THE ROYAL ENGINEERS JOURNAL

AUGUST 1996 VOL 110 NO 2

Guidelines for Authors

The Editor is always pleased to consider articles for publication in the *Journal*.

Guidelines for prospective authors are:

Subject. Articles should have some military engineering connection but this can be fairly tenuous, especially if an article is well written and interesting.

Length. Approximately 4500 words plus illustrations.

Copy. Ideally one copy of the text should be submitted, together with a head and shoulders photograph of the author plus a short pen picture.

Clearance. Articles must be cleared by an author's CO where applicable.

Computers. Articles submitted on 3½in discs are very welcome. Please ensure that text is typed with no formatting, ie LH justified only, and please NO caps-only headings – all upper and lower case.

Copyright. If an article has been published elsewhere before being submitted to the Institution, copyright clearance must be sought by the author; where necessary copyright clearance on photographs, maps or illustrations must also be obtained prior to submission.

Photographs should be of good quality with sharp definition, and don't forget to add appropriate captions. Please do not submit laser/photo copies of photographs for publication.

Rewards can be generous. The Publications Committee has about £350 in prize money to allot for each issue plus valuable annual prizes. All authors receive £10 to help cover costs.

Pseudonyms will not be revealed by the Editor under any circumstances.

Contributions should reach the Editor by:

14 October for the December 1996 issue
Early February for the April 1997 issue
Early June for the August 1997 issue

Submissions before the deadline are particularly welcome.

INSTITUTION OF ROYAL ENGINEERS

Established 1875
Incorporated by Royal Charter 1923

Patron: HER MAJESTY THE QUEEN
Chief Royal Engineer: General Sir John Stibbon KCB OBE

COUNCIL

PRESIDENT

Major General K J Drewienkiewicz ... 1994

VICE PRESIDENTS

Colonel A F George *TD* ... 1990
Major General D A Grove *OBE* ... 1995

MEMBERS

Ex Officio	*EinC(A)*	Brigadier I D T McGill	
	D Engr Sp	Brigadier C C Galloway	
	D Mil Svy	Brigadier P R Wildman *OBE*	
	Comd Engr LAND	Brigadier A S Craig *OBE*	
	Comdt RSME	Brigadier R Pridham *OBE*	
	Regt Col	Colonel R J Sandy	
	Col PB7	Colonel P A J Sheridan	
Elected		Brigadier G Hyde	1994
		Lieutenant Colonel T P Grimshaw	1994
		Colonel M B Mounde *MBE*	1995
		Lieutenant Colonel D W Lewis *OBE TD*	1995
		Lieutenant Colonel B H Stafford *BEM*	1995
		Lieutenant Colonel J D Wootton *MBE*	1995
Coopted (non-voting)	*Corps RSM*	Warrant Officer Class 1 I L George	
	Secretary	Colonel M R Cooper	1994
	Treasurer	Lieutenant Colonel R F Wilsher	1996

Corresponding Members

Colonel T R Bradwell *OBE* , BLO Fort Leonard Wood, USA
Lieutenant Colonel P W Clarke, BLO Pionierschule, Munich
Major R C F Braybrook, BLO Engineer School, Angers
Major E J Ward, Exchange Appointment, Australian SME
Captain A P J Barr, Exchange Appointment, Canadian SME

PUBLICATIONS COMMITTEE

Ex Officio	*D Engr Sp*	Brigadier C C Galloway	*Chairman*
	Regt Col	Colonel R J Sandy	*Vice-Chairman*
	Col Engr Svcs	Colonel N Munro	
	RO1 Training RSME	Lieutenant Colonel R N C Smales *OBE*	
	Surveyor	Major P J Smith	
	Editor RE Journal	Colonel M R Cooper	
Elected	*Senior serving officer*	Colonel I S Mercer *CBE*	1993
	Senior retired officer	Colonel M J Payne	1993
	TA officer	Lieutenant Colonel D W Lewis *OBE TD*	1995
	Asst Editor RE Journal	Mrs J D Scanlan	*Secretary*

INSTITUTION OF ROYAL ENGINEERS' STAFF

Secretary:	Colonel M R Cooper	Tel: ATN 766 (BT 01634 842669/82) 2298.
Assistant Secretary:	Mrs J D Scanlan	Tel: ATN 766 (BT 01634 842669/82) 2299.
Administrative Officers:	Mrs M Bassett/Mrs J Ellender	Tel: ATN 766 (BT 01634 82) 2397.

All correspondence in connection with editorial matters should be addressed to the Secretary, Institution of Royal Engineers, Ravelin Building, Brompton Barracks, Chatham, Kent, ME4 4UG

The Institution of Royal Engineers is Registered as a Charity Number 249882

BLESMA

BRITISH LIMBLESS EX-SERVICE MEN'S ASSOCIATION

ARE YOU ELIGIBLE FOR HELP?

BLESMA is a National Charity specifically for limbless Ex-Service men and women. The Association also accepts responsibility for the dependants of its members and, in particular, their widows.

BLESMA wants to help 5,000 more eligible men and women. The Association promotes the welfare of men or women who have lost a limb or limbs or one or both eyes as a result of service in any branch of Her Majesty's Forces or Auxiliary Forces and to assist needy dependants of such Service limbless.

BLESMA CAN HELP:

Provide permanent residential and convalescent holiday accommodation through its two nursing and residential Homes at Blackpool and Crieff in Perthshire.

Provide financial assistance to Members and Widows in the form of Grants.

Assist in finding suitable employment for Amputees.

Furnish advice on Pensions, Allowances, makes representation to Government Departments on individual entitlements and, where necessary, represent Members and their dependants at Pensions Appeal Tribunals.

A LEGACY MEANS A LOT TO THE LIMBLESS

Help the disabled by helping BLESMA with a donation now and a legacy in the future. We promise you that not one penny will be wasted.

For further information contact:

HQ BLESMA, Dept. REJ, Frankland Moore House, 185-187 High Road, Chadwell Heath, Romford, Essex RM6 6NA

Telephone: 0181 590 1124 Fax: 0181 599 2932

Registered as a Charity under the Charities Act. 1960. No. 207621

OUR REF 500840

ISSN 0035-8878

THE ROYAL ENGINEERS JOURNAL

© Published in April, August and December by the Institution of Royal Engineers, Chatham, Kent, ME4 4UG

Printed by Staples Printers Rochester Limited, Neptune Close, Medway City Estate, Frindsbury, Rochester, Kent, ME2 4LT

Volume 110 August 1996 No 2

Contents

Annual Report to the Corps by the Engineer in Chief (Army)

Introduction

I FREQUENTLY find myself having to remind audiences around the Corps that, in these times, change is here to stay and there is only one way to tackle it; that is in terms of the opportunities it offers. The Corps has always excelled in seizing the initiative and I find we have been doing so throughout this last year.

Readers of the *Statement on Defence Estimates* will have noted that the Corps' operational tour interval has, once again, been the lowest for the Army at only 11 months for 1995/96, with little alleviation forecast for 1996/97 at 12 months. This reflects a Corps that is offering considerable opportunities to do the work we joined to do and to show how vital a defence asset we are, with the versatility to work across the full spectrum of operations from soft to hard security; nation building to war fighting. I will return to Bosnia and our other operations later but would note here that despite these pressures our manning and recruiting position remains healthy, although I am not complacent. Nor am I oblivious to the mounting pressure on the members of the Corps and their families resulting from such a short operational tour interval. Considerable work is done by engineer commanders at all levels and within the Ministry of Defence to ensure that we do not take on unnecessary tasks, exercises or projects. In fact as I report further on, we have had to turn down a number of attractive and challenging projects this year which under other circumstances we would have taken on. I am concerned as to how we sustain our current level of operational tasking and achieve a proper balance between our training and operations.

The first task I set myself as Engineer in Chief (Army) was to produce a Corps development strategy which would make visible to all, the direction in which the Corps of Royal Engineers was heading. I canvassed views across the Corps and from our serving senior officers to ensure that not only was I able to draw on their considerable wisdom and experience but also to give some "ownership" of the strategy to those who would be responsible for seeing it through in the coming years. The *Strategy and Mission Analysis* was published in February and has been widely circulated round the Corps.

There are two areas of work within my own Headquarters which deserve early mention and which result directly from the development strategy. The first is the establishment of a public relations focus within Engineer 1, which branch I have directed to develop a public relations strategy for the Corps. The second is Engineer 2's work on developing a doctrine for the Corps' role in "building the peace." Our current operations in Bosnia have brought this role into sharp focus and we have much to offer in the way of expertise and experience from within the regular and territorial army ranks of the Corps.

Operations and Deployments

Former Republic of Yugoslavia (FRY). Royal Engineers' operations in FRY make a complicated yet fascinating story in the finest traditions of the Corps. There are accounts of ingenuity, initiative, determination, persistence and bravery. Last year's report left a cliff-hanger with 35 Engineer Regiment at reduced notice to move to Bosnia, for the second time in 12 months, to provide a "get you in" package for 24 Airmobile Brigade. However, that was just the start and the account will be clearer if, with the benefit of hindsight, I break it up into the five subsequent phases.

I. **Situation August to December 1995.** In August, 21 Engineer Regiment, with 1 and 4 Field Squadrons, 7 HQ Squadron, 519 Specialist Team RE (Works) and a detachment from 49 Field Squadron (EOD), was the Operation *Grapple* BRITENGBAT with the UN Protection Force. The hostage crisis had developed in June and the Anglo/French Rapid Reaction Force was being prepared to deploy as the response to that escalation.

35 Engineer Regiment with 44 HQ Squadron, 37 and 42 Field Squadrons reinforced by 45 Field Support Squadron and 522 Specialist Team RE (Works), was deployed to the infamous Ploce dockyard camp in August to provide a main administrative base for the 3500 personnel of the brigade and the Combat Service Support Group (UK) that was required to support the increased deployment of UK troops on Operation *Grapple*. The work completed included the provision of tented accommodation and temporary ablution areas, an emergency bulk-fuel installation, the brigade command and control complex, an explosive storage

area, the aviation battlegroup's hardstanding and many other support services and facilities. Particularly notable was the work required to provide support facilities for the largest Army Air Corps deployment ever undertaken. Winterization of the facilities was also a main effort for the regiment, which completed an astonishing amount of work, before departing in November 1995.

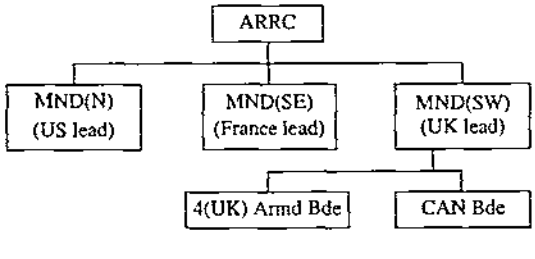
51 Field Squadron, 24 Airmobile Brigade's integral RE support, deployed with its parent brigade and was committed to get-you-in work alongside 35 Engineer Regiment. Unlike the regiment and the brigade, 51 Squadron did not leave the theatre at the end of November but stayed on for a further, cold, four weeks to complete fortification and winterization tasks on Mount Igman.

Support was also provided to the HQs of 24 Airmobile Brigade and the Rapid Reaction Force operational staff by two detachments from Military Survey.

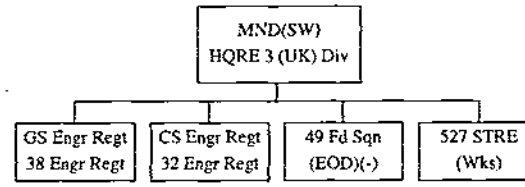
A further, but most significant, element of the force enhancement was the deployment of a strong 6 Troop, 31 Armoured Engineer Squadron. In the event that the situation had deteriorated and a break-in operation into Sarajevo, or one of the enclaves, had become necessary then these armoured engineers would have been the lead element. Once again we are reminded that there comes a time in war when Sappers have to go in front to open up the way. "Follow the Sapper" is a timeless cry.

The deployment of the Rapid Reaction Force signalled a clear intention to the warring factions and created the conditions that allowed the Dayton Agreement to be brokered and the Peace Implementation Force (IFOR) to be deployed.

II. Transition from *Grapple* to *Resolute*. In October 1995, 38 Engineer Regiment had deployed with 5 and 11 Field Squadrons, 15 Field Park Squadron and 527 Specialist Team RE (Works) to take over from 21 Engineer Regiment as the final Operation *Grapple* BRITENGBAT. Again a tremendous amount of work was completed and an invaluable part of the regiment's task was to pave the way for IFOR's deployment over Christmas and New Year 1995/96. The land element of IFOR was based on HQ Allied Rapid Reaction Corps (ARRC) and consisted of three multinational divisions (MND) led by the USA, the UK and France respectively:



The deployment of the IFOR represented a change in gear for all the UK Army elements, not least of all the Royal Engineers. 38 Engineer Regiment became the divisional general support engineer regiment. 32 Engineer Regiment with 2 HQ Squadron, 26 Armoured Engineer Squadron and 77 Armoured Engineer Squadron in the mechanized field squadron role, deployed to provide close support to 4 Armoured Brigade; and 49 Field Squadron (EOD), and 527 Specialist Team RE (Works) redeployed as divisional troops of the Multinational Division South West which was headed up by HQ 3 (UK) Division. The organization of the UK Engineer forces was:



The deployment began in earnest over Christmas and the primary task was the provision of accommodation for the 10,000-strong UK land contingent. Operational requirements and procurement staff worked long hours over the Christmas period preparing and responding to urgent operational requirements for the accommodation required. Prefabricated camps for some 4250 soldiers were designed and procured in a little over 14 days which was a remarkable testimony to the drive and determination of the staffs involved. HQ Engineer Resources and Central Engineer Park played a vital role in this work, and similarly in support of all our operational deployments which should not pass without acknowledgement.

Unlike the MNDs, HQ ARRC did not have a "parent" nation to provide its corps-level troops. As the UK is the framework nation for HQ ARRC, the key HQ engineer staff, including the CE, are Royal Engineers. For the IFOR deployment some enhancements were deployed from the UK and other nations. As corps troops we deployed 62 CRE (Works) and 523 Specialist Team RE (Works) to provide the essential design facility at corps level. However, it was left to the CE to assemble his own corps-level field engineers and it is a credit to him that by sheer dint of personality and determination he persuaded several nations to provide the troops he needed. Going from capital to capital he "begged, borrowed and stole" his force. At the time of writing he commands a unique multinational grouping of some 1700 engineers from Hungary, Romania, Germany, Belgium and the UK; a makeshift civilian field park for first-line engineer stores; a very able design capability from our own Military Works Force; and a geographic support group (GSG) provided by 14 Topographic Squadron.

The GSG provides a full production capability for maps, digital and psyops products. Additionally, detachments from the squadron are deployed to support HQ IFOR, HQ ARRC, HQ Communications

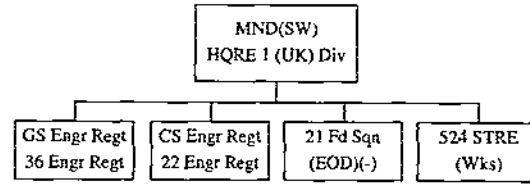
Zone Forward and each of the three HQ MNDs. Finally, 19 Specialist Team RE was deployed in support of the Royal Artillery's IFOR contingent. This considerable commitment meant that some 70 per cent of the field element of Military Survey was committed to Operation *Resolute*

III. Engineer Achievements of IFOR (so far). In theatre the tasks built up quickly with freedom of movement for IFOR and civilians as the priority. Snow and ice clearance was an obvious requirement but put out to contract as quickly as possible. Locating and marking of minefields required ingenuity, patience, close liaison with the troops of the former warring factions, as they are known, as well as courage and skill. Construction of bridges to open up routes quickly gathered a considerable momentum and in the last six months we, along with our Hungarian, Romanian, US, French and German colleagues, have built a vast variety of bridges throughout Bosnia. The IFOR nations' sappers have built Bailey bridges, Mabey Johnson bridges, railway bridges, floating bridges, armoured engineer bridges, in single and combination format, and improvized timber bridges. The real effort, of course, is aimed at returning the country to normal life which, while not a military task per se, begins with the military, and more specifically the Sappers, "building the peace". In this respect the initiative of Royal Engineers within MND(SW) as well as at HQ ARRC has been vital. Discussions with the World Bank and the Overseas Development Agency (ODA) and other such organizations, have been held to open the way for reconstruction to begin. Additionally, the OC Engineer and Transport Staff Corps, joined me on a recent visit to Bosnia to identify what assistance could be provided from that element of the Corps.

In a minute Baroness Chalker sent to the minister for the armed forces following her visit to Bosnia in May, she stated, under the heading, reconstruction, "Cooperation between ODA and IFOR in implementing our initiative to kickstart rehabilitation is outstanding. We owe a particular debt to the Royal Engineers. They are working both with ODA and with the local communities on a range of activities from restoration of local water supplies to rehabilitation of schools and clinics."

The presence and threat from mines in Bosnia is a great handicap to our operations. To help combat this, an urgent operational requirement has been endorsed to provide the Royal Engineers in theatre with a route proving and marking system. The system, which is being deployed as I report, will enable the rapid recovery of troops from a mined area, prove routes through areas which may be mined when access is deemed to be operationally essential and prove routes to utilities that serve military bases. Three systems are to be bought. Each will consist of a flail, a mine detection and marking vehicle and two mine protected vehicles to carry an EOD team.

IV. Operation *Resolute* 2. We have completed the first roulement and, in chronological order, 38 Engineer Regiment has now handed over to 36 Engineer Regiment with 50 HQ Squadron, 20 Field Squadron, 69 Gurkha Field Squadron and 61 Field Support Squadron under command. 524 Specialist Team RE (Works) have taken over from 527 Specialist Team RE (Works) to provide the divisional design capability. More recently, 32 Engineer Regiment have been replaced by 22 Engineer Regiment with 6 HQ Squadron, 8 Armoured Engineer Squadron (in the mechanized role) and 3 Armoured Engineer Squadron. (It is good to have been able to deploy regiments with their normal affiliated sub-units; although in both cases you will realize that they are not complete in that a squadron of each has remained at home. While we aspire to continue to deploy regiments with their own squadrons it is not the driver in selecting who goes.) HQ 1 (UK) Armoured Division have taken over from HQ 3 Division, with the respective RE staff, with 21 Field Squadron (EOD) having relieved 49 Field Squadron (EOD). Thus the organization of the UK engineer forces is now:



64 CRE (Works) and 519 Specialist Team RE (Works) are taking over from 62 CRE (Works) and 523 Specialist Team RE (Works) respectively and 13 Topographic Squadron, with supporting elements, are taking over from 14 Independent Topographic Squadron. 39 Engineer Regiment are due to relieve 36 Engineer Regiment in October and then all our field engineer regiments will have completed at least one tour in Bosnia, many two; some individuals have completed three or more.

The Territorial Army's involvement in Operation *Resolute* has been frequently highlighted by the press and in the Corps most TA regiments have had some soldiers called up, although not all have been Sapper capbadged.

V. The Challenge Post *Resolute*. From the intimations of the various political leaders it is quite clear that there will be some kind of force left in theatre post-*Resolute*. The size remains to be determined but we can be certain that it will be multinational and include a UK contribution. We would be short-sighted if we did not plan on a regimental group from the Corps being part of that force

Northern Ireland

In Northern Ireland the period has been dominated by the US support to the peace negotiations, including the visit by President Clinton, and the subsequent breakdown of the cease-fire. On Operation *Descant*, 9 Parachute Squadron took over from 8 Armoured Engineer Squadron and handed over to 53 Field Squadron. During the cease-fire, community relations projects dominated the activities of 25 Engineer Regiment and some of that work has continued in the somewhat incident-free period that has existed since 8 February. However, the emphasis has been squarely on the "resumption of violence" tagged projects, such as the enhancement of the levels of protection of military bases and the insertion of traffic control measures. Other tasks have included range and training area infrastructure tasks at Ballykinler and Magilligan Training Centres.

As with Bosnia, military engineering in Northern Ireland, and in particular community relations projects, remains a key part of the campaign plan to restore the country to normality. There are clear parallels between this element of internal security operations and the "building the peace" task in peace support operations such as in Bosnia.

The Adjutant General noted in his keynote address to my conference this year, that in peace support operations in Bosnia the other arms often support the Royal Engineers and I would contend that the same is true in Northern Ireland.

Other Operations

The Falkland Islands is our other regular commitment on the operational tour plot and 59 Independent Commando Squadron, 34, 29 and 42 Field Squadrons have provided excellent support there over the past year.

Operation *Cornelius* was the clearance of explosive ordnance, including chemical weapons, from the Bramley Training Area near Basingstoke by 49 Field Squadron (EOD), supported by elements of Military Survey, Engineer Resources, Military Works Force and Central Volunteer HQ RE, from May to November 1995. A total of approximately 7000 items were recovered, many of which were live high explosive rather than chemical. Over and above this, 33 Engineer Regiment (EOD) has supported all our major operational deployments as well as regularly deploying on military aid to the civil power operations here at home.

Last year my predecessor reported on the deployment of 20 Field Squadron to Angola on Operation *Chantress* as part of the UN's Angola Verification Mission Phase III. The squadron had a most successful tour during which, in addition to the UN support tasks completed, it was able to undertake a number of humanitarian aid tasks such as refurbishment of the Lobito town water purification system and provision of schooling facilities.

Montserrat has grumbled away, literally, throughout the last year as Chance's Peak volcano threatens a major eruption. While 59 Independent Commando Squadron deployed a troop in August 1995, Military Works Force has deployed individuals and small detachments from time to time as the threat increased. While on Montserrat, the troop of 59 Squadron was able to provide aid after the island was hit by a hurricane. At the time of preparing my report the volcano remained intact, although it seemed certain that there would be an eruption imminently and a section from 39 Engineer Regiment was on 72 hours notice to move.

The RE Air Support Group continued to provide support to the RAF on operations in FRY and northern and southern Iraq. Additionally, we now maintain one of the air support squadrons of 39 Engineer Regiment as the in-role air support squadron. The nominated squadron is the first in line to provide operational or training support to the RAF wherever it may be required. This is yet another example of our wider role in support of defence and not just the Army.

In addition to work in Bosnia, personnel from 19 Specialist Team RE have undertaken survey tasks in Mozambique, Northern Ireland and Lebanon over the last year.

Finally, we have continued to deploy short term training teams to various locations; most recently to Zimbabwe and Ghana in January 1996 to cover combat engineering. The requirement for "just in time" pre-deployment training support from the Royal School of Military Engineering continues.

Projects and Exercises

In addition to the operational deployments, we continue to play a major part in all-arms exercises and to conduct our own projects and exercises, despite our activities here being severely curtailed because of our operational commitments. After being the only arm to take part in every Exercise *Medicine Man* in 1995, we have had to limit our participation on Exercises *Medicine Man 3 to 6* in

1996 to the mechanized elements only. Both Exercises *Sailfish* (Belize) and *Oakapple* (Kenya) have been covered by Military Works Force providing project management with locally employed labour instead of the more traditional squadron-sized projects. Moreover, we have cancelled our participation in the 1996 Army Field Training Centre projects which have now been put out to contract, while the Tidworth Demolition Bridge has been slipped from this year's programme. Similarly, we cancelled this year's Exercises *Seventeenth Shot* and *Northern Quest* in Gibraltar and Norway respectively.

Exercise *Holdfast 96* was a project involving 67 Gurkha Independent Field Squadron, The Queen's Gurkha Engineers, assisting the Royal Nepalese Army Engineers to build a road from Katari to Okhaldunga in east Nepal. I was fortunate enough to visit this exercise and see for myself the superb training value of the project as well as the benefits it brought to the local population. And Exercise *Pinestick* (Cyprus) was undertaken by 60 HQ and Support Squadron which reconstructed and refurbished Bloodhound Camp.

Exercise *Purple Star* was a combined/joint formation training exercise for 3 Commando Brigade and 5 Airborne Brigade on the east coast of the USA. Both 59 Independent Commando Squadron and 9 Parachute Squadron supported their parent formations on this major field training exercise which in many ways was a prelude to the operational readiness of the new Joint Rapid Deployment Force (JRDF) and Permanent Joint Headquarters (PJHQ) at Northwood. Furthermore, we supported many all-arms exercises including two Exercises *Grand Prix* in Kenya, two Exercises *Trumpet Dance* in the USA, three Exercises *Pond Jump West* in Canada and Exercise *Hard Fall* in Norway.

Organization Changes

This year has been one of settling in to new organizations rather than major changes. My own HQ is now well established in its new leaner organization, the Directorate of Engineer Support (Army) has relocated to Andover with the QMG's staff, and HQ RE TA is now in place in Gibraltar Barracks.

The Corps will sponsor the Civil Affairs Group, which the Front Line First Study directed should be established, and it will rely on the Specialist TA and be centred on our Central Volunteer HQ.

Military Survey has seen the formation of the post of Director Geographic Field Support as part of the agency, as well as the establishment of the Field Support Office at 42 Survey Engineer Group. The task of the Field Support Office is to develop new computer systems and manage in-service IT equipment. 16 Survey Support Squadron was formed on 27 September 1995 as the reincarnation of 16 Field Squadron, which had been disbanded when 25 Engineer Regiment re-roled to Northern Ireland.

The UK engineer parks have been subsumed within HQ Engineer Resources and Long Marston has four detachments at Stirling, Ripon, Waterbeach and Longmoor.

Restructuring of the TA is complete but our allocation of permanent staff has not been as large as we had hoped and there is still some equipment redistribution to be completed.

A small addback of 37 posts in the final rounds of *Long Term Costing 96* has allowed us to keep 522 Specialist Team RE (Works) at Hameln and form a new specialist team RE (air support) which will subsume the RE Air Support Group Technical Wing staff and include a new bulk petroleum section; thus meeting one of the major shortcomings of our support to the RAF. The bulk petroleum section of the specialist team will be located with 516 Specialist Team RE (Bulk Petroleum) at Chilwell in peacetime, to allow better training and operational (short of general war) opportunities. 521 Specialist Team RE (Water Development) is also being enhanced to give it a roulement capability. These measures will ease the tour interval pressure within the Military Works Force which has been deploying 50 per cent of its Specialist Teams RE (Works) assets on each roulement of Operation *Resolute*.

The proposed move of Engineer Resources to Chilwell prompted the Engineer Logistic Review which reported at the end of 1995. The major conclusion was that non-core activities for the Royal Engineers should be disaggregated to the appropriate parts of the logistic organization. The implications of this and the work to implement the consequent recommendations are still being worked out as we go to press but the intention is quite clear and that is that the customer at first line should receive an even better service.

Doctrine

Engineer 2's work with the Directorate of Land Warfare on BA 2000, which you were introduced to last year, has centred on the 3-functional area steering groups covering combined

arms, support arms and logistics. An additional forum is the already established Arms and Services Development Group. My staff attend the meetings of these working groups.

Future work on BA 2000 will be through ACGS's development agenda. This agenda will be taken annually by the Executive Committee of the Army Board and will consist of three parts:

- a trend analysis relating to the strategic environment and other factors relevant to defence,
- a set of assumptions against which the agenda for that year will be set,
- the agenda itself which lays out the aim of specific studies – by whom and in what priority.

It is in effect dealing with the management of change and *Development Agenda 96* and will involve us in much work.

Since last year the various doctrine papers being staffed have included:

- *Engineer Support to Peace Support Operations* being published as *Army Tactical Doctrine Note 32.*
- *Command and Control of Engineers within the Division* and *Tactical Handling of VLSMS* being given Army wide circulation prior to publication as Army TD Notes.
- *Tactical Handling of Engineer Recce* being passed to Director Royal Armoured Corps for use as RE input to an all-arms tactical doctrine note on reconnaissance, to be developed during the coming year.
- *Tactical Handling of BR90* and *Engineer Logistics within the Division* still being refined but should be endorsed by the Corps by the end of this year.

The issue of the *Higher Level Doctrine Handbook* is imminent and contains in its initial publication two papers related to engineer matters:

- *Mine Counter-Measure Doctrine.*
- *The Requirement for Future Mine Systems.*

Finally, there has been considerable work on the preparation and staffing of doctrine papers on the following joint/combined service issues:

- RE Air Support.
- Explosive Ordnance Disposal.

Equipment

It has been an exciting year for equipment, especially bridging. We have seen BR 90 close support bridges coming into the training organization. The first of these, the tank bridge transporter is particularly impressive, as the motoring press have already noted, and this bodes well for the remainder of the BR 90 fleet. The general support bridge will appear in units next year and by the end of 1997 medium girder bridge will only be found in support of the airborne, airmobile and commando brigades; elsewhere only in its overbridge form. M3 is now in production and 23 Amphibious Engineer Squadron are preparing themselves for the delivery of the first rigs later on this year. Much publicity has been given to the equipment bridges built in Bosnia by ourselves, the French, the Americans and most recently the Germans and we have now begun the process to find a suitable similar bridge to bring into service by 1998 as our new logistic bridge to replace Bailey (which is only 56 years old!)

The project to replace our Chieftain engineer tanks has been renamed Future Engineer Tanks to reflect that the feasibility study, which is to start shortly, will consider off-the-shelf solutions. A Challenger-based tank remains the most likely replacement.

The good news is that our ageing and very slow Chieftains will be replaced from 2001.

Mines have become a high profile issue with the international campaign to ban land mines and the government's announced intention to work towards a total worldwide ban on the use of antipersonnel mines. The pressure of this new policy requires that we are more than ever sure of our ground when preparing mine procurement policy. Of particular interest in our future mines programme I would draw to your attention:

ACEATM (aimed controlled-effect anti-tank mine) where development is now complete and the long series of proving and evaluation trials of this new side-attack mine has begun. To date it looks a very promising system.

Shielder is the name given to our new vehicle-launched scatterable mine system (hitherto known by its acronym VLSMS) for which a contract for 29 systems has now been let with the US firm Alliant Techsystems which produces the Volcano scatterable mine system for the US army. The system will be mounted on a flat-bed Alvis Stormer and will enter service in 1999. Unlike Volcano, Shielder will not launch antipersonnel mines.

At last a new hand-held mine detector is entering service. The Ebinger Ebex 420 Pi is replacing the aged, if not senile, Mk 4c with which many successive generations of the Corps have become familiar.

There are two mine detection programmes, MINDER (mine detection, neutralization and route marking) and REMIDS (remote minefield detection system). REMIDS is the subject of a technology demonstrator programme lasting five

years which is designed to identify and show the suitability of current technology to meet the requirement to detect surface-laid mines and minefields. MINDER, on the other hand, is being taken forward as a NATO project, at least for the pre-feasibility study which is to report by September 1996. Both these programmes are technically ambitious and the staged approach being taken should be both cost effective and affordable although there is considerable pressure to find a "magic" technological solution.

The explosive ordnance disposal world has taken delivery of the new ASH Database (appropriately named after the veteran bomb disposal officer and EODTIC Custodian, Arthur S Hogben). The major task of loading the system has begun; this will provide the bomb disposal engineer in the field with access to the most up to date information on the munitions he is likely to encounter in the theatre of operations.

The two airfield damage repair projects, armoured heavy wheeled tractor and flush capping, have continued to move forward significantly with tenders being invited for both items; I am pleased to be reporting no programme slippage.

As ever, procurement plans change as projects develop and different options are explored. Thus it is with Terrier, the replacement for the combat engineer tractor, where feasibility studies have since confirmed that an off-the-shelf purchase will not be possible. Development funding has been reinstated in the programme but the need to carry out development has pushed the in-service date back a year to 2006.

Military Survey has a new range of vehicle-mounted container systems coming into service including the geographic support system and a vehicle mounted TACISYS which will provide terrain analysis and digital geographic support to formations.

Digitization is one area where we need to be more pro-active, as Sappers. Our surveyors may be setting the pace here with the latest developments in mapping and terrain visualization but our overall military engineering command and control has some ground to make up in harnessing the latest technology.

Training Issues

The pace of change in the training world continues unabated. Last year General DZ reported on the "miracle of crisis management" achieved by the RSME and this year the school has continued to achieve the near impossible of examining itself in-depth while continuing to run a vast array of courses. The two most significant training issues are the birth of the Army Individual Training Organization (AITO) and the progress of the RE Employment Structure Review (REESR).

The AITO was launched on 1 April 1996 and has responsibility for all individual training conducted within the Army's many schools and training establishments.

The REESR implementation plan, agreed in July 1995, is well underway. A most significant part of the work is the comprehensive analysis of every trade in the Corps, for which we have drawn in 18 WO2s/SNCOs from across the Corps to assist the RE Training and Development Team to complete this work. Commanding officers, squadron commanders, supervisors and tradesmen throughout the Corps have been questioned in detail and their responses used in this in-depth review. Revised combat courses started in mid-1996 and the new trade courses will begin to be introduced from early next year.

At the RSME(Chatham), Command Wing has moved into its new purpose-built facility. At Minley there have been great strides in the development of the training area driven by the Battlefield Engineering Wing. This year has seen the following improvements:

- The construction of an excellent RE demolition training bridge by Military Works Force and 9 Parachute Squadron.
- The construction of a permanent bridging gap adjacent to Hawley Hill by 77 Engineer Regiment (Volunteers).
- The refurbishment of the station training theatre in the SSVC Cinema.

Last year's report introduced the government's competing for quality programme in respect of both Minley and Chatham. The feasibility study for Minley identified contractorization of facilities management as the only likely option, whilst that at Chatham places greater emphasis on the private finance initiative programme as the way ahead. The potential for private sector use of the excellent training and teaching facilities at RSME is obvious and we can expect to see this initiative developing in the coming year. While work has been underway throughout the last year on the duplication of trades and training within the Army, no firm conclusions have been published yet. Similarly, the study into the future options for the RSME is only just getting underway and will not report until November 1996.

One result of the many studies alluded to has been the welcome decision to retain apprentice training. A new Army Apprentice College will be formed in Rowcroft Barracks, Arborfield in September 1996 and, over the following 18 months, it is planned that the Royal Signals, Royal Electrical and Mechanical Engineers, Royal Logistic Corps and Royal Engineers apprentice wings (in that order) will move there. In recognition of the fact that the single entry system is failing to attract enough recruits, the executive committee of the Army Board has commissioned a study into the reintroduction of junior leaders. Initially it is intended only to recruit junior leaders into the Royal Armoured Corps, Royal Artillery and Infantry to address their serious manning shortfalls. However, I shall continue to fight for the Corps to be included thereafter; I am convinced we need them.

A considerable amount of work has been undertaken by my staff to revise our boat operator and watermanship safety officer training to bring it up to a standard acceptable to the Army Department Maritime Inspector. This has now been completed and the requirement is with the Director of Individual Training Policy (Army) and AITO staff for inclusion in the RSME programme. The requirement represents an increase in training and therefore resources.

We are currently overtraining our troop commanders and not moving them into units soon enough. Presently, the RE troop commanders course (RETCC) is 29 weeks long and, because the output from RMAS does not align neatly with the start of the RETCC, troop commanders often have to spend up to five months on a unit attachment before they can join the RETCC. As a result, for those on short service commissions (SSC), one third of their service will be of no direct benefit to the Corps. Work is now in hand to seek ways in which the RETCC can be shortened, with accompanying reductions to pre-course attachments. A reduced pilot course will start in January 1997 and a more thorough review will be conducted in 1997 with a view to introducing the established course in January 1998.

There would be a number of advantages to both the individual and the Corps if officers who complete the professional engineer training courses (PET) at RSME could also gain a weapons staff qualification. Discussions with the Royal Military College of Science (RMCS) and Cranfield University indicate that it may be possible for Cranfield to accredit the PET courses thus allowing graduates to gain a MSc degree which might then allow these officers to compete for weapons' staff jobs with those officers, of all arms and services, who have completed the Defence Technology Course at RMCS. Colonel RSME (Chatham) is leading the negotiations with the aim of achieving accreditation in time for the start of the next PET courses in October 1996.

Manning and Recruiting

Many of you will know that all army personnel matters, except the formulation of policy, will be undertaken from the Army Personnel Centre (APC) in Glasgow by mid-1997. Due to the simultaneous departure of Colonel PB7 and the officer in charge of the RE Manning and Record Office (REMRO) and the imminent move to Glasgow, both branches have been operating under a single branch head, "Colonel RE Manning", since October 1995. Faced with the move to the APC, with smaller staff but better IT, both REMRO and PB7 are taking the opportunity to review their procedures. The aim is to provide a more forward-looking, long-term service which addresses the current and future needs of the Corps and maximizes the potential of its officers and soldiers. REMRO will form the RE Soldier Manning and Career Management Division, part of the mini-APC, in Glasgow from September 1996. It is planned that PB7 join in December 1996, to complete the RE MCM Div. From autumn this year joint officer/soldier unit visits will be conducted.

Officer Manning and Career Matters. Unlike some other arms, the Corps' officer manning state has remained healthy throughout the year. There are some imbalances, with a seven per cent shortfall of subalterns, offset by seconded Canadians, short service volunteer commissioned officers and captains completing troop commanders tours. There is also a shortage of senior majors. The professionally qualified engineer (PQE) roster is healthy, and the past imbalance between disciplines is being made up by increasing numbers attending the electrical and mechanical course. The number of technical posts available for PQE majors and lieutenant colonels has also increased but the majority of majors still compete for squadron command appointments. The garrison engineers appear to be in balance, but this masks a potentially serious shortage of mechanicals. The survey roster looks in good shape, although one

brigadier post has been cut. A career in the survey or PQE stream seems to appeal to sufficient quality officers, and respective MSc and professional engineer statuses are clearly prized.

The current projection for premature voluntary release for officers is that we will remain under the 30 per annum rate, which is a healthy and sustainable figure for the Corps. This does not imply, of course, that PB7 or those in the chain of command can afford to disregard the pressures that may cause the rate to climb.

SSC extensions are now more readily available, and can be granted by PB7. Applications are not merely "rubber-stamped", and quality still rules, but we are keen, where appropriate, to extend officers to complete a further whole tour, and to allow PB7 and the officer to plan ahead to conversion or departure. Conversion from a special regular commission (SRC) or SSC to regular commission (Reg C) remains difficult. In the longer term a single initial commission may be introduced. The trend is therefore firmly towards later and competitive selection for conversion to Reg C being the norm.

The Sapper pink list quota for mainstream officers seems to be settling down at around 14 a year. The special list system has remained the subject of much discussion over the last year; to date there has been no decision on its future other than no change for now.

The late entry (LE) drawdown has now been completed and the LE officer strength of 235 currently matches the manpower planning target for 1997. However, there remains a structural imbalance, not rectified by the redundancy programme, which centres on a surplus of Reg C(LE) majors. This will work itself out in time. The employment of LE lieutenant colonels has generated a great deal of discussion as the majority of LE lieutenant colonels are currently filling established majors appointments. PB7 together with Engineer 1 and other interested parties have recently addressed the issue and are in the process of establishing eight E1 lieutenant colonel posts. In addition, we should expect to fill two E2 appointments. In future, on promotion, LE lieutenant colonels will be posted into an established appointment.

Soldier Manning and Career Matters. The Corps' soldier manning is just in surplus, which is again in marked contrast to other teeth arms; indeed we are the only teeth arm in surplus. The Infantry, the Gunners and Royal Armoured Corps are all in significant deficit. However, it will be no surprise to know that the Corps continues to be short of drivers, combat signallers, fitters heating, ventilation and air conditioning and geographic technician tradesmen. There are no easy solutions to this imbalance but REMRO has been posting our surplus of plant operator mechanics to regiments as drivers and will continue to do so. Clearly, emphasis on recruiting is necessary for these deficit trades, although pay banding for combat signallers is also a well known concern.

