritus Professor of Civil Engineering at Bristol University, is to be congratulated on producing such a balanced and fascinating account of the work of the giant among nineteenth-century engineers.

EEP

HISTORY OF WORLD WAR I AND II—TIME CHARTS

KEITH SIMPSON AND JOHN PINLOTT

Published by The Daily Telegraph. Order from Dept WW, 135 Fleet Street, London EC4P 4BL. Price: WWI Time Chart £6·15 standard, £11·15 deluxe; WWII Time Chart £6·15 standard, £11·15 deluxe; Pair of WWI & WWII £9·35 standard, £19·15 deluxe)

For some years now *The Daily Telegraph* has been producing history charts of a very high standard. These two charts, WWI and WWII, are well up to standard as one

would expect as the authors are lecturers at RMAS.

They enable the reader to explore in parallel month by month, the military, political, social and technological developments of the two most traumatic wars in World history. They clarify the causes, acts and effects of the two World Wars. The charts are divided into bands, each covering the various theatres of war, politics and social events. Each date and description is plotted in exact time scale. Each is illustrated with over 80 original photographs and with specially drawn maps.

The charts are 60in wide by 36in deep, printed in full colour on one piece of high quality paper and are supplied rolled in a stout cardboard tube. The Deluxe Edition, not seen by the reviewers, is laminated on both sides for lasting display.

Herein lies the rub. The charts are large and could not be smaller and retain clarity. Repeated rolling and unrolling and use of the tube will damage the standard version at the edges. There can be no doubt that they are a good buy if the size is acceptable.

JTH, CTPH, EEP

THE GATHERING WOLVES

ELIZABETH DARRELL

(*Published by Hodder and Stoughton. Price £6.95*)

THIS is an exciting novel. It paints, with a broad brush, what the Corps achieved, in the days of "stick and string" bridging and use of spars, by determined improvisation. There are no other engineer lessons but I hope "Knots and Lashings" are still taught to Combat Engineers!

There is a strong trend of romance running through with few details omitted. From our young Officer hero's point of view it ended that he was "well out of it". An over-sexed Russian *aristo* might have proved hard to live with in spite of her sterling qualities, so sympathetically described.

Obviously a competent engineer with much "trench-warfare" experience, Paul was typical of the splendid influx to the Corps of Temporary Officers. Without these heaven help the Army in two World Wars. In particular I must mention the then (1919) Chief Engineer in Archangel, a civil engineer of distinction between each War from South Africa on. Ralph Stokes bobbed up again twenty-one years later as Chief Engineer in Norway. Of him we should be particularly proud. (See Memoir *RE Journal* March 1980.)

The book should also be read on account of the objective way the reasons are given for the 1917 Russian Revolution. This of course led up to our forces being, at the time of the story, in North Russia. Failure in Man Management on behalf of the Russian hierarchy (who preferred speaking in French rather than in their native tongue) might be an over-simplified factor. Certainly the difference, with one noble exception, of handling men between us and the Russians is marked. The Czarist Regular Officer had no hesitation in shooting out of hand a suspected subordinate.

This reminds me of a story told me by Eric Bolton, a contemporary of mine at the Shop, now alas dead, also serving with NREF. He spoke Russian and was attached to a White Russian Engineer unit who subsequently mutinied. On reaching billets of an evening Eric would ask the Russian CO where the men were to feed and sleep. "Why worry", was the reply, "they are dogs and will fend for themselves".

I must comment on the weather conditions in North Russia, which helps to make Mrs Darrell's tale the more grim. In point of fact by the time we evacuated Archangel there had been no snow or ice. Nor were *all* the Russians who so wished given transport out of the country. I can picture the women weeping on the quay as our troopships and accompanying tenders pulled away.

Forgive me Madam, and I do commend your book, but surely August 1914 was the last occasion where British Officers took their swords on Active service. So here Paul would not have had one with which to join the festivities.

I can also picture a *Prasnyk* at Lyavla (I tried to reconstruct defences there!) where "the dancers would draw all the peasants into their circle—the girls in their kerchiefs

and the young men with fire in their blood".

Then how sad, if it is true, in times of real crisis, in the words of Olga Swarovsky—"You can trust nobody". This to me makes it a most moving and thought-provoking book.

