THE ROYAL ENGINEERS JOURNAL

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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. Normally approximately 4500 words (approximately ten A4 pages double line spacing at 12pt) plus illustrations.

Copy. Ideally one copy of the text should be submitted, typed in double spacing, plus a short pen picture of the author and a head and shoulders photograph. Please don't forget to add captions for any artwork to be included.

Clearance. The author must clear his/her article with his/her 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 saved as an ASCII file (with a .txt extension).

Copyright. If an article has been published elsewhere, copyright clearance must be sought; copyright clearance on photographs, maps or illustrations must also be obtained prior to submission.

Photographs should be black and white if possible, or coloured of good quality with sharp definition. Please do not submit laser/photo copies of photographs.

Rewards can be generous. The Publications Committee has about £250 in prize money to allot for each issue plus valuable annual prizes. All authors receive £10 to help cover costs.

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

Contributions should reach the editor by:

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

Submissions before the deadline are particularly welcome.

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Editorial

SAPPERS continue to be at the forefront of operations in the former republic of Yugoslavia, making a major contribution to what was UNPROFOR and what is now the NATO-led IFOR. That nearly 50 per cent of field army sappers are training for or deployed on operations worldwide and that the average inter tour interval for units is now 13 months – by far the shortest of any arm or corps – and still reducing, makes the well-worn phrase "there are never enough sappers" ever more true.

British sappers have for long been well acquainted with their counterparts in the German, American, Dutch, Danish and Belgian armies through exercises within Northern Army Group. In Bosnia they have become acquainted with engineers from France and Spain as well, which has promoted a growing respect and admiration for their capability and commitment which was unknown and perhaps unappreciated in the past.

There is a surge of articles on Bosnia operations in this issue, all quite different and all with an interesting story to tell. *Royal Engineers and Rapid Reaction Forces* by Lieutenant Colonel Phil Lilleyman gives a high level view of the setting up of IFOR while *Lights on in Sarajevo* by Major Alan Miller is a thrilling account of the the efforts made to ensure that the precondition of the cease-fire was met on time. Further articles at more junior levels illustrate the type of engineer operations which have been undertaken and the demands placed on innovative construction skills and techniques.

An enquirer asked recently who was responsible for the construction of airfields in the Second World War. The answer is to be found in two articles in this issue: *A Gigantic RE Task: 20 Airfields in Two Months!* submitted by M Phillippe Bauduin, and *The Roles of Sapper Geologists in the Liberation of Normandy*, Part 1 of a well researched account by Colonel Ted Rose, of the planning which took place prior to the construction of these airfields.

Never a year goes by without at least one anniversary being celebrated. This year it is the 150th anniversary of RE Yacht Club and the RE Rowing Club. Few yachts have evoked so many memories for sapper sailors over the past 50 years as has *Avalanche*. The article by Brigadier John Constant is a tribute to this grand old lady of the sea.

I am very encouraged by the number and quality of the articles which are continuing to be submitted to the Editor, more than I could hope to publish. The concern expressed in a previous editorial that fewer might be expected following the reductions in the size of the Corps, appears, as yet, unfounded. The downside is that we are unable to publish as much as we would like, particularly those of an historic nature, but we retain them in our reserve pool of articles and pick them up when we can.

A final word about the RE Museum, which will be of interest to many readers. As most of you know, the Museum moved to its present location in the Ravelin building in 1986. Since then its development has carried on apace and later this year the final phase will be complete, marking a decade of unstinting support by many within and outside of the Corps who have made the development possible. Our museum is one in which every sapper can take pride and one which ranks alongside other museums of national importance.

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Royal Engineers and Rapid Reaction Forces

LIEUTENANT COLONEL P LILLEYMAN MBE BSc(ENG)

Lieutenant Colonel Phil Lilleyman joined the Corps late, in 1973, following four years as a graduate civil engineer with Ove Arup & Partners in London and Nigeria. He commanded a mechanised field troop in 12 Field Squadron, was 2IC of 34 Field Squadron and Operations/Training Major of 32 Armoured Engineer Regiment before attending Staff College. As OC of 20 Field Squadron, he took the squadron to Northern Ireland and the Falklands in 1985 and 1986 respectively, being Mentioned in Despatches in Northern Ireland and appointed MBE for his time as OC. More recently he commanded 71 (Scottish) Engineer Regiment (V). His staff appointments have included: DS at the Armour School, DS at the Junior Division Staff College, SO1 Engineer 4 and Chief Instructor Command Wing, RSME. In January 1996 he was posted to Army Recruiting for 15 months to convert that directorate to Defence Agency status and amalgamate it with the Army Individual Training Organization.