Both 9 Parachute Squadron and 59 Independent Commando Squadron are significantly undermanned and have been for some time. Initiatives taken by the squadrons' parent brigades on the selection procedures may see more volunteers qualifying without dropping the standard. However, in order to stem the decline in capability, some blue beret soldiers are being posted to 59 Squadron until the situation improves.

Over the past 12 months there has been a small but perceptible rise in the number of soldiers who have given notice or applied for premature voluntary release. This may imply dissatisfaction with tour intervals. However, this is set against a number of soldiers who have asked to withdraw their notice (16 in the past four months). I conclude that while there is potential for losses to reach serious levels, the current position is manageable but we must monitor it carefully.

From April 1997 all private soldiers, including sappers, will have an annual confidential report. It is to be completed by an officer, or exceptionally by a warrant officer, and is to be held in the unit P File until the soldier is promoted to lance corporal, when the reports will be sent to RE MCM Div.

Recruiting of our soldiers is considerably better than all other parts of the army, but is still approximately five per cent under our manpower target, which disguises the problems in specific trades referred to earlier.

Regimental Affairs

Major General F G Sugden CB CBE was appointed Representative Colonel Commandant for 1996. The following were appointed Colonels Commandant: Major General G W Field CB OBE in March 1996 and Major General P J Sheppard CB CBE in April 1996. The Right Honorable the Lord Goold, Brigadier J N H Lacey OBE and Lieutenant Colonel R B Hawken were appointed respectively as Honorary Colonels for 71 (Scottish), 72 (Tyne Electrical Engineer) and 75 Engineer Regiments

(Volunteers). Major General A D Pigott CBE assumed the appointment of Colonel, The Queen's Gurkha Engineers. Colonel R J Sandy has taken over as Regimental Colonel.

We have had few national events this year other than the Gulf War memorial service at St Paul's Cathedral which the representative Colonel Commandant and other members of the Corps who had served in the Gulf attended. As a Corps we celebrated our long association with Gibraltar by establishing a formal alliance with the Gibraltar Regiment and marking the occasion with a parade which the Chief Royal Engineer and I attended. The Corps was represented on parade by 127 (Sussex Yeomanry) Field Squadron (Volunteers) of 78 Engineer Regiment (Volunteers) and the Corps band. Two sad events were our farewell to Nienburg when 21 Engineer Regiment moved to Osnabrück and the final closure of the Mobile Civilian Artisan Groups. The Chief Royal Engineer, accompanied by the Regimental Colonel, attended parades marking both events in March this year and then in May the celebration of 28 Engineer Regiment's 25th anniversary. We will mark the disbandment of 67 Gurkha Squadron in Hong Kong on 6 September 1996 at a parade to be attended by Major General A D Pigott CBE and the Regimental Colonel.

A small but significant addition to army and Corps dress regulations is the formal adoption of the MacLaren tartan by 76 Engineer Regiment (Volunteers).

Development of the museum courtyard is continuing and will house a display of Corps history covering the period since the end of World War Two. The courtyard display will be opened officially on 3 October 1996. The raising of private finances to provide for the future running of the museum continues and has now reached a total of some £160K. We have a museum of which to be proud. All officers are encouraged to support the Corps museum by visiting, encouraging others to visit and by general donation which, because of its charitable status, can be gift aided or covenanted.

Staying with funds, the Corps Treasurer, Lieutenant Colonel A J Hicks, retired in July 1996 after seven years in the appointment. He has done a great deal to consolidate and improve the Corps' funds. Over recent years the annual subscription to Corps Funds has fallen as the numbers in the Corps have reduced, but prudent investment has meant that our investment income has just about offset this reduction so that our annual income to Corps Funds has remained steady. The new Corps Treasurer is Lieutenant Colonel R F Wilsher.

Corps Funds are available for sports, adventure training and worthwhile Corps activities if a properly presented and justified case is put forward to RHQ RE. Annual expenditure on benevolence over recent years has remained at around £350K, some 28 per cent of the expenditure of Corps Funds. Although the majority of individuals helped are former members of the Corps, benevolence funds can be, and are, used to assist serving members of the Corps where other sources of help are either not available or insufficient.

Membership of the RE Association remains at a fairly steady state but we are looking to the future to see how we can make the REA branches more relevant and more attractive to those about to leave the serving Corps.

There are 35 former members of the Corps as In Patients in the Royal Hospital. They much appreciate the affiliation they each have with their former regiment or squadron and the opportunities to visit those units from time to time.

The Corps band recently underwent its five-yearly inspection by the Inspector of Army Music when it was put through its paces in an impressive and rigorous test of every department (drill, turnout, versatility, musical ability and general musical knowledge). As a result of that inspection the band was graded "Excellent". We have a band of which to be extremely proud. Funding of the band's uniform and musical instruments has now been taken on by MOD.

Sport

Notwithstanding the severe pressures on units, we can again be justly proud of our sporting achievements . In soccer, 28 Engineer Regiment re-established its prowess by winning the Army Cup beating the Cheshire Regiment, 2-0.

1996 has marked the 150th anniversary (Sesquicentenary) of the founding of the Royal Engineer Boat Club which became the Royal Engineer Yacht Club in 1864. The club has had an auspicious history being the senior service yacht club, instrumental in founding the Royal Ocean Racing Club and the only service club to have had an entry in every Fastnet Race since its inception in 1925. Club yachts were second (*Fulmar*) in that year and won (*Ilex*) in 1926. Last year's Fastnet results were too late for my report and reflected the Corps' continuing strength on the ocean where *Right Royal* took the Culdrose Trophy for

the first service yacht at the Fastnet Rock. The Club's patron, His Royal Highness The Prince Philip Duke of Edinburgh KG KT OM GBE, was guest of honour at this year's REYC dinner in the Corps' HQ Mess.

The Corps' Rowing Club was originally part of the Royal Engineer Boat Club and so celebrates its Sesquicentenary along with the yacht club. It is timely, therefore, and highly commendable that the army team of four that won three gold medals at the World Rowing Veterans Championships, contained three Sapper officers. Moreover, this year the club won the HM Forces Pennant at the "Head of the River Race" in London for the first time ever and regained the Joint Services Coxless Fours trophy at the Joint Services Regatta.

We were, once again, dominant in the Devizes to Westminster Canoe Race and were the first service team home.

At cricket 42 Survey Engineer Group maintained their high standard but were not quite able to repeat last year's victory and were runners up in the Army Minor Units Cup.

Likewise our Corps squash team were runners up in the Inter-Corps championships but 39 Engineer Regiment are to be congratulated on being Army Major Unit Champions.

On the piste 35 Engineer Regiment won the Princess Marina Trophy for the best combined nordic and alpine skiing results at the army championships.

Our boxing achievements continue to be considerable both at individual and unit level. 59 Independent Commando Squadron retained the Army Minor Units title defeating 216 Signals Squadron. Individually, Sapper Watts (super heavyweight) won the Amateur Boxing Association final and Lance Corporal Powell (light welterweight) was the Welsh Amateur Boxing Association runner up.

In hockey 42 Survey Engineer Group won the Army Minor Units Cup. In badminton the Corps were runners up in the Inter-Corps championships. And at Bisley the Corps retained the Inter-Corps Full Bore Target Rifle Championships.

On the Corps rugby front, 9 Parachute Squadron won the Army Minor Units Cup and the Corps was second in the Corps' Merit League 1. Within the Corps, 3 RSME Regiment beat 1 RSME Regiment in the Fern Cup and in the Campbell Cup beat 21 Engineer Regiment. We have had at least three players in the army side but must also note, on the subject of individual ability, that the move to professional status by the respective Rugby Unions has, inevitably, cost us at least two excellent players, and soldiers.

Finally, I am pleased to report on our successes in the fencing world. At the 1996 Army Fencing Championships, 1 RSME Regiment won the Inter-Unit three-man team event and the under 20 inter-unit six-man team event; Lieutenant Colonel N A Sutherland OBE won the individual épée and foil titles and Apprentice Tradesman Ravers of 1 RSME Regiment won the under 20 Champion at Arms title. Furthermore, we can bask in some reflected glory from the achievements of Corporal J Williams of 503 Specialist Team RE (Bulk Petroleum)(Volunteers) who is now the Great Britain National Sabre Champion and will be the only fencer representing Great Britain at the forthcoming Olympic Games in Atlanta, Georgia. We wish him well.

Adventure Training

Given the operational pressures we are under there is little time for any adventure training. However, expeditions are taking place and you can read of them regularly in *Sapper* magazine. I congratulate all those who apply their initiative and dedication to organizing and leading these expeditions; without them we would be much the poorer. There are three major expeditions I wish to draw to your attention.

Exercise *Southern Ocean* was the recovery of a 35ft cutter that had run into difficulty on a single-handed circumnavigation and been left at Grytvicken, South Georgia. The expedition which was undertaken by a major, a lance corporal and a sapper, required that the boat was first refurbished – to some extent this is a euphemism for rebuilt – before the three set sail to deliver the boat 3000 miles northeast to Cape Town. The account of the 24-day journey through icebergs and the Roaring Forties makes most exciting reading and fully reflects what adventure training is all about.

As I write, six Royal Engineers, including the expedition leader, are taking part in the British Services Gasherbrum Expedition to attempt the first unaided (without oxygen) British ascent of Gasherbrum 1 (26,470ft) and the concurrent ascent of another, nearby, Himalayan peak in excess of 20,000ft.

This year the millennium has been brought sharply into focus at national level. It seems appropriate, therefore, to make early mention of an Army Mountaineering Association expedition

that is in the early stages of planning and is being led by a Royal Engineer. The Roof of the World Expedition aims to climb the highest mountains on each of the seven continents of the world in a continuous operation during the year 2000. The expedition will climb the mountains in the order: Vinson, Aconcagua, Carstenz Pyramid, McKinley, Kilimanjaro, Elbrus and Everest in what is likely to be the biggest and most challenging expedition mounted in the services since "Scott went to the Antarctic."

MS Appointments

We are maintaining our two-star influence. Major General C L Elliot MBE assumed his appointment as the Director General of Individual Training and first Chief Executive of the AITO on 1 April 1996. Major General K O'Donoghue CBE succeeded Major General P J Sheppard CB CBE as Chief of Staff, HQ QMG in May 1996. In July 1996, Major General R A Oliver OBE assumed the appointment of Chief of Staff HQ AG.

Honours and Awards

The honours and awards received by members of the Corps during the last year are as follows: one CBE, four OBEs, 16 MBEs and one Queen's Gallantry Medal. In addition, Brigadier J D Moore-Bick, currently CE ARRC, has been decorated with the Hungarian Military Order 1st Class, a singular distinction; the first to be conferred on a NATO officer and the highest ever awarded to a non-Hungarian. The matter of honours and awards is debated with much emotion these days. I encourage each commanding officer to ensure that no event or contribution that he believes deserves public recognition should pass without being submitted for an appropriate award.

Summary

I am certain that change will continue, driven by technology, social attitudes, funding pressures and a whole host of other factors. Whatever future conflicts we may be engaged in and for whatever reasons, the purpose of our involvement may become increasingly difficult to quantify. The simple maxim of "Queen and Country" is being overtaken by "Great Britain plc" as a justification for much of our operational tasking. I do not know what operations I will be reporting on this time next year but I expect there to be one or two that neither the military operations, nor the new Permanent Joint HQ staff are aware of at the moment. These are challenging and exciting times in which we soldier, providing a plethora of opportunities in many fields, especially in operations, for the Corps to demonstrate its many diverse skills and talents. Officers and soldiers at all levels with vision and initiative will seize these chances.

One result of the current emphasis on construction engineering is that we are now portrayed rather too much as a technical Corps than a combat support arm. Clearly we are both but we must retain a balance in our training and ethos if we are to attract and retain the future young officers and soldiers who will serve the Corps and the army most effectively.

Finally, it has been an excellent year for the Corps and our reputation in Bosnia, Northern Ireland, the Falkland Islands, Cyprus and elsewhere is second to none. It has, however, been the busiest I can recall since I joined the Sappers 29 years ago, with 2000 soldiers on operations and a further 1500 training to roule them; up to 40 per cent of the Corps. The pressure of a real task is always to be preferred to the alternative of looking for work and we have the satisfaction of being exceptionally useful. Nevertheless, our units and individuals need to feel valued and their continuing efforts and motivation cannot be taken for granted. Wherever I visit the Corps I see sound, solid leadership at all levels, a sense of pragmatic realism and exceptional commitment from all ranks. The Corps is certainly earning its pay and I feel enormously proud to be the Engineer in Chief.

How Engineers Engineer

COLONEL EMERITUS PROFESSOR SIR ALAN HARRIS CBE
BSc(Eng) Hon DSc FEng FCGI FICE FIStructE

Born in Plymouth in 1916, of a maritime family, the author joined the Corps in June 1941. Volunteering as a parachutist, a damaged knee and medical downgrading saw him posted to Chatham in 1942. He volunteered for port construction and was posted to 933 Port Construction and Repair in 1943, where he undertook courses in diving and underwater bomb disposal. OIC advance party in Normandy, he landed in Port en Bessin on D+2; was detached as OIC divers, Mulberry B with fleet of French fishing boats; in August was in Ostende; and was OIC advance party Xanten am Rhine for construction of a timber-piled Bailey bridge built in cantilever. At the end of the war he worked with others to set up a control commission team to open up the Dortmund-Ems canal. He was mentioned in despatched and received the Croix de Guerre.

Amongst the author's many accomplishments since the war, is service as a colonel in the Engineer and Transport Staff Corps and being elected Professor (now Emeritus) of Concrete Structures at Imperial College.

Problem Solving?

At a recent joint meeting between the Royal Engineers and the Institution of Civil Engineers, extensive consideration was given to the training of engineers, consideration which was explicitly intended to cover both service and civilian engineering – indeed, admirable accounts of actual experience of training were given from both sides. Lists were available of the matters to which RE training aimed – fully detailed, and reminiscent, somewhat, of aiming at the end of a barn with a bowl of rice – good cover of the target, but little penetration. It might be worthwhile endeavouring to put some near-philosophical order into what engineers are trying to do, what is needed for them to do it an how they might set about doing it.

To start off with, they are not problem-solving. Problems they meet along the way and sometimes they need to solve them; at other times they change the problem so that it can more easily be solved or, better still, they dodge it.

The place of problem solving may, perhaps, be illuminated by considering two popular recreational problems – the chess puzzle and the crossword. Both are connected with activities of the practical intelligence, the first with the game of chess and the second with the use of words. Both are useful exercises; the chess puzzle exercises the mind in the use of two-dimensional space by pieces with limited mobility, and the crossword exercises it in the meaning and spelling of words – I have known French students of English who sought to extend and deepen their knowledge of its words by grappling with crossword puzzles. Note, however, that these are still puzzles, problems created by one intelligence for solution by another; in both, familiarity with the mind of the author helps provide a speedy solution. More, they are not only subsidiary, but disparate to their basic activities, which are the waging of competitive games on the chessboard and the use of the English language. Both these activities are imaginative exercises of the intelligence; in the puzzles, so far from the creative imagination being called upon, they deal with a rigidly defined construct from which the mind has to work back.

Engineering Operations

Let us sketch out the sequence of intellectual processes involved in a typical engineering operation – problem solving will be seen to take its subsidiary place.

Such an operation is a function of the practical intellect, devoted to some useful end (as distinct from the speculative intellect, devoted to the search for knowledge for its own sake). That useful end is

Colonel Emeritus Professor Sir Alan Harris CBE
How Engineers Engineer p112

typically of two sorts, making a useful thing or contriving action to achieve a useful outcome. Both form part of engineering; the second is, perhaps, more peculiarly part of military engineering, in that action is essentially linked with time. Both are subject to a preliminary activity called variously "design" and "planning;" the words are virtually synonymous, and imply asking such questions as "what is to be made or done, how and what is needed for the purpose?", and terminates with instructions adequate for execution. The sequence of processes entailed in the procedure of carrying out engineering works or operations correspond, though sketchily, to the time-honoured formula for the "appreciation of a situation" which went, did it not, something along these lines; "Purpose (nowadays, doubtless in deference to mid-Atlantic English, it is mission – we shall see later that the difference between a purpose and a mission is substantial), factors, courses open, courses adopted, plan."

Let us set against this the stages typical of an engineering operation, whether of planning, or of design.

Appreciation of the task. This comes first. It is rare that an engineer is master of what the task is to be, he is usually acting under instructions. Nonetheless, his role begins now; his client/superior officer will have an idea of what he wants, but the engineer may know more of what he could have; it is the engineer's responsibility to explore what is really needed, and he will not hesitate to return to the originator if new possibilities are revealed later in the process. It is here that the purpose/mission distinction becomes clear. A purpose leaves the engineer free to contribute, a mission is an order which the engineer has to execute by such means as he can. The mission is indeed a problem which the engineer must solve; a purpose leaves him free to make an engineering contribution to deciding what is to be done. It is good that engineers start by rebutting the quip that they know everything about what they are doing except "why." Their starting point should be a clear understanding, not only of what they are to do, but why.

Information. He must gather all the information he can about the task, starting with the physical data, whether geographical, meteorological or tidal, then passing to the availability of materials, labour and plant and including all matters concerned in the total function: what are the likely unspecified loads, what is the probable ill-use or misuse, are changes of use to be expected?

Conception and appraisal of possible schemes. Now the real work starts. The engineer meditates on all the knowledge he has gained, seeking in his mind a concept of a scheme which will satisfy the requirements of its intended function. Sometimes an idea will spring to mind of startling completeness; sometimes it doesn't. So it goes. The computer can help greatly in visualizing ideas and in facilitating their development. But without that intense meditation nothing will happen.

Usually, there will follow a string of ideas which must be subject to critical appraisal – good engineers are as notable for the acuity with which they examine their own ideas as for the fecundity with which they produce them; both creative and critical faculties are equally necessary.

Having conceived an idea, the engineer will appraise it against three criteria: functional soundness, economy in execution and reliability in use. Questions of functional soundness may well prompt a return to the promoter – either negatively by indicating unrealistic requirements, or positively, indicating unexpected possibilities. As for economy, the designer must know how the work is to be built; in general, if he can think of one way, there will be six; if he can think of none, then none there probably is. But economy is more closely related to simplicity of execution than it is to quantities of material. A method of construction that proceeds simply with successive operations following one another smoothly with no back-tracking or interference is the best assurance of economy.

At this stage there will be few detailed costings or structural calculations; the engineer will rely on his judgement and experience. It is essential that, having fixed in broad terms a method of execution, there are no details which are inconsistent with it. Detailed analysis of some minor features may be necessary to ensure that they are indeed so consistent.

This process is repetitious; the time will come when a **decision** must be made – this requires judgement, not only as to its matter, but also as to its timing – the decision can be rushed with dire consequences to the design, or it can be delayed too long and miss a deadline. Decision is a matter of will, of character. Some panic and decide too soon on a project of huge and unresolved complication, when a little more time would enable the scheme to be torn up and started again, with better results. Others are unable to resist the search for perfection, forgetting that one adequate scheme on time is worth many masterpieces too late.

Moreover, working too much on a scheme can over elaborate it; there is a **right time** to decide; it is, like the elephant, easier to recognize than to define. Experience helps.

But the moment of decision is the capital moment; hitherto it has been all in the mind, but now harsh reality threatens. Now the ponderous wheels are set in motion which will end in construction. There is much work yet to be done in the development of the scheme, work which can go wrong and wreck a right decision, but nothing now can save a wrong one. The significant decisions concerning structural form, material and method of construction, have now been taken.

Preparation of the instructions needed for execution. This is what remains. (In what follows, consideration has been restricted to the design of a structure; while the planning of an operation is analogous, it defeats clarity to seek words which apply to both construction and action.) Such instructions may require detailed checking of the strength of structural elements – a process often mendaciously referred to as "design" – it is no such thing. Design is not working out the dimensions of a beam – the significant design decision was that to have a beam. But while the competent engineer will have an approximate idea of the size of the elements of his structure, it is now necessary to bring to bear the full armoury of structural analysis to foresee how the structure will behave in practice and to enable it to be so detailed that it will function as required.

However precise the figures, they can never serve as more than an aid to judgement. Accident-prone structures can be recognized: the detail which is adequate if perfectly executed, but which is catastrophic if inexactly done; the possibility of progressive failure. The achievement of safety is an art which is nourished by knowledge of the site and its processes.

It is a rare structure to which someone does not, at one stage or another, entrust his life – the extreme example is the footbridge over a chasm. The avoidance of loss of life due to structural collapse is, indeed, a major factor. Were it an absolute requirement, however, all things built would approach the condition of a pyramid, be hugely expensive, take an eon to build, be utterly stable and no use to anybody. In practice, total safety in this sense is unattainable, spend what one will on design, analysis, selection of material, supervision and testing of construction, application of no matter how many shelf-loads of codes and regulations. It is not enough, moreover, that the work should not collapse. The idea of safety is best subsumed in the more general concept of reliability, whereby the work can be relied upon to continue to function as intended for as long as is required, a reliance which includes, needless to say, the avoidance of fatal collapse.

Structural analysis requires three operations:

1. **The definition of an action on the structure.** Such an action may be a load, the effect of environment such as variation in temperature or humidity, the wear and tear of use and likely misuse. It is very rare that such actions are capable of precise definition – the only well-known instance is an open-topped water-filled reservoir which can be overloaded only by the unlikely replacement of water by a liquid of higher density. Otherwise, loads vary over a very wide spectrum with a frequency which typically follows the familiar Gaussian bell-shaped curve; it is extremely difficult to determine a load which will never be exceeded. In consequence, the prudent engineer will cast a sardonic eye over load values fixed by official regulation; they may, or may not, be satisfactory from the point of view of legal defence, but no prudent engineer will assume that they can never be exceeded. With some loads, of course, such as those caused by wind and wave, the variability is well-known and every effort is made to assess probabilities by statistical analysis and to design to provide strength on a probabilistic basis. In addition, loads in practice are of three sorts – steady and of long duration, when rupture load is the criterion; repeated, when elastic stress leading to fatigue failure must be guarded against; dynamic load, when energy absorption and natural frequencies of vibration count. Nor should change of use be lost sight of – when an office is turned into a library, floor loadings are increased. Perhaps the engineer should see to it that the load for which the floor was designed should not be forgotten, but enshrined in some official documents.

   One further predicament with which the engineer has to wrestle should be mentioned – the coincidence of extreme loads. The most familiar is the concurrence of a high tide with a storm-force wind from the most unfavourable quarter – but there are others.

2. **The analysis of the effect of the action on the structure.** The means of structural analysis are immensely powerful these days, but the engineer should not be misled by the seeming accuracy of eight significant figures emanating from a computer. He should remember that the answers are no more accurate than the questions, ie than the loads on which the calculations are based. Moreover, he will get answers only to questions which he asks. If he has never heard of buckling, the computer will not tell him. As a general rule, the operations of a computer are of extreme accuracy within their terms of reference, but if they are inexact, they can be wildly

inexact. The prudent engineer will thus generally accept only such answers as appear to him to be about right.

Moreover, the huge prestige of mathematics was gained in the service of disciplines whose needs are not ours. Though non-linear functions are beginning to be susceptible to mathematical analysis, most such analysis is based on the assumption of perfect elasticity, ie that stress is proportional to strain.

3. **The comparison of the effect of the action with a criterion of adequacy.** This is just as important as the evaluation of the action – and is just as often neglected. There are many criteria in use: safe stress, elastic stability, and ultimate collapse are chief among them, but they must always be viewed in the light of the designer's knowledge of the nature of the load. *(See paragraph 1 opposite.)* Until very recently, triaxial stress conditions in large concrete masses could, indeed, be analysed, but would then be looked at only with blank curiosity because there was no available distinction between combinations of stress which were safe and those which risked rupture. This inadequacy has now been made good, but it is necessary to bear in mind the total lack of meaning in figures which appear at the end of a series of mathematical computations, in the absence of a criterion by which to judge them.

Classic Military "Appreciation of a Situation"	Engineering Design
Purpose/Mission	**Appreciation of the task** Keen enquiry as to all aspects of the task and the need to be satisfied (including why), leading, perhaps, to advice as to what is available beyond the knowledge of the promoter.
Factors	**Collection of relevant facts** All possible information relevant to the task and to the total function is assembled, together with information relating to means available for achieving result.
Courses open	**Conception and appraisal of possible schemes** General ideas of a project will be imagined which will then be appraised in terms of function, economy and reliability in use.
Course adopted	**Decision** The crux of the operation.
Plan	**Instructions for execution** The examination of the project in detail sufficient for instructions for execution to be drawn up, which implies the thorough checking of the project for soundness, strength and reliability.
	Collaboration during execution The author of the design must be ready to advise during execution.

Comparable intellectual processes.

In parallel with these processes, there continues the preparation of the detailed drawings of what is to be built. The purpose of these drawings is to give instructions to the builders, and it is good to know what instructions are necessary and how they are best expressed for ready comprehension. This presumes a knowledge of construction methods.

The specifications and contract documents are part of the design and should complement by description and definition the information contained on the drawings.

The designer's work has not finished when a roll of drawings and a bundle of documents have been handed over. It is a rare job which is free of alarming incident, and the designer may well be alone in the ability to assess its importance and to deal adequately with such problems as it raises.

Striving for Excellence

The engineer is expected to produce a work which fulfils its function satisfactorily, at a price and a time within the given target; he will feel obliged by the very magnitude of his task to seek not merely adequacy, but excellence in the final product. Excellence is to be recognized by unity: the work is seen to be one thing, with its parts visibly serving the whole, not just a heap; by simplicity, that air of ease which is typical of all good art; by necessity – perhaps the secret of excellence. It is paradoxical that a work in which there is nothing that is not seen to be necessary produces an effect, not of privation, but of magnificence.

These characteristics are not to be consciously striven for, but when the designer has striven for goodness, has done his sums right, has struck out all that frippery which looked so pretty, when he has done all this and looks at his work and sees that it is single, simple and spare, he

knows he has attained excellence. He is God on the seventh day.

The process of design is eminently a matter of management and teamwork, remembering that good design is not the result of consensus, but of command – a design produced by a committee is proverbially bizarre. Discussion by all means, but dispute is to be avoided – it leads to emotional commitment and confusion.

How is the engineer to be equipped for this task? The requirements are formidable. He must first (and this is basic) know his materials – what they are made of, how they are made, how they are shaped, formed, assembled and erected; how they behave under load and under all the various agencies of ruin which begin to act as soon as construction is complete; and, finally, how, in the long run, they fail (grass will conquer in the end.)

He must study and have a knowledge of great works of history. "I pass for a man of quick wit", said Napoleon, "but it is rather that I have much reflected." To this he must add his own firsthand experience, of which it has been said by Detoeuf, a famous French mechanical engineer, "Real experience is secret. It is born of small, daily incidents; small, repeated errors; small, renewed successes which, by their number, mark laws to which habit submits. It is not thought out, it is lived; one lives with it unconsciously, as with gravity."

"Time spent on reconnaissance is seldom wasted", but on condition that one knows what one is looking for, recognizes it when seen, and is able to use it. Experience of works requires cogitation over observation to be of value.

So, we have study, experience and responsibility (there is no replacement for necessity – it is surprising how fast one learns when responsibility and necessity drive.) A foundation of maths is probably essential, not so much for calculating as for understanding a language; there are ideas which can be expressed only with difficulty in other than mathematical terms.

All very burdensome, but there is an historical line of research open.

An antique guide book (c 1923) refers to the Albert Hall and the contemporary Albert Memorial. The former, designed, it says, by Lieutenant Colonel Scott RE for a joint stock company, cost £200,000. We know of its difficulties; designed before the beginning of the science of acoustics (the Greeks had inklings of the art, at any rate for the human voice out of doors), leading to that famous echo which prompted a French musical friend to remark "The only way for a British composer to have his composition heard twice in public is have it played in the Albert Hall", but there it still is, echo removed and immensely successful.

Just in front, says the guide book, is the Albert Memorial designed by the famous gothic revival architect, Sir Giles Gilbert Scott, and costing £120,000, and "far from commanding universal admiration." As we know, it is now in a state of decrepitude and awaits, under cover, extensive repair.

It is not widely known that, apart from the Albert Hall, the Royal Engineers undertook a very large volume of civil engineering works in the nineteeth century. There was the Coles building in the Victoria and Albert Museum; elsewhere there was a sequence of dockyard buildings, mostly covered ship-building slips from Sheerness round to Devonport. Indeed, the Corps became an effective civil engineering arm of HM government. The instruction received at Woolwich by regular RE officers was highly technical and, at a time when cast iron was followed by wrought iron and then by steel, put them in the forefront of knowledge of these materials and leading practitioners in their use.

At a time when there is much discussion as to how engineers should be educated, some historical examination into how it was done at the Shop might be worthwhile – it clearly worked.

In conclusion, one quotes Countess Morphy, the authority on traditional British cooking. "Plain cooking", she said, "is not to be entrusted to plain cooks." We have seen how engineering works can excel by their simplicity – such works are not produced by simpletons.

The Suspension of the Civil Power

ANON

"SE NON E VERO, E BEN TROVATO"

WE were all rather proud of the aerial ropeway; we were sure that it was the only one in active operation against the Japanese. It didn't belong to us, but was operated by a detachment from elsewhere under a Sapper and Miner subaltern, with a platoon of Gurkhas guarding the engine house at the top of the pass.

It had been put up towards the end of the 1943 monsoon. The idea was to ease the truly horrendous 12-mile stage across the Mayu Range in the Arakan, between Bawli and Goppe Bazaars, where the annual rainfall was over 400 inches. The trouble was that there was no stone worthy of the name in the Arakan; it was said that a hundred million bricks were fired to surface the road from Chittagong, some 100 miles. We took what looked like stones from the chaungs (streams) to surface mule and jeep tracks, only to find them decaying into bottomless mud within weeks. You could lose your boots in a few paces, mules got bogged down and even drowned, and the maintenance work was out of all proportion to the tonnage delivered.

The ropeway had been found on a tea garden in Assam, where its record over many decades had been blameless. Transplanted to the Goppe Pass it ran from the engine house at the top (2000ft) for about three miles to a camp at paddy level, whence the track to Goppe was comparatively easy. At the top it was an imposing sight, with an exceptionally long span of about 300yds across a 400ft deep gorge, to the first pylon. There were two functions: to load supplies forward to Goppe, and to bring what passed for stone to the summit to maintain the tracks on either side.

For most of the time it worked a treat, but there was a snag. The steel wire rope was worn and polished with many years' use, and the grips from which the load hoppers were suspended were liable to slip. This would occur with a too-heavy load in an upward-bound hopper, which would then slide gently down until it met the next one coming up. What happened next was always interesting. Either the two would travel together, sagging fearsomely and straining the asthmatic Ford V8 engine to its limit; or they would slip back together to the third upward-bound hopper. This was always too much for the engine which would stall, and the three hoppers would settle stranded on the ground. The Gurkhas would then rush down, unload the hoppers, and the engine would be started up again. All this could be much more difficult than it sounds, and there were stringent orders that human beings were under no circumstances to try joyriding on the ropeway.

It happened on a day that the local civil administrator, dressed as a sub-lieutenant in the Royal Burmese Naval Volunteer Reserve, arrived at the summit. The poor man was in a hurry to get to Goppe and no doubt – like many others before him – had been exhausted by the dreadful climb up through the mud. He insisted on riding on the ropeway. The subaltern protested and, being overruled, extracted a signature absolving him of any blame for the consequences.

And then the worst happened. As the Civil Power departed, a hopper began to slip ... to the next one ... and to the third. The motor stalled. The three hoppers came to rest in the chaung at the foot of the gorge. And the Civil Power was suspended – literally – 400ft from anywhere.

The Gurkhas knew exactly what to do. With such an important person aloft, the urgency was extreme. They charged down the khud, both feet together, and threw the upward-bound rocks out of the hoppers in a matter of seconds. Thus released, the hoppers shot upwards, and the six miles of steel wire rope began to vibrate like the string of a giant violin. The Civil Power found himself describing a simple harmonic motion, amplitude 100ft, period two seconds, damping negligible. It was well over half an hour before he could be winched back to land.

He was never seen on the Pass again.

Social Engineering – A Sapper Contribution to the Welfare of Army Families

LIEUTENANT COLONEL DONALD F DENSHAM-BOOTH OBE FCIOB FBENG PENG

"D-B" graduated in 1939, was commissioned into the Duke of Cornwall's Light Infantry, and transferred to the Corps at SME Middle East in 1942. Serving with 13 Corps Troops Engineers, 8th Army, he assumed command of 56 Field Company in 1945, prior to the crossing of the River Po and the final assault on Trieste.

Following postings to Malaya, the War Office, Longmoor and Malaya again, he was appointed CO HQ Army Emergency Reserve RE (Transportation and Movement Control) at Longmoor in 1961, responsible for the reorganization of their ten regiments.

Posted to Aden in 1964, he returned as Staff Officer 1 RE (Works Planning), and was granted a defence fellowship to study social science. He joined the Town Planning Department of University College London as a research associate in 1967, preparing a report on social planning for the Defence Minister (Army). This was followed by an attachment to MOD Quartering (Maintenance) for the purpose of drafting a charter and guide book for the embryo housing management staff and implementing the new establishment.

"D-B" then served as a housing commandant in South West District, retiring from the Active List in 1973, but continuing in post as a retired officer until final retirement in 1984. During this latter period he contributed to the development of the present Army Families Housing and Welfare Service, drafting the revised charter and handbook published in 1979.

THE purpose of this article is to review the substance of a defence fellowship report on social planning submitted to the Defence Minister (Army) in 1969 and to illustrate the subsequent development of housing and welfare services resulting from Sapper initiative. It not only marks 25 years of a more enlightened approach to the care of army families but serves also as a tribute to those who have participated in the evolvement of a better quality of life in married quarters.

INTRODUCTION

THE need for research into social planning of married quarter estates became apparent in the 1960s for the following reasons:

- Proposed withdrawal of troops from east of Suez and the concept of a UK based army with unaccompanied overseas tours.
- A MOD requirement that relations between the army and civil communities must change, with servicemen being identified as part of the community and not as a separate society.
- The rejection of Ministry of Public Buildings and Works proposals to integrate new married quarters with council housing developments.
- The need for provision of social amenities for families as proposed by Director of Personal Services (Army) (DPS(A)) and Director of Quartering (Army) (DQ(A)) at the QMG's conference 1966.
- The "Sweeney Report", sponsored by DQ(A), recommending a more professional system of Army housing management.
- The emergency housing programme of 1967 to provide accommodation for families returning from overseas.
- The rapid expansion of barrack married quarters and the purchase of civilian housing estates.
- A SSAFA report concerning the social deprivation of service families on isolated estates.
- The introduction of Military Aid to Civil Communities.
- The inauguration of Defence Fellowships in 1967 for the purpose of studying the social sciences relating to military affairs.

As SO1RE (Works Planning) to DQ(A) the author was in a unique position to apply for one of the first defence fellowships.

Lt Col Donald F Densham-Booth OBE
Social Engineering - A Sapper contribution p118

Historical Background

Sappers have traditionally been responsible for the design and construction of military works, installations, barracks and married quarters at home and overseas. This function led to the establishment of RE Works Services under the Director of Fortifications and Works, as works executives on behalf of the "Q" staff. Prior to civilianization, when MPBW (Ministry of Public Buildings and Works) assumed most of these works responsibilities, a comprehensive establishment of qualified architects, engineers, quantity surveyors and estimators was maintained, supported by clerks of works, military foremen of works and tradesmen, covering every aspect of the design and construction process. RE Works Services had the capability to design and build, either with direct labour or by the employment of contractors, to meet military needs in peace or war.

When this responsibility passed to MPBW the RE works organization became reduced to a number of specialist teams within the revised establishment of a military engineering service (MES) for employment where the use of MPBW civilian staff was impracticable. In spite of these limitations the Corps continued to exert considerable influence on the planning of new works through the employment of RE staff advisers to DQ(A). It was therefore possible to ensure that the needs of army units in their barracks, married quarters and technical installations were satisfied in accordance with synopsis scales.

Origin of Married Quarters

Before the establishment of army barracks it was the custom for families and camp followers to reside with the baggage train, wherever deployed. Such families were not formally recognized and spent their lives in or under the quartermaster's wagons and around camp fires, like the families of "wild west" pioneers.

Early barracks were in the form of hutted camps and recognizing that soldiers' families could no longer be ignored; accommodation was provided by setting aside one corner of each hut with a screen of blankets. This "corner system" continued for some 50 years, but with the improvement of social conditions during the last century the habit of mixing families with the soldiery became unacceptable and by 1850 a move towards segregation developed.

Having accepted married families as a military responsibility scales of entitlement were introduced accompanied by improvements in the provision of accommodation. Initially huts were set aside as married quarters, with a scale of one "entitled family" to ten men, one room being provided irrespective of family size. From about 1860 permanent barracks were being constructed and it became the practice to provide double storey blocks adjacent to barrack lines, subdivided to allow each entitled family the occupation of two rooms. Communal cooking and sanitary arrangements were provided for each block.

The introduction of the Public Health Act of 1875 defined minimum standards for "Bye-Law" housing and these planning controls led to the construction of industrial-type terraced cottages to provide married accommodation on the periphery of Victorian barracks.

Although this type of permanent housing met basic needs, with rooms "two up, two down" and a privy in the backyard, no planning consideration was given to the social and environmental needs of families which were to grow up in the 20th century. The first permanent married quarters were therefore simply appendages to a military environment, with little provision for family amenities or leisure facilities. No thought had been given to social planning at that time.

Postwar Married Quarters

The end of World War Two and the subsequent withdrawal of troops from overseas, created a need not only for a greater number of married quarters, but also an improved standard in living accommodation and the provision of amenities to satisfy the expectations of army families. A great change in attitudes and aspirations occurred throughout all classes of society in the postwar era, not least among service families. The pre-war provision of a bath tub on the landing, or the supply of "pots, chamber, without handle, soldiers" was no longer acceptable and higher standards were demanded.

To meet the immediate requirement for additional accommodation, new married quarters were hastily provided on the principle of in-filling barrack areas. This had the benefit of cost saving by using Crown land and limited expenditure on external services. However, little provision was made for the development of family amenities and the meagre existing social facilities of garrisons usually proved inadequate. The expansion of married populations frequently occurred in isolated locations, where employment for women and

suitable educational arrangements for children were either remote or non-existent.

The majority of postwar married quarters were greatly improved due mainly to the application of design standards recommended in the Parker Morris Report "Houses for Today and Tomorrow". Requirements were laid down relating to floor areas, spacial use, kitchen layout, storage, sanitary arrangements, heating, lighting, power points and insulation. MOD synopsis scales were amended accordingly and soldiers' married quarters became at least equivalent to council housing, as far as treasury cost limits would permit. Sapper planning staffs and MPBW architects involved in the provision of new married accommodation were therefore confronted with the task of satisfying higher standards in scales and specifications, within tight financial constraints, which led to the adoption of some unorthodox construction methods.

In order to speed up construction time, various building systems were adopted including "Jesperson" (concrete framed with slab floor and walls); timber framed (with traditional cladding); "Vee-Brick" (perforated cavity brick walls); mono-pitch roofing; cellular partition walls and dry lining; and mobile homes (on plinths with main services). Where surplus barrack huts existed, these were frequently converted into sub-standard married quarters.

During the initial rush to provide homes for soldiers' families, little thought or financial provision had been devoted to the creation of the social amenities required to sustain the viability of expanding communities. It became apparent that some form of social planning was necessary, not only to meet the aspiration of postwar families, but also to facilitate the integration of service communities with the civil population.