CEFT

MONTY

NIGEL HAMILTON

(Published by Hamish Hamilton. Price £12·00)

FEW member of the Corps are aware that in the *RE Journal* of 1937 appeared a prophetic study *The Problem of the Encounter Battle* written by a controversial character: Colonel (temp Brigadier) Bernard Montgomery, then aged fifty. Monty wrote en route to the UK from the Quetta Staff College where, as an instructor, his merits had been recognised by Major General Guy Williams, a most intelligent Sapper, (General Sir Guy C Williams, KCB, CMG, DSO Chief Royal Engineer 1946–51), who prompted the article.

It was at this time that Gort wrote: ". . . Pandit Montgomery Colonel Sahib is once more holding forth pontifically on the rostrum, while the poor students below catch an odd forty winks. He fancies himself more than ever now, I expect". This splenetic remark represented then a widely held view of the "insufferable Monty". Nevertheless the Commandant reported on him in these terms ". . . had a marked influence on the course, and the students have been fortunate in learning from so experienced and convincing a trainer . . . strong personality and decided views . . . widely read . . . has experience in command and on the staff in peace and war . . . demands a high standard from those under him both of work and of conduct. Outstanding . . . fitted now for promotion to Major-General".

How fortunate were we and our allies that, despite the immense animosity that Monty continually aroused, he was to find himself only five years later placed at last to answer the call for which he had so diligently prepared and which, he was convinced, would inevitably come to him. Yet throughout his service until the very moment of Gott's death, the odds against Monty finding himself in that key position appear now as well-nigh insuperable.

He created enemies on every side. Even as a lad in World War I he "knew the answers", and said so to his superiors as well as to his subordinates! In the years of peace, his single-minded concentration on the profession of arms endeared him little to the military "establishment", which set store unduly on those talents which could best be displayed in the hunting field or at house parties where the pheasants were plentiful. To make matters worse, the lucid thinking of the "Pandit" was accompanied by an insufferable cockiness which, although useful as a pedagogue's tool, appeared in a wider context as a most distasteful trait.

Severely wounded and almost left for dead in World War 1, which he finished as a brevet Lieut Colonel, he nearly died again in 1938. All the mistakes on the Somme and at Passchendael, in Ireland in the twenties, and in Palestine, India and Egypt had been observed and codified by him and, in 1939, he emerged as a military thinker and trainer head and shoulders above his contemporaries, but still undervalued by his superiors save one. It was Alanbrooke who understood his temperament and appreciated his outstanding talent; not only did he save Monty from the "scandal" of his instruction on VD—a potential disaster at the time, disproportionate now to modern eyes, he also worked unceasingly on Churchill to place Monty in command of Eighth Army.

It is this theme "The Making of a General" that turns this long first volume into an epic which is enthralling quite apart from the high drama of Dunkirk and Alamein. After those long years of studious preparation, developing a self-confidence which, surprisingly to some, was quite genuine and, indeed, was fully justified at Dunkirk, Monty had no doubt that he would himself receive the call to lead the British Army to

victory. With so many obstacles ranged against him: physical frailty, animosity in high places fuelled by his manifest disregard of authority, his lack of the accepted social graces and most important of all Churchill's undervaluation, nothing but total crisis could have produced the opportunity; and when the call came none but he could have answered it. As a witness of his arrival in the Desert, that has always been my opinion; it is reinforced by everything in this profound book. This definitive biography should lay to rest for ever the myth that credit for the victories of Alam Haifa and Alamein should be shared with Auchinleck.

Nigel Hamilton, a young votary of Monty's, has steered most successfully between the pitfalls of adulation on the one hand and myth-based condemnation on the other. With access to a vast amount of new material, patiently researched, he has produced a biography which is candid, accurate, humorous and mature. The humanity of his hero, so often doubted by those who did not know him, at last shines through. The carapace which purposely he used to obscure emotion at times of duty was never more apparent to me than when I had to report to him, twelve hours after the Alamein victory that Dick Carver his stepson, was missing. I was ordered at once without comment or question "to replace him". This, I now know was the same boy to whom in 1937 his stepfather, seeking sympathy, had written with undisguised emotion when "the light of his life had gone out". He was not on duty then, and the windows of his soul were open.

Readers of this book will find the vividness and skilled analysis of the military scenes remarkable, the more so from one who had never attempted military history before. My only regret is that the author has taken a few paces along that path of amateur psychology now well-worn by Lord Chalfont. The "Master" whom I served and to whom I said goodbye only a few weeks before his death was vain and eccentric; he found it hard to be magnanimous to his equals and superiors and, on many occasions, his treatment of his family was incomprehensible. But to trace these defects to a schizoid condition created by the lack of maternal affection is to my mind, unlike all else in this book, not proven.