I WRITE this article amidst news full of hope for peace in Bosnia and of NATO's role in it all. As the Allied Command Europe Rapid Reaction Corps (ARRC) takes centre stage and before we move into a new era of peacemaking, I thought it important to record the transitional phase from UN to NATO and to highlight the role played by Royal Engineers in support of the predominantly British and French Rapid Reaction Force (RRF).

In mid-June of last year I was one of a group of ten British officers sent at short notice to work with a similar number of Frenchmen to determine the scope of operations for the RRF. Originally this force was known as the Reserve Force but it became the Reaction Force and then the Rapid Reaction Force, seemingly as political confidence grew. We were the RRF Planning Team (RRFPT), charged with writing a formal estimate which would, through its many iterations, become the Force Commander's Directive.

The aim of the RRF was plain enough, and was born out of the frustrating and embarrassing lack of potency being displayed by the UN. It was to be used to facilitate the execution of the current UN mandate but it was to be seen to be new and to do new things. Reinforcing failure was not an option and, like the operational manoeuvre groups of the former Soviet operational strategy, we were to get to grips with the situation and render unstable the current stalemate. The force was to be more robust than hitherto: it was to force freedom of movement and it was to be prepared to meet force with overwhelming force, whilst still operating within the current UN mandate.

Although the aim was plain enough, the mission analysis and estimate process was not so easy to set in practical terms. We were on the very verge of the tenets of wider peacekeeping in that we were considering the use of punitive force against one side in a three cornered fight. By the rules (Army Field Manual: Wider Peacekeeping) this risked penetrating **consent** and carrying through to **conflict.** Nevertheless, we began to put together a document called the "RRF Concept of Operations". It went through five editions, each more focussed and more commented upon than previously. Not surprisingly, the areas which caused most difficulty were command (including the transfer of authority of national assets to the UN) and rules of engagement. This latter area tended to polarise views in HQ UN Peace Force (HQ UNPF) as it raised the question of peacekeeping **or** peace-making. However, if the RRF was to act in a way which would be a catalyst for change, robust thinking was necessary.

It has to be said that the academic process of writing this estimate soon began to be overtaken by the practical considerations of deployment. It

Lt Col P Lilleyman MBE
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had been planned to study settings posed by defence analysts from UK MOD but this never fully took off. All too quickly we were wrapped up in preparing for the imminent arrival of the RRF and these worthy academics from UK got pushed into the margins.

Time was short before the force was to arrive but despite this it became increasingly plain that nobody wanted us. Croatia, Bosnia, and the fledgling Federation of Muslims and Croats, in Bosnia, were all hostile to the deployment, unless there was to be a new State of Forces Agreement (SOFA). Equally, it was obvious that the UN was embarrassed by the infrastructure requirements and added to all this was a thinly veiled hostility from the in-place forces, who favoured an internally generated reserve. It was little wonder that by July we became more focussed towards facilitating the deployment rather than planning operations.

Having said all that, a great deal of valuable planning work was done by the RRFPT. The final edition of the "Concept of Operations" was signed by General Janvier (Comd UNPF) and became the Force Commander's Directive for RRF Operations. It addressed the knotty problem of rules of engagement and the transfer of authorities. It also set up air control systems, the construction of G4 supply concepts and a clear statement of requirement for many aspects of the deployment, including accommodation. And it was to this latter problem that my energy was soon diverted in order to facilitate first the arrival and then the accommodation of 6500 British, Dutch and French troops into the Former Republic of Yugoslavia; and that is the tale I hope may interest you.