In addition to the modernization of existing quarters and the construction of new married accommodation, it was necessary to augment the emergency building programme by the purchase of speculative housing developments throughout the country. Large numbers of vacant properties were readily available, due to a slump in the housing market and where these were accessible to service bases Treasury agreement was given to purchase, providing they met the requirements of synopsis scales. The acquisition of this form of housing produced various anomalies, not only in design and construction, but also in standards of heating, fittings, fixtures, food storage and refrigeration. A further problem was caused by the multiplicity of fuel requirements, particularly for heating systems served either by gas, electricity, oil or solid fuel. In some cases this caused financial hardship for lower paid families unable to meet their fuel bills, resulting in the disconnection of supplies, condensation problems and poor health.

With the rapid growth of married families and the wide dispersal of quarters, often beyond barrack confines and situated among civilian communities, the need to develop a professional method of housing management became apparent, to ensure proper administration and adequate maintenance services. In these circumstances it was also becoming increasingly difficult for commanding officers to provide welfare support for their scattered families, particularly in view of frequent unaccompanied tours of duty. Furthermore the existing married quarters administrative staff (MQAS), which had been established primarily to allocate quarters and provide communication between families, barrack services, and MPBW, were not equipped to deal with family welfare casework, social relations and community development.

Housing Management Staff

At the QMG's conference in 1966 DQ(A) introduced a paper known as "The Sweeney Report" which outlined proposals for a more enlightened approach to the management of rapidly expanding army housing estates. As a result, a draft establishment for a management staff organization was prepared to replace the limited resources of the MQAS, with a specific duty to support commanding officers and their unit families officers in dealing with family welfare matters. When this draft was produced the notion that service married quarters should be integrated with public authority developments had been firmly rejected, it being envisaged that families should be housed within the confines of barracks or garrisons to facilitate administration and supervision.

This militaristic approach to estate management was reflected in the original draft establishment which adopted the designations of Housing Commandant and Housing Warden for the supervisory staff.

It was at first intended that wardens should wear MOD police-style uniforms and be provided with litter trolleys and pointed sticks, the latter for collecting rubbish or brandishing at miscreants. No guidelines for the implementation

of a professional form of estate management practices had then been devised, other than the need to exercise firm control over a diversity of married quarter estates, and to provide support for commanding officers on family welfare matters.

Whilst it was accepted that some degree of integration with the civilian community was inevitable, long standing social barriers existed and the facilities necessary for joint community activities were either very limited or non-existent. As the role of the housing management organization developed, family circumstances continued to change and other factors affecting the improvement of the social environment became apparent such as:

- The increase in the number of very young army families.
- Schoolgirl brides with children became a new phenomenon.
- The influx of wives from different ethnic groups.
- Families had higher expectations in terms of their environment, access to work, children's health and education.
- Matrimonial difficulties, leading to separation or divorce.
- Irregular occupancy, repossession and rehousing.
- Problem families; child neglect and abuse: "Children at risk" registration.

Such factors as these, combined with the sometimes hostile attitudes of adjacent communities and the reluctance of local authorities to provide support, presented considerable difficulties for housing commandants in the early stages of social integration and the development of community relations.

During the course of the defence fellowship study in social planning it became obvious that a survey of families attitudes and expectations was essential in order to determine the means whereby relationships between the army and civilian communities might be fostered, as well as improving the physical environment and enhancing the quality of life in married quarters.

Social Survey of Soldiers Families

It can be said that a well constructed social survey has the advantage of enlisting the enthusiasm of the society being studied by enhancing their sense of belonging to the community, urging them to help remedy its faults and giving them pride in their achievements. It also affirms that the authorities really care about the welfare of individuals. As a tool of social science it provides information essential to the physical planning and social development of a viable community.

With a view to providing guidelines for the future planning and management of married quarter estates, a random sample survey of 1000 soldiers' families was conducted during the summer of 1968. This involved the distribution of a 10-page questionnaire covering all aspects of army family life, to be completed without disclosing name or address of the respondent. The questionnaire contained particular reference to family size, type of accommodation preferred, furnishings and domestic equipment, environmental issues, friendship patterns, social activities, educational matters, health and child care, family and community needs.

A separate "cost of living" study of young soldiers' families was also carried out at the same time, at the request of the Forces Pay Review Committee.

The social survey was well received by soldiers' families resulting in an exceptionally high response rate of almost 60 per cent. The manner in which questionnaires were completed indicated that much time and thought had been given to the subject matter, particularly by wives in the lower age/rank groups. A computer analysis of replies provided a very clear indication of the expectations, aspirations and community needs of young army families, upon whom the future morale and efficiency of professional soldiers to a great extent depended.

Conclusions drawn from the survey disclosed shortcoming in the design of married quarters, layout of estates, lack of provision of essential amenities and a disregard of factors relating to community development. This information served as a guide to those concerned with the planning of new married quarters and the management of existing estates. It also gave recognition to the requirement for further improvement in the provision of family amenities such as community centres, properly equipped children's play areas, pre-school playgroups, shopping and transport facilities. The survey also suggested various means for establishing closer relations with neighbouring communities and better communication between families and local authority agencies.

The survey of low paid soldiers' families provided valuable material for consideration by the Pay Review Committee, with beneficial results. It was established that young married soldiers, (under 21 and not entitled to married quarters), were receiving insufficient remuneration in 1968 for them to maintain a minimum acceptable standard of living. By comparison with civilian families in receipt of social benefits, they were

only slightly better off, whilst young policemen were earning up to three times the pay of a married soldier under 21 serving on detached duty.

To summarize the conclusions drawn from this sample survey the following salient features were brought to the notice of the Defence Council:

- Army families tended to be deprived, not privileged as perceived by the civilian community. They were able to express their attitudes, perceptions, expectations and aspirations in a well informed and intelligent manner.
- They were well aware of the political influences affecting their circumstances.
- They were concerned about their physical and social environment.
- They recognized the need for family roots and the benefits of good educational and health standards.
- They wished to participate in decision making which in any way affected their quality of family life.

Development of the Housing Management and Welfare Service

Following completion of these social planning studies and the results of the social survey, the author was directed to prepare a charter and guide book for housing commandants, under the sponsorship of both the AG and QMG. Among the requirements were the need to place more emphasis on the provision of welfare support to families by the statutory authorities and other civil agencies and to ensure the feedback of information relating to estate planning, provision of social amenities, married quarter modernization and maintenance services.

In the AG/QMG foreword to the handbook first published in 1971, recognition was given to the fundamental changes in the pattern of Army life and the need for reforms. It was accepted that on large estates, where families of various units were intermingled and amenities centralized, it was no longer possible for commanding officers to exercise effective control without the support of a separate management organization. There was a need for a more personal and effective welfare service, in addition to the administration of married quarters, and for this reason housing estate management was to become an "A" service, sponsored by DPS(A).

The charter published in 1971 described the new concept of estate management and community development stressing the need for encouraging good neighbour relations between occupants of married quarters and extending outwards towards adjacent civilian communities. Housing commandants were also required to establish close personal links with other community leaders, local authority officials and the staffs of social services and voluntary welfare agencies. It was emphasized that housing commandants were not intended to supplant the commanding officer's responsibility towards his married families, but were to provide advice and support regarding welfare matters when necessary.

To assist housing commandants in achieving these objectives, housing wardens were allocated to individual estates on a scale of one to approximately 200 quarters. They were required to provide a focal point of contact for occupants, control estate labour in the upkeep and cleanliness of communal areas, deter vandalism, protect the interests of separated families and ensure that repairs and maintenance works were requisitioned and satisfactorily completed. The role of housing wardens expanded as they became accustomed to their duties and soon they became the catalysts, or social enablers, promoting the development of good relations both within married quarter enclosures and with adjacent civilian communities.

Where amenities were lacking, action was taken to remedy the situation in consultation with estate wives' committees organized by housing wardens. Having identified areas of need, priorities were then agreed and housing commandants initiated requests for appropriate new works services, or financial resources from army welfare funds. The active participation by families in the improvement of their environment was always encouraged, with the intention that they should assist in the management and operation of any community facilities provided.

Housing commandants were in daily contact with families through their housing wardens and were able to identify families with problems, before they developed into "problem families". Using their personal links with supporting agencies they were in a position to point families in need in the right direction, or where necessary, make representations on their behalf. Apart from ensuring that the statutory authorities provided the services to which families were entitled, it was not unusual for housing commandants to refer individual problems to the member of Parliament for the occupant's constituency.

In order to improve the ability of housing commandants and their wardens to recognize and help resolve the problems of married families,

regular courses of instruction in social matters were arranged with the cooperation of Bristol and Exeter universities. The curriculum for such courses, under the auspices of the sociology departments, covered subjects relating to the improvement of communication between army welfare personnel and civil agencies. This included an understanding of public housing, environmental health, social work and social benefits, child care, pastoral care, marriage guidance, safety in the home and the activities of SSAFA, as well as other voluntary welfare organizations. Further to improve the professional status of housing management staff, those suitably qualified were encouraged to become members of the Institute of Housing and the Institute of Welfare Officers. It is commendable that a Plymouth housing warden (an ex-warrant officer), was appointed National Chairman of the Institute of Welfare Officers in 1994, a clear indication of the progress made in the development of army family welfare.

The Social Planning Report of 1968 recommended that a more detailed professional examination of army welfare needs should be conducted to confirm the original findings and if necessary initiate further improvements. Subsequently a welfare inquiry committee was established under the chairmanship of Professor Spencer resulting in the "Spencer Report" of 1976, which recommended that the army housing management organization should be retitled the Army Families Housing Management and Welfare Service (AFHWS), with an increased establishment and a more comprehensive welfare responsibility. This new service was eventually implemented in October 1978 and included the provision of WRAC welfare assistants, community leader wardens, youth leaders and SSAFA social workers in specific areas.

The army housing and welfare organization has continued to flourish, contributing to the constantly changing welfare needs of families particularly during the Northern Ireland emergency, the battle for the Falklands and the Gulf campaign. More recently the *Options for Change* programme has placed an additional burden on the welfare services due to problems created by unit relocations, redundancies, resettlement and rehousing. The expertise of housing commandants and their staffs, together with the practical assistance given by the Army Families Advice Bureaux have combined to help families throughout this period of turmoil.

Following the implementation of *Options for Change*, it was inevitable that the MOD cost-cutting exercise would seek to reduce expenditure on the administration of married quarters and the welfare support provided for service families. A tri-service housing management organization has already been established in the form of a Defence Housing Executive (DHE) based in London, with six regional headquarters covering the UK. Further developments are now under consideration which involve the eventual sale of all UK married quarter stocks, with a "lease-back" arrangement whereby they may be reoccupied by service families on an "as required" basis.

The continuing need for welfare assistance to families is to remain as a single service responsibility and it is intended that an Army Families Support Service (UK) (AFSS) should be established with effect from 1 April 1996. Although this will entail the disbandment of AFHWS, it is proposed that many of the existing staff at present deployed in army stations and garrisons will continue in their posts, serving either with the DHE or AFSS. In spite of this upheaval, it is hoped that the high standard of service achieved by AFHWS will be maintained, so that army families will continue to benefit from housing and welfare support in order to sustain the morale of all ranks serving in the new streamlined professional army.

Conclusion

There is no doubt that the standards of housing and family welfare support have been greatly enhanced during the past 25 years by the application of social engineering techniques which have focused on improving the quality of life for army families both physically and socially.

It may be contended that social engineering bears little comparison with combat engineering, the primary function of the Corps. Nevertheless, the application of any practices which serve to improve living standards will fortify the morale of fighting soldiers, thus contributing to greater efficiency in the performance of their duties.

Bridging for the Next Millennium

LIEUTENANT COLONEL J FITZGERALD-SMITH BEng MICE

Qualified at University College, Dublin in 1939, the author had designed two bridges, built in Ireland, by 1941. War service from 1941 to 1945 included service as a platoon commander in 78 Division Engineers in Italy, followed by various postings vaguely relating to civil engineering instruction or design. He achieved a lifetime ambition when he received a posting to MEXE, where Sir Donald Bailey was his director – a most rewarding experience. Upon retirement from the army in 1969 he was fortunate enough to be able to return to MEXE as a scientific officer in bridging. A period of 14 years followed where he felt he could make a useful contribution to military bridging. For 11 years subsequent to that he has been self-employed as a military consultant, mostly on post-design development of the medium girder bridge, with occasional calls on his experience sometimes from as far afield as India and Singapore. This year he was proud to receive a certificate from the Institution of Civil Engineers to commemorate 50 years on their roll as a member.

Introduction

ALL military equipment is designed to a general staff requirement. The equipment can be no better than the requirement that brings it into existence. This article is about military bridging, an item of equipment about which I feel I can speak with some conviction. As a young sapper I was trained on those earlier bridges like the Ingles, large and small box girders, and floating boat equipment; and sufficiently experienced to realize the quantum leap forward that the design of the Bailey bridge was to make on me as a young sapper officer. All of us who had the fortune to use it as our wartime bridge can have only the greatest admiration for it, and owe a debt of gratitude to Sir Donald and his production team.

I had the great fortune to join MEXE when Sir Donald was director, and to be part of the team that continued to produce masterpieces in military bridging technology like heavy ferry; light assault floating bridge; heavy assault floating bridge, and then the jewel in the crown – medium girder bridge (MGB). This remarkable bridge outranked all rivals and sold eventually to over 32 countries. For over 30 years the bridge was simply the best in the world. Its great success was undoubtedly its guide system. Produced against a general staff target that asked for the moon and got it, the equivalent Bailey bridge employed 10 times the manpower in comparison. What used to take 250 men (an old field company) ten hours to build could be built by 30 men in one hour. The staff knew what they wanted, and had experience of all the difficulties sappers would meet on bridging operations. At MEXE, included in the design teams were battle-experienced officers who could feed their ideas into the design to achieve the target.

What Next?

BUT now to come to my theme. There is an old Chinese proverb which says "Be careful for what you wish your wish may be granted." When I joined MEXE as a scientific officer, MGB had successfully completed troop trials and was being issued to the British army. The staff were putting their minds to the next generation of bridging. The cry going about was "Bridging for the Seventies" – our NATO allies would be involved as they, hopefully, would be equipping their armies with the fruit of such a joint venture. We are all aware of the old joke that a camel is a horse designed by a committee – and if there was a baby produced then, it was stillborn. The seventies went by and the cry became "Bridging for the Eighties" – fortunately no British sappers had to contend with the monster of genetic engineering then considered. The new cry became "Bridging for the Nineties".

Lt Col J Fitzgerald-Smith
Bridging for the next Millennium p124

Changes in Concept

Two major upheavals occurred in the nineties: the breakup of the Soviet Union as a monoblock military organization, and *Desert Storm.*

As a direct result of the breakup of the Soviet Union, it is unlikely that either as a national army or as part of a NATO force we could become involved in a war on the scale of WW2; brush fires, and conflicts like Bosnia yes, but nothing on the grand scale. One of the effects of the cold war that prevailed from the fifties to the nineties, was the way it distorted our perceived bridging requirement. Too many of those that might have drawn up realistic bridging requirements were conditioned by the way bridging exercises were conducted in NW Europe. You don't learn much about planning a bridging operation on a site that has been bridged many, many times before. A requirement seemed to emerge for fewer and fewer men, and faster times, and for more reliance to be placed on machine-built bridges, and, worst of all, it was thought that nothing ever would go wrong! What NEVER! Well hardly EVER.

The second factor that completely changed our concept of bridging requirements, was *Desert Storm.* We all recall those recordings of whole columns of Iraqi tanks being picked off in night time like targets in a fairground, and the remarkable capability of smart bombs, guided with such accuracy that it is possible to place one down the hole made by another!

The question must be asked, "what is the point of trying to build a bridge in an hour or even five minutes when it can be taken out in less time than it takes to build?" Even if by some miracle a bridge was spared, the fate of an armoured column using it is likely to be sealed if the enemy had such sophisticated weapons.

Operations against an unsophisticated enemy can be covered adequately by the present range of bridging, like the MGB.

Yes, I am saying that there is NO requirement for a bridge such as is currently being produced as "Bridging for the Nineties". How can a requirement written in the sixties or seventies be right for a bridge to be used within today's prevailing conditions?

I am NOT saying that there is not a bridging requirement for the next millennium. There is; but it is for a replacement bridge, needed to restore communications after the shooting war has ended when everybody will be on the same side trying to speed the return to normality. Also, under these conditions, a night time build of under an hour would be unnecessary.

The Replacement Bridge for the Next Millennium

Many of the requirements for a military bridge are still valid for a replacement disaster relief bridge, and I advocate one based mainly on the Bailey-type concept.

Most important would be lightness, for two main reasons: the roads in the area may not be open, and the source of replacement bridging may be an aircraft flight away. It should also be remembered that even if aircraft were available, unloading facilities at the disaster end may have to rely on manpower alone.

Another requirement I would write into my disaster relief bridge is that it "must not be too costly to manufacture."

Much of the cost of a MGB set is in the special pallets and trailers, launching equipment such as building frames, and launching noses, which are necessary. Bailey panels do not require special pallets: ten panels can be carried on a GS 3-ton truck. However, a panel identical to the Bailey panel in dimensions but made from zinc magnesium alloy (DGF 232), would have about the same strength as a Bailey panel but would weigh one third of its weight, that is 200lb. Bailey uses the same panels in the launching nose as are used in the main structure, so that every pound of material transported can be used in the final bridge.

If helicopters were available even a Wessex (present day Puma) could carry a pre-assembled Double Single Aluminium Bailey truss, which could be lifted straight into place. The heavier lift helicopters like the Sikorsky (CH54) (now Chinook) could lift an undecked aluminium Bailey-type bridge 80ft long straight into position as it would not weigh more than 10,000lb.

Bailey requires considerable manpower to level in the bank seats and roller positions. Today, a size 4 dozer can be carried in an aircraft like the Hercules and this would be available to prepare the site while the bridging stores are being unloaded.

Manpower

We now come to the important question of a reduction in the manpower required to build the new bridge, although even with a lightweight Bailey-type bridge, weight would probably only

be reduced by 50 per cent. (For reasons of economy, aluminium would be used for the bridge panels only.) However, I know from one or two areas in the MGB design, where the guide system was not too effective, like fitting the bank seat beam, or fitting the second span junction post, that an inordinate amount of time could be spent making the connections.

I would say that it is well worth putting in an effective guide system. I have designed such a guide system which, in use, would reduce the working party to 24 men.

There is a secondary advantage in reducing the size of the building party. In a disaster situation the building team may have to be flown to site, and then fed and housed where both food and accommodation may be in short supply. In deciding the size and composition of working parties consideration should be given to a strange military paradox: in a theatre of war (for war read disaster) generally the most common commodity is MANPOWER – the rare item is trained manpower. The ideal design of bridge should take this into consideration. Only one man in every four needs to know what he is doing. Consider a lifting panel party of four men, only one of these needs to know what the party is doing, the other three are just providing muscle. When it comes to making the connection, again only one man needs to know what he is doing. The Corps returns to its traditional role of directing unskilled labour. In a situation where there is no shortage of unskilled military or civil labour, a recce and supervisory team could consist of one officer; one senior NCO; four junior NCOs, all specially trained.

Bridge Versatility

An important feature that a bridge design for the next millennium must have is that it should be capable of being used over the largest variety of dry gaps in a single or multispan configuration. It must be capable of being extended by additional girders and storeys – another reason why such a bridge would not be dissimilar to the Bailey.

The same superstructure with suitable pontoons should be capable of being used as a floating bridge. Such bridges may have to be flown into a disaster area, where unloading aircraft by hand might be the only option. The universal pontoon (ex MGB pontoon), which I designed in 1983, is not entirely suitable; it is not that it is too bulky or heavy, (when nested for air transport it only weighs 2000lb) but they are not easily man-portable. The Bailey tripartite pontoon centre section was about the same weight. (It was this pontoon that I had to man-handle into the water when I built the first Class 40 Bailey Ferry for the Po Crossing in Italy in 1945.) Something will have to be done to make the new pontoon more man-portable.

A valuable property of the Bailey-type bridge is that it does not have to be designed around a particular load class. It need only be as strong as the use for which it is built. A replacement bridge need not be much stronger than Class 30 and extra wide carriageways are best dealt with by building two twin bridges. More realistic than MLC 30 would be a requirement for Class 30 wheeled vehicles closed up nose to tail.

Conclusion

Since starting to write this article, the prophetic nature of many of my views was demonstrated by a bridging operation screened on television. The US army engineers were building a floating bridge for NATO in Bosnia. The shooting war had finished. It was in everyone's interest to build the bridge. Six-meter sections of a ribbon bridge without its special vehicles was being flown in by heavy-lift helicopter. If the British army had to mount a similar operation it would be interesting to hear how it would be done.

M2 is not an answer! And have we sufficient universal pontoons to provide even one bridge? There should be sufficient pontoons in NATO stores to bridge a gap of at least 1km with whatever bridging superstructure is available.

A lightweight Bailey-type of superstructure is the kind of bridge that NATO forces should hold for its millennium requirements. Its versatility has been amply demonstrated over the last 50 years in both war and peace.

One thing is certain. The bridging produced in response to the requirement written for "Bridging for the Nineties" is NOT the equipment for the next millennium. It is a beautiful piece of engineering equipment; but as the French general said of the Charge of the Light Brigade at Balaclava "It is magnificent but it is not war."

It is not a "Bridge Too Far", but a "Bridge Too Late". If you were to ask me could I do better, the answer would be "YES."

Bridging – Where Do We Go From Here?

COLONEL TOM FOULKES BSc(ENG) MICE MIOD

Colonel Tom Foulkes is Colonel ES 42 at HQ QMG where he is responsible for managing engineer, artillery and small arms equipment. Educated at Clifton, Sandhurst and Shrivenham, he commanded the Independent Field Troop AMF(L), 1st Field Squadron and 28 Amphibious Engineer Regiment. He has been involved in the development of engineer equipment since the early eighties serving in Operational Requirements, the Procurement Executive and Equipment Support Management.

A third generation Sapper, he enjoys photography, history and triathlon. He is President of Corps football.

THE Corps has waited a long time for Bridging For The Nineties (BR90), so long in fact that active professional debate about bridging philosophy, developments and future needs has been put on hold for the past 10 years or so. But things are about to change because BR90 is here at last. Production at Vickers Bridging in Ettingshall is well under way and the first elements of the close support bridge (CSB) system will be issued shortly. We should now start applying our minds to the future once again.

Looking ahead into the next 25 years, there are really only two questions that matter: what type of equipment will we need? and how much should we have?

The first issue has to be analysed from first principles, and to answer it we must keep returning to the fundamentals that determine our basic requirements. Again, there are two key factors: the nature of terrain, and the nature of operations. Study of terrain yields likely spans; and the nature of operations influences load class and speed of construction.

Taking terrain first, we can make few predictions about future theatres of operation. Ten years ago, who could have anticipated NATO's current deployment in the Balkans? So we must be careful not to neglect the unexpected. But even if we cannot be specific about terrain in a positive sense, can we afford to rule anything out in a negative sense? I would suggest not, at least not without incurring significant risks. We must therefore prepare for all kinds of gap-crossing operation. In other words, our bridging equipment needs to provide a continuous capability across the full range of gaps from minor drainage ditches at the bottom end, to major rivers hundreds of metres wide at the opposite extreme. For an Army with a world-wide strategic role there is nothing new in this, but I would suggest it remains a fundamental principle of sufficient importance to bear repeating.

Similarly, the pace of future operations is difficult to predict but is likely to remain high and even increase. Satellite communications, information technology, attack helicopters and high powered armoured vehicles, all indicate a strong trend towards ever more rapid operational manoeuvres. Equally, electronic sensors, airborne systems and long-range artillery are simultaneously reducing enemy response times. From this we should conclude that there will be a continuing demand for rapid construction both to enhance operational surprise and maximize survivability. Exactly how fast will be fast enough is more difficult to determine although the maximum speed of deployment, construction, stripping and dispersal of bridging equipment will have to remain compatible with

Col Tom Foulkes
Bridging - Where do we go from here p127

And anyway, would we ever have enough? I believe the best way round this problem is to acquire a new pontoon system which can provide traditional floating bridges to replace M3 crossings in slower time, thereby releasing scarce M3 resources for redeployment to forward areas. But at the moment we have no such equipment. I see a strong case, therefore, for developing a truly "universal" pontoon system which can be used with not just one but all types of in-service bridging equipment (ie, BR90, MGB and logistic bridges). Furthermore, if one in every three universal pontoons were to be fitted with a 360-degree water-jet propulsion system, this concept would not only enhance our floating bridge capability but could also extend our ferrying capacity at the same time.

We need a "universal" building frame like this to provide a non-ABLE means of assembling BR90.

Logistic Bridging. My next concern is "logistic bridging", by which I mean the type of equipment needed for semi-permanent structures on MSRs and for non-military traffic. Such bridges must, of course, be compatible with military vehicles including tanks, but the time available for their construction will be far greater than for "front line" bridging. In the past, we have used existing stocks of aged extra wide Bailey bridge (EWBB) and heavy girder bridge (HGB) in this role, but these stocks are now almost exhausted. We should therefore start thinking hard about our future tasks and decide what type of replacement equipment will meet those needs. Fortunately, this has been made much easier by the fact that a number of promising products are already on the market and are being used by military engineers in one-off applications in such places as Bosnia. British companies have done much in recent years to refine and improve the basic Bailey-type panel bridge for use in a wide range of civil engineering construction applications. Consequently, these ready-made and fully-developed commercial, off-the-shelf systems are available for military use now. Market leaders in this field, such as Mabey & Johnson Ltd, are already supplying a number of NATO and UN forces and might be able to provide us with a cost effective service on two levels: standard sets of equipment for normal training; and a surge capacity to support operations as and when required. Could this type of "just-in-time" approach both meet our operational needs and prove good value for money? Probably. It is certainly worth considering.

APC-Launched Bridges. Another conspicuous anomaly, it seems to me, is the one currently emerging in our armoured bridging capability. Why should all our armoured bridges have to be laid from tanks? Why not from APCs as well? I suspect the answer lies in the old cold war concept of high intensity operations combined with a desire to launch the longest possible bridge from the laying vehicle. But recent UN operations in Bosnia have shown that future "peacekeeping" armoured forces are likely to be based on Warrior formations and will not necessarily include tanks, at least in the initial stages. So if we are to support such forces with integral close support bridging from under armour, we shall have to acquire a new APC-based launching system. There may be two options for this: vehicle-launch (like the Chieftain AVLB), or trailer-launch. A number of armies around the world are already interested in this concept, and at least one UK company (Alvis Ltd of Coventry) has started development. Surely we should be taking an active interest too.

Reversionary Mode for BR90. The resilience of BR90, or lack of it, also bothers me. Its entire concept is based on mechanized construction and relies on the automotive bridge launch equipment (ABLE). This is very effective for reducing build time and manpower, but what if ABLE were to be destroyed or disabled? Would it not be prudent to develop some form of reversionary, non-ABLE, means of construction as a fall-back option? Of course. And what is needed, I would suggest, is a new type of "universal" building frame, something like the MGB setup, which could be used to launch BR90 bridges by the tried-and-tested cantilever and counterbalance method. This device should be designed in such a way that, like the universal pontoon mentioned earlier, it could also be used for MGB and logistic bridge building as well as BR90. In this way it would both add significantly to the operational sustainability of BR90 and provide a valuable "force multiplier" for our whole bridging capability at the same time.

Piers and Trestles. In practice, gaps seldom conform to the assumptions of military planners and often exceed the bridging spans available. Intermediate support systems for multi-span bridges are therefore important. Unfortunately, our development of piers and trestles has been left behind by the BR90 programme and we now need to act decisively

Bridging - Where do we go from here p129

the maximum speed of related tactical manoeuvres. This maximum capability potential will remain important even though many bridges, even in forward areas, are likely to be built under less demanding conditions. From this, and other factors mentioned later, I would suggest that speed of construction will continue to be one of our cardinal performance criteria for many years to come.

Turning to structural design, future load requirements will be determined by the nature and concept of operations. As long as Britain and its allies possess heavy tanks, our bridges must be capable of carrying them. And very recently, events in Bosnia have shown that even when "light" forces are deployed in the initial stages of a campaign, it is quite possible that heavier forces, including tanks, may be required to reinforce them at a later date. We must therefore ensure that all our general purpose bridging retains the capability of carrying both our heaviest tanks and their tank transporters. There may be circumstances in which special "light" bridging for "light" forces will be appropriate, but we must examine carefully what loads would be involved as they may not be quite as low as some are inclined to assume. It is quite possible, for example, that the highly concentrated axle loads imposed by DROPS-type logistics vehicles will emerge as the determining factor here. It would certainly be a mistake to assume that future, non-tank "light" forces could be supported with low load class bridging of the old airportable bridge (APB) type. In fact, it might be wiser to assume that all bridges will have to carry tanks at some stage of a campaign and that therefore all should be designed to the same load criteria. It follows therefore that heavy tanks are likely to remain a critical-load condition and design-driver for most types of bridging in the foreseeable future.

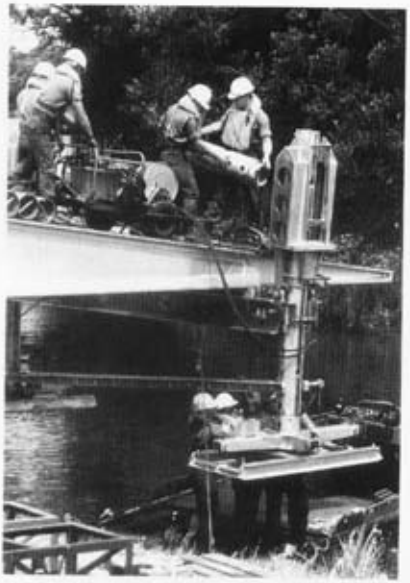
If this is a fair assessment of our generalized requirements, how does the Corps' present and planned equipment capability match up to these criteria? Fortunately, pretty well. In fact, operational analysis carried out in the early stages of the BR90 programme (or, to be more accurate, for its predecessor, the tri-national Bridging For The Eighties (BR80) programme) came to very similar conclusions and consequently BR90 delivers much of what we need. After all, when ten men can complete 30m of MLC 70(T)/100(W) bridge in just 20 minutes, we cannot really ask for very much more.

Or can we? BR90 is fine as far as it goes, but time has marched on since its genesis way back in the 1970s and several important factors have changed since then. In part, this has been brought about by new operational scenarios, but it is also the result of advances in industry and the ravages of time on our old equipment. Make no mistake about it, BR90 is an outstanding concept and will provide us with a more comprehensive bridging system than any other in the world. But when assessing our bridging capability **as a whole,** I cannot avoid the conclusion that significant gaps will soon start appearing unless we manage to maintain the excellent progress which BR90 has begun. To my mind, the six most notable of these are as follows:

Wide River Crossing Capability. Our ability to provide and sustain crossings over wide rivers is starting to look pretty thin. Yes, we still have the M2 amphibian, and very shortly we shall be replacing it with the excellent new M3 amphibious bridge and ferry manufactured by EWK Ltd of Kaiserslautern. But we shall have far fewer M3 rigs to go round. So what will happen when we have to provide semi-permanent crossings on two or three Main Supply Routes (MSRs) at the same time? M3 has been optimized for getting bridges and ferries into action quickly and then pulling them out again fast. It is less suitable for long-term crossings.

Wide river crossing. Will we have the resources for this type of operation in future?

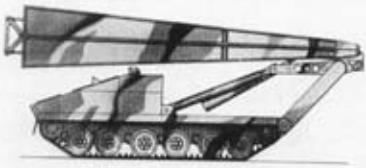
Bridging - Where do we go from here p128



Piers. Do we need a new "universal pier" system?

in order to catch up. At least two new equipments are needed: a trestle for the new AVLB-launched No 10 scissors bridge, and a "universal" pier set for two-span BR90 and other bridges.

"Light" Strategic Lift Bridging. Excellent though it is, the BR90 system is massive and unwieldy. Its dedicated vehicles are also extremely heavy (approximately 38 tonnes gross), and its bridges are currently of no use without ABLE. So how would we respond if we had to deploy a "light" force by air to some remote theatre? The answer in the short-term is probably the light aluminium alloy, hand assembled medium girder bridge (MGB). MGB is still manufactured by Williams Fairey Ltd of Stockport and remains an excellent military bridge, but for how much longer can it keep up with our growing needs in the years ahead? Or will a new "Light Bridge" be required to provide airmobile forces with both bridges and ferries like the old MLC 16 airportable bridge (APB) used to do? If so, what load class should it have? With Warrior and DROPS vehicles integral to so many possible future scenarios, presumably nothing less than MLC 40 would do. Could MGB take on this new role, perhaps with some further development in such areas as ramps, end panels and jacking systems? Both options must be worth considering.



APC-launched bridges. Shouldn't we have some? (Alvis Stormer armoured bridgelayer.)

Before turning to the vexed question of quantities, we should not underestimate the significance of two other key factors: logistics and mechanization.

Logistics. BR90's modular interchangeability provides important advantages in terms of flexibility and logistics. But it has proved an expensive design- and cost-driver during development. Do we want to see more of the same in future systems, or should we be prepared to accept a greater logistic burden in return for less initial cost?

Mechanization. Now that minimizing manpower has become such a dominant feature of military planning, have we fully come to terms with its consequent emphasis on greater mechanization? Should we accept the trend of BR90, or should we attempt a return towards man-built systems in future?

The final issue in this debate concerns quantities, and like all the best questions in life it has no answer. But it has to be addressed nonetheless. In its starkest form the question is simply this: how much bridging do we really need? Clearly, we must own enough to conduct normal training, and we must also hold sufficient stock for immediate deployment on operations. Perhaps we should even have enough to do both at the same time. But do we really need to hold sufficient stock in peace to cover every possible contingency in war, however remote its probability? The real issue here is estimating how much will be needed on operations, once deployed. In the past we have attempted to answer this question by detailed forward planning based on careful study of actual terrain. But today the range of possible operational scenarios has become so extensive that that approach will no longer do. Fortunately, BR90's component commonality and interchangeability helps reduce the scale of this problem by allowing reconfiguration between all four types of BR90 bridge (less the single piece, 13.5m No 12 bridge). However, the basic problem of how much is needed in the first place still remains.

Fully developed modern Bailey derivatives are available now.

Recognizing that this question is impossible to answer, no matter how hard we study it, perhaps we should consider adopting an entirely different approach which would treat bridges more like spare parts. Thus, maybe the time has come to put our trust in British industry and rely on them to supply what we need, when we need it. Provided tooling and raw materials are available, modern production methods using robot welders and computer controlled machining centres can turn out bridge panels and components to exceedingly high standards faster than ever before. Flash-to-bang times of one panel every 15 minutes, or four 32m bridge sets every day are now perfectly possible for steel panel bridges. Aluminium alloy bridges (such as BR90 and MGB) are more complex and time-consuming to manufacture, nevertheless a BR90 32m bridge set could still be produced in about ten weeks. Just how much operational risk would greater reliance on this type of lead time represent? Would it be acceptable in today's climate of extended warning times? Do we really have to go on owning all our war stock in peacetime, or can we afford to start looking for a better balance between operational risk and capital investment? I suggest the whole issue, including industrial "surge" capacity, deserves a long, hard, calculated look.

So where does all this leave us; and in what direction should the Corps be turning to face the challenges of the future? Fortunately, the success of BR90 stands us in good stead and means the overall picture is in pretty good shape. Witness the fact that with the advent of BR90 we shall soon be operating the most advanced, comprehensive and coherent military bridging system in the world. But although it provides an excellent foundation for the future, BR90's impact on the battlefield should not be assessed in isolation and I believe a number of gaps are now emerging around its periphery. It has been so long in development, and defence planning has moved on so far in the meantime, that a wide-ranging review of our complete bridging inventory is now required. We should start by deciding what we need to achieve and then testing it against our actual and planned capabilities in the full range of possible operational scenarios. The results, I suspect, will indicate a number of potential deficiencies including wide river crossing, APC-launched bridging, and operational resilience. However, in addressing the outcome of this analysis we should bear in mind fresh ideas and recent developments in industrial capability. Any shortcomings are unlikely to be particularly complex or expensive to resolve, and most are already receiving attention from the MOD Central Staff, Procurement Executive and Defence Research Agency. But at the same time, I believe they deserve widespread discussion and consideration within the Corps itself so that their resultant visibility and relative priority for the Army as a whole can reflect the outcome of well-informed professional debate. Bearing in mind the length of the equipment procurement cycle, we cannot afford to procrastinate. The Corps is now at a turning point, and where we go from here on bridging for the next 30 years will be determined very largely by the decisions we take today.

Bridging - Where do we go from here p131

"An Officer Not Only of Great Talent But of Rare Coolness and Courage" Major General W S Trevor VC Royal (Bengal) Engineers 1831 to 1907

JOHN N RHODES TD MA PhD AMA, Curator RE Museum

John Rhodes has been the senior professional curator at the Royal Engineers Museum since 1992. Before that he was an assistant at Maidstone Museums and Art Gallery after completing the Graduate Certificate in Museum Studies at Leicester University in 1986.

Virtually his only connection with the Corps before 1992 was between 1967 and 1969 when his platoon in the Royal Lincolnshire Regiment (T) consisted of transferred members of 863 (County of Lincoln) Movement Light Squadron RE (TA) when the TA became the TAVR. However in his last territorial appointment at the Northumbrian University OTC he had passing acquaintanceship with several Sapper cadetship officers and bursar, some of whom he has failed to recognize subsequently at Brompton.

On 6 September 1994 the Victoria Cross (VC), other medals, and memorabilia of Major General William Spottiswoode Trevor, of the Royal (Bengal) Engineers, were presented to the Royal Engineers Museum under the will of Miss Dorothea Nicol, his great granddaughter. The VC was a particularly appropriate addition in that it served to replace one previously on loan and awarded to Lieutenant James Dundas, for the same action at Dewangari, Bhutan, in 1865 which was removed in 1983 and sold. General Trevor's other medals and papers contain a fascinating story about a very remarkable Sapper and the contribution of Royal Engineers to the development of the Indian Empire.

The first medal awarded to Trevor was the Kabul Medal, 1842, engraved "William S Trevor. Taken hostage during the retreat". At that time Trevor was a boy aged ten! With his mother and her other six children, he had been captured after the murder of his father Captain R S Trevor, 3rd Bengal Cavalry, who had been sent to Kabul with his family to command the puppet Shah Shoojah's Lifeguards. Trevor's memoir, published in *The RE Journal* of 1908 (2nd series Volume VII) recalls that terrible experience and how the new Afghan leader, Akbar Khan, had amused himself by setting up fights between the young Trevor and Afghan boys, awarding his victories with gifts of mutton legs. A sad little inscription on the family tomb at Kensal Green hints further at the horrors experienced by Mrs Trevor and her children during their nine months' captivity, by commemorating Captain R S Trevor's eighth child, Jessie Machnachten, born in captivity in Kabul on 16 July 1842, who died at Ferozepore on 16 December 1842. Yet Trevor could not have worn his Kabul Medal with his others for it came to the museum unmounted and with no miniature to match. However it seems appropriate that it should be included alongside them in the museum's VC display.