To those who served him well and were not "near the throne", he was a superlative commander who in almost every case won their loyalty, intense admiration and—not generally known—their deep affection.

The book has lessons for every generation: the appalling level of incompetence to which Britain can sink: the need for a discomforting realism if disaster is to be avoided: the realisation that the fighting man is more important than his machine: that the British soldier well led will work miracles: that leadership demands not only professional ability and the self-confidence that should go with it, but also the ability to communicate that confidence to every private soldier.

CLR

ELEMENTS OF FOUNDATION DESIGN

G N SMITH AND E L POLE

(Published by Granada Publishing Ltd. Price £10·75 hardback; £6·95 paperback)

THE authors, both lecturers in Civil Engineering at Heriot-Watt University, assuming a basic knowledge of soil mechanics, have set out to provide a description of recent developments which have occurred mainly in the field of foundation engineering.

In addition to a clear exposition with good diagrams they use worked examples to improve and consolidate understanding.

Military Engineers will find the Chapter on Reinforced Earth of particular interest.

EEP

BOOK NEWS FROM INSTITUTION OF CIVIL ENGINEERS

All books in this section are published by Thomas Telford Ltd and are obtainable from Marketing and Sales Dept, Thomas Telford Ltd, 1–7 Great George Street, London SW1P 3AA.

CIVIL ENGINEERING HERITAGE: NORTHERN ENGLAND

edited by M F Barbey: Price £9·75

WITH the growing interest in the engineering structures of the industrial age, this book seeks to give expert and informed guidance to the background of many of our bridges, railway viaducts and other engineering structures.

The eight areas of the book are each prefaced by a map showing the general location of sites and a short history of civil engineering development in the area. Many of the subjects are illustrated and grid references show their exact location. The works selected also provide an indication of the scope of civil engineering involved and of the way in which it has contributed to the social and economic development of the surrounding area. The book thus enables both technical and non-technical readers to appreciate the importance of works which might otherwise be taken for granted.

LONDON DOCKS 1800–1980: A CIVIL ENGINEERING HISTORY

Ivan S Greeves: Price £12·50

THE history of the civil engineering works which have gone into the making of the Port of London provides a fascinating record of achievement and disappointment, of competition and co-operation over nearly two centuries. From the early 19th century to the present day there have been constant changes to meet the economic requirements of the time caused by increases in ship size and alterations in handling systems, and it has been up to the civil engineer to provide new, or modify old, structures to meet these demands. This book provides the first history of the port to concentrate on the engineer's contribution particularly in dealing with the problems met during the construction both within the upper docks and down river at Tilbury. Copiously illustrated, often with contemporary photographs, this book gives a unique insight into the changes which have occurred.

The history, although written from an engineer's point of view, is not highly technical and provides fascinating side-lights on some of the incidents which have occurred during the work. The use of the docks for constructing the Mulberry Harbour Units is described.

I recommend you read this book and then take a trip down the river—you won't regret it.

TWENTY YEARS OF BRITISH MOTORWAYS

Proceedings of a Conference in London: Price £20·00

THE aim of this book is to review developments in the motorway programme since it began in the 1950s. It assesses the impact of motorways on transport in Britain and on the economic and social life of the country. It also considers what lessons the past twenty years has for the future.

Your reviewer found this book of considerable interest.

SMALL COMPUTER SYSTEMS AND THEIR APPLICATIONS IN CONSTRUCTION

Proceedings of a Conference in London: Price £11·00

THIS book discusses the modern Micro-computer, which is now sufficiently robust to be a site tool, although its many integrated site uses have yet to be fully developed. The state of the art and of the market are considered, concentrating on the use of technology to minimize total cost of ownership. The book also describes a particular site application of the Project Cost Model system, and an approach to short term planning and control using an on-site mini computer is explained. The book then

discusses the need to provide appropriate programmes at acceptable prices, and a final section approaches the question of the use of small computers from the human point of view.

THE ENGINEER AND CONSTRUCTION CONTROL

W I Elsby: Price £4·50

MOST conditions of contract for construction work give wide powers to the engineer responsible for the project, but the way he exercises these powers can be crucial in completing the work to the satisfaction of all parties. The same basic "rules" are equally true for military engineers responsible for works. This book provides a step-by-step system for control and discusses how it can be put into operation. It gives practical guidance with examples on the means available to engineers to reach decisions and to ensure that they are carried out.