Mixed Agendas

An early disillusionment, if not an initial shock, was the realization that the host nation was not a benign host. There are two difficult traits to understand in the Balkan mentality: one is the denial of the right of people to do anything unless they ask permission first; and if they do ask, to say no, at least initially. The second is their way of turning a blind eye to human degradation and suffering when some avenue of self-interest is to be explored. In addition, there seemed to be conscious efforts by the ARBiH (Bosnian Muslim Army) and HVO (Bosnian Croat Militia) to confine the activities of the RRF such that nothing could take place with which they would be uncomfortable. Freedom of movement was severely restricted. Up to the eleventh hour, in early July, the Croats were refusing permission for the French to land at Ploce Port unless there was a renegotiated SOFA. UN pressure was applied in New York and agreement for landing was eventually obtained. However, the demand for a renegotiated SOFA continued and landing agreement was given on the condition that the RRF would use Ploce only as an administrative base and the French would transit through Croatia en route to Bosnia as quickly as possible.

The French arrived at Ploce during this restriction of movement crisis. As a result, 2000 Frenchmen were forced to squat at the port with the minimum of facilities until clearances could be obtained for their onward movement. This was an impending embarrassment as it blocked further deployment, the UK implementation force for 24 Airmobile Brigade and its support helicopters being only a few days behind in the plot. The French relieved the situation with characteristic unilateral action by simply driving out of Ploce and through the border into Bosnia, without clearance, and taking up residence in the area of Tomislavgrad, again without clearance. The Bosnian Federation considered this an affront and retaliated by closing the border to UN movement. In addition, UN movement was restricted inside Bosnia by long delays at checkpoints throughout the country. All this was difficult to understand when the tenets of our being there were to help those who seemed bent on being so unhelpful.

The French

Working with the French took some getting used to. They are not used to working cheek by jowl with a foreign nation, therefore there were times when one could have been forgiven for thinking they had divergent agendas. It was not that they waved the national "red card" any more than we did, it was more that they did it behind closed doors. Also, theirs is very much a "top down" command, whereas we tend to muddle through on individual initiative. Some might say that mission command is our natural state, but top down and mission command are uncomfortable partners and by the end of my tour, we were tending to drift into separate camps.

However, I must say that I liked the French. They were courteous and tried hard to speak English to each other when in our company. They see us as equals but one has to be careful of equating ranks as their responsibility boundaries lie a rank level above ours. Beyond that, they have a

depth of military tradition and a sense of duty and honour that I hope we share as an Army. The things we do naturally as soldiers, they also do. There are good soldiers and bad ones but in similar proportions to our own and, believe it or not, they have a sense of humour, and I suspect they are quite brave too.

The First Two Weeks

Together with the French contingent, the RRFPT totalled 18 officers. It was led by Brigadier Viggers (Commander Royal Artillery 3 Div) with a French deputy (Colonel Le Flem – Foreign Legion). In addition, there was one G2, two G3, four G3 Air/Aviation, six G4, two G6 and one Sapper.

An unwelcome surprise for me was the assumption of the G4 team that responsibility for accommodation matters, which I had traditionally felt was well within an engineering remit, was theirs alone. For example, they began to negotiate for real estate for camp sites, contracts for utilities and accommodation resources. Much of this was of a G4 nature, but it was obvious that engineer resources and the provision of utilities was of significant interest to engineers, particularly as it was the province of the Chief Engineer (CE) UNPF and his staff. We resolved this pretty amicably and it was decided that I should take the lead on all matters relating to the provision of new accommodation, but it was a salutary lesson nonetheless. Not only must we as a Corps be the focus for inserting a force into theatre but we must do it on our terms as the overall managers of this process and not as an adjunct to G4 plans.

In the first two weeks I also got a good look at the UN HQ in Zagreb. Our initial briefings were heartening. The briefers outlined their panoramic responsibilities so well that one could have been forgiven for wondering what there was left for us to do. It was only later that I began to to be reacquainted with that fundamental difference between talk and action. The UN is a camel of an organization, hopelessly overstaffed, horribly inefficient and designed, presumably, to ensure that all ethnic groupings are equally represented regardless of their ability or commitment. Those within its ranks have little loyalty to the UN system and seem to view its inherent impotence with indifference. It is not corrupt but it is simply the ultimate bureaucracy whose dead hand stifles entrepreneurial spirit. Functionaries are praised more for the accuracy of their accounting than for the prosecution of problems.