After returning to Britain, Trevor was educated first at Edinburgh Academy, as befitted the grandson of William Spottiswoode, Laird of Glenferemet, in Perthshire, whose name he bore. He and two of his brothers then followed their late father into the army of the Honourable East Indian

Company (HEIC), William being commissioned into the Bengal Engineers on 11 December 1849. During his subsequent engineer training at Chatham, he was one of five HEIC ensigns detached on special duties for the Great Exhibition of 1851, and his effects include a set of medals from the exhibition. Such medals were mounted in blue silk-lined boxes bearing the recipients' names and presented by a grateful Prince Consort to those engineer officers who assisted: "The Executive Committee in the arrangement and management of the Exhibition", and who could not, like civilians, have received a financial regard for their services. ("History of the Corps of Royal Engineers" Volume II pp344-5.) A similar set, presented to First Lieutenant H W Tyler RE for his work in the Persian, Chinese and Colonial Department of the exhibition, is also on display in the museum.

Soon afterwards Trevor was posted to India and almost immediately saw action in the second Burma War of 1852/3. The "Pegu" bar on his India General Service Medal hardly conveys an idea of the service he saw or what prompted his two Mentions in Despatches, the first for his part in the assault on the Rangoon pagodas in April 1852, when his arm was broken, and the second for his role alongside Ensign Garnet Wolseley, 80th Foot, in the capture of the Burmese stronghold near Donubyu. In their despatches his superiors commented on his deadly accuracy with a revolver, an observation repeated several times in his subsequent military career. Indeed his interest in shooting extended into his retirement, for his memorabilia includes a life member's badge of the National Rifle Association, dated 1895.

After the war Trevor remained in Burma engaged chiefly on survey work until 1857 when he was sent to the hill station at Darjeeling to build barracks there. He was thus remote from the main actions of the Sepoy Revolt of 1857/8, but earned his Mutiny Medal by attaching himself to the so-called "Darjeeling Field Force", a scratch body consisting mainly of Gurkhas and European convalescents under the command of Captain the Honourable E Curzon. This force defeated mutineers of 75th Native Infantry on their way from Dacca, in what could have been little more than a skirmish at Cherubundar on the Bhutan frontier.

Soon after, in 1858 whilst still in Darjeeling, Trevor married Miss Eliza Ann Fisher, the daughter of a chaplain or missionary there. He was then posted to Calcutta where his two

Major General W S Trevor VC.

daughters were born and where, probably in 1863, his young wife died.

It was in Calcutta where he came to be first engaged on public works, forming the most productive part of his career which overlapped so considerably with those of his brothers, Major General John Salisbury Trevor CSI, Royal (Bombay) Engineers, Colonel Salusbury Thomas Trevor, Royal (Bengal) Engineers, and Sir Arthur Charles Trevor KCSI. In 1860 William found himself constructing the Ganges and Darjeeling Road. In May 1863, he became Controller of Public Works Accounts in Bengal, where he demonstrated that administrative ability at which he reputedly excelled, though he also made a number of enemies in the Bengal Civil Service by virtue of his criticism and subsequent overhaul of the accounting methods then in operation. About that time he began to lay out the Eden Pleasure Gardens, where cricket is played today in Calcutta, a project subsequently completed by his younger brother Salusbury. For a short time in 1864 he was placed in charge of the Calcutta Mint.

In February 1865, after an embarrassing reverse on the Frontier, a small expedition was sent from Bengal to restore British prestige in Bhutan. The

An officer not only of great talent p133

then Captain William Trevor and Lieutenant James Dundas[1] were ordered to accompany this so-called Dooar Field Force with a body of Bengal Sappers and Miners. The force was led by Brigadier Henry Tombs VC CB, late of the Bengal Artillery, and was divided into two columns, one under his direct command and the other under Brigadier Tytler. Tombs hoped to conduct a speedy campaign, teach the Bhutanese a lesson and retire, for his troops were affected by cholera and the commanding officer of one of his British regiments, the 55th, was stricken with fever.

Tombs' attack began with an artillery bombardment of the Bhutanese defences. Here Trevor's sappers and miners cleared the ground for the guns in support of the column advancing to storm the blockhouse at Dewangari, which Tombs saw as the key to the Bhutanese position. Trevor stationed himself in rear of the guns, accompanied by Lieutenant Henry Garnault[2], another Bengal Engineer, while Dundas and Lieutenant Kellow Pye RE[3] remained among the sappers. Trevor's final orders from Tombs, before the latter set out with the assaulting infantry, were that when the final gun position had been levelled, the sappers were to prepare scaling ladders and powder kegs, and were to be ready within an hour and a half to bring them up to the assault.

Unfortunately the artillery bombardment was completely ineffectual and the attack became bogged-down under the walls of the blockhouse. Trevor, seeing this, set out to join Tombs for further instructions. He was already weak from the fever affecting the force and had to rest two or three times but after about a quarter of an hour, as he approached the top of the hill, he met Brigadier Tombs walking down towards him. Tombs needed the scaling ladders immediately for the infantry were losing heart and the Bhutanese were rallying. But as the sappers could not be ready within half an hour Trevor suggested, after a brief reconnoitre, that the walls might be climbed without ladders and the blockhouse entered through the gap between the top of the wall and the roof. But when Tombs tried to persuade the Sepoys to do this they replied that it had been already tried, "by their own *Sahibs* and men, who had been beaten back badly wounded, and that no man could climb in the face of such big stones as the enemy threw." Tombs therefore looked round for officers to set an example. His aide-de-camp, Major Sankey, RA, was the first to respond, but Tombs ordered him to desist for he had no other staff officer with him, and consequently Trevor himself volunteered, throwing away his scabbard and scaling the blockhouse wall with his sword between his teeth. Here he was closely followed by Dundas who must have been close on his heels, for Trevor claimed to have first seen him drawing a Bhutanese arrow from his side, "Just as I began my examination of the stockade". The two of them crawled head first over the top of the wall and into a gallery from which Trevor emptied his revolver into the enemy below. They were closely followed by Garnault, Trevor's sapper orderly, and about eight of the infantry, Sikhs, Pathans and British. Indeed after the action a Bugler Keily of the 55th Regiment, sought Trevor's support for a decoration for his own bravery. In the desperate confusion of climbing into the blockhouse and clearing the gallery, Trevor was wounded in the head by a sword cut and Dundas suffered a broken hand. Yet afterwards Tombs was amazed that either officer emerged alive "from so desperate an undertaking".[4] Though the fight was quickly over the slaughter of the Bhutanese was considerable. An officer of the force later wrote of them, "some few may have escaped but the rest were shot down where they stood and lay in heaps. If Englishmen had not been present, even the 45 prisoners whom we took would not have escaped with wounds but would have been numbered with their dead ..." [5] Afterwards Tombs congratulated the two engineers warmly and promised that he would recommend them both for the VC, which quickly became common knowledge amongst their brother officers. Tombs, in his despatches on the campaigns, (which remained unpublished) described Trevor as, "An officer not only of great talent but of rare coolness and courage".

Unfortunately the gallantry displayed in the storming of Dewangari was soon overshadowed by outside perceptions of the Bhutan campaign as a minor embarrassment. Within a week of Tombs' victory, 140 men of the 600 strong 29th Regiment were hospitalized with "Bhutan fever". Then

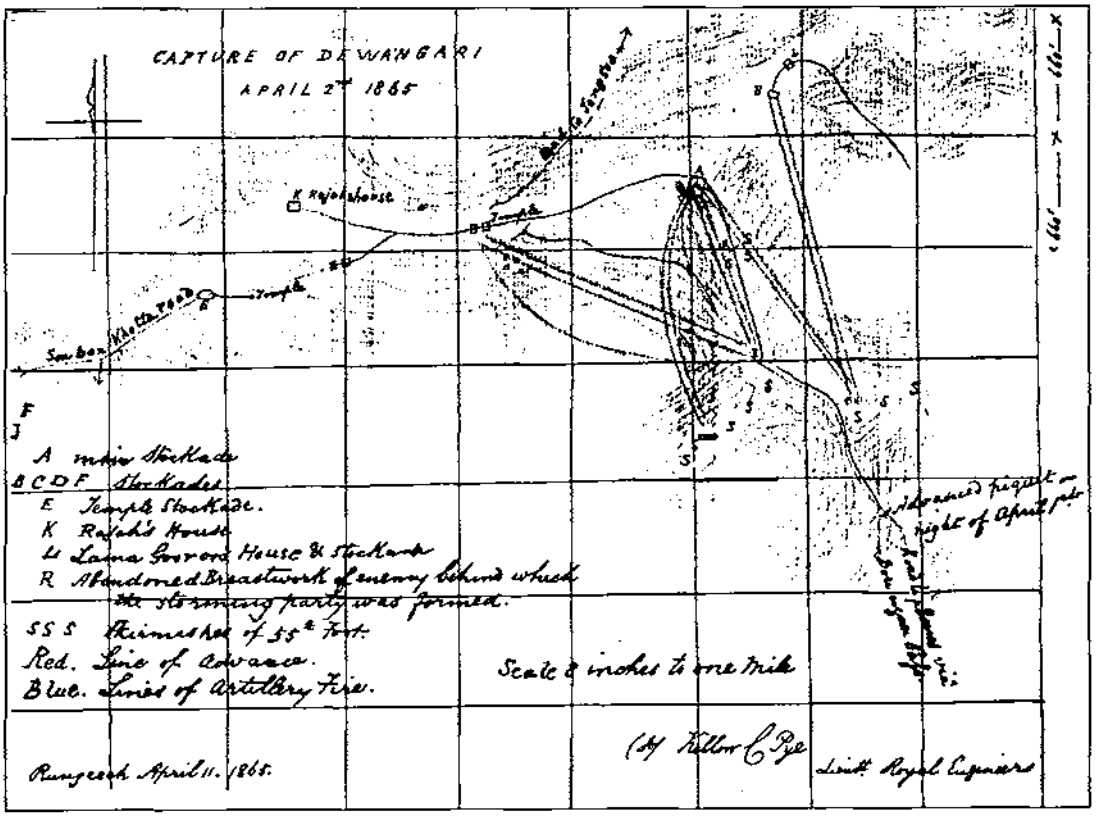
[1] James Dundas VC commissioned lieutenant 8 June 1860, killed by an explosion in Afghanistan on 23 December 1879.

[2] Henry William Garnault, commissioned second lieutenant 7 December 1855 died at Madras, 13 September 1870.

[3] Kellow Charles Pye, commissioned lieutenant 19 December 1860, died at Calcutta 8 April 1877.

[4] (Public Records Office (PRO) WO32/7374).

[5] Snelling S J "Forlorn Hope at Dewangiri". *Medal News* October 1989.



Reduced copy of original map held in the RE Museum, showing planned attack on the blockhouse at Dewangari. Please note: In notes on original map, the red line refers to the single lines shown and blue to the double lines.

between May and June, over 400 of 55th Regiment were admitted to hospital where many died. By November 1865, of 51 officers engaged at Dewangari one had died and 35 had taken sick leave, 19 of them to England, including Trevor, whose head wound was still affecting him after two years.[6] In England there was public disquiet at press reports that Bhutanese prisoners had been murdered in cold blood. The perception in sections of the army in India also was that action against an unsophisticated enemy like the Bhutanese hardly warranted the award of two VCs.

Early in 1866 while Trevor was convalescing in England he learned unofficially that the CinC, India, Sir William Mansfield, had not recommended the award of the VC either to him or to Dundas. Trevor asked his younger brother, Salusbury (at the time second captain, then in Calcutta) to approach the CinC to establish a reason for this and discovered that, while Mansfield was prepared to consider the deed itself worthy of the decoration, he believed the two engineers, "Had been guilty of the unofficerlike irregularity of rushing on at the head of the assaulting parties to the neglect of [their] own proper duties and of striving to cut out the regimental officers in the performance of mere feats of gallantry". On 26 February 1866 Trevor wrote a detailed description of the action so that his brother might clear up a number of the CinC's misapprehensions, but shortly before Trevor returned to India he received from the Adjutant General in Simla the official letter, dated 22 June 1866, stating that the CinC and the Governor General of India were recommending that Trevor should be promoted to brevet major for gallantry, "in Bhootan (sic) and earlier", but that he should not receive the VC. His brevet majority dated from 15 May 1866. At some stage the Secretary of State for India had been alerted to the possibility of a dispute over this and informed the CinC of the army, His Royal Highness Field Marshal the Duke of Cambridge, but he declined to intervene.

[6] Snelling S J *op cit.*

Trevor, however, was not prepared to let the matter rest there and felt better able to take control of events once he had returned to India. From Calcutta he first sought Tombs' support for an appeal against the CinC's decision in order to clear Dundas and himself, of the "slur of unofficerlike conduct". As Trevor put it, "I feel ... that had we been guilty of any unofficerlike irregularity, situated as we were under your immediate observation, you would have been the first to check our presumption and the last to bring our conduct under favourable notice". "Moreover VCs, ... bestowed on the field naturally attract the notice and comment of the whole force. A corresponding degree of comment follows if the promise made on the field does not meet with the support of the CinC and Government of India".

Brigadier Tombs responded most positively to Trevor's appeal, indicating that he had not been aware of the CinC's objection to his recommendation, for he had hitherto believed that this decision was just one aspect of the British government's belittling of the whole Bhutan campaign so that his own hands had been, in effect, tied. However, in this case, Tombs believed that if Trevor were to appeal against the decision with his full support, the CinC would reconsider. Accordingly Trevor showed Tombs' letter to Colonel Sir Henry Durand, Secretary to the Government of India, Military Department, and himself a former Bengal Engineer.[7] On his advice, Trevor attached a copy of Tombs' letter in an application to the CinC for a rehearing of the case. But Mansfield considered it, "Inexpedient to reopen the question", for it was understood that Trevor's brevet majority was, "in satisfaction of all claims on account of distinguished service including Dewangari". Durand then recommended Trevor to forward all the correspondence direct to the Governor General. That Trevor felt able to pursue his claim thus far suggests an officer of enormous tenacity and remarkable boldness. Though his letters are full of the polite, almost obsequious, phraseology Victorians used in their formal correspondence with authority, he coupled this with a clear assertion of his rights. "Claims of this description are open to reconsideration up to five years after the event and many precedents exist for granting the distinction after longer delays and not less positive denials than in my case". Trevor's appeal to the Governor General in Council was based on three main points:

- General Tombs promised the VC to Lieutenant Dundas and himself on the field, "under authority vested in him by the Queen's Warrant", (for the award).
- That in leading the way into the Dewangari blockhouse they acted under his personal orders.
- That the duty thrown on them, "was a desperate one".

Accordingly the Council requested a report from Tombs, which he duly submitted on 6 May 1867 and in which he firmly maintained that, "Captain Trevor and Lieutenant Dundas ... carried out my orders and did not (as He the CinC would appear to think) officiously take advantage of their position to deprive the infantry officers of the storming column of their right to lead it into the blockhouse". Moreover he congratulated both officers afterwards and, "Told them publicly in the presence of Colonel Hume of the 55th Regiment and other officers that I would do my utmost to get them the VC. I cannot state positively that I actually promised it to them, but I considered at the time, as I do now, that the Royal Warrant authorized me ... to confer the distinction subject only to confirmation by Her Most Gracious Majesty".[8]

In Council, discussion concentrated on whether Tombs had actually promised the VC to both officers. A majority felt that he had made it clear their action deserved it and that he certainly had the authority to recommend this directly. They voted in support of the award. Sir William Mansfield would not agree. However in December 1867 the Secretary of State for India accepted the majority recommendation and on 24 December 1867 this was endorsed by the CinC of the army, the Duke of Cambridge, who had the final responsibility for recommending the award to the Queen. The award and citation were published in the *London Gazette* of 31 December 1867 (*ibid*).

On 13 January 1868 the two VCs were sent to the CinC India, for formal presentation, but Mansfield did not perform this himself. The honour fell to Major General Fordyce, the GOC in Bengal, who paraded the local brigade in full dress on the *maidan* at Fort William, Calcutta, on 23 March 1868 at 6.30am! Even at that time, so his adjutant informed Lieutenant Dundas, it would be too hot for officers' full dress red coats, so the dress for the ceremony would be, "Long blue frock coats, pouches, cock-it-up hats and white legs". Trevor

[7] Henry Marion Durand KCSI CB, commissioned second lieutenant 12 June 1828, major general 1 March 1867, killed by a fall from his elephant on frontier of Tong 1 January 1871.

[8] (PRO WO33/7374).

and Dundas could be at the Flag Staff mounted, if they wished, to take the salute but all would dismount for the presentation.

Tombs does not appear to have suffered for his stalwart support of his subordinates, for on 11 March 1867 he was promoted major general and the following March he became KCB. Whether Trevor's own tenacious pursuit of the VC was held against him by those in authority in India remains an open question but certainly Colonel J P Steel, who wrote Trevor's memoir for *The RE Journal* in 1908, felt that the latter's subsequent distinguished service failed to secure due recognition when compared with the achievements of two of his brothers, Sir Arthur Trevor KCSI and Major General John S Trevor CSI. All William had to show for his 22 years service in Public Works in India was a medallion for the Calcutta International Exhibition of 1883/4, presented to him as a member of the organizing committee, and promotion to major general on his retirement in 1887. Moreover in those 22 years he only saw military action again once, and that during a period of European leave when in 1870 he went to France as an unofficial observer on the Prussian side in the Franco-Prussian War. On the other hand his younger companion at Dewangari, James Dundas, went to Afghanistan in 1879 as a captain but was killed there in an accidental explosion while setting a charge at Sherpur, outside Kabul.

The Trevor papers, now deposited in the museum, contain several reports made by William in this latter part of his career for the Government of India which highlight his administrative talents. Between 1867 and 1870 he was a superintending engineer and served for a time as consulting engineer to the Bengal Irrigation Department. In 1872 after two years' home leave, he became Superintending Engineer in charge of "First Circle" military works. In 1874 he was put in charge of famine relief in Bengal north of the Ganges, for which he received the formal thanks of the Government of India. After a short period as CE in Central India he returned to Burma in February 1876 as CE, a post he retained until 1880 when he succeeded his elder brother, John, as Director General of Railways in India.

In Burma in 1876 he prepared proposals for defending the strategic railway to Pegu and Rangoon harbour against possible attacks. In 1879 to 80 he was seconded to prepare a report for the reorganization of the RE establishment in the Public Works Division of India for which he received an official commendation from the Governor General in Council. His valedictory report on leaving Burma in 1880 set out the Public Works requirements for British Burma and a programme for their implementation. His last post was Secretary to the Government of India, Public Works Division, in Calcutta and Simla, between 1882 and 1887, after which he retired with the rank of honorary major general. At the beginning of this period he carried out the professional inspection of the Corps of Bengal Sappers and Miners on behalf of the CinC India. Vibart, the biographer of "Men of Note" of the old HEIC army said of him, "It was as an organizer and administrator that he was most successful and gained [his] reputation ... He was always an advocate for simplification and directness of procedures in the work of all branches of the Public Works Division. (Vibart H M "Addiscombe, its Heroes and Men of Note". London 1894 p575.)

Of General Trevor's daughters, the elder died in 1878 (probably in Calcutta and unmarried), the younger, Florence, married in India Captain Maule Brackenbury, of the Royal Engineers, in 1882 after his return from Afghanistan (Maule Campbell Brackenbury CSI, commissioned lieutenant 22 June 1865, Colonel 8 September 1895, died 1915).

In his retirement General Trevor lived with his daughter in Victoria Street, London. He died there on 2 November 1907 and was buried in the family vault at Kensal Green Cemetery.

BIBLIOGRAPHY

- Royal Engineers Museum. Trevor MSS (9409.4).
- PRO. War Office Papers (WO 32/7374).
- ed. Porter W. *History of the Corps of Royal Engineers* Vol II. London 1889.
- Vibart H M. *Addiscombe, its Heroes and Men of Notes*. London 1894.
- Snelling S J. Forlorn Hope at Dewangari. *Medal News* October 1989.
- Steel J P Memoir of Major General W S Trevor VC Royal Engineers *Journal* Vol VII 2nd Series 1908.

ACKNOWLEDGEMENT

I AM grateful to Mr Simon R de M Trevor, and his father Brigadier K R Trevor CBE DSO, whose family history research in the Public Records Office and elsewhere provided the author, over several years, with much of the background for this paper.

Roles of Sapper Geologists in the Liberation of Normandy, 1944

Part 2. Quarries, Water Supply, Bombing and Cross-Country Movement

COLONEL E P F ROSE TD MA DPHIL MCIWEM CGEOL FGS
PROFESSOR C PAREYN D-ES-SC

The first part of this review (Rose & Pareyn, 1996) documented the roles of sapper geologists in planning for Operation Overlord, *the D-Day landings of 6 June 1944, particularly with respect to beach conditions and potential airfield sites. This concluding part describes other ways in which a small number of highly skilled geologists contributed to operations in the northwest European campaign.*

QUARRIES

IN World War Two, armies achieved a high state of mechanization. In many instances the network of roads behind the forward troops could not cope with the traffic, and roads had to be strengthened, widened, or new roads built. On D-Day, 8851 vehicles landed in Normandy. By D+50 there were 152,499 military vehicles in an area little more than twenty miles broad and ten miles deep (32 by 16km) (Anon, 1945b). The weight of some of the vehicles and the passage of those equipped with caterpillar tracks proved destructive to road surfaces, and road maintenance became a serious problem. The armies also needed hard standings for stores depots, vehicle and gun parks, and runways for their supporting aircraft.

All this meant a requirement for aggregates – which was met by Quarry Group RE. Commanded by Lieutenant Colonel A R O Williams RE, who had earlier distinguished himself as CRE of the tunnelling companies in Gibraltar (Anon, 1989), this comprised a HQ group and five quarrying companies, initially with a total strength of just over 900 all ranks – largely recruited from the UK's quarrying industry – supplemented by the Pioneer Corps, prisoners-of-war, or local civilians *(Table 1)*. Geology guided the group's deployment in two ways:

- **Geological maps.** In 1944 the Geographical Section, General Staff, of the British Army copied and printed in full colour, for general Allied distribution, all the 1:80,000 scale geological maps of the Carte Géologique de la France (Kaye, 1957). Sheets originally published between 1895 and 1926 covered Normandy – and the reprints may still be consulted in the Department of Printed Books at the Imperial War Museum. Williams (1950, p223) later recorded: "Of obvious importance in planning stone production

Table 1. Personnel and Main Items of Plant and Equipment for Quarrying Company, RE

Men	
4 officers	
173 other ranks, including 52 quarrymen, 50 drivers and sundry tradesmen, plus approximately 100 unskilled men: Pioneer Corps, prisoners, or civilians.	
Excavators, ⅜ or ¾ cubic yard	
Base machines	3
Face-shovel equipments	3
Dragline equipment	1
Angle dozer (7ft blade)	1
Compressors, mobile	
200 cubic feet capacity	7
100 cubic feet capacity	1
Rock drills	
Drifters, 4in	3
Jackhammers, 50/60lb	3
Jackhammers, 25/35lb	8
Drill sharpener and furnace	1
Drill steels	
1¼in, round	3 tons
1in, hexagonal	6 tons
¾in, hexagonal	6 tons
Crushing and grinding units, mobile	
10 tons/hour	5
25 tons/hour ("Iowa")	1
Vehicles	
Dumpers, 3-cubic yard (Muirhill)	12
Tippers, 3-ton	20
Trucks, 15cwt	2
Van, utility	1

From Williams (1950), with Imperial units of measure as in the original.

Figure 1. Map showing positions of main roads and British military quarries in Normandy, 1944. (From Rose & Pareyn, 1995; after Williams, 1950).

and the allocation of Quarry Group's plant and manpower to the best advantage was knowledge of the stone resources of the areas occupied and likely to be occupied by 21 Army Group. Field reconnaissance yielded much useful information of a detailed nature, but for an overall picture geological maps proved invaluable."

- **Geologist advice.** Major F W Shotton's geological opinion was sought when appropriate, and indeed after the war he recalled sometimes accompanying Williams on reconnaissance visits to potential military quarry sites (Shotton, written com, 1989). The experience provided the basis for the guiding statement inserted postwar in a Corps textbook on quarries and gravel pits (Anon, 1957, p8): "Sound geological knowledge is required for the selection and development of a quarry. Information and advice should be sought from the geologist at Army headquarters as regards both the reconnaissance and the quarry plan."

Initially, production started in existing quarries at Creully, Esquay, Douvres, Reviers, Carpiquet South, Blay and Tilly-sur-Seulles *(Figure 1)*. Apart from Esquay, a sand deposit, all these quarries were within Jurassic limestones. They produced rock which was weak and far from ideal for road repair *(Figure 2)*, but within the restrictions imposed by the front line and sector boundaries, there were no alternatives. Weak rock quarries were set aside as those yielding stronger rocks became accessible

Figure 2. . Quarrying of weak Middle Jurassic limestone near Carpiquet, August 1994, using a 30-ton shovel. The rock, known locally as Calcaire de Caen (cf. Fig. 7), is of Bathonian age and similar to the Bath Stone of the Cotswolds in southern England. It occurs as near-horizontal strata. (Copyright The Imperial War Museum, London; Photo CL811).

with the progress of battle, and the quartzite or well-cemented sandstone quarries at Mouen *(Figure 3)*, Perrières, Etavaux, Maltot and St Martin-des-Besaces were brought to production. In June, 12,905 tons were produced in France, rising to 107,270 tons in July, and a peak of 145,498 tons in August *(Figure 4 over the page)*. As the Allied armies advanced, so French quarries were replaced by those in Belgium and finally Germany as sources of aggregate. In total, 49 different quarry sites were operated during the 11-month campaign, to supply a total of some 1,800,000 cubic yards (1,376,000m^3) of crushed rock.

Water Supply

By D+1 the existing water supply network in the British-held area had virtually ceased to operate, due to failure of the electricity supply to the pumps

Figure 3. Quarry in early Palaeozoic (Cambrian) quartzites near Mouen, southwest of Caen. The rock has been inclined by late Palaeozoic deformation of the Earth's crust. Photographed at the present day, this site was the first to yield strong rock to the Quarry Group RE in 1944. (From Rose & Pareyn, 1995).

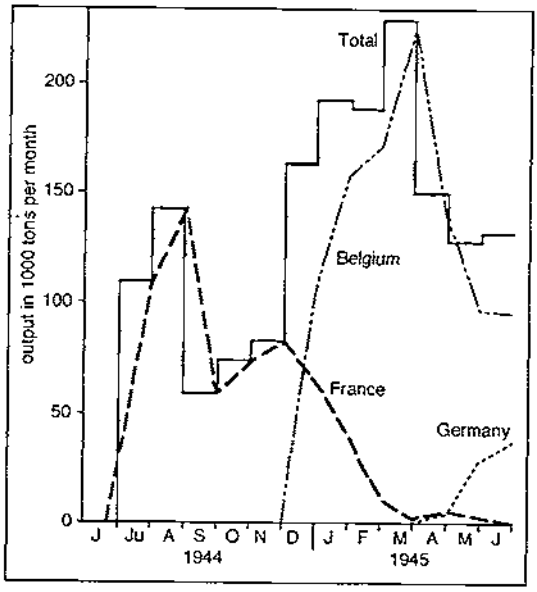


Figure 4. Monthly 1,000-ton quantities of stone produced or distributed by the Quarry Group RE, from June 1944 to June 1945 – in total, and progressively from sources in France, Belgium, and finally Germany.
(From Rose & Pareyn, 1995; after Anon, 1945a.)

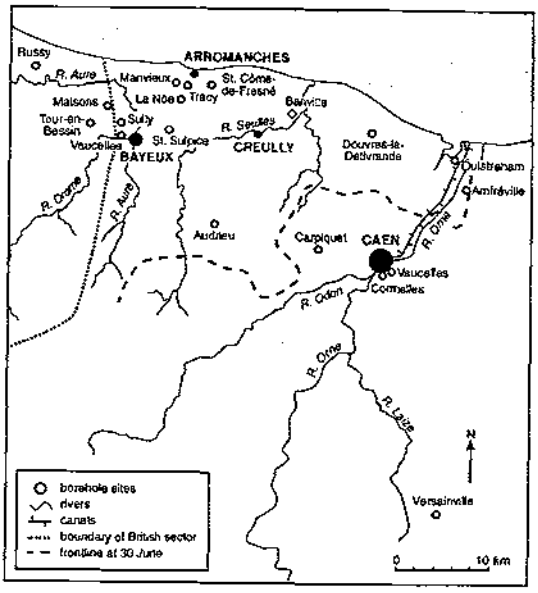


Figure 5. Map showing positions of the main rivers and British military borehole sites in Normandy, 1944. See Table 2 for borehole depths and yields, Figure 7 for strata normally penetrated.
(From Rose & Pareyn, 1995).

from the power station in Caen, still in German hands (Wilson & Nowers, 1994). However, west of the River Orne *(Figure 5)* water was available from small rivers and existing deep wells. A network of water purification and storage points was quickly established. These comprised mobile pumping sets, mobile filtration and chlorination plants, and sectional steel storage tanks. Ultimately about 50 water points were established in the area covered by I Corps, twelve of which were operated at any one time. During the first week of battle, each division required approximately 50,000 gallons per day from RE sources. Existing wells *(Figure 6)* were soon supplemented by new wells, developed with geologist expertise:-

- **Specialist map preparation.** Shotton (1947) has recorded that in the planning stage of Operation *Overlord*, geological activities included the preparation of water intelligence maps, and that water supply intelligence work continued and developed after D-Day. King (1951, p115) has recorded that maps on the scale of "1/50,000 or thereabouts" were prepared for all the bridge-head areas of Normandy before D-Day, showing the main aquifers divided into three main zones: (1) where small springs might be expected but where boring was unlikely to produce large supplies; (2) the main outcrop area with if possible water table contours; and (3) subsurface contours on the top or base of the aquifer to indicate depth of boring. A distinction was made between groundwater expected to be of good quality and that expected to be saline.
- **Borehole site selection.** Thirty-three boreholes were put down in Normandy, according to a summary recorded by Shotton (1945) for ISTD (Inter-Services Topographical Department), and after the war published by Bigot (1947). According to Shotton, only one (at Le Haut d'Audieu) was sunk without geologist advice, by 2nd Canadian Drilling Company. Of the others, six were shallow holes put down in alluvium near the River Drome, in ground unfavourable for deep boreholes. The gravel of the alluvium effected a natural filtration, reducing the number of filtration pumps and plants required. Two of the other boreholes were deep wells through the Cretaceous Chalk, to the east of the area shown in Figure 5. One hole was abandoned as crooked, the other due to operational moves, before a satisfactory yield was obtained. Most boreholes *(Table 2)* penetrated Middle Jurassic oolitic and/or bioclastic limestones and subordinate clays *(Figure 7)*, commonly extending into the underlying Liassic marly limestones. Only one reached the Pre-Cambrian (Brioverian) basement (the St Lô phyllites).
- **Borehole drilling supervision.** Wells were drilled by No 8 Boring Section RE, deployed within line-of-communication troops during the build-up phase following the initial assault (ie from D+5 onwards) (Anon, 1945b). The section was commanded by a geologist,

Figure 6. "Well" at Hermanville-sur-Mer. However, the apparent well-head is a postwar memorial. The water source was probably the local pond (mare), since the hydrogeological setting and calculated abstraction rate make a borehole source unlikely.

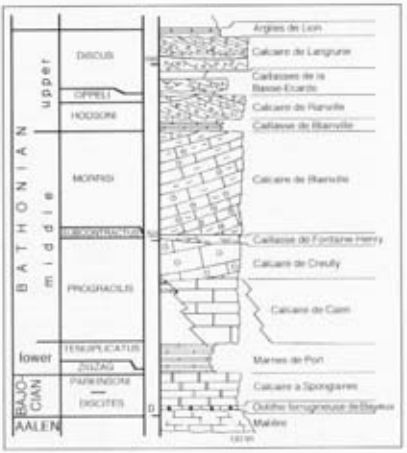


Figure 7. Part of the Middle Jurassic sequence of Normandy (somewhat generalized), to be found between Bayeux and Caen. Stage and ammonite zone names are to the left, formation names (in French) to the right. Total thickness is some 100m, mainly limestone (calcaire) but with some clays (argilles) or marls (marnes).
(From Rioult et al, 1991).

Lieutenant A K Pringle RE. A first class honours graduate of Glasgow University, with civilian experience as an exploration geologist in the Middle East, Australia and New Guinea (Munro, 1985), Pringle was ultimately to become Professor of Applied Geology at Strathclyde University in his native Scotland.

The military boreholes produced acceptable yields *(Table 2)*, and contributed to the successful sapper utilization of water resources in Normandy for military purposes – a use now extensively documented by Rioult et al. (1994).

Bombing

Geologists, although not sapper geologists, were used to enhance the effectiveness of the Allied bombing campaign *(Figure 8)* against northwest Europe in at least two ways:

- **Target selection.** According to Simon (1957), four geologists were used in the Industry Section of the British Intelligence Centre located at RAF Medmenham, Buckinghamshire, which later became the Allied Central Intelligence Unit. Also, at least one geologist was a member of the combined strategic target committee whose function was to select bombing targets.

- **Damage assessment.** A geologist, Captain (later Lieutenant Colonel) F W Anderson, was seconded in July 1941 by his former civilian employer, the British Geological Survey, to the Ministry of Home Security to join a team of scientists led by Professor (later Lord) Zuckerman in order to carry out geological work in its research and experiments department (Rose & Rosenbaum, 1993). Anderson had been commissioned into the TA in 1930 as an infantry officer.

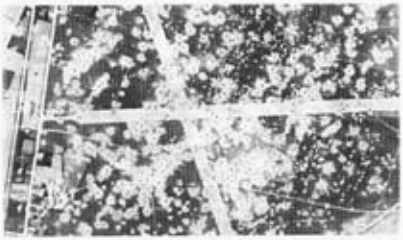


Figure 8. Landing ground and runways of Le Culot airfield blanketed by a very heavy concentration of craters after an attack by RAF Bomber Command on 13 August 1944. (Misidentified as Carpiquet, SW of Caen, by Rioult et al, 1994, p75). (Copyright The Imperial War Museum, London; Photo C4562).

Table 2. Royal Engineer Boreholes for Groundwater through Jurassic Strata in Normandy, 1944

Locality	Depth (m)	Yield (m^3/h)
1. Sully	34.75	18.00
2. Amfréville	100.60	3.00
3. Tracy-sur-Mer (La Noë)	97.50	0.45
4. St-Côme-de-Fresné (Buhot No 1)	105.15	11.80
5. Maisons	26.00	13.50
6. Tracy-sur-Mer (La Rosière)	38.00	18.00
7. St-Côme-de-Fresné (Buhot No 2)	24.40	13.60
8. Banville	45.70	14.50
9. Douvres-la-Délivrande	39.60	22.70
10. Tour-en-Bessin (Grivilly)	20.70	nil
11. Manvieux	45.70	nil*
12. Ouistreham	33.00	31.90
13. Tour-en-Bessin (Le Coudray)	25.00	9.10
14. Audrieu (Le Haut d'Audrieu)	58.00	3.40
15. Caen (Vaucelles)	73.25	28.70
16. Vaucelles	7.00	13.60
17. Cormelles	62.50	14.00
18. Audrieu (Le Base d'Audrieu)	30.50	9.00
19. Versainville (Château)	70.10	4.50
20. Russy (Russy No 1)	28.35	3.20
21. Russy (Russy No 2)	18.30	2.70
22. Russy (Russy No 3)	18.30	2.70
23. Carpiquet	81.40	4.10
24. St Sulpice	15.25	1.34
25. Audrieu	45.70	18.20

*Abandoned before completion due to operational necessities.
Data from Shotton (1945), Bigot (1947). According to Shotton, most yields were calculated from pumping tests carried out over 24 hours.
See Figure 5 for geographical position, and Figure 7 for generalized Middle-Lower Jurassic sequence penetrated by most boreholes.

in the Royal Hampshire Regiment, effectively to found the Officers' Training Corps at Southampton University where he was a lecturer in Geology and Zoology. He left in 1935 on appointment to the British Geological Survey, but rejoined his old regiment in 1939, just before the outbreak of war (Rose & Rosenbaum, 1993). By 1945 he was a local major in charge of the research and experiments contingent of the British Bombing Research Mission, still carrying out duties as a geological expert whilst meeting command responsibilities for the contingent. He had participated in active-service missions to study the effects of aerial bombing, sometimes in the very front line, in locations which included Sicily, Italy and France – notably Normandy.

Names and service affiliation of the geologists who served at Medmenham have not to our knowledge been published, although several geologists are known to have served in World War Two with RAF rank. One of those who served at Medmenham in the Photographic Intelligence Unit was L R Wager, a distinguished mountaineer and "polar" explorer, and a squadron leader RAFVR – until in 1943 appointed Professor of Geology in the University of Durham, and from 1950 in the University of Oxford (Hargreaves, 1991). N L Falcon also served during the war in air photographic interpretation, as a lieutenant colonel in the Intelligence Corps, before becoming postwar a TA sapper geologist and later Chief Geologist at British Petroleum (Rose & Hughes, 1993b; Rose & Rosenbaum 1993).

Cross-Country Movement

Two roles in this category can be distinguished amongst the geologist tasks listed by Shotton (1947) after a lecture to the Geological Society of London:-

- **Terrain analysis.** "When the invasion had taken place ... The printing of maps showing predicted soil types was greatly developed with particular reference to the movement of tracked and wheeled vehicles – a development rendered important by the scale of operations in winter and early spring under adverse weather conditions." It seems, however, that this development largely postdated the battle for Normandy. 1:100,000 scale maps published in 1944 by the British War Office (Geographical Service, General Staff No. 4416) overprinted with Suitability for Cross Country Movement (Trafficability) are preserved in the Imperial War Museum, London. But these are for Germany only, and "prepared by U.S. Geological Survey for Chief of Engineers, U.S. Army," although printed through the facilities of the Institut Géographique National in France. Kaye (1957) has described how a group of seven geologists was employed in terrain studies within the Intelligence Division of the office of the CE of the US forces within the northwest European theatre.
- **River crossings.** "For the final attack across the Rhine, the bed and approaches of the river were investigated in detail, since amphibious vehicles must be able to enter and emerge from the river without difficulty if the operation were to go smoothly. Other geological matters investigated were the constitution of the Rhine bed at the place where pile bridges were to be constructed ..."

Shotton arrived in Normandy about 3½ weeks after D-Day. After the breakout from the bridgehead on 25 July, the Allied advance was so rapid (400 miles, some 640km, in 42 days) that apart from operational bridging, geotechnical engineering problems scarcely arose. Shotton later recalled (written com, 1989) that "It was hectic travelling to Brussels" and that he gave intelligence on the crossing of the Meuse as well as the Rhine. Although British geologist roles in guiding military movement were effectively initiated in Normandy, they were developed subsequently.

Conclusion

THE American armed forces in World War Two were supported by a military geology unit based upon the United States Geological Survey. This furnished the engineers with complete geotechnical folios in preparation for every operation in which American troops took part or planned to take part – with one exception : "the Normandy landings for which the work was done by British geologists" (Anon, 1945c). For Normandy, sapper geologists uniquely provided specialist expertise for the Allied armies as a whole – at least until assumption of full-scale American staff work for the US sector in the spring of 1944 (Kaye, 1957; Snyder, 1957).

Few geologists served as such in the British army (Rose & Hughes, 1993a; Rose & Rosenbaum, 1993). This contrasts strikingly with the employment of geologists in the American army, whose Military Geology Unit had a wartime roster of 88 geologists, 11 soil scientists, and 15 other specialists, plus 43 support staff including illustrators, typists and photographers. The American unit produced 313 studies for use by the American services during the war, including 140 major terrain folios, 42 other major special reports, and 131 minor studies – in total containing about 5000 maps, 4000 photographs and figures, 2500 large tables, and 140 terrain diagrams (Anon, 1945c; Hunt, 1950; Terman, 1994). The remarkably small British geological staff also contrasts with the German army, which began the war with a large number of military geologists (Rose, 1980) and several military geological textbooks, and which increased its establishment from 25 teams of military geologists in 1941 to 40 teams by November 1943.