PQEs and CWs might find this very useful particularly if they are involved in contract work.

WATER RESOURCES—A CHANGING STRATEGY

Proceedings of a Conference in London: Price £18·00

THIS book discusses the steps taken by engineers to resolve the wide range of problems in selecting water resources and timing their introduction and their management. It covers the role of water resources in national development; the assessment of need for water resource development; water resource development itself; operational aspects of water resources; water quality and environmental aspects and the financing of water resource development.

Of no direct value to the military engineer it is worth reading as part of general engineering education.

RECENT DEVELOPMENTS IN THE DESIGN AND CONSTRUCTION OF PILES

Proceedings of a Conference in London: Price £24·00

AN important new volume covering piling developments in the following areas: mechanically jointed precast piles; bored piles in unstable ground conditions; the lateral loading of piles; protection and precautions required in aggressive ground conditions; ground displacement due to pile driving; behaviour of deep foundations in granular soils; minimising noise and vibration in piling; the effective stress analysis of piles.

A book for the PQEs and not for general consumption.

ICE WORKS CONSTRUCTION GUIDES

A SERIES of pamphlets or short guides to basic construction practice. Written by senior experienced engineers, the guides are designed to aid young engineers in the transition from the university environment to work on site, whilst also providing a basic introduction to the subject for those approaching it for the first time. Each deals succinctly with the terms used, the purpose of the technique and the most appropriate choice of equipment or procedure to suit the kind of conditions which a newcomer to the subject may be meeting for the first time.

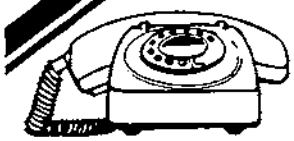
Unit Libraries, YOs and JOs might find this series very useful. The first three of the series are:

PILE DRIVING, by W A Dawson. *Price £2·00*

ACCESS SCAFFOLDING, by C J Wilshere. *Price £2·00*

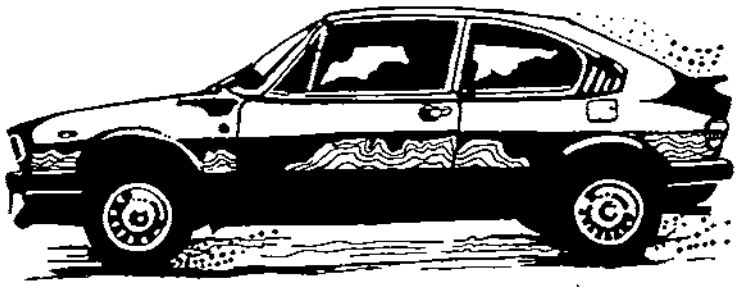
EARTHWORKS, by P C Horner. *Price £2·50*

Dial 0602 411991



For a new car

That's the number of Naafi's expert car sales and finance force at Nottingham — the people who, if it's humanly possible, will get you the car you want at a price you can afford. They can organise discounts, HP, quick easy insurance and all the other benefits that make up our very special service. Written quotations will be provided on request.



It's a wonderful way to buy a car
So ring Naafi now!

SCORPION

Designed and developed to meet the challenge of the 1980's—the Scorpion family is probably the most versatile and exciting range of armoured fighting vehicles ever conceived.

Scorpion fulfils the British Army specification for a fast, highly manoeuvrable combat and reconnaissance vehicle capable of sustained operation, day and night, in virtually any climatic conditions—and on almost any terrain.

The Scorpion is just one of a family of seven vehicles all based on the same basic concept—and all use the same engine, transmission and suspension for optimum interchangeability and to reduce to a minimum the duplication of spares. Its members include: Spartan—armoured personnel carrier; Striker—armoured guided weapon carrier; Sultan—armoured command vehicle; Samaritan—armoured ambulance; Samson—armoured recovery vehicle; Scimitar—armoured 30mm gun, anti-APC vehicle.

The supreme versatility of the design enables the building of armoured fighting units in configurations to suit any specific purpose—complete with all necessary command and support vehicles. And with major spares and service facilities common to all vehicles.

ALVIS

a force to be reckoned with . . .

ALVIS LIMITED HOLYHEAD ROAD
COVENTRY ENGLAND