The Beginnings at Ploce

By far the most pressing priority in early July was the development of Ploce Dockyard into a camp for the 3600 troops of 24 Airmobile Brigade and the Support Helicopter Force. This task fell to 35 Engr Regt Group of 560 men, which included a large slice of 45 Fd Sp Sqn and 522 STRE. A very potent force, but a force which needed materials to do anything. My job was to facilitate the arrival of 35 Engr Regt Gp by representing their problems to the UN. Preliminary recces and designs of Ploce Dockyard Camp had been done by the STRE and a list of critical stores produced. So the Regiment knew what it wanted but had to procure this material through the UN.

To illustrate some of the difficulties of these early times it may be useful to consider the procurement of stone hardcore. The STRE calculated that 100,000m^3 was required, split down into 25,000m^3 in the first week, a further 25,000m^3 in the next three weeks and the balance over a three-month period. Local prices put the cost at $2M and this was placed before the UN CE in Zagreb. He turned it down believing it to be madness to "tip $2M into a swamp at Ploce" but offered no realistic alternative. We invited him to come to Ploce and recommend how else the work could be done. This visit was a huge success owing to a professional presentation by the STRE and the infectious enthusiasm of CO 35 Engr Regt Gp. The CE agreed to the plan but went on leave before committing this to higher authority. We then had to convince his deputy with a similar visit. He was helpful and suggested that batches of stone be split into $300,000 lumps so that the funding could be agreed in theatre but pointed out that the RRF had, as yet, no overall UN funding.

The Security Council had mandated the deployment of the RRF but the funding was yet to be resolved. UK and France had agreed to underwrite any expenditure but at a high level and only if the UN could not provide. In short, there was no money in the bank for serious quantities of engineer materials and the main body of 35 Engr Regt Gp was due into theatre in less than two weeks' time.

A further problem was soon to surface in the form of Croatian obduracy. The French had upset the port authorities by staying longer than planned and, perhaps more, by foraging in corners not allocated to them. There was also a general chill

in the air as the Croatian authorities seemed to be unhappy with their lack of control over this "invasion". Whatever the reasons might be, the Croatian minister responsible for liaison with the UN declared that no authority had been granted to use Ploce Dockyard as a UN base. The advance party sappers, who were by now stretching tape measures over everything, were told to stop until a formal agreement was made. By the time a meeting was put together between the UN and representatives of the port and Croat authorities a further week of planning and detailed reconnaissance was lost. In the meantime, I was having immense personal difficulty fathoming the nuances of the UN procurement system. Basically, it was necessary to have an approved design before authority could be granted for the supply of stores. This design was called the engineer works request (EWR) and was the accounting authority for all engineer materiel. The EWR had to be sponsored by the demanding unit, countersigned by the UN regional engineer and the UN military command engineer, authorized by the UN CE in Zagreb, passed to an appropriate authority for purchasing agreement, according to its value, and then to the UN procurement organization in Zagreb which would raise a purchasing order, which was then sent to the Materiels Management Unit (MMU) in Zagreb (or Split), or it was sent back to the originator, for purchasing from local sources. Appropriate authorities for funding could be in New York or Zagreb according to the cost. From $70,000 to $300,000, the head of the Directorate of Administration in Zagreb could authorize the money, below $70,000 the UN CE (or the military force engineer (FE)) could be the authority and if the cost of the materials was less than $3000 it could be bought by the unit on the authority of the CE (with three tenders having been taken). If the materials were in stock with the MMU, and authority was given by the CE, and their value was less than $3000, then they could be issued from stock. What a game of snakes-and-ladders!

Map of area covered in this article.

There was another peculiar thing called a systems contract (a sort of credit account at a shop). The UN underwrote the costs of purchases at a particular supplier up to a certain level of funding. In this way we might find that the equivalent of the B&Q in Split could supply plumbing stores up to a value of $8M (say). B&Q in Split was, therefore, treated like an extension of the MMU stores. If the unit had the authority to purchase, the MMU in Split could get the required stores from B&Q without money changing hands. The hiccup in the system was that money never did change hands very easily and only those suppliers who could wait for the UN to pay would entertain the arrangement. In addition, the authority to fund these contracts was vested in UN New York and therefore it took too long to get them organized. Indeed, the major systems contracts for plumbing and electrical stores were never funded in my five months in Bosnia.