As sapper geologists comprised a relatively small group, their individual qualities became proportionately more important : academic excellence, professional experience, and military commitment. Of the individuals cited above, half (Bagnold, Bernal, Falcon, King, Shotton and Wager) were postwar elected to fellowship of the Royal Society (FRS) for civilian achievements – the highest national accolade for a British scientist. All had pre-war postgraduate professional experience of direct military relevance. Some (Anderson, Bagnold, King) had already held commissioned rank in the reserve or regular forces – for the others, over five years of war provided time enough to achieve it.

'Operation *Overlord*', which launched the Allied armies on to the beaches of Normandy on D-Day, 6 June 1944, and the subsequent battle for control of Normandy demonstrated more clearly than any other campaign of World War Two the diversity of geologist roles potentially available in both the planning and the operational phases of a time of conflict. These roles were demonstrated by a temporary exhibit after the war at the Geological Museum, London (Butler, 1947) – but this was soon dismantled, and its components are currently untraceable. There is no indexed reference to geology or geologists in the official (Ellis, 1962) history of this part of the Second World War. However, the perceived value of the geologist contributions to the liberation of Normandy stimulated postwar the production of a geological part (XV) to the Corps textbook series Military Engineering (Anon, 1949), and the formation of a pool of geologists within the Reserve Army (Rose & Hughes, 1993b,c). As far as the Corps was concerned, a lesson had been learnt.

ACKNOWLEDGEMENTS

THIS two-part article is based upon a single paper by the two authors presented at a symposium on Military Geology in War and Peace convened by the Engineering Division of the Geological Society of America at the society's annual meeting, in Seattle, in October 1994. For summaries of the 29 symposium papers, see Geological Society of America Abstracts with Programs, v26, no 7, pp275-278, 345-348. Most of the full texts are scheduled for publication as a book in 1996/7. Thanks are due to staff at the RE Corps Library, Chatham, and the Imperial War Museum, London, as well as individuals to be acknowledged in the symposium version of this paper, for help to locate archive material; to sources acknowledged in individual captions for permission to reproduce figures, especially Blackwell Publications for re-use of figures first used in our 1995 article; and to Jane Pickard and Lynne Blything, both of the Department of Geology at Royal Holloway, University of London, for preparation of the typescript and original line drawings respectively.

REFERENCES

Anon, 1945a, *The Administrative History of the Operations of 21 Army Group on the Continent of Europe 6 June 1944 – 8 May 1945*: Germany, BAOR, 151 p, appendices A-U.

1945b, *Operation 'Overlord' – An account of the RE Works Contribution*: Chief Engineer's Branch, HQ

Second Army. RE Library Acc no 12609, 63 p, 30 appendices, unpublished.

1945c, US Geologists in the War: *Discovery*, v6, p 355-356.

1949, *Military Engineering Vol XV: Application of Geology*: War Office Code 8287: London, His Majesty's Stationery Office, xxx + 216 p, maps A-G.

1957, *Military Engineering Vol V, Pt III: Quarries and Gravel Pits*: War Office Code 9422: London, Her Majesty's Stationery Office, xiv + 238 p.

1989, Memoir in Brief: Lieutenant Colonel A R O Williams OBE: *Royal Engineers Journal*, v103, p 312.

Bigot, A, 1947, Forages pour recherches d'eau dans le Calvados. VII – Forages de l'Armée Anglaise en 1944: *Bulletin de la Société Linnéenne de Normandie*, sér 9, v5, p 130-133.

Butler, A J, 1947, War-time geology: special exhibits in the Geological Museum, South Kensington: *Museums Journal*, v46, p 233-238.

Ellis, L F, with Allen, G R G, Warhurst, A E & Robb, J, 1962, *Victory in the West. Vol I. The Battle of Normandy*: London, Her Majesty's Stationery Office, xix + 595 p. (Reprinted with additional data, January 1994).

Hargreaves, J, 1961, L R Wager. A life 1904-1965: Oxford, Joshua Associates, 141 p.

Hunt, C B, 1950, Military Geology, in Paige, S, ed, *Application of Geology to Engineering Practice. Berkey Volume*: Boulder, Colorado, Geological Society of America, p 295-327.

Kaye, C A, 1957, Military geology in the United States sector of the European theater of operations during World War II: *Bulletin of the Geological Society of America*, v 68, p 47-54.

King, W B R, 1951, The recording of hydrogeological data: *Proceedings of the Yorkshire Geological Society*, v 28, p 112-116.

Munro, S K, 1985, Alexander Kerr Pringle [obituary]: *Proceedings of the Edinburgh Geological Society*, v 15, p 5-6.

Rioult, M, Dugué, O, Jan du Chêne, R, Ponsot, C, Fily, G, Moron, J-M & Vail, P R, 1991, Outcrop sequence stratigraphy of the Anglo-Paris basin, Middle to Upper Jurassic (Normandy, Maine, Dorset): *Bulletin du Centre de Recherches Exploration-Production Elf Aquitaine*, v 15, p 101-194.

Rioult, M, Bauduin, P, Heintz, A, Poisson, E & Quéré, G, 1994, *L'eau à la source de la victoire 1944*: Caen, Agence de L'Eau Seine-Normandie, 112 p.

Rose, E P F, 1980, German military geologists in the Second World War: *Royal Engineers Journal*, v 94, p 14-16.

Rose, E P F & Hughes, N F, 1993a, Sapper Geology: Part 1. Lessons learnt from world war: *Royal Engineers Journal*, v 107, p 27-33.

1993b, Sapper Geology: Part 2. Geologist pools in the reserve army: *Royal Engineers Journal*, v 107, p 173-181.

1993c, Sapper Geology: Part 3. Engineer Specialist Pool geologists: *Royal Engineers Journal*, v 107, p 306-316.

Rose, E P F & Pareyn, C, 1995, Geology and the liberation of Normandy, France 1944: *Geology Today*, v 11, p 58-63.

1996, Roles of sapper geologists in the liberation of Normandy, 1944. Part 1. Operational planning, beaches and airfields: *Royal Engineers Journal*, v110, p36-42.

Rose, E P F & Rosenbaum, M S, 1993, British military geologists : through the Second World War to the end of the Cold War: *Proceedings of the Geologists' Association*, v 104, p 95-108.

Shotton, F W, 1945, *Summary of Normandy Boreholes for water*. British Geological Survey archive document dated 21 May 1945, ref 21 AGp 8779 WK, 5 p plus covering letter, unpublished.

1947, [abstract] Geological work in the invasion of North-West Europe: *Quarterly Journal of the Geological Society of London*, v 102, p v.

Simon, L J, 1957, Additional notes of the use of geology in the European theatre of operations during World War II: *Bulletin of the Geological Society of America*, v 68, p 1567.

Snyder, C T, 1957, Use of geology in planning the Normandy invasion: *Bulletin of the Geological Society of America*, v 68, p 1565.

Terman, M J, 1994, Military Geology Unit (MGU) at the United States Geological Survey (USGS) during World War II: *Geological Society of America Abstracts with Programs*, v 26, no 7, p A-275 – A-276.

Williams, A R O, 1950, The Royal Engineer Quarrying Companies in the North-west European Campaign: *Quarry Managers' Journal*, v 34, p 214-225, 2 maps.

Wilson, C & Nowers, J, 1994, *D-Day June 1944 and the Royal Engineers:* Chatham, The Royal Engineers Museum, 14 p.

Strange Occupation

COLONEL H A BAZLEY

Harold Alonzo Bazley was commissioned from the Royal Military Academy Woolwich in July 1917. After service in France and Germany (mostly with 3 Field Squadron in 3 Cavalry Division) he was posted to 3rd Bombay Sappers and Miners. In July 1921 he joined the Survey of India. Having missed the YOs' Course due to the war, he was sent to Cambridge for a special course in October 1923, after which he and others were allowed (without pay and at their own expense) to stay on and take the mechanical sciences tripos. Following this were five years with the Ordnance Survey, three as Garrison Engineer, Tidworth, and five years in Egypt as Deputy CRE and ACRE, Suez Canal Zone. During World War Two he held a succession of posts concerned with the recruitment and training of survey troops and preparations for Operation Overlord. *After two years as D Survey, Garrison HQ Home Forces, he was posted to the Control Commission for Germany, as DD Survey, in 1945.*

The following notes reflect the author's experiences during the period he spent as Deputy Director Survey in Germany immediately after WW2. They were sent for publication by the author's son, Major John H Bazley.

THESE are the personal reflections of my wife and myself during the three years or so of our stay in Germany just after the war.

With rather touching faith in our ultimate victory the authorities informed me about 12 months before the surrender that I would be required to go to Germany immediately on cessation of hostilities to take charge of the German Survey Service. I was flown out to Germany the day after the surrender in 1945 and my wife was able to join me in 1946.

The country was in a state of chaos, resulting largely from Allied bombing, and the economy had almost ground to a halt. The devastation in the industrial Ruhr and in the railway marshalling yards was unbelievable; the railway system had broken down, locomotives were scarce. Gas supplies were very restricted and the distribution network was severely damaged. Rations for the Germans were very meagre and fuel for heating almost non-existent. In order to get a supply of coal some Germans hit on the idea of greasing the railway lines on a slope so that the coal train would skid to a halt and could then be looted.

One of the first aims was to get the German economy going again and so reduce its dependence on Allied resources. Work was carried out on a priority basis and it took some years before the situation became anything like normal.

Field Marshal Montgomery had issued strict orders against "fraternizing" but my wife and I felt that this bitterness could not be kept up for ever and that something more positive needed to be done. The Germans were only too ready to cooperate and indeed regarded us more as liberators from tyranny than as alien conquerors.

We were housed very comfortably in the middle of a German community (there was no segregation), had very adequate rations, enjoyed a central heating system and ample domestic help. The contrast between our own conditions and those of the Germans around us living on almost a starvation diet and with few if any comforts, was embarrassing and painful. We decided to do something to help the children, who could hardly be branded with war guilt. It was Christmas 1946 in the depths of a very severe winter when we got the *bürgermeister* (mayor) to give us the names of some 20 local children and, with much help from members of the various messes who provided jellies, sweets, and other titbits, we laid on

Col H A Bazley
Strange occupation p145

a children's party at our house where they stuffed themselves full. It was striking to see how immaculately the children were turned out and the pleasure of their parents when they came later to fetch their offspring and found that the "conquerors" invited them in and regaled them with German gin! The problem of language was overcome by the introduction of simple games – hunt the slipper and so on – which needed no verbal explanation. It was the first time that some of the younger children had ever known the delights of sweets and chocolates let alone the fun of paper hats and crackers.

This party broke the ice and led to some German families inviting us back to their houses where they did their best to entertain us with their meagre rations. We were thus gradually able to discuss fairly objectively the events which had led to the war and its tragic consequences. Two incidents stand out. An elderly lady was knocked off her cycle by a passing car and lay in the gutter in a very dazed state. We noticed that no German went near her but we went along, did what we could and arranged for her to get proper medical attention. Raising this matter with some of our German acquaintances later, we asked why no one went to help. The reply was "Oh, if anybody had helped, the police would have assumed that they were responsible and they would have been taken away for questioning. They might never have been seen again." Such was their fear of involvement with the German police. The other incident concerns a number of German girls who asked my wife, who was then Commissioner for British Girl Guides in Germany, if she would give them a talk about girl guides. The Germans were not permitted at that time to have any scouts or guides or indeed any similar youth organizations. The girls on this occasion assembled and stood rigidly at attention when my wife met them, but were soon put at their ease as she gathered them around in an informal circle. Intense interest was shown and after a time my wife sensed that they had accepted her as a leader, but she also had a most uncomfortable feeling that they would have obeyed any instructions from her quite blindly and without question. This was a typical example of the effect regimentation had had on the people of this nation which had contributed so much to the success of Hitler's dictatorship.

In the winter of 1947 I had occasion to visit Berlin, on duty, and it so happened that Lady Robertson (wife of the military governor) had invited my wife to visit her in order to discuss the organization of British Girl Guides in Berlin. In those days it was necessary for every civilian to be given an equivalent military rank, so my wife was appointed brigadier. It was perishing cold, there was no heat on the train and when we got to Marienberg, the checkpoint on entering the Russian zone, my secretary got out of the train and prepared to brew up some tea by the side of the line. The Russians saw this as a ruse to help someone make an illegal entry into the Russian zone and aimed a machine-gun at her, so she scrambled back into the train in double quick time. We arrived at the terminus at Berlin without further incident and were transported to a hotel run by the NAAFI for British officers. Our first contact there was with the German hall porter who offered his services on the black market in exchange for a few cigarettes, but orders were strict and we declined. The bedroom furniture still bore the jagged scars of air raids – holes and splinters everywhere. There were large cracks in the walls and the windows were glazed with that misty substance which took the place of glass in those days. However the hotel was warm and the food adequate. Indeed the official charge of sixpence per day for "extra messing" seemed more than justified.

We managed to fit in a visit to Hitler's Chancellory in the Wilhelmstrasse in the Russian sector. At the time, before the Berlin Wall was erected, there was free movement between the sectors of Berlin for both Allied and German personnel. On the way there we passed the burnt out framework of the Reichstag building and were impressed by the changing of the Russian guard at their war memorial, incongruously sited in the British sector quite close to the Brandenburg Gate which marked the sector limit. The Chancellory was a shambles, the floors littered with glass from the remains of broken chandeliers, and covered with papers from the safes of Hitler and his staff, rain dripped through the roof and formed icicles, while the whole place had a sinister reek of burnt destruction. At that time the atmosphere was so disturbing and evil that no German dared to set foot inside. The famous bunker where Hitler, his staff and Eva Braun spent their last days was in the garden, but flooded so that we could only go a short way into it accompanied by a Russian soldier with a torch, but there was no mistaking the ditch by the entrance where Hitler is said to have been burnt after committing suicide by taking poison.

The city was more rubble than buildings and women could be seen on the bombed sites clearing it away with their bare hands. Their dejected but determined looks were in accord with the estimate of 15 years which we were given for the completion of this task. A visit to the State Opera House in the Russian sector provided welcome relief, and a performance of "Madame Butterfly" was of the highest standard.

Our visit was in sharp contrast with that proposed by our German chauffeur, Felix, who came along one day to say that he would like to visit his ageing mother in Berlin. Rather surprised I said that it was almost impossible to get a permit for a German to go there. He realized this, but said that all he wanted was my permission to be away for the weekend, as he had his own ideas of how to get there. Warning him to take care, we packed up a few rations to take to his mother and fervently hoped we should see him return. He reappeared all smiles as usual on the Monday morning and when asked how he had got on, said that all had gone well on the outward journey but that on the way back he had had a bit of bother with some Russian soldiers. He had got there by jumping on the train, getting off just before reaching the checkpoint, walking over the border and getting onto the train again. On the way back he repeated this procedure but was spotted by some Russian soldiers as he got off the train and they chased and eventually arrested him. He was taken to a hut and interrogated, being first made to remove his boots, but catching his captors off guard he hurled his boots through the window and jumped out after them. The Russians fired at him repeatedly but he hid in the woods and eventually crossed the border back into the British zone.

Felix was a remarkable character. He had been Rommel's chauffeur and was certainly the most efficient driver and man of parts I had ever met. Whenever I went to a meeting or to the club he always brought the car round to the door from wherever he had parked it within seconds of my appearing, no matter what time of the day or night. If my wife was with me he was always on the spot with a rug to wrap round her knees. A superb driver, he always got us safely to our destination whatever the weather or road conditions.

Conditions during the occupation were slow to improve. The currency was almost worthless, and the Germans got most of their necessities either by barter or through the black market. There was practically nothing in the shops. In each town there was an exchange shop where surplus articles were displayed and exchanges made. Instead of being marked with a price, items bore a ticket stating the thing required in exchange: an overcoat for a pair of boots, for example. On the black market, the main trading item was cigarettes, and most things were obtainable for them.

Petty theft was naturally common. The electric light bulbs outside our front door were regularly stolen despite various wire contraptions to secure them. Cats were also bartered, their skins being much sought after on the black market. A more serious nuisance was to find that on returning to one's parked car, all four wheels had disappeared!

Before we moved house from Bunde to Detmold in Westphalia, the Russians had overrun the place and only later retired to the agreed zonal boundaries. The recollection of their stay was vivid in the minds of the Germans. There were numerous stories of pillage, watches and jewellery being stolen. The huge bronze figure of Hermann's denkmal[1] on the hill overlooking the town was peppered with holes from the bullets of Russian soldiers out on a spree. Because of political disagreement our relations with the Russians became strained from time to time and rumours of a Russian invasion were often current among the Germans. We had established a friendly relationship with a German family nearby and they solemnly begged us to take their jewellery and their young son to England rather than let them fall into the hands of the Russians. This request was occasioned by having heard the sound of gunfire close at hand, which in actual fact came from our own forces' manoeuvres.

Next to us was a large house full from attic to cellar with German refugee families. Among these was a Prussian general who had commanded a division on the eastern front. He told a remarkable story. His division had included an *SS (Schutzstaffel)* brigade and when he found that a lot of looting was going on in his area in Poland, he pinned it down to this brigade and issued orders

[1]Hermann, who was a chief of the Cherusci tribe, is better known to historians by his Roman name "Arminius." He had supported the Romans in several campaigns and had become a Roman citizen of equestrian status. He was a patriot at heart, however, and he allied with other German tribes and ambushed a Roman army in the Teutoburgh Forest in AD9. The entire Roman force of three legions, about 20,000 men, under the command of Publius Quintilius Varus, was annihilated.

that it was to stop. In spite of this the *SS* members, who were a law unto themselves, took no notice. The general then reported the matter to Keitel, the Commander in Chief. The result was that Himmler, the head of the *SS*, gave orders that the general be recalled and retired. It was lucky that he got away with his life but at the time we met him he was in great financial difficulty for, until he had been cleared of suspicion by the Allies, he could not draw his pension. The general was a charming man who doffed his hat every day as he passed our house pushing his barrow with road manure for his allotment, where he was growing runner beans to supplement his household's rations.

The large house also accommodated Prince Rupert of Lippe, a young boy who had lived in Detmold Schloss. Our visit to this castle surprised us by the English character of much of the contents ... pictures of Queen Victoria on the wall and genealogical tables showing close connections with our own royal family. What a pity that our two great nations could not have lived in harmony as they had done in the past. Our life in Detmold was enhanced by an excellent club where, in the early days, a first class German orchestra was only too delighted to give their services in return for a meal and some beer.

We acquired an excellent maid, a refugee from Stettin on the Baltic coast. As the Russians approached, her family left their home in Stettin and set out west carrying what they could. The father and his three daughters separated and Gisela managed to reach a farm near the British zone boundary, after having had to drop most of her belongings through exhaustion. She got herself up as a child (she was of small stature), put such belongings as she had into a doll's pram and pushed it over the frontier. Gisela worked for us all the time we were in Germany, growing from a near skeleton into a plump little person. Later she came to England with us and only left to return to Germany to marry a childhood friend. We met her father, too. He was badly off, but had managed to live in an old railway station ... a quite charming old man, a true philosopher.

My duties involved much travelling in order to ascertain the whereabouts of the various departments of the German Survey Service which I was supposed to control. A visit to Berchtesgaden was included in my work schedule and provided quite an astonishing experience. Half way up the mountain to Hitler's Eagles' Nest, were the homes of Hermann Goering and other members of Hitler's staff ... most elaborate houses, little damaged by bombing. From there one travelled by a single track mountain road, through tunnels in the rock and round hairpin bends until one drew up at a massive door with huge bronze fittings, opening into a passage which led straight into the mountainside and up a gentle slope to a lift shaft. The lift was a two-tier affair in which the big shots travelled in the top half and the servants and underlings in the lower. It went straight up to the Eagles' Nest where each level opened onto a landing, the top one being close to Hitler's round room with a wonderful view of the Austrian lakes below and where Hitler "entertained" his foreign victims and dictated his terms. The house was quite undamaged and what a thrill I had to find that the lift man was the same who had taken Hitler up and down! He told me that Hitler had not used the Eagles' Nest a great deal but that members of his entourage had made frequent visits.

Travelling around in those early days was sometimes an improvised affair and could have its exciting moments. There was an occasion when the Dakota I was in, with a full load of passengers and ready for take off, was held up while a large number of German prisoners with a heavy guard was taken on board filling all available standing room. "Can we get off the ground?" someone asked the pilot. "Well I hope so!" He replied. Remembering the saying: "If you get it on a Dakota, you can get it off," I too hoped for the best. Not far from the airfield was a wood and I breathed a sigh of relief as we just skimmed the treetops and flew safely up and away.

At one period it fell to my lot to work in the Reparations and Restitutions Division of the Control Commission. The restitutions part of this rather grandiose title consisted of returning to the country or origin, articles of all kinds stolen by the Germans during their occupation. Simple in principle, but extremely difficult in practice because of the problem of distinguishing between genuine ownership demands and phony ones.

The reparations part of the division involved the review of all German factories which might be considered suitable for distribution to Allied countries. A comprehensive stock-taking and valuation of each factory was called for and submitted to the Inter Allied Reparation Authority which sat in Brussels. Details were decided with representatives of the 17 nations involved who were accommodated at Bad Salzuflen, the pre-war spa. Whether or not it was a part of the

process of getting the best they could out of the situation, there was great competition as to who could throw the most elaborate party. These were frequent and lavish, the tables groaning under the fat of the land, much of it looted, and the supply of drinks was unlimited. Visions of huge blocks of ice with coloured lights embedded in them remain in my memory. All was not peaceful however. With so many members from rival countries gathered together it was not surprising that there were frequent incidents during which one nation's representatives (usually the Russians) got up and stormed out of the assemblage. The Russians were most difficult to satisfy. Not only did they want every nut and bolt dismantled for sending back to Russia, but they pestered me for everything to be done in a frantic hurry, and threw out hints of an international incident being created if the deadline was not met. They also required all their local offices to be connected by telephone to Moscow so that they could report nightly in the most detailed fashion.

It is a matter of history that Hamburg, one of the greatest of the German cities and ports, suffered one of the heaviest bombings of the war. In 1946 we stayed there in one of the few remaining hotels, with something remaining of its prewar glory ... elaborate candelabra, plush curtains etc contrasting harshly with the surrounding devastation. The Germans who still remained talked of the final blitz as a landmark in history, rather as we might say "before the flood". Whole streets had literally been set on fire, "blockbusters" had killed thousands of people in deep shelters and the harbour and docks were a mass of twisted metal and heaps of rubble. The local government was striving hard to sort the mess out and the occasional shop was opening though with little to sell. It was a treat to go the short distance from there to Schleswig Holstein, which was largely undamaged. The club at Travemünde was still functioning (under British control) and the beaches around provided a quiet respite from conditions elsewhere. One of our most pleasant recreations was a weekend at the sailing club at Dümmersee, not far from Hanover. The British had taken this German centre over lock, stock and barrel, with clubhouse and living accommodation (hutted buildings) all intact. The lake was nowhere more than about four feet deep, a great asset when one either got becalmed or was capsized in a fierce wind and had to wade ashore. The clubhouse bar was adequately stocked with NAAFI supplies and the only immediate reminder of the war was the sight of the tail of a wrecked plane which stuck out incongruously from the lake. As a diversion from sailing one could stroll along lanes and watch the storks in the fields, or see them on their great nests on farm roofs.

It took some years before any semblance of order was created out of the wartime havoc and devastation. Eventually, however, the authorities (British and German) decided on a currency reform which introduced the new Deutschmark. The effect was immediate and electrifying. Shops which were bare one day appeared full of goods the next. People, especially the young, gazed in wonder at articles on display which many of them had never seen before. This was a turning point in the German economy and an enormous boost to German industry. One might say, I think, that from then on they never looked back.

The German surrender in May 1945 brought many problems to the Allied forces including the "vetting" of suspicious characters who posed as refugees. One such was a man who said he was a former sailor and produced a passport to prove it. Something about him and his behaviour aroused suspicion that he might be Himmler and he was taken aside for more detailed scrutiny by a doctor. He was made to take off his outer garments, which he did under protest, and a thorough examination of him was undertaken starting from the feet and working up. The final check was to be his teeth but there was a crunch as he bit on a phial in his mouth, later found to contain prussic acid, and he very quickly fell in a heap, dead. He was identified as Himmler from his dental records.

All these notes are written as remembered and are not in strict sequence of occurrence. To those of us who served in the British Army of the Rhine during the years immediately following the end of hostilities, it was an experience never to be forgotten. One feels that these recollections may be of interest to some of the present generation who only from hearsay can have any knowledge of day-to-day conditions in that time of strange occupation.

Armoured Engineers in Bosnia?

CAPTAIN B G LEGG BEng (Hons)

Captain Ben Legg was commissioned into the Corps in December 1989. Following an attachment to 23 Engineer Regiment in Osnabrück came 100 RE Young Officers' course, and then a posting to 28 Amphibious Engineer Regiment as recce officer. In September 1991 he attended the Royal Military College of Science, Shrivenham, to study civil engineering, graduating in July 1994. As a troop commander with 32 Engineer Regiment for two years, he went on tours to Canada and Bosnia, and is currently operations officer of 23 Amphibious Engineer Squadron.

Introduction

Following a completely unexpected order to deploy to Bosnia-Herzegovina in June 1995, 6 Armoured Engineer Troop prepared themselves and their vehicles as best they could for the unexpected, and flew out within two weeks. The 100-strong troop spent nearly five months providing engineer close support to UN Task Force *Alpha*, (UNTF-A), specifically 19 Regiment Royal Artillery on Mount Igman, as well as taking part in battlegroup training with 1st Battalion Devon and Dorsets, for route opening and convoy escort operations.

You may think it an odd decision to send tanks to the mountainous country which managed to hold up several of Hitler's armoured divisions for years. However, if you read on you will find out how we well and truly earned our pay, learning and relearning several valuable lessons along the way.

Hurry Up and Go!

Following the Bosnian Serb seizure of UN hostages in April 1995, the British, French and Dutch governments offered men and equipment to the UN's new peace enforcing body, to be known as the Multi National Brigade (MNB). This brigade was made up roughly of two halves plus a cumbersome HQ. The British and Dutch forces were in Task Force *Alpha* with 6 Troop providing their engineer close support; the French forces formed Task Force *Bravo*.

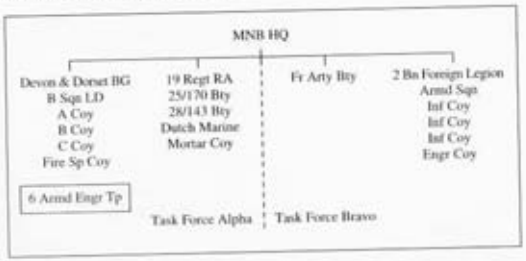
Being under a fair amount of pressure to become operationally effective as quickly as possible, we naturally wanted to make our two weeks in Germany prior to deployment as productive as possible. Fortunately we had been incredibly busy over the previous year training in armoured engineering, combat engineering and personal military skills. This had included Exercise *Medicine Man 4* – an all-arms month-long exercise in the British Army Training Unit Suffield, Canada; a two-week exercise in Hameln; a three-week regimental exercise on Bergen-Hohne training area; a recce cadre; a patrol competition near Iserlohn practising infantry skills, and Exercise *Worpaint*, a field defences and construction tour back in Canada.

During our last two weeks we then managed to prepare and paint the vehicles (with a lot of help from the rest of the regiment), have a short armoured engineering exercise and shoot on the ranges with both personal and crew weapons. Whenever we could fit them in we covered a number of additional subjects such as high frequency communications, media training, rules of engagement, driving, and mines awareness. Finally we managed to fit in a couple of days' leave.

It is worth adding at this point that most armoured engineers have three trades: armoured

Captain B G Legg
Armoured Engineers in Bosnia p150.

engineer, combat engineer and an artisan trade such as electrician, plumber, carpenter or bricklayer. This provides the unit with great flexibility, although it does cause other problems, such as soldiers spending a large percentage of their time on trade courses, and the difficulty of gaining continuous relevant experience in all of the trades. In Bosnia flexibility was vital to carry out all of the various tasks which we were given.



The organization of the Multinational Brigade.

Finding Our Feet

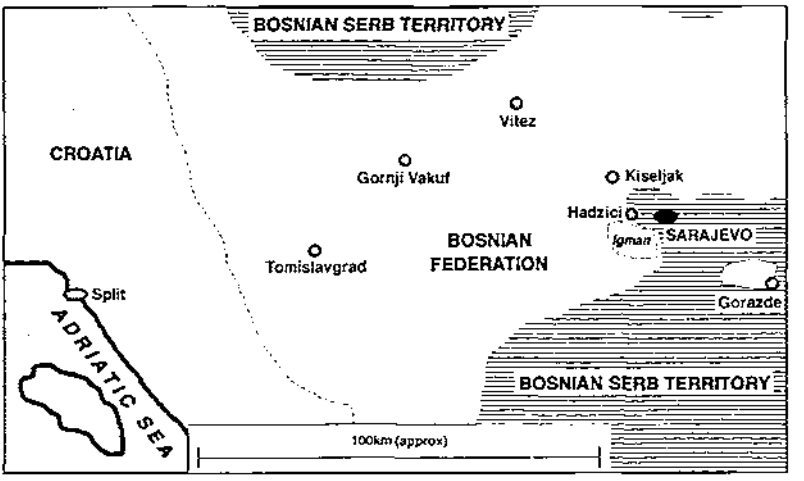
In total, my front-line vehicles consisted of four Spartan command and reconnaissance vehicles, four Chieftain armoured vehicles Royal Engineers (AVRE), four Chieftain armoured vehicle-launched bridges (AVLB), three combat engineer tractors (CETs), two Challenger armoured repair and recovery vehicles (CRARRVs) and four 432-based armoured vehicles. In the echelon we had four Scammell bridge transporters and a further ten soft-skinned vehicles; effectively, about half of 31 Armoured Engineer Squadron! Later on in the tour we also took on a further three plant vehicles and three four-tonne trucks.

This ungainly cavalcade eventually arrived by ship in Split, and our first main task began: to move the whole lot up to Tomislavgrad (TSG), set up camp and establish workable logistic support to cover any eventuality. Fortunately we had an excellent echelon commander in the shape of Captain Tom Gallagher, who, with a fair amount of help from 21 Engineer Regiment, ensured we always had excellent support. We continued to rely on it even when we joined the MNB as its own supply system fluctuated between unreliable and non-existent.

Meanwhile, following several tactical exercises without troops (TEWTs) and discussions I attended with other elements of the MNB, much work was being done by both recce sergeants. Reconnaissances were carried out on all the troop's likely deployment routes and they included a search for an in-theatre training area. There was much scepticism from others in Bosnia as to the likelihood of the tanks ever leaving TSG as, according to official pamphlet calculations and road signs, most of the bridges still standing were either Military Load Class 20 or 30 – the largest had all been blown earlier in the war. As our vehicles ranged in weight up to 62 tonnes for the CRARRVs, the sceptics should have been right, but even at that time we were quietly confident – based mainly on the long memories and gut instincts of the older armoured engineers. Many of them had driven across large areas of Germany in the now extinct field training exercises which used to cover much countryside away from the usual training areas, and crossed safely many under-classed bridges. Added to those instincts were a

Trialling an adapted hard surface mine clearance device on an AVRE.

Armoured Engineers in Bosnia p151.



Map of Bosnia showing key locations.

few basic calculations by myself, desperately trying to remember everything which I had learned at Shrivenham, and having a tank commander, Corporal Flaherty, who had built the most risky bridge – at Tarcin – to a minimum of MLC 30 on Operation *Grapple 1*. Knowing the size of the safety factors normally used also gave me a bit more confidence. Despite all this, when we did eventually move, we crossed each bridge carefully, one vehicle at a time in ascending order of weight, closely observing the behaviour of the bridge with each pass.

With a much clearer idea of the country and the likely operations in which we might get involved, I carried out my own TEWTs with the vehicle commanders, followed by a short troop exercise. The TEWTs, the reality of the situation and the lack of outside distractions, managed to really concentrate our minds. During the exercise we not only practised opening routes into the enclaves, overcoming all obstacles along the way, but also practised how to deploy a long distance to the assembly area before such an operation, which in Bosnia was half the problem. We made the tanks as light, low and narrow as possible, offloading removable equipment onto trucks travelling with the echelon. A novel idea was introduced, of taking apart the tank bridges with a crane and strapping the parts onto DROPS (demountable rack offloading pallet system) pallets. Unfortunately armoured engineers do not have their own DROPS vehicles, so these had to be borrowed for each deployment.

On the last day of our exercise we lost our freedom of movement and had to return to TSG because local Croats were trying to charge the UN an enormous amount of rent for the training areas. Fortunately we had learned all of our main lessons.

Initially we were kept busy with combat engineer and plant tasks in and around TSG, several demonstrations for high-ranking officers and joint training with the French Foreign Legion. The latter included joint explosive ordnance disposal (EOD) training and comparing each other's engineer capability. Our main role has always been engineer close support to armoured units in Central Europe. Theirs was support to the faster moving Legion in the desert. We found that their "assault pioneer" skills, such as mine clearance by hand, were very good. In other engineer skills however, such as clearing obstacles from under armour, building field defences, bridging and plant work, their training and equipment were quite limited compared to our own. These differences in capabilities led later in the tour to several temporary exchanges of equipment between ourselves and the Legion engineers (as well as engineers of other nationalities) for specific tasks.

Mount Igman

The call to action soon came, in the form of providing engineer support to the artillery. They had just been given orders to move up to Mount Igman, to a position where MNB guns could dominate Sarajevo. The task was supposed to last a maximum of two weeks and involve digging and revetting two battery positions plus one reserve for the 105mm light guns, hardening the headquarters and providing a water point. However, it soon became clear that far more was required as it seemed likely that the gunners would be on Igman for several months, up to and including winter. Consequently, much reorganization and winterization of vehicles and equipment was carried out, and many aspects of living comfortably in trenches, forgotten since the First World War, were relearned.

One of the best types of job carried out was that of building seven observation posts (OPs) on Igman and in Sarajevo, all in strategic points overlooking Serb positions. The work varied from house-hardening, to blasting ledges into cliffs, digging trenches, and building very sturdy log cabins. Some were built and occupied covertly, others were overt, with UN flags flying and white sandbags in abundance. Each OP made an excellent task for a section commander to recce, design, order the resources for and build, often under hostile BSA (Bosnian Serb Army) fire.

In addition to the numerous other combat engineer and basic construction tasks, we also supported a few "short-term deployments". This was a new concept in which the gunners would deploy a few kilometres away, fire their guns, then pull out before they received counter battery fire. These missions required integral sapper support to clear access tracks, build gun scrapes, dig basic trenches and cut down trees within the guns' arcs of fire.

In addition to problems encountered and overcome during numerous tasks, there were two recurring dilemmas. The first was acquisition of field defence stores. The MNB system provided none, so normally the necessary stores were "acquired" or local materials such as trees were used. The most memorable example of this was trading petrol with the local Muslim ABiH (Army of Bosnia Hercegovina), who were "guarding" Mount Igman, for the use of a sawmill. The second problem encountered was the relative ignorance of other arms when it came to field defence methods and standards, despite this being an all-arms responsibility. To overcome the problem we would often leave one or two men as experts to educate a section or so of infanteers or gunners, and to use any power tools required. The men ranged in rank from senior corporals to (on occasions) fairly junior sappers. All were welcomed whenever they appeared.

The Siege of Sarajevo

About six weeks after our initial deployment to Igman, the Devon and Dorsets were warned off to be prepared to relieve the siege of Sarajevo. Although the Igman logistic route had always been open, it was of poor quality, very long and often harassed by BSA fire. The UN needed the shorter tarmac roads through Serb territory to be open to convoy traffic, so that food and fuel stocks in the city could be replenished before the onset of winter, to prevent a humanitarian disaster.

Although 6 Troop kept a presence on Igman (about 20 men) our main effort now turned to preparing for route opening and convoy escorting operations into and around Sarajevo. This preparation was in two parts: the first to get the tanks from TSG to Kiseljak, and the second to carry out joint training with the UNTF-A and the French Foreign Legion.

Moving the tanks 130km to Kiseljak would test the older armoured engineers' faith in the tanks' mobility to the limit. To add to the challenge of narrow streets, steep gradients, weak road shoulders and low-load classed bridges, there was no freedom of movement to pass any of the Bosnian checkpoints en route. However, orders were given to move, and Staff Sergeant Drummond led the cumbersome packet of vehicles, the journey being completed with no long-term breakdowns, no damage to bridges and only one mishap when an AVLB, driving close to the edge of a mountain road at night, caused the road shoulder to collapse. The

LCpl Hague's section building OP *Green* on Mount Igman.

tank fell part of the way down a cliff until stopped by trees and resulted in an 18-hour recovery operation during which the road had to be closed. Unfortunately the route was vital to MNB plans, so throughout the recovery generals were breathing down my neck and I had to be prepared to push the tank right over the cliff in order to clear the road. The tanks all made it, however, and this was one of the key factors in affecting the decision to send a battlegroup of Challenger main battle tanks to Bosnia under NATO command a few months later.

Once the tanks arrived at Kiseljak Brick Factory, preparations began for joint training with the UNTF-A and the French Foreign Legion. As there were no training areas, this mainly involved studying aerial photographs, and carrying out recces, model exercises and TEWTs. As with our initial deployment to Igman, I once again had members of 4 Field Squadron attached, including field sections in AFV 432s with scatterable mines clearance devices fixed to the fronts, and an EOD team.

We were also ordered to paint the vehicles green and black again because the new concept of operations was that the MNB was the UN's second echelon – all white vehicles being the first. As long as the first echelon could do their jobs unhindered, the MNB would be held back, but should any white vehicles be stopped from carrying out their duties, the MNB would enter the fray to lay down the law.

Our proposed tactics for an advance through hostile territory were loosely based on normal battlegroup "advance to contact" drills. However, these were significantly adapted to take into account the likely threat, UN Rules of Engagement, the mountainous terrain, the abundance of minefields and the assets which we had at our disposal. From an engineer perspective, the main threats would be hastily erected barriers or surface-laid mines placed by the local Serbs to stop the advance. In a wartime scenario, with the equipment that we had, we could have cleared all of these, albeit with an element of risk. However, Rules of Engagement, combined with the desire to keep the support of the majority of the population, meant that our tanks would remain quite far back. As they were by far the heaviest and most aggressive looking of the battlegroup vehicles, they would only be brought into view if they were going to be used.

That reduced the engineer presence forward to two recce Spartans with a small packet of light armoured vehicles close behind. This in turn meant potential passing problems for tanks and other vehicles moving forward on the narrow roads, exacerbated by breakdowns, local confusion and mines on many of the verges. One factor in our favour was that speed was never a top priority, so everything could be controlled deliberately and calmly.

After three weeks of waiting around in the brick factory, we were finally given our orders. I in turn gave mine and we formed up ready to go. Both recce vehicles deployed to the edge of the confrontation line and then ... the operation was cancelled! The next day white UN vehicles drove into Sarajevo unhindered. The bombardments of BSA positions by the artillery of the MNB and NATO aeroplanes, followed by the threat of using ground forces, had proved enough to bring the Serbs to the bargaining table. 6 Troop was privileged to have played an integral part in that process.