A distressing part of all these difficulties was that their solution reminded me of approaching the unit pay office as a subaltern. The staff knew the answers, but would not tell unless you asked the right questions. There was no help desk and it all had to be stumbled upon through trial and

frustrating error. There were good sources of advice but in the main these were on the fringe of the system. I am eternally grateful to Lieutenant Colonel Mark Mans (CO 21 Engr Regt), who, as the Chief Engineer at Sector SW, understood what had to be done and took the trouble to explain it. I am equally grateful to the Civil Secretary who was a great ally in these early weeks. He granted DM80,000 cash from UK funds in order to get 35 Engr Regt Gp sufficient materials to begin work. He also helped to get the wording right for a special dispensation for 35 Engr Regt Gp. This allowed EWRs to short-circuit the system with the paperwork following post factum. Other critical factors were the establishment by 35 Engr Regt Gp of a liaison officer in Zagreb to establish close links with the OC of the MMU in Split (a former sapper WO2, Brian Morris). There is no substitute for having your own man at the point of action, particularly when communications are as chronically ineffective as they are in Bosnia and Croatia. But all this greasing of wheels should have been done by the UN representatives themselves and not forced from them by confrontation.

The Insoluble Problem

All the time that the focus was on Ploce, another challenge was gathering critical mass. The French, who had moved to Tomislavgrad Plain on a "30-day pass", needed a permanent home and one fit for winter. However, because freedom of reconnaissance was denied, there was no scope to find accommodation. Equally, Tomislavgrad could never be winterized into a permanent home as most of the French were camped in tents on the hills surrounding the Plain at 1300m above sea level. Temperatures there would be well below freezing, with severe winds, when winter came. This problem seemed to be taxing few minds in July, including those of the multinational brigade (MNB). If, however, we waited until that fact was apparent, it would be too late to offer a range of options.

The RRFPT drew this matter to a head before the team was dissolved in late July. There were two meetings each day in Zagreb, one at 12 o'clock and one at six o'clock. The six o'clock was an internal meeting to review the day; however the 12 o'clock was an extremely powerful committee for forcing issues through the UN system. It was chaired by the COS UNPF (brigadier) and all heads of departments were represented. We set the agenda and asked questions from what was described as the "critical issues list". Any issue could be raised, but it was those whose wheels were no longer turning that were raised to greatest effect. This put the head of the relevant department on the spot amongst his peers and was the most potent means of precipitating action.

By the third week in July we were reviewing, at each 12 o'clock meeting, the funding of systems contracts, the provision of materials for Ploce plus the camps in Sector SW for UK elements of the MNB, and the problems of freedom of movement. This latter difficulty was not only preventing the French from performing reconnaissance on winter camp-sites but was also locking 24 Airmobile Brigade into Ploce with no scope for collective training. However, the major, apparently insoluble, problem was that with three months to go before the onset of the harsh Bosnian winter, we had no accommodation plan for 3000 or so French and Dutch troops of the MNB. To make matters worse, the following factors suggested that a quick resolution was unlikely:

- The UN had identified a $266M shortfall in their mandate funding and were looking for savings in infrastructure support.
- The HVO and ARBiH were as obdurate as ever on freedom of reconnaissance.
- The MNB itself seemed unconcerned with the issue, presenting it as a UN problem for the UN to solve.

I had raised a statement of requirement (SOR) on 11 July as part of the developing Force Commander's Directive. This had been submitted to the UN FE who, in turn, had produced a list of resources required, which totalled $49M. This was for all of the RRF winter accommodation as a consolidated bid. On 17 July we were told at a 12 o'clock meeting that approximately 2000 Corimec accommodation units were being ordered from Italy, with a corresponding quantity of kitchen units and ablution containers. Although the lead time meant we would not see delivery before late September, this seemed to be the best that could be done. If the British or French were to look for their own sources of supply, in order to speed things up, I was advised by the Civil Secretary that it would be most unlikely that the UN would fund the buy as they could argue that supply was possible from UN sources in a "reasonable" time. Also, JHQ suggested that no other single European supplier could better these timings at acceptable cost.

The overall requirement was refined several times but the fundamental situation changed little

between 18 July and when the RRFPT was disbanded at the end of that month.