Unfortunately this did not change the fact that the troop was now spread between Igman, Kiseljak and TSG. There was also a plan to move some of the vehicles down to Split as reserves during the approaching winter, looked after by a small maintenance team. A quick glance at the map will tell you that this is quite unmanageable for a troop. We therefore pulled out of TSG completely and put the Split maintenance team under the administrative command of the echelon of 21 Engineer Regiment already based there. The bulk of the troop then concentrated for the last few weeks of the tour on establishing organized, winterized camps both on Igman and in Kiseljak – the two centres of attention for UNTF-A.

Eventually, a couple of weeks after the cancelled operation, we did carry out our only true armoured engineer task of the tour. We laid a No 8 tank overbridge across a river on a main supply route, near the edge of the hostile Serb town of Hadzici. It was placed over a seriously war-damaged road bridge which would not take more than light wheeled vehicles. However, contrary to all earlier plans, the top priority for this task seemed to be to catch up with the press, who were already at the bridge waiting for something to happen. A small group of engineer armoured vehicles therefore shot off down the road with only the Spartan machine guns for protection, laid the bridge, then returned quite uneventfully to Kiseljak.

Conclusion

Before even arriving in Bosnia we learned one valuable lesson – the importance of constant training. Although we had no prior warning of our deployment, we had experienced a full and varied year prior to June 1995, which had ensured that

we were operationally prepared in all four skills: armoured engineering, combat engineering, artisan trades and basic infantry procedures. Armoured engineers are very much "jacks of all trades", which for our tour was perfect. However, we must be careful not to lower standards in our primary role, which at times is quite a challenge.

During the tour we carried out the vast majority of Sapper tasks capably, as well as our own specialist role tasks. However, although we had an unusual orbat, we found that there were not enough artisans with a spread of trades at the section commander level and often had to borrow them from elsewhere. We were conspicuously short of class 1 electricians and plumbers. In armoured engineering, we showed that the reliability of our equipment dramatically improved when we had unchanging crews for a reasonable period of time, who were able to drive the vehicles regularly and had good spare-parts backup. We then demonstrated the ability of tanks to move virtually anywhere, using the bridge load classes on signs or derived from pamphlets as only a guide.

As already mentioned, there were a couple of other-arms problems which had quite an effect on the troop. From our observations, most people seemed quite inexperienced in building field defences and at supplying field defence stores. This problem seems to have arisen due to training restrictions. However, we showed what could be achieved using non-standard materials to construct perfectly adequate defences and by much improvisation, adapted these for a long-term stay.

The MNB's greatest problem was logistics. Its mission was achieved only because everything worked at a slow, methodical pace. Unfortunately logistics support seemed to be virtually non-existent, with all the various nationalities tapping into existing national supply chains from other formations in order to keep going. At times this, coupled with the seemingly leisurely pace of UN bureaucracy, seriously slowed down work in progress.

Our five-month tour, in addition to playing a small part in history, taught many people many things. Despite the long working hours, personal danger and basic living conditions, the importance and variety of our tasks made our time in Bosnia thoroughly enjoyable. To have been the troop commander was for me an honour, privilege and education which will stay with me forever.

Journal Awards

The Publication Committee announces the following awards for articles of special merit published in the April 1996 *Journal*.

ROYAL ENGINEERS AND RAPID REACTION FORCES
by Lieutenant Colonel P Lilleyman MBE – **£75**

LIGHTS ON IN SARAJEVO – PRECONDITIONS FOR A CEASE-FIRE
by Major A M O Miller – **£75**

FEASIBILITY, DESIGN AND CONSTRUCTION OF GRAVITY FLOW WATER SYSTEMS IN NEPAL
by Major T R Urch – **£50**

REINFORCED SOIL DESIGN AND CONSTRUCTION WITH PARTICULAR APPLICATION TO BRIDGE ABUTMENTS
by Captain A H Hay – **£50**

OPERATION ASTRIDE OR THE OPERATION THAT NEVER WAS AND OTHER STORIES ABOUT 32 FIELD SQUADRON
by Major S McCloghry MBE – **£25**

THE BATTLE GROUP ENGINEER OPERATIONS OFFICER WITHIN FRAMEWORK OPERATIONS IN BOSNIA
by Captain D J Digby – **£25**

OVERBRIDGE, UNDERBRIDGE: BRIDGE REPAIR IN BOSNIA ON OPERATION GRAPPLE 6
by Lieutenant T P Clarke – **£25**

Operation Resolute:

An Oceanographer's Perspective

SECOND LIEUTENANT S GARDNER BSc

Following three years at Southampton University Second Lieutenant Gardner attended the Commissioning Course at RMAS in January 1995. Armed with a degree in Oceanography it was obvious that he should join the Royal Engineers. When able to spare time away from the rugby pitch or rowing, he completed many exercises, did far too much drill and prepared for what lay ahead after commissioning. Early in 1996 he joined 26 Armoured Engineer Squadron for an attachment on Operation Resolute, *before returning to attend the troop commanders' course.*

Introduction

THE commissioning course at Sandhurst was drawing to a close and, with a week to go, we were making preparations for the next hurdle. The year had been a very busy one to say the least, but most enjoyable. I now had five months to spare before attending the troop commanders' course, and was to be attached to 32 Engineer Regiment, based in Hohne, Germany, from 11 January to the end of April.

A week before the commissioning parade I called Major Tenison, OC 26 Armd Engr Sqn, who informed me that the squadron had been put on standby for a deployment to Bosnia. I was to accompany them on what would now be an even more valuable attachment, and should report on 3 January. This came as good and bad news at such short notice, creating a very hectic last week on top of the usual mayhem. There were a number of things I had to get done including a multitude of injections, collection of documents, and a quick trip to the dentist. This resulted in the captain "whipping" my wisdom teeth out just in case! With a numb tongue I thanked him profusely!

Christmas came and went, and the planned New Year parties went out the window, I am sure not for the last time. On 3 January I flew out to Hanover, feeling very apprehensive about what lay before me. On arrival at Hohne everything took a little skip sideways, as I was stitched up quite well by Lieut Marc Owen, being taken to the squadron offices and initially interviewed by the acting 2IC (LCpl Clifton-Brown), with a very stiff vodka. It did cross my mind to wonder who this crew-cut, 2IC lunatic was? Then I was taken to one of the sapper annexes, being told the officers mess was under reconstruction. Every few minutes an "acting" captain or lieutenant would proceed to introduce himself to me, then rush outside for a bloody good laugh. Eventually the game was given up and I was taken to the officers mess to settle in. However, to end things properly Lieut "Boo" Crew was serving that night, and after I said grace (which is never normally done), ate a bowl of soup with half a bottle of Tabasco sauce in it, she promptly poured a jug of water over Marc's lap! – I retired to bed a very confused second lieutenant, with all my thoughts back in England.

The flights to Bosnia were delayed, so the extra week in Hohne was spent becoming accustomed to an engineer regiment, how it was set up, how it

Second Lieutenent S Gardner
Operation Resolute p156

worked, and the personalities within it. Having completed all my administration, been issued with large amounts of cold weather equipment, and packed it all into impossibly small bags, I joined the flight for Split on Saturday 13 January.

The site of the future Neames HGB bridge. Left: 61m gap on original alignment. Right: pontoon bridge (MLC 55 on a good day.)

Bosnia

Our arrival in Split was met with surprising efficiency. Once in the pipeline everyone seemed to be processed rapidly and, along with hundreds of others, the transit centre in Split coped well with the balance of 26 Armd Engr Sqn; about 80 men from the squadron had been in theatre since October, on Operation *Grapple*. After just one night in a warm, dry building we left Split and set out for the town of Mrkonjic-Grad and our new home in an old bus depot.

My first impression of the country, once we entered the areas which had been fought over, was one of bewilderment; most houses were totally gutted; there was nobody to be seen save the odd Croatian manning inadequate checkpoints, and we had been warned to watch out for mines anywhere off approved routes.

After a six-hour trip we entered the bus depot, just east of the town, in darkness, so little could be seen of the area. The temporary accommodation was a large field tent within one of the main hangers, in which everyone settled down for the night, lying shoulder to shoulder. What lies ahead?

As an attached second lieutenant without the engineering experience of the YOs' course but all the skills of someone with a degree in oceanography, my lot in life is to be seen and not heard. So over the next three months I intended to take in as much as I could. My first trip out of camp saw me accompany the OC, who was liaising with other Arms in our area. This involved visiting the Light Infantry, Light Dragoons, and Artillery at Banja Luka to the north and in Sanski-Most to our west. Travel by road is most time-consuming due to the fact that the road system had not been repaired for three years and was heavily pitted; in places the whole road had subsided leaving a drop of hundreds of feet too close for comfort. Having called in at Sipovo, I had a glimpse at how a brigade HQ is set out, with each of the various Arms represented as a cell. During the day we also looked at a demolished bridge which had left a wet gap of just over 60 meters. At the site was a pontoon crossing, put in sometime during the war, but it was only able to take light traffic. 26 Armd Engr Sqn will have responsibility for improving the pontoon, to take heavier traffic, as well as building a new bridge on the old alignment.

After a few days in our camp at the bus depot, my next excursion was to accompany Sgt Shaw and Sgt Harding on a bridge and route recce in Banja Luka. We set out in two CVR(T) (combat vehicle reconnaissance (tracked)) Spartans, my first experience in any armoured vehicle so the journey was enjoyable until ... both Spartans suffered problems with the track alignment wheels not 15 miles down the road. This meant the recce was completed the following day in Land Rovers. With the CVR(T) off the road, I caught a lift back to Mrkonjic-Grad with Capt Jim Willis, Battle Group Engineer Operations Officer, who was coordinating engineer tasks in the 2LI area. On return to camp it was surprising to see how much more "maintenance" had been carried out. The camp was looking good. (To cheer me up a little more were eight letters; so she does love me.)

One aspect which continued to impress me was the standard of food produced by the chefs. The quality was outstanding and the quantity immense, despite the conditions and lack of amenities; meals became highlights of the day. (I remember thinking that if this continued for my whole time with 26 Sqn, I would return a bloater!) A very big hand to the chefs.

Attending the evening O group, I discovered I was soon to move up to join a section of 3 Troop which had been tasked with erecting accommodation for the QRH, so I prepared my kit to be away

for a couple of weeks or so. After settling in, I accompanied two field sections whose next task was to construct accommodation and shower facilities for a squadron of the QRH based at Bos-Petrovac, 50km to our west on a very windswept and exposed plain. Bos-Petrovac was several hundred meters higher than our camp and on arrival the temperature was -18C. Due to the low temperature, the task was given a high priority and as soon as stores were ready we raced up to begin construction, collecting the design report on the way. The plans unveiled a very complex 250-man, self-contained camp. Without prior knowledge of the scale of the camp, we arrived, unable to lay hardcore on the required scale. However, under the direction of the Clerk of Works, SSgt Cooper, we struggled to begin construction, putting each Corimec on individual foundations, firstly hacking away at the frozen ground to level in the support blocks. The units soon sprung up and by the end of the week the QRH had vastly improved accommodation and the luxury of hot water.

Then, on 7 February without any warning, the OC visited, and within five minutes I was in the back of his vehicle, off to stay up at a troop location positioned near the bridge site I had visited in my first week.

The bridge, named Neames (after General Neames VC), and a pontoon project, had begun. As a squadron task it involved realigning the pontoon approach roads to leave the area of the main carriageway clear for preparatory plant work, prior to building a HGB over the gap of approximately 60 meters. I stayed for three days, and helped set 120kg of PE4 to break up the ruined supports of the carriageway. This was a great experience, and a spectacle on detonation. Preparation of the new roads and banks could now go ahead, with one little problem ... on the initial excavation of the site, a body was discovered buried under the rubble! Rumours from the ARBiH suggested a further 200 bodies within the rubble, a possible mass grave. It had to be investigated and brought the bridge build to a halt. I left before it was resolved.

A week later I was attached to 1RRF, for a brief three-day visit. Y Company 1RRF were based in a "shoe factory" on the outskirts of Mrkonjic-Grad, and to my delight one of the platoon commanders, 2nd Lieut John Swift, had been in my company at Sandhurst and at university with me at Southampton. Having been in Bosnia with a new regiment now for over a month, it was great to be able to chat to a contemporary. It soon brought reality back to my attachment, which had been a totally new experience for me so far, and we had a laugh about times gone by.

Under the Dayton Peace Agreement, our area, known as the "anvil", was slowly being reoccupied by civilian refugees, many of whom were returning to burnt out houses (see photograph below), with no possessions and very little food. Accompanying John with his sections, I spent the few days patrolling the town in his Saxon and on foot, helping to supervise the limited food distribution from a warehouse in town. It was a great change of scene for me; a few months before I would never have thought that I would be in a foreign country walking down a street, with a friend, helping to implement a peace agreement! Then upon return to the shoe factory, sitting in the operations room was another friend of mine, 2nd Lieut Rob Freeman, who had been in my platoon at Sandhurst! Very bizarre and an enjoyable turn of fate.

On return to the squadron, my next escapade was to travel "in the belly" of an AVLB to recover a No 8 bridge laid weeks before. Again a great experience and I soon understood the attraction for any armoured engineer. The bridge was recovered expertly, but in very boggy ground. On exit, the tank sunk deep in the soil and this is where the CRARRV came into its element. Within fifteen minutes the 55-tonne AVLB had been dragged from its place of rest onto firm ground! A

Operation Resolute p158

very impressive display by all those involved.

The next highlight was to spend a week with the Warrior-mounted B Coy 2LI, up at Sanski-Most, under command of Major Kellett, followed by another good week under the wing of Lieut Peter Chapman. Some time was spent out foot patrolling with a local Muslim commander "Captain Lucas". Joint patrols with the local forces were enjoyable, being able to actually see the country and walk alongside the Muslim soldiers. Having been selected by the Corps it was very interesting to see what the Infantry was getting up to in the area.

Neames HGB bridge under construction.

On 11 March, I rejoined 3 Troop as they were about to begin the "16-bay triple single" HGB (Neame bridge) build located near Skender Vakuf on Route *Clog*. Now part of Cpl Campbell's section, working on the bridge was fun; I climbed around like a monkey. Each HGB panel weighed about 700kg, so every part was brought in by crane then manhandled into place. We worked with a Dutch section of eight, who were both entertaining and hard working; it was a novel experience working with our allies.

With seven of the bays constructed, work progressed fast. Fine weather made it warm by day and the build flew along. The bridge was huge! As this type of bridge isn't used a great deal by the regular Army the only experience of HGB bridge building came from Sgt Shaw. Every step was addressed with a bit of hot planning and there were a few dicey moments. As every two or three bays were completed, the whole structure needed booming towards the gap, and the Dutch engineers' Leopard armoured engineer vehicle had no difficulties at all in carrying out this task. A most impressive project from start to finish. The deadline was met with two days to spare, and to end the week on a high note, the troop was invited to the Dutch brigade camp, set in an Olympic ski village, for a meal and a few beers.

I left 3 Troop on 16 March, and prepared my now filthy kit for a week out in the field with 2 Troop, in an AVRE. We were to deploy as part of the brigade reserve to provide mobility support if required, with a squadron of Challengers from the QRH and C Coy of 2LI in their Warriors. Not a bad week. As fourth man on an AVRE, under Cpl Frew and his crew, I was able to see how the vehicles operate and experience what it was like to live on one. It was good to be out of camp and living literally in the field, (which had been ploughed deeper by the vehicle tracks than ever it would be by locals.) However these armoured engineers have far too many home comforts! – constant hot water, cooker units and warm engine decks on which to sleep. It made a change from the only exercises I was used to at Sandhurst, living in a soggy hole.

Flights confirmed, I returned to Hohne on 31 March. A few things to tie up, and then everything changed once more as I began my troop commanders' course and returned to learn the theory behind all I had seen in Bosnia.

Conclusion

My attachment with 26 Armd Engr Sqn in Bosnia was a very valuable one and, from start to finish, I feel I experienced or witnessed many activities I would not otherwise have done with a regiment in barracks. Items ranged from being a sapper on stag, to laying demolition charges, constructing accommodation, building a HGB, armoured engineering and even a glimpse of a brigade HQ at work. I had the opportunity to work with almost all parts of a squadron, and patrol with Saxon and Warrior infantry platoons, as well as seeing a Challenger squadron in the field.

Spending a lot of time within the sections, and talking with the soldiers themselves, was my most satisfying experience. I was often impressed with their morale, even in the coldest, dirtiest situations; I am looking forward to commanding a troop of my own.

Operation Resolute p159

Sustainable Methods For Clearing Landmines After Conflicts

TERRY THOMAS BA PhD AND ANDY SMITH BA

Dr Terry Thomas is Director of the Development Technology Unit, a group at Warwick University specializing in designing technologies for small enterprises and rural areas in developing countries. From schooling in London he entered the Royal Navy, taking an engineering degree at Cambridge. After a year at sea, and teaching at the Navy's electrical school, he started a two-year graduate apprenticeship with Associated Electrical Industries Manchester, which ended with helping build Dungeness "A" nuclear power station. Since 1963 he has been in the academic world, firstly in Khartoum and from 1966 at Warwick University. His research activities and teaching have taken him from electronics via driverless transport systems and transport studies to "intermediate technology." Frequent visits to Africa brought him into contact with the urgent issue of economically and sustainably clearing antipersonnel landmines left by past civil wars, which is the topic of this paper.

Andy Smith was born in rural Devon in 1954. He took a degree in Philosophy at Warwick University in 1982, and by 1986 was a member of the Development Technology Unit, working on various practical and computer-based tasks. He has helped establish a training centre in rural Africa, and been involved in the production of many reports and two books. In 1994 he was influential in the unit's adoption of mine-clearance as a working area, and now manages the Mine-clearance Support Programme and its associated company, the Development Technology Workshop. During 1995 he led a small team on a fact-finding survey of demining in Mozambique, which spawned a short but successful project to develop and prove locally manufacturable demining visors and shields. Current obsessions include research into practical demining methods and control strategies that may be sustainable under indigenous financing and management. His engineering aims include the development of an appropriate antipersonnel mine clearance machine and of cheaper (and possibly better) mine detectors.

Introduction

The extent of the mine problem in countries formerly engaged in war is well documented, and is of major humanitarian and political concern. Seriously affecting over 40 countries, landmines and unexploded ordnance are particularly prevalent in Cambodia and Laos, Afghanistan and Kurdistan, Mozambique and Angola, El Salvador and Nicaragua.

In recent years civilian methods of demining have been developed which entail mapping the limits of minefields, locating and confirming actual mines and ordnance (by "eye" or with metal detectors and probes) and exploding or otherwise

Terry Thomas & Andy Smith
Sustainable methods for clearing landmines p160

rendering them harmless. There are many types of mine, some very difficult to detect or dangerous to clear, some containing more than 10kg of high explosive, most containing under 250 grams.

Humanitarian demining teams commonly comprise nationals, often ex-soldiers, under the management of expatriates, using imported military equipment in a military-style organization. Mine clearance is generally very slow and consequently expensive per unit of area cleared. The active military in the countries affected are not usually involved in post-conflict (humanitarian) demining, which is, in many ways, a new activity. It has drawn together several sorts of organization: international agencies, official aid programmes (like the Overseas Development Administration's emergencies programme), non-governmental agencies (like the Halo Trust, Oxfam and the Mines Advisory Group), commercial companies, universities and military units. Some of these are involved in funding demining, some in doing the job and some in trying to advance demining technology.

The authors of this paper work in a university research unit that supports front-line demining groups. The unit, which has received invaluable assistance from the Royal Engineers, has worked for many years on "bottom-up industrialization" in less developed countries. We have considerable experience of both what it is possible to achieve in countries with a poor supply and skills infrastructure, and of communicating with and training local artisans. This background of seeking to provide interventions that will result in self-sustaining improvements within developing countries, colours our approach to the problems of humanitarian mine clearance.

The practical response of our unit to date has been to try to provide demining groups with answers to some of their immediate problems. At the same time we have endeavoured to collate information and are designing new equipment specifically for non-conflict demining.

In this article we discuss what might make the provision of demining equipment sustainable, describe some specific steps with which our unit has been connected and conclude by asking the help of interested readers in advancing the art of humanitarian demining.

The issue of sustainability

In "development" circles, the issue of sustainability is hotly debated. How can short-term interventions from outside assist a country to lift itself out of poverty? Experience has shown that many (if not most) support initiatives that rely on alien skills, experience and values do not survive after the external organizers have left. Post-conflict mine clearance is not normally considered as a long-term development exercise, but rather as an emergency process of repair and restoration. This approach would be tenable if the problem were finite and it could be confidently stated that outside experts would not be needed after a set period. When, in global terms, mines are being laid much faster than they are being cleared, and when estimates of the time required to clear any one country vary from 5 to 50 years, the need to achieve local sustainability becomes obvious. This need is recognized by the UN and many NGOs (nongovernmental organizations) in the field. Indeed, it was this need that prompted the British Mines Advisory Group (a demining NGO) to interest us in their needs originally.

During our work we have interviewed representatives from many demining organizations (mostly in the field) and found that they are concerned to achieve demining "sustainability". Some NGOs have established local manufacture of uniforms and probes, but with uncertain funding and short-term contracts, the issue of organizational sustainability has not been realistically addressed. Nor has the high cost of the demining equipment that is currently imported, such as detectors, body armour and visors. We found a sense of desperate inevitability about the anticipated rapid decline of any established infrastructure as soon as it was put under local control.

A common view is that the only answer to the sustainability problem is to find a "technological fix" to make demining much faster and allow full clearance before overseas money runs out. Development experts argue that a better answer would be to devise organizational structures that, while varying from accepted demining practice, were appropriate and sustainable locally. However, they also acknowledge that this would take time and require a different range of field experience from that available to most mine-clearance organizations.

Towards sustainability

As a step towards sustainability the reduction of the total cost of demining (and of its foreign exchange component) can be approached broadly in one of two ways. One might:

- either continually refine existing demining practice and reduce the expenditure on equipment, management and manpower, to achieve a substantial

A marked minefield in Mozambique, photographed during a survey last year.

reduction in costs per hectare cleared. This approach may include the use of dogs, and changing organizational methods;

- or seek a technological fix that will dramatically reduce the cost of finding and disposing of mines. This approach may include the adaptation of military mechanical clearance techniques to meet the standards and constraints of humanitarian demining.

There is some overlap in the approaches. For example, the availability of a "smart" hand-held detector might enable a many-fold reduction in the level of false alarms. A higher certainty in detection would greatly accelerate manual demining. Smart detectors are being researched in various industrialized countries, but appear likely to be very costly and too complex to repair in most mine-infested countries.

We argue that both approaches should be followed and that cutting costs by up to 90 per cent may be feasible. The first approach does not sit comfortably with the current situation whereby much demining is undertaken on short-term contracts that put commercial demining organizations in competition. This discourages the full sharing of experience that the approach requires. For the second approach it is unfortunate that all relevant existing research and development activity is based far from humanitarian demining operations and targeted to achieve solutions primarily to meet military needs.

Various new high-technology, wide-area methods for remotely identifying or destroying mines and ordnance have been proposed. These are not yet proven and will certainly be expensive. It also seems unlikely that they will achieve the very high clearance rates (over 98 per cent of devices rendered safe) that is demanded of humanitarian demining. Certainly these proposed methods will not meet the normal criteria of third world sustainability, namely being cheap, operable in poor rural areas and not heavily dependent on foreign exchange. At worst, these methods can damage and render unstable the significant fraction of devices that they fail to detonate.

Safety, speed and cost

It would be tidy to treat safety as a fixed constraint within which speed of demining should be maximized and cost minimized. In practice these three aspects of mine clearance interact in complex ways.

Any demining organization has a keen concern for the safety of its operatives. Accidents are distressing, demoralizing and expensive. Demining often takes place in difficult locations where disease may be common, banditry prevalent, the terrain itself hazardous and movement by vehicle unusually liable to road accidents. The personnel may have spent several years fighting in irregular forces prior to working on mine clearance and be difficult to mould into safety consciousness. Some private companies have the need to make a profit as another priority. It is within these constraints that those controlling a demining operation have to set the day by day safety standards for their operatives or subcontractors.

Deminer safety must be weighed against the safety of the civilians who live in mine-infested areas, because increasing deminer safety can slow the rate of clearance and increase the risk of civilian casualties among those waiting for their area to be cleared.

Of similar concern is the knowledge that fast clearance is unlikely to be as thorough as slow clearance, but that finding the last few mines may take as long as it would take to completely clear the next area. The argument is often made that fewer civilian casualties would result by clearing whole regions with a target of 80 per cent efficiency, then going back over the ground a second time to find and clear the remaining mines and ordnance.

Certain types of terrain are especially time-consuming to clear. Some of the mines and ordnance

Sustainable methods for clearing landmines p162

may have been abandoned a decade or more ago. In the humid tropics and in the absence of farming activity, mined areas will often come to support dense bush if not actual forest. Tangled among this undergrowth can be the tripwires of fragmentation mines with a killing range of more than 50 metres.

For safety, some organizations fire or throw grappling hooks across an area in the hope of snagging the tripwires and detonating mines from a safe distance. Others fire coloured cotton thread over the area in the hope that it will catch on the thin wires and reveal their presence.

While increasing safety by adding more levels of caution to existing practice is liable to slow the process, we contend that increasing safety by the use of appropriate equipment need not. For example, the use of a shield at high risk times such as when defusing or detonating a device adds nothing to the time taken. Other safety aids, such as various means of containing a controlled blast or of increasing the distance between a deminer and his target, may actually increase demining speed.

Antipersonnel mines and some ordnance are of low explosive power, typically containing less that 250 grams of high explosive (much less in the case of more modern antipersonnel mines). Even quite modest amounts of body protection will greatly reduce injuries from the explosion of such devices. An obvious example is the 4mm polycarbonate visor that can provide full blast and environmental fragmentation protection less than one metre from an antipersonnel blast. Similarly, being a few centimetres further away from a blast (by using long-handled tools) can prevent the loss of a hand in the event of an accident.

It seems likely that mechanical methods of clearing the ground and detonating fragmentation mines from a safe distance could be developed, so allowing deminers to make much faster and safer progress over mined areas.

The unit cost of clearing a hectare of land can usefully be viewed as the cost per hour of demining divided by the speed of demining (eg in hectares per demining day). Reducing unit cost is therefore a matter both of increasing speed or reducing daily costs or doing both.

Factors which affect the "daily cost" equation are:

- Detector "hire" (currently a $2000 detector might serve for from 300 to 900 days).
- Supervision costs (an experienced expatriate demining manager or trainer usually costs between 50 and 100 times more per day than a locally recruited deminer).
- Transport and logistic support (for access, for maintenance and supply of equipment and consumables, provision of mobile accommodation and for evacuation in the case of emergencies).

As with so many technologies, there is the option of reducing labour costs by increasing the performance (and invariably the cost) of equipment. In demining, the ultimate form of this option would be the completely "remote" detection and destruction of dangerous devices. However the technology to achieve this does not yet exist, and may not be appropriate to use when it is.

Incremental improvements to manual demining

Humanitarian demining is usually done by a process of finding and then disposing of each device. Such devices usually contain some metal, so a metal detector is the basic instrument used to find them. Unfortunately most ground contains pieces of metal – including bullets, fencing and bottle tops – so there is a high incidence of false alarms. Also, soils with a high iron content can cause false alarms and, of course, completely non-metallic mines are undetectable in this way.

The possible introduction of very "smart" detectors belong to the category "major technological innovation" discussed later. There is, however, some scope for incremental improvements in more conventional detector design and we are exploring this possibility.

The process of probing for and uncovering a mine may be undertaken either crouching or lying on the ground. The necessary close proximity of deminer to mine calls for the most careful procedures coupled perhaps with protective clothing.

Final disposal is achieved by defusing or destroying the mine *in situ*, or by transport to a disposal site. Humanitarian demining organizations are of course keen to prevent any "recycling" of the mines that they clear.

The most obvious approach to incremental improvement of demining is to begin by identifying current best practices. Our experience of interviewing front-line operatives in Mozambique has shown that they would welcome the chance to discuss and compare methods, and regret the rareness of opportunities to do so. Other methods of identifying and promoting good practice include movement of staff between organizations (which happens) and requirements by funding agencies that contracting organizations report upon their methodologies (which rarely happens).

Blast testing of Development Technology Unit designed shields and visors under RE supervision.

The next approach to incremental improvements involves the reduction of equipment costs, where possible in conjunction with some increase in performance. The major specialist equipment is the metal detector and we have identified several improvements, mainly ergonomic, to existing military devices that would be welcomed by users. We also find that there is scope for local or regional manufacture in southern Africa, SE Asia etc. The underlying electronic technology is not complex and the production processes are within the scope of urban industries close to mined countries. We estimate that the effective costs of detectors could readily be reduced by a factor of five.

Protective equipment, for example: visors, shields, blast controllers, and tooling such as probes and markers, are generally manufacturable locally even in small towns. In the interests of developing sustainability, reducing immediate costs and increasing safety, we believe demining organizations should try to source these within countries or even within districts of operation.

Finally there are improvements in equipment that do not amount to major changes. One that we are researching is modification to metal detector electronics and to detector ergonomics to increase discrimination and ease of use. Another is investigation of *in situ* methods of device destruction that do not require removal or the introduction of explosives.

Major innovations in technology

Somewhat critical mention has already been made of very high-tech methods of wide-area detection and mine clearance. Our concern is with more immediate improvements and we would pinpoint two as having particular promise: better detection and the introduction of small-scale mechanical clearance devices.

The ideal detector would allow an object under the ground to be visualized so well that operators could reliably decide which "detected" objects required probing or even immediate disposal and which constituted no threat. Many physical and chemical techniques can be used, including smell (probably best applied using dogs), types of radar, soil resistance measurement, ultrasonics and quadrature nuclear resonance (which can detect the nitrogen in underground explosives). We may expect steady progress in this area from military researchers, however there is still some distance to go before a satisfactory level of reliability and processing speed can be reached.

Small-scale mechanical demining is promising in the short to medium term. Effectively combining the three processes of vegetation clearance, detection and disposal, mechanical techniques are already widely used for breaching minefields during conflict. They variously employ bulldozing, flailing, excavation or milling and rolling processes. With such techniques it is unavoidable that some, or even most, devices explode, therefore the equipment and operator must be suitably protected.

Our analysis leads us to believe that mechanical equipment for humanitarian demining can be very much lighter and lower powered than that used for military purposes. Strongly influenced by our commitment to localising manufacture, we plan to develop a mechanically simple milling or probing device. It appears to be both practical and economic to make such equipment robust enough to tolerate typical antipersonnel explosions and fragmentation devices. The machine can then be lightweight and manoeuvrable enough to be used on soft ground and between mature trees. To avoid the need for it to carry armour to protect its operator, it can be controlled remotely via a cable. The degree of remote control planned is low compared with contemporary robotic practices in the admittedly easier environments of industry and farming: its cost should therefore also be tolerably low.

It is not yet certain whether a sufficiently high effectiveness (say 98 per cent of devices destroyed)

Sustainable methods for clearing landmines p164

can be attained using such "down-sized" mechanical equipment or whether supplementary detection processes would be required. Considerable research and development is needed to ascertain guidability, destruction rates, portability, safety and maintainability in the field. The Development Technology Unit is not the only organization to appreciate the potential value of small-scale mechanical clearance devices and within a few years it may be possible to compare the performance of two or more rival machines.

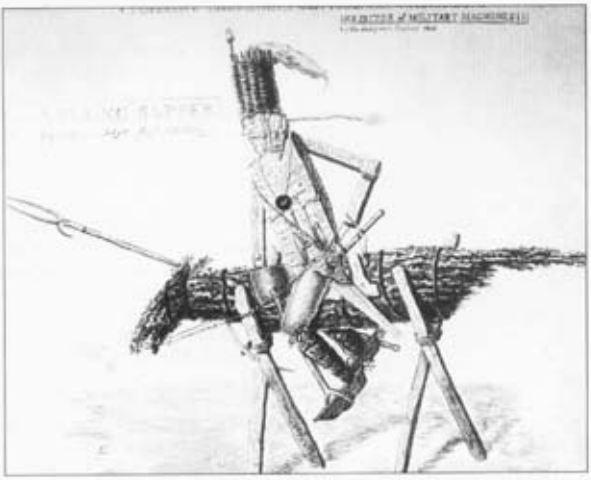
Moving forwards

Everyone would like to see progress in humanitarian demining, coupled wherever possible with political agreement, to limit the problem in the future. In this article we have tried to show that progress, in the form of accelerating demining and making the cost much cheaper per hectare, is possible. Where the resources will come from to achieve that progress is not yet clear.

Our approach is broadly supported by many with extensive experience, including Colonel Paddy Blagdon (ex-UN, now World Bank mine-clearance adviser) and Major Alaister Craib (European Union demining adviser), both former RE officers. While continuing with incremental improvements to manual demining equipment, we hope to be able to organize programmes for identifying and sharing best current demining practices, and for developing our mechanical demining concept.

As mentioned, the Royal Engineers (both serving and retired) have provided invaluable assistance throughout our work. Brigadier John Hooper, whose letter appears in the correspondence section of this issue, has been especially closely associated with it. We would like to appeal through these pages for further assistance from any reader who might have particular experience of, or insights into, small-scale mechanical demining equipment, or who feels qualified to assess the ideas of others.

The Flying Sapper by Captain Adye, Royal Artillery



This unusual watercolour picture of a Sapper officer mounted upon a horse! by Captain Adye, Royal Artillery, dated 1815, hung in the Officers Mess of the Junior Leaders Regiment in Old Park Barracks, Dover, until their disbandment, when it was transferred to the RE HQ Mess in Chatham. It is inscribed "No 2 Ordnance Hieroglyphics humbly submitted to Sir Wm Congreve Bt Inspector of Military Machines".

The Flying Sapper p165

Back to School and All at Sea!

JOHN BOOTH

The author was educated at Selby Abbey School, Selby Technical Institute, and the Universities of Goettingen and Bristol. He joined the Royal Engineers in May 1945, ending this part of his career as deputy chief clerk, Chief Engineer 5 Division, in BAOR in 1948.

He held various Youth Service posts in Lincolnshire, Warkwickshire, and Somerset and joined the staff of Wiltshire County Council as a Youth Officer in 1966. He was a university extra mural lecturer in fine art.

In 1978 he embarked on a publishing career. His books include: Antique Maps of Wales, Looking at Old Maps, Looking at Old Prints, The Day War Broke Out *(St Dunstan's charity book) and more recently since his retirement, a major work on the Titanic Disaster with co-author Sean Coughlan.*

His hobbies include writing, collecting antiques and old maps, and prints in particular, trout fishing and chess, and when driven to it by his wife, whom he married 49 years ago, repeated action with the lawn mower!

ORDERED to report to the School of Military Engineering at Chatham, in 1945, I was instructed to remove my cap badge and shoulder flashes and replace them with the insignia of the Royal Engineers. The rather grand title of my new establishment had conditioned me into thinking that I was about to embark on something quite different from the usual military provision, perhaps with the odd white-haired academic dashing hither and thither between lectures. I could not have been more wrong.

My rude awakening came on the morning of our first classroom session. As I set out to cross the square, which was surrounded by a series of barrack blocks serving as our accommodation, a bellow was delivered by an indignant sergeant, "stick under arm", from outside the distant guardroom: "Get off the bloody square." He was astonished to learn that in the Royal Army Service Corps lorries were even parked on the square! It took a little time to explain that until the previous day I had not been a Royal Engineer, and was therefore quite unaware of the sacred nature of his square!

Two courses were running in tandem; our group training as engineer clerks, the others as surveyor clerks. Each student was issued with a typewriter, and told that mastery of the machine was to be his first priority.

Satisfactory completion of the course brought its rewards; now a member of the Temporary Establishment Engineer Services, or TEES for short, meant a substantial pay increase to 6/6d per day.

Within a matter of weeks I was posted overseas, departing from Tilbury in one of Mr Kaiser's welded wonders, the Liberty ships that had made such a significant contribution to the war at sea. Tilbury proved to be snowbound, damp and deeply depressing, hardly living up to the description in my *Gazetteer* which claimed the docks were "as among the finest in the world." I boarded as the January daylight faded. Sleeping quarters were several decks down with three-tier bunks that folded upwards when not in use; the quarters were confined but comfortable. The general layout of the vessel as a trooper worked well, and as the galley was situated topside there were no cooking smells below decks.

The gentle throb of the engines indicated that we were under way. Donning my greatcoat, I made my way on deck to discover the rails lined with soldiers "sick as dogs", to coin a phrase, and this with the vessel hardly under way!

I suddenly noticed that the line of lights on the distant shoreline was disappearing only to reappear seconds later and promptly disappear yet again. Clearly this motion was responsible for

John Booth
Back to school and all at sea p166

the green and distressed state of many of my companions, and I was grateful for my earlier boating experiences on Yorkshire's Ouse river.

I awoke the following morning to a Tannoy announcement that breakfast was being served, with a choice of scrambled egg or kippers. Being somewhat partial to the latter, I dressed and seizing knife, fork, spoon and mug, skipped up the companion way in anticipation of the treat in store. Perhaps I should have known better! The smell of fried kippers produced a feeling of nausea so strong that I grabbed the nearby handrail for support as knife, fork, spoon and mug clattered to the deck and I fled for the safety of my bunk. I remained "bunk bound" until the late afternoon, when rumour had it that tea and fruit cake a plenty were being served in the galley and I made a cautious and satisfactory return visit with no ill effects.

I was awakened next morning by a loud, disturbing rumble and crashing noise which appeared to be coming from somewhere near the bows. I hastened on deck. To my amazement the sea had vanished! Gone were the waves, and in their place a vast plateau of snow-covered ice stretched in all directions, our ship a lonely interloper in nature's wonderland. Walking quickly aft I was amazed at both the thickness and the size of the giant chunks of ice now bobbing in the wake of the speeding ship. Memories came flooding back about the fate of the luckless *Titanic*, yet here was a much smaller vessel ploughing her way through a major ice-field with impunity, her skipper seemingly regardless of the damage ice was capable of inflicting on her rudder and stern gear. I watched with some trepidation as huge blocks of ice bumped and scraped their way along the sides of the ship. Unlike the *Titanic*, there were no rivets to pop, but I just hoped that Mr Kaiser's welders had done a good job in plating her. After breakfast I returned to the deserted deck and settled down near a warm ventilator, confident that if the worst happened it would be possible to walk the rest of the way to Germany! Some two hours later we began to pass small vessels, dredgers and the like, imprisoned in the ice and I knew we must be approaching our destination.

As we neared Cuxhaven we reached ice-free water and orders came over the Tannoy for us to prepare to disembark. It seems we were to spend the night in Hamburg, some 50 or so miles from Cuxhaven, although with our slow-moving train I began to wonder whether we would ever reach it. None of the carriages were fitted with upholstery and all were unheated – although the wooden slatted seats proved quite comfortable.

Arriving in Hamburg as darkness fell we were warned to avoid the night spots. I accepted this sound advice and managed to avoid the assaults and robberies inflicted on some of my comrades.

I had previously seen something of the damage inflicted on Hull and Bristol by German bombing, and the terrible destruction of London had been widely reported in the press and on radio. Hamburg had suffered a far worse fate; few buildings remained standing and for the most part, the city was a giant heap of rubble.

My destination was the transit camp at Bielefeld. The highlight of my stay was a chance meeting with the town's aptly named Fire Chief, Willie Fritz. Willie told me that before the war he had been a professional racing driving. On a visit to his flat, I met his charming wife, and there on the walls was the photographic evidence of his previous motoring exploits. Learning of my near-death experience on a Merryweather turntable ladder, Willie ordered out his own Metz turntable, regarded at that time as the world's highest, and I was privileged to climb it. In the crew room I was amazed to discover that there was a set of portable breathing apparatus for each member of the crew, as against the single heavy "Salvus" equipment carried by British crews. Even more remarkable was their fire hose which was made from paper! Willie explained that whilst it could only be used once, the couplings were cut off and fitted to replacement hose.

Days later I was on my way to the CRE at Wolfenbüttel, following in father's footsteps for operational duties with the Royal Engineers. Within a matter of days I was posted to the DCRE at Celle, a delightful town on the banks of a river. The DCRE offices were located in a spread of buildings which included a woodworking shop. The military presence consisted of a major, his driver and some half a dozen sappers including a corporal cook in charge of catering arrangements. The major lived in style in a house some distance from the offices.

I quickly realized that I had the responsibility for all administration in the office, a task made the more difficult because the major, a regimental officer, had not the slightest idea of Engineer Services procedures.

The coming of spring brought its compensations, my free time enabling rambles along the banks of the nearby gently flowing river in the hope of seeing a rising fish. The German owner of the works had apparently noticed my preoccupation with the river. In conversation with him I gathered it contained no fish, but would I like to borrow his boat? This took the form of a beautifully built Canadian canoe about 14ft in length and so light that it could easily be carried on the shoulder. The following Sunday morning I set off for the river with the canoe and its single bladed paddle. I felt the Army was getting a bargain for my services at 6/6d a day, but the job did have its compensations!

I saw little of my sapper colleagues except at meal times. My lonely existence in the evening was not helped by the Forces Radio and AFN's (American Forces Network) "Midnight in Munich" which tended to turn one's thoughts to home and loved ones and in my case probably had the reverse effect to what was intended. Daytime meal breaks were not helped by the aggressive attitude of one sapper, who repeatedly went out of his way to be objectionable. One of his usual outbursts at lunchtime was followed with the comment "If you weren't wearing that bloody stripe I would sort you out." "That is easily remedied" I replied, "I can take my tunic off if you care to step outside." The warring parties were quickly followed by the rush of mess mates eager to see the fun. It proved to be very short lived. My Liverpudlian adversary executed some pretty footwork, came at me with arms flailing and ran into a swinging right which caught him on the point of the jaw. He fell backwards and lay still. There was no movement. "My God," I said, "Have I killed him?" The answer was provided by the corporal cook who delivered a bucket of cold water to my assailant's face, greatly aiding his spluttering recovery. To my amazement he got to his feet and extended his right hand with the comment "No hard feelings Corp." I was still trying to come to terms with the lucky blow my limited boxing experience had provided and willingly shook his hand.

Some weeks after the incident I was ordered to appear before the CRE at Wolfenbüttel and felt certain that a charge of striking a private soldier was the likely reason. To my astonishment the colonel wanted to know my reaction to the "C" report submitted by the DCRE. Now it was his turn to be astonished, for a "C" report demanded that its content be submitted to the NCO concerned and I had no knowledge of it. The colonel was interested. "Can you think of any reason why the major should have submitted this adverse report?" "Yes, Sir, but I do not consider it was anything to do with my work." I now realized that an imprudent remark I had made about the major's black market activities had been overheard by his driver and this was the major's way of dealing with the threat.

The colonel's next question asked for my views about people who resorted to black market activities. "I think it is criminal Sir." "Did I think the DCRE was involved in such activities?" "I have no direct knowledge of that, Sir." "Well I am going to send you where you will have direct knowledge, except that you will now keep your mouth tightly shut and report weekly to your new DCRE at Brunswick who is the only person who knows why you are being sent there." "And by the way" he added as an afterthought, "Your promotion to full corporal has just come through."

Brunswick had suffered badly at the hands of Allied bombers, many of the buildings in the old town having been completely destroyed. In addition to the DCRE, Brunswick housed the HQ of 5 Division and the offices of the Chief Engineer. The DCRE offices were located close to a small park on the outskirts. Beyond lay a large complex taken over as a divisional HQ by the British Army and commanded by one of Field Marshal Montgomery's favourite generals, Sir Richard McCreery. The DCRE offices and accommodation were located in a corner tenement building some 30 or so yards from the stores and included a builders yard complete with its own carpenters shop employing some half dozen German tradesmen and labourers. Support staff included two sergeants (stores and transport) a couple of sapper drivers and myself.

The DCRE was a somewhat elderly Major Burgess, who had recently discovered that his stores had been mysteriously disappearing, even before he could issue the many domestic and household items required by the families of servicemen now arriving at Divisional HQ in increasing numbers.

My role was to supervise the stores office which as far as I could see was ably administered by a youngish German named Martinius. I was to report weekly to the major in person and in writing. There was much transport activity mainly with stores and materials leaving the yard with

civilian transport and drivers. Established procedure was for the driver to call at the stores office when Martinius would sign the release note, but no check was made on the consignment itself. Question: "Martinius, how do you know that the goods you have signed out are on the vehicle?" "They must be, Sir, or they would not be on the list." "And what about items that may be on the vehicle that are not on the list?" "How can that be, Sir, with the sergeant supervising the loading?"

The major was both concerned and impressed. "Well what do you suggest Corporal?" he enquired. "A sentry type checkpoint Sir with a reliable checker on duty." Sentry box and checker arrived the following morning.

A few days later the major sent for me to enquire how the new arrangements were working. I explained that providing our checker was reliable which of course I could not guarantee, all appeared to be well. "You need have no worries on that score," added the major. I later discovered that our sapper checker was a military policeman. He had already been advised by the stores sergeant that there was really no need to go aboard the vehicle, as he had previously checked the load. This advice was apparently taken until about a fortnight later when the checker suddenly decided to climb aboard and discovered half a dozen appliances including kettles, irons and electric fires hidden beneath a folded tarpaulin. I called the sergeant and advised him of the find. "That's them bloody thieving Germans, they must have loaded 'em when my back was turned." I rang the major and told him of the discovery. "Tell the sergeant to come to my office." A subsequent grilling by two members of the Special Investigations Branch followed. We never saw the sergeant again. Later rumour had it that he was holidaying in Colchester.

Some weeks later a third posting came through which involved a short walk from the DCRE to divisional HQ just down the road. Doubtless the Royal Engineers had been responsible for allocating the accommodation that made up the many and varied units employed in a divisional HQ. Without question, the finest building on the campus, an imposing two-storey block standing aloof and as far away from the main gate as it was possible to get, was that occupied by the CE, Colonel F C Nottingham. As at the time I was a non-smoker, my boss, Captain Collins, who ran the vital electrical and mechanical works, asked what I did with the 50-tin free issue cigarettes that we all received, and he and I entered into a trading arrangement whereby I exchanged the cigarettes for his German Marks. This enabled me to make limited purchases of gifts to send home from the few shops in Brunswick that remained, and permitted Captain Collins to continue to smoke like a chimney!

Any local trading was difficult because we were issued with paper money known as BAFs (British Armed Forces Vouchers) which could only be spent in our own establishments. This was an attempt to prevent trading with the Germans with whom we were supposed not to "fraternize". On one of my Saturday shopping expeditions into Brunswick I noticed a long queue of mostly uniformed servicemen. I joined it in the belief that a NAAFI club had probably opened in the city. "What are we queuing for?" I asked a nearby pallid looking soldier. "They

£1 British Armed Forces Special Voucher, generally known as a BAF, c 1947.

have just reopened the brothel mate, despite old Monty!" was his somewhat caustic reply. I beat a hasty retreat, at the same time wondering what the connection was between the recent Commander of the British Army of the Rhine and a Brunswick brothel!

My shopping jaunts into Brunswick enabled me to send a variety of gifts to my "future intended" including wood carvings and various other pieces of decorative treen. I also commissioned a very able German artist who lived in the city to make a series of charcoal tinted drawings of the ancient city churches. These were framed and sent home, together with a rather fine spelter dachshund, and still grace our living room. My favourite piece was a 10in carving of an old country woman carved out of a single block of hardwood, and later unfeelingly used by my wife as a doorstop until the day our terrier chewed off its head!

My unexpected promotion to sergeant brought about a number of sweeping changes to my lifestyle. The comment from Charlie Thatcher, the chief clerk and now my immediate boss, was that it had taken him more than 20 years to reach WO1 and here I was a sergeant at 19! The sweeping changes were brought about firstly by the camp commandant, secondly by Field Marshal Montgomery and thirdly, and by far the most important as far as I was concerned, by the new Minister of War in the Labour government – Mr Emanuel Shinwell. The intervention of the first party did however nullify the efforts of the second party to improve my fitness.

It had apparently been brought to the camp commandant's attention that the CE's branch personnel had never attended his weekly Monday morning inspection, a regimental turnout of all branches in the divisional HQ, to be inspected by a somewhat portly captain together with a loud-mouthed and uncouth sergeant major whose Scottish regiment was doubtless pleased to be rid of him. Added to this unfortunate development was a directive from Rhine Army HQ, that all ranks major and below would undertake physical training including a cross-country run on two mornings in the week, to be concluded with a cold shower! This, we understood, must be enforced as it was a direct order from the great man himself.

Quite naturally, the responsibility for ensuring these orders were carried out rested firmly on the shoulders of WO Thatcher. He, being a master of delegation, turned to his deputy – me! A branch meeting was called to acquaint all the staff with our new responsibilities. The two other sergeants in the branch asked that the three of us meet to resolve matters as neither of them had any regimental training and were incapable of taking the camp commandant's parade. A satisfactory compromise was arrived at; they would undertake the PT sessions and I the weekly inspections.

The colonel was most anxious that a high standard of turnout was ensured. I advised him that I proposed to parade the branch for inspection some 15 minutes before we were due to parade when we would march to join the main parade. Word had gone round the branch about the colonel's concern and the turnout was creditable.

Arriving at the parade ground we halted and I marched up to the sergeant major, saluting because the captain was already present. "Chief Engineer's Branch, where do you want us sergeant major?" I enquired. "At the back behind the cooks" was his surly reply. I wondered what the colonel's response would be on finding out that the senior Corps of the British army had lost its usual place of honour. Time would tell. I dressed the three ranks and stood them at ease to await the eventual arrival of the captain and his obnoxious sergeant major. As they approached I brought the branch to attention, took three paces to face the captain and saluted with the words "Chief Engineer's Branch ready for inspection, Sir". He returned the salute and made a beeline for the front rank, jumping slightly as I bellowed "Centre and rear rank stand at ease."

The inspection continued, with the sergeant major and myself following respectfully in the wake of the captain who was now displaying a certain lack of zeal (doubtless with breakfast in mind) after his lengthy perambulation around the several hundred lower ranks of the HQ staff.

As the captain reached the centre rank I sang out "Dirty belt, name and number, Sapper?" The sergeant major turned on his heel pad in hand but I was ready for him. "I am to report defaulters to the Chief Engineer, thank you, sergeant major." He glowered and fell in behind the captain. After the parade a very concerned sapper came to see me. "I did blanco my belt and did my brasses last night sergeant, am I on a charge?" "No, you are not" I retorted. "That was just to let the sergeant major think it was one in the eye for the Royal Engineers." I continued with this useful ploy on future parades, the colonel beaming his pleasure on learning that his branch had passed muster!

The Warrant Officers' and Sergeants' Mess at divisional HQ catered for some 40 senior NCOs headed by the Mess President WO1 Johnson, the Rhine Army Fire Inspector. On learning of my previous employment in the National Fire Service and my aspirations to enter the fire service as a career on my eventual release from the army, we became great friends.

Mr Johnson was happily married, although his wife was in the UK, and as I was now engaged to be married, we spent many happy evenings in the bar of the mess, often with the bar to ourselves. Whisky cost 6d a tot and as Minister of War Shinwell had recently raised all the Forces pay, our evenings in the mess proved a most cost effective and satisfactory alternative to seeking outside pleasures. Sadly this latter choice resulted in some quite serious consequences for many of our colleagues as I shall now relate.

The evening had been a convivial one and around midnight Messrs Johnson and Booth said good night to Hans, the German bar steward, and tottered off to bed. About an hour later I was awakened by someone shining a torch in my face. "What's your name?" came a voice from the darkness. Now, for someone to wake an otherwise "happy" senior NCO in the middle of the night and in the manner described, was asking for trouble. "Put the bloody light on", I ordered. My unwelcome visitor complied. There standing before me was the largest Red Cap sergeant I had ever seen, complete with white belt and gaiters, holster on hip! "What the hell do you think you are doing sergeant?" I demanded. "Is that your name on the door, Sergeant Booth?" he asked. "Of course it's my name – why?" "Sorry you have been troubled" he muttered, and departed.

Breakfast was normally served in the mess from 0800hrs onwards. On this eventful morning the sole occupants of the dining room were Mr Johnson the President, WO1 Crooke of Army Education, WO1 Thatcher (my boss) and myself – four bodies out of a possible 40. "Where the hell is everyone this morning?" demanded the PMC. He called Hans over – "Hans, go upstairs and see where everybody has got to." Hans returned some minutes later with the news that although all the beds had been slept in, we were the sole occupants of the building. Some hours later, news of the previous night's activity was relayed to Mr Thatcher on one of his numerous visits to "the camp". Sometime after midnight the previous evening, a staff car carrying General Sir Richard McCreery and his wife, pulled up at the guardroom after an evening visit to the officers club in Brunswick. It was singularly unfortunate that at the same time a sergeant with a female on his arm staggered through the gate ahead of the car. The general ordered the guard commander to call the sergeant over. The sergeant, knowing that he had just brought a German national into a restricted area, let go of her arm and she collapsed and attempted to scramble behind some convenient bushes.

Not surprisingly, the general's presence appeared to have a sobering effect on the sergeant. "Is that the way a senior NCO in the British Army and his wife conduct themselves in front of the Germans?" demanded the general. "She's not my wife she's a German friend" replied the sergeant, attempting to steady himself against the general's car – which did not go unnoticed.

Now the fat was really in the fire! Some anti-fraternization regulations were still in force and here was a German national entering a divisional HQ. The first arrest was the soldier on guard duty, quickly followed by the unfortunate sergeant. The general ordered the guard commander to telephone the camp commandant, advising him that General McCreery required his presence at the guardroom at once.

Details about the incident were doubtless given to the camp commandant, and whether he in turn alerted the provost marshal, it is difficult to know. Both arrived at the guardroom at the same time, the latter gentleman having brought a posse of military police with him in the jeep. Here was the explanation for my late night visitor; all the garrison messes had been searched on the orders of the general.

Hindsight permits me to record that I had never seen any females in the mess, apart from German employees. How some 30 or so German women had been smuggled into the building without our seeing them was as ingenious as it was remarkable.

At dinner that evening, with the exception of one WO1 reduced in rank to sergeant, all our mess mates were new faces. With one of Monty's old generals in charge, most of our NCOs had been jumping one way or another – mostly downward!

Old Bill

LIEUTENANT COLONEL E E WAKELING ERD

This account is based on a report written by Major R A Shorter, OC No 1 Bomb Disposal Company, at the time this bomb was recovered.

DURING the last war, No 14 Bomb Disposal Company RE was responsible for rendering safe all bombs dropped in Yorkshire, a fairly large area. To do this it had sections in Leeds, Wakefield, Sheffield and Hull.

On 23/24 June 1943, the war diary of No 14 BD Coy reads: "Raid on Hull, with SD2s." A rather bald statement giving no indication of the fact that one of the bombs would require the most technically demanding recovery of an unexploded bomb (and the longest continuous effort) in the history of wartime bomb disposal.

The 1000kg (2200lb) bomb (nicknamed "Old Bill") fell in Hull Market Place and failed to explode. It took over two and a half years of searching, digging and shoring before the bomb was found, defused and brought to the surface. Six separate shafts were sunk in an attempt to locate it.

At that time a system was used for grading unexploded bombs in that those which affected the war effort, ie dropped near factories, railways, etc, were given a Category "A", which meant: immediate start with the loss of the lives of bomb disposal officer and men being an acceptable risk. The Germans had a "long" delay fuse, which could explode a bomb any time up to 90 hours after landing, and when dealing with a Category A bomb, the risk was high IF the bomb was fitted with one; of course, there was no way of knowing how the bomb was fused. Bombs with lower categories were left for four days after which time it was comparatively safe unless the bomb was accidentally knocked by a pick or shovel, when the clock might restart!

Sheet steel piling can be seen inside the timbered shaft.

Work to recover Old Bill commenced on 3 July 1943, nine days after the raid.

The first shaft was 8ft by 8ft, lined with timber, the sides supported by 10ft-long planks. It was dug to a depth of 20ft, with no sign of the bomb, tail fins (which would have become detached), or the bomb's passage through the earth (the trace).

A second, smaller, "search" shaft was started on 6 September. A 6ft by 3ft 9in, could be dug at a faster rate, and was located so that one side of the shaft was over the hole of entry. The trace, which was fairly straight, was followed for 16ft, by which time it had moved just 4ft from the vertical. It then began to flatten out and a piece of the alloy tail fin was found at 18ft. Further probing seemed to indicate that the trace had flattened out completely, placing the bomb well away from the shaft, and it was therefore decided to fill it in and start again.

Shaft number three was started on 22 October. Again a timbered excavation, 10ft by 10ft, it was dug to a depth of 23ft, more pieces of the tail fin being found at 22ft and 23ft. It then became impossible to continue because every spadeful lifted was soon replaced from below; the earth on the outside of the excavation was sinking, forcing silt – a sort of liquid earth – up through the floor of the shaft; it was difficult to stand on the floor, one just sunk in.

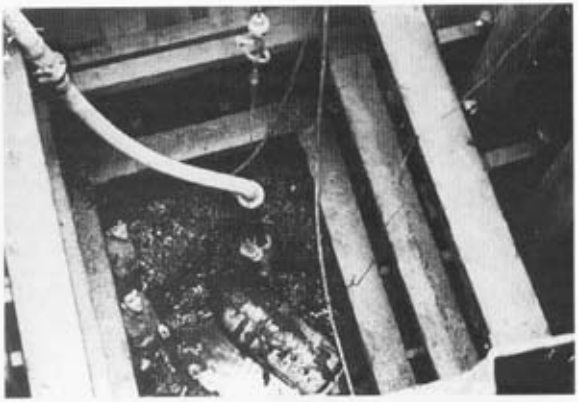
Because of this problem, it was decided to use sheet steel piling, which could be hammered to a depth greater than the working depth, thus preventing this "boiling up" effect. Obviously, steel piling could withstand external pressures better than timber and, being interlocked, was much stronger. Not knowing exactly where the bomb was situated, fingers were crossed that the piling didn't hit it! On 24 February 1944, shaft number four, 17ft 6in by 15ft, was started. The shaft was taken down to 28ft but unfortunately nothing else was found and no sign of the trace discovered, even after probing to almost 50ft.

Shaft five was started on 1 June 1944. The technique changed in that it was started with a large timber shaft 22ft by 20ft, to a depth of 10ft, when a smaller shaft was sunk. This time 17ft by 13ft, with sheet steel piling which was

Lt Col E E Wakeling ERD
Old Bill p172

23ft long. More parts of the fin were found at 28ft 6in and 33ft, but work was again stopped because silt was making it dangerous to continue. Before filling in the shaft more probing took place, down to a depth of 58ft, without success.

All five shafts had been sited using the standard method of taking the hole of entry as the datum and then following the line of the trace, the position of the tail fin, and making allowances for the type of soil, etc. This usually worked; well, nine times out of ten!



The 1000kg bomb, as it was discovered at a depth of 38ft. The extreme condition of the soil can be seen, along with the size of the timbers to counteract the pressures from outside the shaft.

It was then decided that a new approach should be made as there was, by this time, a "bomb locator" in existence. A number of 6in holes were bored in the ground, in the form of a grid, and were lined with asbestos pipes. The locator was then lowered into each, and a reading taken at one foot intervals. Unfortunately, the locator located "metal", of course, and the last shaft was lined with sheet steel piling! Once this was removed, the pipes were put down to 50ft.

By now it was August 1945! The war was over and still the bomb hadn't been found!

On 28 March that year, 14 Coy had moved to Shoreham, to clear the beach minefields along the south coast, and No 1 BD Coy had taken over responsibility for "Old Bill"!

It was November before the results of the locator readings confirmed that a "large amount of metal" would be found at a depth of 36ft, well outside the area already covered by the previous shafts!

On 25 November 1945, the sixth and final shaft was started. It was 17ft 6in x 15ft, and used 33ft-long sheet steel piling.

The bomb was found in the centre of the shaft, at the predicted depth, on 31 January 1946. The fuse (a standard 25B German impact fuse) was immunized, the explosive removed, and the bomb was brought to the surface on 2 February 1946, 953 days after it had been dropped.

Some of the equipment required for the operation.

Lieutenant Richards with his successful team. 2 February 1946.

Operation Grapple – Protective Structures

MAJOR J F PELTON BSc(ENG) ACGI EURING CENG MICE C
AND LIEUTENANT S B GEORGE

Major Pelton first deployed to Bosnia on Operation Grapple 1 *with 519 Specialist Team Royal Engineers (Works) and spent the tour assessing bridges and designing protective works. He subsequently returned two years later to command 23 Amphibious Engineer Squadron for Operation* Grapple 5 *where he was involved in constructing protective works as well as being engaged in many other aspects of engineer support to the United Nations' mission. He is currently attending Army Command and Staff Course 30.*

Lieutenant Simon George was commissioned into the Corps in December 1991. A premature departure from 106 Young Officers' course was caused by an urgent posting to 42 Field Squadron, 35 Engineer Regiment, as Troop Commander 7 Field Troop and immediate deployment on Operation Grapple 1. *In September 1993 he was posted to the Royal Military College of Science for a three year degree course, and in July of 1996 was back soldiering again when he took over as Regimental Training Officer 1 Royal School of Military Engineering Regiment at Chatham.*

This article is based on a presentation by the authors to a Joint Professional Meeting which took place on 21 February 1996 at Minley Manor.

INTRODUCTION

CONSTRUCTION of protective structures has been a common feature of Operation *Grapple* deployments, and specific examples have been described in previous editions of the *RE Journal* [1]. The standard designs used in Bosnia are now almost taken for granted, and with the end of Operation *Grapple* it is therefore appropriate to record how they were developed and the underlying design assumptions which were made, in order to assist those involved in the design and construction of future protective works.

DESIGN (Major Pelton)

THREAT

AT the start of Operation *Grapple 1* British forces deployed into the Former Republic of Yugoslavia under the protection of UN flags, blue headgear and white painted vehicles.

Maj J F Pelton & Lt S B George
Op Grapple - Protectice structures p174

With resources stretched to the limit, all available effort was concentrated on preparing bases and routes for winter. Hardening various facilities was, of necessity, given a relatively low priority – until 8 January 1993, when the supposedly safe town of Tomislavgrad was shelled. During the afternoon and evening of 8 January, about 140 rounds of 152mm and 122mm artillery ammunition landed in the town. Many hit the immediate area of the two British camps located there and two rounds landed inside the perimeter of the engineer camp. Fortunately no one was hurt although one round destroyed a storage ISO container and the other damaged several vehicles and destroyed others. The effect on the threat assessment was dramatic. Suffice it to say that by first light on 9 January, 37 Fd Sqn and 44 Fd Sp Sqn had constructed extensive improvised protective works and the design process had been started.

The design work was carried out by 519 STRE (Wks) and started by identifying the weapons against which structures would need to provide protection. From a survey of the weapons in use, together with a consideration of their method of employment, it became evident that the main threat was from artillery firing either ground or air-bursting shells. The warring factions employed little fire direction, aiming at significant features such as towns rather than pinpointing targets, and maintained comparatively low rates of fire. It was therefore considered reasonable to design for single round near misses. The rounds in use were either fuzed to burst in the air or on impact, so penetration of the round prior to detonation was not a consideration. (In reality it would have been impractical to provide protection against rounds fitted with a delayed action fuze.) In addition there was a threat from man-portable weapons such as small arms and hand-held antitank weapons fired either by accident or by disaffected individuals. By considering the heaviest weapon in each class known to be in use, the following weapon design parameter list was drawn up:

- 14.5mm heavy machine gun.
- RPG 7.
- 152mm round fired by the Yugoslav M84 152mm artillery gun.

Requirement

The requirement was to design structures which provided protection in the following order of priority:

- Collective protection for otherwise unprotected personnel. From experience during the early stages of Operation *Grapple* it was found that there was sufficient warning of artillery strikes to allow personnel to take cover in a shelter.
- Protection for critical facilities such as command posts, operations rooms and medical facilities.
- Enhancement of the base perimeters.
- Protection for sentries and gate guards.

Materials

The urgency of the need to provide protective structures following the Tomislavgrad attack was such that any materials used had to allow rapid construction, be easily transportable and, preferably, be locally available. An assessment of the possible materials yielded the following results and assumptions:

Concrete. Concrete was not considered to be suitable as:

- Casting *in situ* would be difficult due to the extreme winter weather (temperatures went as low as -52°C in places) and the shortage of locally available sand.
- Pre-cast units, such as walls, were available in Split. However, units which were thick enough to prevent projectile penetration would have had to be manufactured resulting in a delay of at least one month. The transportation of the units over the poor roads to bases such as Vitez would also have been difficult with available transport.

Steel. Steel was also ruled out as it was in very short supply in Bosnia and extremely expensive.

Timber. Timber was readily available in a variety of sizes up to a cross section of 300 x 300mm and 6m in length. The quality varied but it was mostly sound. During later deployments the price increased with demand although initially it was cheap and locally available.

Sandbags. Sandbags found a wide application and were available in large numbers. Materials such as geotextiles and geoweb, having a similar utility to sandbags, were only available in small quantities, difficult to obtain and expensive.

Hesco-Bastion Concertainers. Hesco-Bastion Concertainers were used during the Gulf War and found to be excellent and versatile for use on most forms of protective structure. Following the Gulf experience the Engineer Resources system sent a considerable number to Bosnia with the initial deployment and rapidly dispatched more as demand developed.

Fill Material. Fill material varied considerably. Sand was not available and alternatives, such as quarry tailings, were used instead. Soil excavated in the areas of the camps was of variable quality and often found to be frozen, creating problems later.

Design Loads

Design loads were derived using CONWEP, the computerized version of the American Weapons Effects design code TM5-855-015.[2] Weapon characteristics not already known, such as those for the M84 "Nora", were entered from sources such as Yugoslav weapons catalogues. The weapons were modelled in terms of their blast loadings and projectile, or HEAT jet, penetration. The structural effects produced were such that:

- A minimum of 650mm of fill material was required to prevent projectile penetration, both small arms and shrapnel.
- An additional stand-off of at least 1m would be required to prevent penetration by an RPG-7.
- A blast loading of 6t/m² was appropriate for structural design.

Results

Results of the design work were summarized in an operational aide memoire.[3] The main structures designed were as follows:

- Collective shelters which consisted of an inverted ISO container surrounded by Hesco-Bastion Concertainers and covered with a timber and earth-fill roof. The ISO container provided a final spall liner and some protection if the roof collapsed. It was inverted because ISO container floors are much stronger than their roofs.
- Two types of blast walls. The first type consisted of Hesco-Bastion Concertainers stacked a maximum of two high. Stacking three high proved unstable unless additional rows of Concertainers were added at the base. This was considered inappropriate as Concertainers were in short supply. The second type took advantage of the number of empty ISO containers which were available and involved stacking sandbags inside up to the top of the container against the wall nearest the structure to be protected. This system provided particularly good protection against HEAT projectiles as it created the necessary stand-off with no additional effort.
- A number of sangars were designed based on the standard sandbag sangar designs already in existence.
- In addition to these new structures a number of designs were also drawn up to enhance the resistance of existing structures such as the school building at Vitez. Apart from blast protection, such as walls and blast film on the windows, shoring and sacrificial roofs using standard design details were incorporated.

Vitez School Hardening.

CONSTRUCTION (Lieutenant George)

Design into Practice – Vitez

Following the attack on Tomislavgrad, Lt Col Stuart, CO 1 Cheshire Battle Group, gave orders for 42 Fd Sqn to treat the hardening of the Vitez camps as its highest priority in order to protect personnel from further attack. The task involved providing protection for some 800 men, including 600 infantrymen as well as Sappers, REME and RLC personnel. Although some minor protective works such as sangars had already been constructed, we now concentrated efforts on collective protection.

Vitez School Building

7 Troop were given orders to fortify the Vitez School immediately, as the school contained the operations room, hospital (medical support troop) and Battalion HQ; all vital elements needed to control and support UN operations north of Gornji Vakuf. The building was also big enough to provide shelter for every soldier in the camp while construction of collective shelters in the vehicle park and around the accommodation was being completed.

A reconnaissance of the site identified a weak roof which would be expensive, time consuming and labour intensive to reinforce. The resulting plan was therefore to sacrifice the first floor, using the roof to detonate any rounds and the reinforced concrete first floor slab to protect personnel on the ground floor. The reconnaissance also identified the need for:

- Blast protection around the exterior ground floor walls.
- Shoring of the first floor slab.
- Protection against flying glass.

The perceived nature of the threat meant that the work had to be done

Op Grapple - Protectice structures p176

quickly with whatever equipment and materials were available or could be purchased locally; there was no time to order and wait for further stores. The plan was to board all windows and create a flat, compacted base around the school on which 19 ISO containers could be placed to form a blast wall. The ISO containers were filled with sandbags, stacked against the wall nearest the school to a width of 650mm, the minimum required for protection against 152mm rounds.

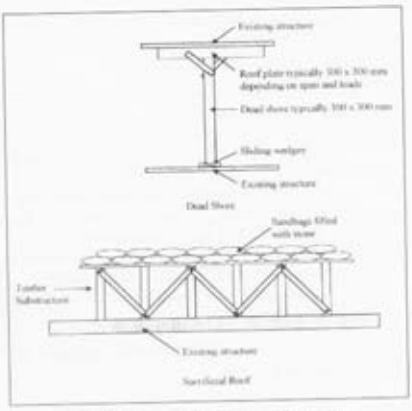
The squadron's carpenters set to work building the dead shores in the lower floor of the school, using 300 x 300mm timbers purchased from a timber yard in Vitez. Timber was cheap and readily available from this source, being delivered within just 24 hours' but, once erected it dried out and shrank! After one close shave, when an officer leant on a support causing it to swing out from its base, it soon became standard practice to check the wedges daily.[4] The initial hardening of the school was completed by boarding up all windows on the lower floor and using blast film on the upper floor to protect occupants running for cover.

Hesco-Bastion Concertainers proved to be invaluable and were used as blast walls to supplement the ISO containers and as the basis for four collective shelters. After training, and with the correct fill, Concertainers were quick and easy to construct. The S26 self-loading dump truck was found best for filling the Concertainers as the grab allowed the fill to be placed accurately; it was also useful for lifting a compactor into the part-filled Concertainers to compact the fill in layers. Some other lessons learned are described later.

Collective Shelters

The final protective structures constructed at Vitez were collective shelters, built to 519 STRE (Wks) initial design.

Using a field troop (minus some of its key tradesmen detached to maintain camp services), and with all necessary materials available and fine weather, each collective shelter took a week to construct. They provided protection for those working in the vehicle park and living in accommodation units some distance from the school building. A trial which later took place at Kirkcudbright, proved that the shelters were adequate protection, never-the-less we were relieved not to have had to test them.



Typical Enhancements to Existing Buildings.

Trial and Design Review (Major Pelton)

Kirkcudbright

Ideally a trial should be carried out before a structure enters service. Some aspects of the protective structures had been proven during trials of similar structures designed for use in Northern Ireland. However, the collective shelters in Bosnia had to be built quickly and trials therefore followed at Kirkcudbright in November 1993, organized by the Defence Research Agency. Two trial shelters were constructed using the Hardening Aide Memoire design[5]. They were tested by detonating British L15 155mm rounds at various stand-off distances from 10m to contact and at various locations around the shelter. Despite the accumulative effect of many detonations on each shelter the trial proved

A collective shelter at Vitez.

the concept whilst highlighting the need for a number of improvements. The key conclusions from the trial report[6] are as follows:

- The shelters will provide protection against the design threat and protect occupants against a direct hit on the roof or walls. The pressures and noise levels inside a shelter during detonation would only cause minor injury and discomfort.
- Damage to the Hesco-Bastion Concertainer walls will cause the roof beams resting on them to collapse, making repair difficult as well as possibly causing injury to occupants. Therefore, it was recommended that a ring beam on top of Concertainer walls be included in future shelters.
- Construction standards have a significant effect on the performance of the structure.

The Hardening Aide Memoire was updated by MWF following the trial.[7]

Lessons Learned From Field Experience

The structures have now been in service for, in some cases, nearly four years and successive squadrons have built and varied them to suit different locations. The following details areas which have caused the greatest difficulties:

- Poor or hurried construction will result in a weakness in the structure which an explosion will inevitably exploit. Where time prevents correct construction, such as happened following the initial attack on Tomislavgrad, then commanders must be prepared to rebuild such structures later.
- Variations from the basic design are invariably necessary depending on site conditions. However, significant variations, such as using different types of supporting beams for overhead protection, should be checked by a chartered engineer (PQE) before construction.
- Frozen fill has remained an endemic problem throughout winter deployments. Using frozen fill has, on occasions, been impossible to avoid but inevitably leads to, often rapid, collapse. When compounded by difficult ground conditions structural stability can become an intractable problem. A recent *Sapper Telegraph* (Issue No 3, Aug 95) included a suggested construction sequence for Hesco-Bastion Concertainers as a guide.
- Foundations can also become a problem. The structures are by their nature short-term solutions and therefore require minimal ground preparation. However some structures designed for a six-month deployment are still being used four years later and are beginning to show signs of distress. As much care as possible should be used in selecting the site excepting, of course, that its position will be dictated by the required location and available space. Structures that are in place for a long period of time should be monitored and, if necessary, rebuilt.
- Minor details, the ergonomic aspects of structures, can make a significant difference to the performance of protective structures. Narrow entrances, badly constructed approaches as well as the lack of interior lighting, heating and basic comforts can turn an effective protective structure into an unusable waste of effort or, at worst, a deathtrap.

Conclusion

The structures designed and constructed for Operation *Grapple* have been tested and proven and have found common acceptance with the British army and other UN contingents. They have offered good protection against all the design weapons and beyond. Kirkcudbright demonstrated that collective protection shelters could, for example, take a direct hit from an artillery round and still protect its occupants. However, the structures were designed within the original context of Operation *Grapple 1*. Circumstances change and have done so, even in Bosnia. Future designers and builders should, therefore, review carefully the design assumptions inherent in standard designs and take advice before embarking on protective works. Explosive energy has the uncanny ability to exploit any weakness, with potentially devastating results.

REFERENCES

(1) Weber Capt TA, Operation Grapple 1 Some Lessons Learned, *The RE Journal* Vol 108 No 1, April 1994.
Urch Capt TR, BRITENGBAT in Bosnia – Operation Grapple 5, *The RE Journal* Vol 109 No 2, August 1995.
Digby Capt DJ, The Battle Group Engineer Operations Officer Within Framework Operations in Bosnia, *The RE Journal* Vol 110 No 1, April 1996.
Jackson Capt DRA, The Role of Hesco Bastion in Gorazde's Collective Protection, *The RE Journal* Vol 110 No 1, April 1996.
(2) TM5-855-1, Fundamentals of Protective Design for Conventional Weapons, 20 Aug 92.
(3) The Operation *Grapple* Hardening Aide Memoire, 64 CRE (Wks), MWF, 1 Mar 93.
(4) As described in Capt Weber's article. See (1) above.
(5) The Operation *Grapple* Hardening Aide Memoire, 64 CRE (Wks), MWF, 1 Mar 93, Annex F.
(6) Hulton Maj FG, Bosnian Bunker Trial Report on Trials of the ISO Container/Hesco Bastion Collective Protection System, DRA (Christchurch), Dec 93.
(7) The Operation *Grapple* Hardening Aide Memoire (Edition 2), 64 CRE (Wks), MWF, 15 Apr 94.

The authors wish to thank Mr Freddie Hulton from the Defence Research Agency and all those others, too numerous to mention by name, who have assisted both with the production of this article and with the design and construction work which it describes.

Memoirs

BRIGADIER W McM KEANE CBE

Born 7 May 1897, died 28 October 1995, aged 98.

WILLIAM McMahon Keane had the distinction of having a trench named after him, and recorded on the Somme trench map, shortly after arriving in France as a young subaltern. Years later during the Second World War he was heard to remark during an infantry attack demonstration "I'm glad that the British Army no longer attacks in straight lines – that's exactly how we used to see the Germans coming at us."

Bill Keane was commissioned into the Corps in 1916 and went straight to France after training. He served in 154 Field Company (37 Division) and later 63 Field Company (Lowland Division) in Germany. He was at Chatham from 1923 to 1926 as a Party Training Officer and Assistant Adjutant and during this time he attended Caius College Cambridge.

In 1926 Keane went to Egypt spending five years there successively as Garrison Engineer at Abbasia and Second-in-Command of 2 Field Company. A spell in the War Office, QMG's Department, was then followed in the three years up to the war by an interesting assignment managing the conversion of the Monkton Farleigh underground stone quarry to use for ammunition storage. Brigadier Keane wrote some notes on this project for the April 1989 *Journal* shortly after Monkton Farleigh "mine" had been opened to the public.

Of the war years, JHF writes:

"In Freetown (1939-1941) he raised and trained the first companies of West African engineers. He was successively CRE Freetown and Chief Engineer West Africa.

"In 1941 he was posted to a territorial division with the highest possible of three recommendations for a CRE '– likely to make a poor unit into a good one'. We certainly needed him. He had to dispense with four company commanders – two of them regulars – but he did this with no acrimony, because he gave everyone a second chance but never a third.

"I remember, as a very young adjutant, sending him in a flagged-up copy of Kings Regulations as a suggestion as to how to deal with a particular problem. 'Take that bloody book away from me, boy,' was the result! It was written only for infantry battalions in peacetime!

"Although he was old enough to be my father - having been in battle two years before I was born – I found that I could talk to him easily without ever finding myself put down or over-ranked. Most unfortunately for us he was posted away on promotion to brigadier while we were mobilizing for overseas in 1942.

"I last saw him in April 1944 in company with Brigadier B T Godfrey-Fausset, Chief Engineer X Corps in 5th Army, at Isernia in Italy. Keane was at that time Chief Engineer of V Corps in 8th Army."

Keane's last job in the Corps was as Commander 26 Engineer Group TA. He retired in 1950 and he and his wife went to live at Corsham near his old project at Monkton Farleigh. He moved to Cornwall after his wife's death, to live near Wadebridge. Bill Keane was a keen sportsman having played cricket for the Corps and for Sierra Leone and Egypt.

He became President of St Enodoc Golf Club and continued to pursue a lifelong interest in oil and watercolour painting. JHF REJ

Brig W McM Keane CBE

MAJOR GENERAL E M MACKAY CBE MICE

Born 26 December 1921, died 16 November 1995, aged 73.

THE part that Captain Eric Mackay played in the 2nd Parachute Battalion's epic defence of the Arnhem bridge in September 1944, so graphically described in Cornelius Ryan's "A Bridge too Far" and, more recently, in Martin Middlebrook's "Arnhem 1944", is fairly well-known to the post-war generation of Sappers and has been prominently covered in the obituaries in the national press. Eric Mackay's contribution to the Corps, however, possibly owes more to his time in command of the Malaysian engineers when he embraced a golden opportunity to demonstrate the power of engineering in winning a counter-revolutionary war and keeping the subsequent peace.

Eric MacLachlan Mackay was educated at Fettes and enlisted into the Royal Scots Fusiliers in 1940, being commissioned into the Corps the following year. PE, a lifelong friend, recalled at the memorial service in March this year how Mackay had, from his earliest days, a fascination with things military and technical. His bubbling enthusiasm, which included a love of anything to do with speed, carried on into adult life. It is no surprise to learn that he was among the earliest Sapper volunteers for parachute training.

He joined 1 Parachute Squadron and served with them throughout the rest of the war. Their first assignment was in northwest Africa where, in early November 1942, they took part in the operations by 1st Parachute Brigade to seize forward airfields from which fighter cover could be mounted for the protection of the force. They went on from there to take part in the invasion of Sicily in the summer of 1943; then back to Europe and Operation *Market-Garden* in which Mackay's A Troop, positioned in a school building, became involved so dramatically in the attempt by 2 Parachute Battalion to hold the northern end of Arnhem bridge until the relieving forces of XXX Corps could break through.

The *Daily Telegraph* obituary, which owes much to Mackay's own account published in *Blackwoods* in 1945 and reproduced in *The RE Journal* in 1954, tells how Mackay's men beat off a series of attacks as the school building crumbled around them. JEH a corporal in B Troop whose men were then under Mackay's command, recalled: "I can still see the small figure of Captain Mackay striding, regardless of the enemy fire, through the debris-strewn classrooms, where glass had been broken from the windows, holes smashed through the walls by tank gunfire, blood-soaked clothing and equipment littering the floor, encouraging each tired, unshaven, unwashed but indomitable Sapper who sat or knelt by each window waiting for the next assault by troops of the 11 (SS) Panzer Division." They inflicted "... brutal losses with their marksmanship on the German infantry ..." until, after two Tiger tanks had been brought into action, further resistance would have jeopardized the wounded lying in the cellars, and Mackay led the last six unwounded in an attempted breakout.

He was unlucky; he ran into a force of infantry with two tanks. After a sharp fire fight, Mackay dispersed his men and played dead himself, hoping to escape later, but a bayonet thrust into his thigh forced him to surrender. He made one vain attempt to escape by jumping off the tailboard of a German truck. He was more successful when he reached the prison camp at Emmerich on the

Maj Gen E M MacKay CBE (p180)

Rhine. He escaped with three of his men and luckily found an unguarded rowing boat on the river and eventually reached Nijmegen exactly a week after their initial parachute landing. Mackay's feat was all the more remarkable in that he had a piece of shrapnel embedded in one foot, which he could not pull out and which was going septic. He also had a gash on his head and the wound in his thigh from the bayonet thrust. For these activities he was awarded the United States Distinguished Service Cross and appointed MBE.

After a brief spell in Norway commanding the U-Boat immobilization force, Eric Mackay went to Indo-China to command a company in 20th Indian Division. In his own words this was "... a culture shock for me fresh from 1 Para Squadron. Peace was soon shattered following a disagreement between General Douglas Gracey and Ho Chi Minh. The 10,000 day war began and we fought from September 1945 to April 1946 when the French took over. Next I was summoned to Bandoeng, in the central highlands of Java. It was an extraordinary situation. The enemy, Soekarno's revolutionary army, had half the city and 23rd Indian Division had the other half." After various adventures "... later we got fed up with the enemy's antics and drove them out of the southern half of Bandoeng." Shortly after this he went to Malaya in command of 35 Squadron in 7th Indian Division.

Eric Mackay's career then followed the normal peacetime pattern of regimental duty and staff appointments interspersed with courses. He enlivened this period by indulging his taste for motor sport, driving at Le Mans and in the Alpine Rally and doing the Brighton Speed Sprint in a Cooper. His professional experience was then enhanced by a further spell in command of a squadron, this time 33 Squadron of 37 Engineer Regiment in Cyprus, where, as well as the normal tasks called for by the EOKA crisis, he was involved in the hectic work for the build-up of the force for the Suez crisis and in the operation itself.

Eric Mackay was promoted lieutenant colonel in 1963 and appointed chief engineer of the Malaysian armed forces. Confrontation had begun and the importance of engineering in establishing the infrastructure of roads and airfields in both east and west Malaysia required a tripling of the strength of the Malaysian sappers and the acquisition of a fleet of appropriate construction plant and vehicles. As well as having the vision to achieve this he succeeded in breathing a sense of professional pride into his units which gave them an unmatched reputation and benefited many individuals in their later careers. GAH: "None of the British chief engineers could have brought more enthusiasm to the job or been more dynamic in implementing ideas – particularly in the world of engineer plant. 'Maximum horsepower at the work face,' was the oft heard cry and all involved had to put their shoulders to the wheel to ensure that the wide range of machinery ... was put to good effect." He was a pioneer of wheeled plant and demonstrated its potential when properly managed, at a time when there was much scepticism as to its suitability for large-scale military engineering.

His style of command was to be explicit as to what he required of his subordinates and then to trust them to get on with it while ensuring the necessary backing from his staff. ELVW: "In the end, he also ensured his subordinates got the credit, though the truth is it was his leadership and example that drove the ship forward.".

This was the background from which Eric Mackay then filled three more chief engineer appointments: Strategic Command (1970-72), UK Land Forces (1972-73) and finally BAOR (1973-76), after which job he retired from the Army.

In "retirement" Eric Mackay set about his second career as a civil engineering contractor with the same sort of flair applied throughout his service. CGCB, who had served under him in Malaya and left the Army shortly afterwards, writes: "It was a great pleasure to meet up with him again in 1978 in the Sultanate of Oman where I was operations manager for Shell. Unknown to me he had taken up the appointment as general manager of the local cementation affiliate. I was involved in a major emergency which concerned a severe leak in an underwater hot bitumen line and was desperate for a load of rapid hardening concrete. The manager of the plant told me I would have to wait, as the plant was about to receive a visit from their new GM. In decidedly colourful language I told him that I could not wait with bitumen at 200 degrees and that he should send me the concrete, together with his general manager, if necessary, at once. Half an hour later the truck arrived, closely followed by a landrover, the occupant of which was the new general manager – Eric. Eric did a superb job in Oman, where he established a relationship with the government the benefits of which last to this day." He later moved to Dubai where he headed up the cementation activities run by the Galadari family; and thence to Singapore to run the Galadari operations in the Far East before

returning home a few years later. He was also regional director Iraq Engineering Services from 1981 to 1982 and chairman Amorshield Security Products from 1986 to 1990.

Eric Mackay married first, in 1945, Thérèse Roth, whom he had met while participating in the Alpine Club's downhill luge in Switzerland. She died in 1985. They had a handicapped son, Alec, whose development and future was their main concern. In this as well as in his own determined efforts to lead a normal life after being struck by the virus which left him permanently linked to an oxygen supply, Eric was very much supported by his second wife, Margaret (Hadders) whom he married in 1994 and who survives him. Alec was tragically killed in a traffic accident only a few weeks after Eric's death. Two months before Eric died, he received the following letter from the President of the United States: "Dear General Mackay, Hillary and I were so sorry to learn of your health problems. You are in our thoughts and prayers during this difficult time, Sincerely, Bill Clinton."

RW ELVW GAH CGCB PE ACL JEH

TERENCE CUNEO CVO OBE

Born 1 November 1907, died 3 January 1996, aged 88.

PERHAPS the most striking feature for any new visitor to the RE HQ Officers Mess is Terence Cuneo's picture of the breaching of the minefields at El Alamein. By focusing on the lonely soldier concentrating on the earphones of his mine-detector while surrounded by the mayhem of the battle, Cuneo catches the essence of what is required of a Sapper in war, unflappable courage coupled with technical integrity. This first commission, arguably the masterpiece of Cuneo's commissions for the Corps, typifies the artistic merit of his work which, because of his perfectionist's attitude to detail often resulted in his denigration as a "mere" illustrator. As the obituary in The *Guardian* put it, "... he was one of the most popular artists of our times. Yet on another level he was a complete failure. If giving pleasure to many kinds of people is an indication of artistic excellence, then Cuneo will have to be regarded among the greatest of twentieth century British artists. However he is unrepresented in the Tate Gallery."

"Terence Tenison Cuneo was born at Shepherds Bush on November 1 1907. His father, Cyrus Cincinnato Cuneo, started out as a boxer but at nineteen used his prize money to study art at Colorassi's Studio, Paris, where he became one of Whistler's favourite pupils. In 1903 he married Nell Tenison, a fellow art student. She claimed a connection with Lord Tennyson, the poet, while Cyrus Cuneo included Garibaldi in his family tree. The couple settled in London, where they immediately achieved success as illustrators. Cyrus Cuneo died from blood-poisoning in 1916, when Terence was only eight. The boy developed a passion for railways and horses – well into adulthood he rode in Billy Smart's circus. His mother taught him painting, and after Sutton Valence School he went to the Chelsea and Slade Schools of Art."[1]

In the 1920s and '30s Cuneo established himself as an illustrator for many periodicals including the *Illustrated London News* and *Picture*

Terence Cuneo CVO OBE (p182)

Post and in 1939 he enlisted as a war artist. Apparently his early association with the Corps was not a happy one. As 238919 Sapper Cuneo in 1939 the nearest he came to painting for the Corps was being given a brush and told to "start painting the inside roofs of them Nissen Huts brown." But such irritations proved merely temporary, for the immense worth of his talent was soon recognized and he achieved great acclaim during his most varied wartime career working as a war artist with departments as diverse as the Ministry of Information and Military Intelligence (MI5). After the war he became renowned for his portrait and figure paintings, which included several Royal Commissions. But it is probably his ceremonial, military and engineering subjects for which he is today best remembered. His first Army commission came from the Parachute Regiment and, as he himself said, this marked the beginning of a remarkable relationship with the British Army which brought him both adventure and travel as well as many valued friendships. This relationship lasted for nearly forty years.

Cuneo's close relationship with the Postal and Courier Services arose from the need for high quality artwork on commemorative covers but, as the walls of the Mess at Mill Hill testify, many magnificent works resulted. Of the thirteen commissions for the Corps,[2] eight were on a postal theme. Many, such as *First Airmail* and *Sleigh Post* have become familiar through reproductions and as Christmas cards. *The Flying Postman* was presented to the Corps by Postal and Courier services on their transfer to the Royal Logistic Corps.

Cuneo always had an affection for military subjects and his output was vast. Outside the services he is often better known as a train artist. "While on leave [during the war] Cuneo painted a picture of an Essex mill which was seen by the public relations officer of the London and North-Eastern Railway, who asked him to copy it for a poster. This led to further commissions for the railways. In 1952 Cuneo risked his life when he climbed on to the Forth Bridge in a fierce winter gale in order to gain a good view of the A4 locomotive. By that time Cuneo had become an extremely successful commercial and popular painter, specializing in industrial subjects and machinery as well as railways." [1]

Most people know of Cuneo as the man who put a tiny mouse into all his paintings, and indeed this idiosyncrasy became his trade mark over the years. It all started when he was working on the Coronation painting and his cat, Cleopatra, brought a dead mouse into the studio and dropped it at his feet. The delicacy of the rodent intrigued him and, leaving the serious work to one side, he painted a little picture of the mouse, itself sitting painting a still life of a cheese. Encouraged by his family he painted more and more mice, eventually incorporating them into his serious works as well.

Terence Cuneo's contribution to the recording of Corps History has been enormous as has his contribution to the recording of the history of the British Army in general, a history in which he too has earned a rightful place. He will be sorely missed by all of us in the Services who knew him and his work.

HAH

[1] © Daily Telegraph 5 January 1996

[2] The complete list is as follows: *The Sappers at Alamein*, *The Amazon Bridge* (Bailey crossing of the Rapido), *The Hook Defences in Korea*, *First Airmail* (the arrival in Köln of the inaugural airmail flight from Britain), *Sleigh Post* (rail to sleigh transfer of post in the 1919 campaign in northern Russia), *Air Drop* (air to ship transfer of mail to the Beira patrol), *The Flying Postman*, *The Last Dispatch* (General Gordon sending his last dispatch by Nile steamer from Khartoum in 1884), *Royal Visit to BFPO London*, *Northern Ireland* (the Sapper and Infantry role in Northern Ireland), *Falkland Islands* (varied roles of RE units), *Post Call* (distribution of mail to soldiers in the First World War), *Sergeant A J Knight VC* (Sergeant, later Second Lieutenant Knight, of the Post Office Rifles winning the VC in the First World War).

BRIGADIER G BOMFORD OBE MA DSc FRICS

Born 28 June 1899, died 10 February 1996, aged 96.

BRIGADIER Guy Bomford, who has died aged 96, saw action on the North-West Frontier and was the author of *Geodesy (1953)*, the authoritative work on the subject.

Geodesy is defined in the Oxford English dictionary as "that branch of applied mathematics which determines the figures and areas of large portions of the earth's surface, and the figure of the earth as a whole". One of the first effective practitioners was Eratosthenes, who lived in the 3rd century BC, and succeeded in calculating the size of the earth to within 15 per cent of modern measurements.

Bomford's book came out in new editions every ten years and became increasingly important with the development of the space industry. The positioning of satellites depends on geodetic calculations.

Between 1921 and 1948 Bomford was engaged in the Survey of India. Wartime demands forced him to break off for the Survey of Iraq in 1941 and of Java in 1942. And between 1942 and 1945 he also completed the Survey of Burma.

Guy Bomford was born on June 28 1899, the son of Surgeon-General Sir Gerald Bomford of the Indian Medical Service.

Guy's father encouraged his scientific and mathematical studies from an early age. During sermons, the two of them would compete to see who could calculate the square root of the sum of the hymn numbers to the greater number of decimal places.

By the time Guy won a scholarship to Marlborough, he was solving mathematical problems usually studied at university. He passed out top of his intake at the RMA Woolwich and was commissioned in 1917. After further military training, he went to France with 94 Field Company – though he was still in base when the war ended.

He saw action in 1919 when he was posted to the 2nd Queen Victoria's Own Sappers and Miners, in India, and spent nine months within 14 Company RE in the Wana Column, Waziristan, a country with 7000ft hills and wide extremes of temperature.

This campaign has been described as the most desperate and costly in the history of the frontier. The tribesmen, directed by a skilled Afghan general, were numerous, well armed, and included considerable numbers of soldiers who had deserted from the British-Indian army, led on by tribal loyalties and the promises of agitators.

At this time the British forces in India were accustomed to other theatres and lacked experience of frontier warfare, which required special training, tactics and excellent marksmanship. Half a tribe might be fighting for the British and the other half for the rebels. Sometimes, under a flag of truce, they would visit each other socially prior to another bout of ferocious fighting and killing. The fate of anyone ambushed but not actually dead in these wars was likely to be extremely unpleasant. On retirement all would settle down together in their original villages.

Bomford adapted himself quickly to frontier warfare; after one foray into hostile territory he was the only officer to return alive. As a sapper he paid particular attention to ensuring that there were adequate supplies of water for horses and men. He was mentioned in despatches.

Bomford began his monumental Survey of India in 1921, though he retired the next year to England in order to read engineering at Queens College. He graduated with first class honours (marked distinguished).

Brig G Bomford OBE (p184)

For most of the next two decades he was engaged with works in India, though in 1932 he made the survey of the Persia-Baluchistan border. From 1942 to 1945 he was Deputy Director of Survey in the 14th Army and in 1946 Director of Survey in South East Asia Command. During the war he made many of the maps upon which the 14th Army relied for the Burma Campaign.

Late in 1941 when an invasion of Burma by the Japanese seemed imminent, Bomford had established a small survey group in that country for the triangulation and production of maps. When the Japanese invaded, the records were buried at Myitkina. Subsequently Bomford and his companions had to walk many hundreds of miles in conditions of great hardship to reach the safety of India. The Japanese discovered the buried records and took them to Singapore from where they were recovered after the Japanese surrender.

On retirement from the Army in 1948, Bomford became Reader in Surveying and Geodesy at Oxford, a post he held until 1966. A senior member of Brasenose College, he instructed undergraduates, supervised specialists and computed all the projections for the Oxford Atlas, some of which were of his own devising.

Bomford was appointed a Fellow of the Royal Institute of Chartered Surveyors in 1950, Chairman of the Royal Society Geodesy Sub-Committee from 1961 to 1968, and President of the International Association of Geodesy from 1963 to 1967.

He was also a Fellow of the Indian and National Academy of Science which he had helped found in 1935. He was appointed OBE.

As a young man Bomford had played rugby; later he became a philatelist and a palaeontologist. He quarried ammonites and built up an internationally renowned collection. One of the many new specimens he collected was given a name *Parkinsonia bomfordi.*

At the age of 92 he was invited by the Military Survey to reopen its headquarters, named the Bomford Building.

In addition to Geodesy he was the author of *Geodetic Triangulation and Geodetic Survey in India 1930-35*, a book of personal reminiscences.

Guy Bomford married, in 1925, Audrey Edith Barclay; they had a son. In 1939 he married Annette Brown; they had two sons.

COLONEL R C GABRIEL MA FIMgt

Born 28 May 1917, died 17 February 1996, aged 78 years.

Robert Gabriel had two great passions in life; the first was passenger ships and the second India.

Educated at Marlborough, he was commissioned from the Shop in January 1937 (37 YO Batch) and then attended the usual young officers' courses, and Queens College, Cambridge.

At the outbreak of World War Two he served some months with the BEF in a "searchlight" battalion before being posted to Combined Operations where he worked in various appointments until 1945 and where, in the initial stages, he managed to booby-trap the bed of David Niven; suitable revenge was exacted by the latter!

Staff College training at Haifa intervened between November 1942 and March 1943 following which he moved to India to the new Combined Operations Training Centre at Coconada.

In July 1945 he was posted to the Madras Sappers and Miners in Bangalore and took part in the Malayan landings (Operation *Zipper*) and in the reoccupation of Java. In January 1946 he assumed command of 65 Field Company which he retained until April 1947 when he returned to the UK.

After a tour as Brigade Major 23 Engineer Group (TA), he entered the RE (Tn) world as a student on the Long Transportation Course which gave him the opportunity, for part of the time, to indulge in his love of ports and ships.

In 1952 he returned to India as Commandant Transportation Wing, Indian College of Military Engineering, and then moved to the Canal Zone in Egypt for his staff stint as DAA & QMG 3 Infantry Brigade.

From 1956, when he was promoted lieutenant colonel, he served in a series of movements and transportation appointments in Longmoor, Marchwood, Singapore and the MOD.

He was promoted colonel in mid-1962 on the staff of the Director of Movements. A year later he was appointed Commander, 1 Railway Group at Hounslow where he remained until his retirement on 30 March 1968.

After retirement he moved to the family home in Bournemouth where he settled down to write a book entitled "A Century of Sea Travel to India and Beyond, 1870-1970". He intended the book should be the definitive record of passenger shipping for that century and he had the support of major shipping companies in his research. It took several years, much frustration and several condensations and, even then, has not yet been published. There is hope, however, that the work will see the light of day, courtesy of a friendly collaborator.

Coupled with this task he wrote many articles for shipping magazines and continued to add to his enormous collection of picture postcards of passenger shipping, both through correspondence with worldwide collectors and by visits to any place, no matter how far, where a new addition could be obtained. His collection was, arguably, one of the most comprehensive in the world.

Robert Gabriel was a generous man who supported many individuals and good causes both here and in India. A number of people have reason to be grateful to him for their education which, without his support, they would never have received. He was a staunch friend and minutely conscientious in all his duties whether military or personal.

HAA

Col R C Gabriel MA (p186)

MAJOR (QM) J W S LISTER

Born 15 April 1910,
died 15 May 1996, aged 86.

JOHN William Stephen Lister was one of the last quantity surveyors in the RE Works Service, before responsibilities were transferred to MPBW in 1960. Born in London, at 14 he lost his father, who had served on the North West Frontier, and consequently joined the Royal Engineers as a boy soldier, training at Gosport and Chepstow. He worked hard to educate himself and over the years obtained professional qualifications as a clerk of works and quantity surveyor.

As a young soldier, he served in Germany, returning to England for his foreman of works course at Chatham, just before the Second World War started. After a brief spell with the British Expeditionary Force and subsequent evacuation, he embarked at Liverpool for the long journey via Cape Town to Port Suez. Much of his war service was spent in such exotic locations as Eritrea, Abyssinia and the Sudan. Here he was responsible for controlling several major engineering projects while still quite junior. These included the two dams in Asmara, Eritrea, a large camp at Jebelein in the Sudan for the supply route to the western desert, and road construction and maintenance in Abyssinia. During this time he was very much on his own and had to recruit and supervise large numbers of local tribesmen to carry out work. He ended his war service with the push up through Italy, maintaining the road systems so necessary for the advance. John had a fund of interesting and amusing stories of his war experiences and was an excellent raconteur.

He was commissioned in 1946 and posted to Singapore where he played an important role in the reconstruction of the island that had been so devastated by the Japanese. After a spell on construction works in the UK, he served for several years in Germany, including working on the building of the major military headquarters at Mönchengladbach. His last few years service were spent engaged in the important field of tendering, letting major contracts and works supervision, in the UK, Antwerp, Northern Ireland and BAOR. The reduction in forces in 1960, when the RE Works Service's responsibilities were transferred to MPBW, led to him leaving the army after 37 years' service. He then took up the post of clerk of works to Oxford City Council where the achievement for which he will be remembered was the construction of the Oxford County Offices, opened by the Queen in 1976, to whom he was introduced.

He reluctantly went into semi-retirement after this, but continued to be active in the family construction firm up to his 80s.

John always set himself the highest standards in everything he did. He often said, "If a job's worth doing, it's worth doing well." Working in the construction industry, this principle sometimes brought him into conflict with those who were prepared to compromise. However he was justifiably proud of a recent public accolade by the chief architect of the Oxford County Offices who said "without John Lister, the building would never had been completed."

He had been trained as a carpenter in his youth, a skill he took pride in all his life. He was an enthusiastic gardener and only the infirmities of age restricted his activities.

In 1937 he married Anne, who tragically was killed in the same traffic accident. They are survived by their two sons, six grandchildren, and two great grandchildren.

Maj (QM) J W Lister (p187)

Correspondence

Irrawaddy Crossing

From: Lieutenant G Webb BSc(Eng) PEng

Sir, – While memory still serves let me give a brief account of the 92 Field Company crossing of the Irrawaddy, ten miles SW of Myinmu, between 12 and 19 February 1945. This account augments that of Major John Clark given in *The Indian Engineers 1939-47*, by Lieutenant Colonel Sandes.

Equipment consisted of a raft made up from Jap timber pontoons found at Monywa, and three tows of Jap steel boats driven by two 22hp outboard motors, each towing ten Ranger assault boats in two files.

The crossing began on the night of 12 February, the first flights being virtually unopposed. I was in charge of the raft and by dawn on the 13th the bulk of the 1st Northants and their equipment were across, forming the bridgehead.

The enemy was reacting with heavy artillery fire and during the day Lieutenant Roy Balston gallantly went to the rescue of a boat tow whose engine had failed and which was drifting downstream. All were subsequently rescued after dark.

The most intense Japanese reaction started on the night of 14 February. I had just returned on the raft, and was preparing to reload when all hell broke out on the far bank. The Japs had infiltrated along the small strip of beach along the water edge and had dragged a heavy machine gun into position between the bridgehead and the river, with the line of fire across the river towards our launching beach. Unfortunately one tow of boats carrying Indian infantry was caught directly in the enemy fire, the rubber boats being ripped to shreds and most aboard lost. Ferrying was discontinued for the rest of that night.

The fire fight had died down by dawn, although shelling continued. I took the first raft across to witness a most gruesome sight. All the Japs who had infiltrated along the shore, lay dead, in many cases their internal organs were splattered over the sand – I can vividly remember a greenish/yellow liver or spleen.

Our ferrying continued for the next four or five days, under heavy shell fire, causing a number of casualties. On one occasion I was with Major John Clark, when he caught a shell fragment in the knee and I was fortunately able to help him hop on one leg to our jeep and to safety. At that stage we had begun using several alternative launching and returning beaches, to keep the enemy artillery guessing.

On the 19th on a trip with the raft to the bridgehead, the Northants gave me a Japanese sword to carry back to 92 Coy in appreciation of our support to the success of the crossing.

The sword hangs on the wall in the anteroom of the IE Kirkee Mess in Pune (Poona) with the following inscription:

> "This Japanese sword was presented by 32 Indian Infantry Brigade to 92 (Royal Bombay) Field Coy IE on the 19th February 1945 at the crossing of the Irrawaddy 10 miles SW of Myinmu when they kept the bridgehead supplied by operating rafts and small boats for 7 days, under heavy shell fire".

Yours sincerely, Geoff Webb.

Sustainable methods for clearing landmines after conflicts

From: Brigadier J H Hooper OBE DL

Sir, – As you will see elsewhere in the *Journal* there is an energetic, talented and devoted team in the University of Warwick which has been conducting research into improved mine detection and clearance equipment and systems. I have had the pleasure of being associated with the team for some months and have been greatly encouraged by the results which a disciplined academic approach to the problem has been producing. They have made a lot of progress.

My excuse for taking up your readers' time is that we were getting blown up on British and American mines in Oman in 58/59 and I was privileged to work with the Halo Trust on mine clearance problems in Cambodia in 91/92. Since returning from Cambodia I have been involved off and on with the problems of controlling the distribution of mines and their detection and clearance but I need help.

I do not propose to say much about the problem of controlling the distribution of mines. I am surprised that the UK is not prepared to support the US proposal to ban the export of mines: the UK has not exported mines for at least 20 years so it does seem strange. A total ban on exports would not prevent the development of "better" mines. By "better" I mean more effective in terms of what they are intended to achieve and capable of being switched on and off by remote control or put into a self-destruct mode, again by remote control. I believe it

is unrealistic to achieve a complete ban on the use of mines and am not prepared to spend too much time on that. I am, sadly, forced to the conclusion that as there is money in mines someone somewhere will exploit the manufacture and export of them whatever rules may be in force. However, it does not mean that one should not try to get a total ban on their use.

If there were to be a worldwide ban on the manufacture, development, sale, export or anything else you may care to think of connected with mines today there are enough lying around the world to keep demining teams going for years. It is that aspect, the detection and clearance of mines, which catches my attention. I need not go into the horrifying statistics of injuries sustained daily in various parts of the world through land mines. Suffice it to say that the numbers are huge and we should be doing more about getting rid of them. The sad fact is that it is cheap and takes no time at all to lay mines but it is expensive and time-consuming to detect and clear them.

One problem is that there are MOD funds available for research into military mine clearance but hardly any for research into humanitarian mine clearance. The two are different and the humanitarian aspect is much more urgent. The spin-off from humanitarian mine detection and clearance research could only have a beneficial effect on military methods. The reverse would also be true but the Official Secrets Act knocks on the head any bright ideas one might have about a serious exchange of information.

The military requirement is for rapid breaches which achieve a reasonably high degree of clearance of both anti-personnel and antitank mines. Sometimes noisy mechanical means are acceptable while at other times a clandestine breach is required. The breach might have to be created during darkness or daylight, in fair weather or foul. The humanitarian requirement is to achieve a much higher degree of clearance but one can choose the weather conditions and secrecy is not a problem. Neither, usually, is time a problem.

In the humanitarian context it is worth noting that there may be a trade-off between a very rapid, moderately high clearance with a significantly reduced possibility of further injuries and a very slow, total clearance (if that can ever be guaranteed) with local people sustaining substantial numbers of further injuries while the total clearance is awaited. The economic situation in these sad countries forces people to penetrate known minefields to gather fuel, recover livestock, or for other reasons upon which their continued existence depends, and any reduction in mine numbers must therefore be beneficial.

Apart from the problem of funding research there is a problem of the co-ordination of research, development and production of mine detection and clearance equipment, to say nothing of keeping up to date a readily available list of the mines likely to be found in the world and passing on best practices. There are literally dozens of organizations and agencies wasting money on duplication of effort, reinventing the wheel, fighting for further funds for actual clearance operations, recces of previous recced areas; all due to the lack of a central coordinating authority. The United Nations Department of Humanitarian Affairs' Mine Clearance and Policy Unit (DHA MCPU) ought to be doing it but so far I have seen little to merit its existence.

I thought at one stage that the University of Warwick would receive funds from the ODA to continue its good work but, sadly, that has not come about and the search for funds continues. However, there was agreement that Warwick might be the coordination centre in UK for work on mine detection and clearance and that it would be the clearing house for any bright ideas that might be forthcoming. One of the problems is that one needs to look at even the wildest idea as there may be the germ of a really good solution in it.

Many of the ideas floating around are indeed wildly impractical, at least when first mooted. Someone needs to look at the wild idea and to discuss it with the author. So often the author has no idea that mines can be found in head high jungle, scrub, on rocky ground, in fact almost anywhere. He does not know that there are multi-impulse fuses, blast resistant mines and proximity fuses. It might have escaped his attention that a lot of people cannot read their own language let alone read English and that adding two and two can present a problem if you've never been taught maths.

The expense of sending a member of the university to visit all the authors of bright ideas would be prohibitive but as Sappers have retired to just about every part of the world, not just the UK, it could be that a retired Sapper could very conveniently visit an author. The object would be to act as a filter. Hopefully, the totally impractical aspects of the idea could be exposed, the idea refined through discussion and then a workable idea submitted to Warwick.

Of course, there will be plenty of bright ideas from the retired Sappers, too. I am hoping that as a

result of this letter and the article, many a Sapper will put pen to paper, pencil to drawing board or whatever and come up with his own bright idea. We need them. Equally, I believe we need Sappers to investigate proposals for improved detection and demining systems and equipment to assess their practicality at an early stage.

I wonder how we could go about getting help of this nature? Yours faithfully, – J H Hooper

Feasibility, Design and Construction of Gravity Flow Water Systems in Nepal

From: Colonel R B Downs

Sir, – I was interested to see from Major Urch's article (April 1996) that the Corps is still involved in village water supplies in Nepal.

It would appear from his article that he has too lightly dismissed the problem of overflow water.

Whilst building the Gurkha Depot at Dharan in the late 1950s, the Corps also provided a separate supply of water to Dharan village. No particular attention was paid at that time to overflow problems, as it was expected that taps would be turned off after use. Unfortunately, they were not, and the consequent continual overflow produced erosion problems.

The enclosed photograph of the main street was taken in 1960, when I was stationed at Dhubi as one of the team rebuilding and widening the Jogbani-Dharan road. It can be seen that the street has become a stony river-bed from the constant overflow from the taps.

It is clear that unless proper drainage is provided between the taps and the animal water-holes and crop drainage areas proposed by Major Urch, then there will be serious erosion around the villages from the tap overflow. Yours faithfully – R B Downs

Reviews

ENCHANTED SAFARIS
Roy E C Griffiths

Published by The Book Guild Ltd, 25 High Street, Lewes, Sussex BN7 2LU – Price £15
ISBN 1 85776 428 X

Roy Griffiths begins this story of his life with his experience as a surveyor in the Jordanian desert when serving with 42 Survey Engineer Regiment, then based in Egypt. Clearly this overseas travel early in his life led to thoughts of a career in foreign lands and his first appointment after leaving the army was to the Snowy Mountain scheme in Australia. However, marriage caused him to reconsider his proposal and he opted instead for an appointment with the National Coal Board. Such is life!

The author lays no claims to experience as a writer and treats his readers as friends to whom he is telling a tale. As the book progresses this style becomes absorbing and the reader anxiously awaits the next thought, problem or experience in his life and work in many parts of the world. The story extends from his first move to Kenya and his early career with East African Railways and Harbours to spells in Canada, California, England and Tahiti, but Kenya holds his attention and is loved by his family. The problems, and pleasures, of working and living a "safari" style of life in the conditions of the 1950s in Kenya, with a wife and daughters to care for, are vividly described.

Back in England in 1973, Roy became disenchanted with working for other people and decided to set up his own consultancy, soon realizing that his real problems had only just begun! The purchase of a house in Wiltshire established a base for both the family and for his future operations, the latter soon extending overseas. It was almost inevitable that before long Roy

Correspondence p190

would open a branch of his company in Kenya; the story of this particular exercise will bring nods of recognition from everyone who has served in Africa.

The author has cleverly avoided dwelling on technical details of his work which would be of little interest to many readers; he has instead concentrated on the human side of his travels, especially relating to his growing family of four daughters. After reading of the love he had for his wife and family it came as a surprise to find in Chapter 14 that his wife Molly had left him and his daughters had "broken their bond" with him. With no build-up to this event you are left with the feeling that another book is coming!

Roy closed the Kenya branch in 1983 and returned to his base in England to operate mainly in the United Kingdom although with some overseas excursions. In 1987 he moved his base to Scotland but at the same time began to suffer some health problems. Nevertheless work progressed with the help of his new secretary whom he married the following year: they divorced 15 months later. Shortly thereafter Roy embarked on a holiday in Spain followed by a more extensive journey "back in time" to visit his former stamping grounds and many friends and colleagues in Kenya.

This is a very personal tale told by a man who has enjoyed the attractions of being "on safari" but not seeking to glamorize a life which has had many pitfalls. Those who know the areas mentioned in the book will regret the lack of a few maps, but this does not detract from the stories of Roy's feelings for his family, his work, his friends and his colleagues who make up this book of his life of travel.

EWB

A WIDOW-MAKING WAR
The Life and Death of a British Officer in Zululand, 1879
Edited by Howard Whitehouse

Published by Paddy Griffiths Associates, 1995, Price – £12.99 including post and package
ISBN 0 952148803

In December 1878, at one day's notice, Captain Warren Wynne Royal Engineers was given command of 2 Field Company RE at Shorncliffe and ordered to proceed to Natal on active service for the impending war against the Zulu nation.

The company landed at Durban in January 1879 and joined Colonel Pearson's column which followed the coast eastwards into Zululand.

Wynne had left his wife and children in England and fully expected that they would join him in Natal when the campaign in Zululand was over. Sadly he died three months later of fever.

He had seized every opportunity to write home and also kept a detailed diary. His widow had these papers published privately solely for members of the family, and this edition of the letters and diary is the first opportunity for them to reach a wider audience.

The editor is a recognized writer on the British in Africa and the book is full of learned asides which enhance the interest of the letters and diary.

There is a fulsome acknowledgement for her help, given to Mrs Beverly Williams, Assistant Curator at the Royal Engineer Museum, who has mounted a special exhibition on the Zulu War at the museum which runs until 3 November.

The book is highly recommended and is available from the museum at £12.99 including postage and parking.

JEN

Explanation of Abbreviations and Foreign Words Used in This Journal

2IC ..... second in command
ACGS ..... assistant chief of general staff
AER ..... Army Emergency Reserve
AFV ..... armoured fighting vehicle
AG ..... adjutant general
AMF(L) .... Allied Command Europe Mobile Force (Land)
APC ..... armoured personnel carrier
ARBiH ..... abbreviation used for Muslim Army
Armd ..... Armoured
AVLB ..... armoured vehicle-launched bridge
AVRE ..... armoured vehicle RE
BAOR ..... British Army of the Rhine
BD ..... bomb disposal
BEF ..... British Expeditionary Force
BiH ..... Bosnian Muslim Army
BMH ..... British military hospital
BRITENGBAT ..... British engineer battalion
CE ..... chief engineer
CinC ..... commander in chief
cm ..... centimetre
CO ..... commanding officer
COS ..... chief of staff
Coy ..... company
Cpl ..... Corporal
CRARRV. Challenger armoured recovery and repair vehicle
CRE ..... commander RE
DAA ..... deputy assistant adjutant
DAD ..... deputy assistant director
DADFW ..... DAD field works
DROPS ..... demountable rack offloading and ..... pick-up system
E&M ..... electrical and mechanical
eg ..... *exempli gratia* (for example)
Engr ..... engineer
EOD ..... explosive ordnance disposal
EODTIC ..... EOD Technical Information Centre
EOKA ..... Ethnike Organosis Kupriakou Agonos (loosely translated: National Organization of Cypriot Struggle)
etc ..... et cetera
Fd ..... field
GOC ..... general officer commanding
Gp ..... group
GS ..... general service
HEAT jet ..... high explosive antitank jet
HGB ..... heavy girder bridge
HQ ..... headquarters
HM ..... Her/His Majesty
ISO ..... International Standards Organization
IT ..... information technology
JHQ ..... Joint HQ
JNCO ..... junior non-commissioned officer
LCpl ..... lance corporal
LI ..... Light Infantry
Lieut ..... lieutenant
Ltd ..... limited
m ..... metre
MEXE .... Military Engineering Experimental Establishment
MGB ..... medium girder bridge
MLC ..... military load class
mm ..... millimetre
MOD ..... Ministry of Defence
MPBW ..... Ministry of Public Buildings and Works
NATO ..... North Atlantic Treaty Organization
NCO ..... non commissioned officer
NGO ..... nongovernmental organization
No ..... number
OC ..... officer commanding
ODA ..... Overseas Development Administration
PE ..... plastic explosive
plc ..... public limited company
PMC ..... president of the mess committee
PQE ..... professionally qualified engineer
psyops ..... psychological operations
PT ..... physical training
Q ..... quartering
QM ..... quartermaster
QMG ..... quartermaster general
QRH ..... The Queen's Royal Hussars
RA ..... Royal Artillery
RAF ..... Royal Air Force
RAFVR ..... RAF Voluntary Reserve
RE ..... Royal Engineers
REME ..... Royal Electrical and Mechanical Engineers
REYC ..... RE Yacht Club
RHQ ..... Regimental Headquarters
RLC ..... Royal Logistic Corps
RMA ..... Royal Military Academy
RPG ..... rocket propelled grenade
RRF ..... The Royal Regiment of Fusiliers
RSME ..... Royal School of Military Engineering
RMAS ..... Royal Military Academy, Sandhurst
Sgt ..... Sergeant
SSgt ..... Staff Sergeant
SSAFA ..... Soldiers, Sailors and Air Force Association
SNCO ..... senior NCO
SME ..... School of Military Engineering
SQMS ..... squadron quartermaster sergeant
Sp ..... support
Sqn ..... squadron
SSVC ..... Services Sound and Vision Corporation
STRE ..... specialist team RE
Svy ..... survey
SW ..... southwest
TA ..... Territorial Army
TACISYS ..... tactical information system
Tn ..... transportation
UK ..... United Kingdom
UN ..... United Nations
US ..... United States
vip/VIP ..... very important person
Wks ..... works
WRAC ..... Women's Royal Army Corps
WO2 ..... warrant officer class 2
WW2 ..... World War Two
YO ..... young officer

Articles sent on computer disk for publication in the Journal

QUITE a few articles are now arriving in our publications department filed on 3½ in floppy disks

AND,

WE ARE VERY HAPPY about this.

However, some considerable work is being caused because of the way text is being produced. To ease our burden, could those intending to send information on disk take note of the following simple requirements:

- Type straight text only, ie no formatting other than a single manual carriage return at the end of a paragraph.
- Have all text left justified only, ie not justified or centred.
- No "Capital only" headings – all headings should be upper and lower case.
- Please read the guidelines printed on the inside front cover of the *Journal*.

Our recently acquired Applemac computers can read both Apple and DOS software which makes it very easy for us to pick up disk submissions, but we do need to know exactly which programme has been used to produce the text ie Word Perfect, Claris, Microsoft Word etc and the version number – please include this information on the label of the disk you send.

We thank you in advance for your cooperation.

And look forward to hearing from you soon.

50th Anniversary Articles

The Editor of the *Journal* would be pleased to receive articles from anyone who took part in projects during the aftermath of WW2, or have something interesting to relate of happenings during the year of 1946/7, with a view to their publication on or near to the 50th anniversary of the event. Accounts of later events are also welcome as they can be kept for publication in the appropriate issue,