Zagreb to Kiseljak

Originally it was planned to have a divisional HQ to control the RRF, however that would have placed another HQ between HQ UNPROFOR (UN Protection Force) and the executive force of the RRF. In early July it was decided to have a two-star operational planning staff instead, and this group would be formed from HQ Royal Marines, led by Major General Pennefather.

In preparation for the pre-advance party on 10 July, the RRFPT had put together an initial organization for what was still known as HQ RRF. In this, the combat support elements were headed up by full colonels but it became increasingly clear that theirs would be a planning and coordinating role only and therefore both artillery and engineers would be headed by Grade 1 staff officers and I was to stay on!

The new operational staff, the RRF Operations Staff (RRFOS), formed up at Kiseljak on 18 July. I remained based in Zagreb until the dissolution of the RRFPT, arriving at Kiseljak on 31 July to find all the best bed spaces gone, and feeling a bit marooned. My established lines of communication were severed and the RRFOS had priorities other than winter accommodation. They were planning an air/land campaign and naturally enough my cell, consisting of a SO2 (FR) and a SO2 intelligence/geographic (Mark Burrows – military survey), got drawn strongly into that; and interesting it was too. In digression, I appreciated for the first time how useful a Taciprint team is in operations for assessing and presenting terrain intelligence. If I can claim credit for putting a SO2 geographic into the staff, Colonel Mike Brooke chief G1/G4 RRFOS has all the credit for insisting on a Taciprint team. They earned a great deal of credit for the Corps.

To my undying shame I will have to tell my grandchildren that I was on R&R in UK for most of the air and artillery campaign. However, I saw the beginnings and well remember it too. All welfare phones were cut off from when H-hour was known and we all lived in our flack jackets and helmets until it became plain that the Serbs no longer had the capability to engage forces in Kiseljak with artillery. However, despite the intense activity in Kiseljak as the air and artillery went through the target lists that the RRFOS had prepared, the winterization programme continued; and I have jumped ahead two weeks.

Just before taking up residence in Kiseljak I attended a meeting at Tomislavgrad to clarify the MNB's intentions. Here, for the first time, the MNB was specific on the requirement for a substantial force of 1100 soldiers to remain on Mount Igman, overlooking Sarajevo, during the winter. In addition, the balance of the French elements of the brigade (about 2200 men) were to move into the Kiseljak/Kresevo area in order to offer close support to those on the mountain.

Colonel Le Flem, the deputy to Brigadier Viggers, was at this meeting as it had been decided that my work in Zagreb would be continued by him when the RRFPT was dissolved. He now commanded the RRF Planning Cell (RRFPC), which had been established as a liaison group between HQ UNPF and the RRFOS.

On 6 August, I heard from Colonel Le Flem that the Corimec shelters required in the SOR were not to be funded owing to the $266M shortfall. The provision of accommodation was to be a contributing nation's responsibility. This was critical news. We had assumed the UN were processing a bid for Corimec shelters since mid-July but now, one week into August, we found this was not so; nothing had been done or was to be done. Equally, we knew from earlier investigations that no other European suppliers could meet the bill in a better time. So even if we could get the UK and France to pick up a contract at Corimec, the best we could hope for would be deliveries in late October, at the start of winter. I briefed General Pennefather on the issue and he directed me to prepare a paper which would consolidate all the facts and which he could give to Deputy Chief of Defence Staff (Commitments), who was visiting with CDS (Chief of Defence Staff) on 9 August. In addition, he allowed me a ten-minute slot on a planned study day on 10 August, which was to be attended by General Smith and the one-star commanders.

The facts were daunting. The provision of winter accommodation needed effort in five areas if it was to be resolved satisfactorily. We at RRFOS controlled none of these and some were simply beyond control. They were:

- Resources. It was estimated that we required a minimum of 1900 accommodation containers with 31 Rub-halls and ablutions, etc. None of these existed as stock and the minimum lead time to produce Corimecs was 2½ months. Add to this the recent news that the UN were side-stepping the requirement

altogether and the critical nature of resources was plain to see.

- Engineers. We required engineers to do the building. It was mostly a French problem but they do not have engineers as we do. Engineers at division and corps are specialists, grouped in regimental strength. Their field engineers are mostly in company groupings integral to battalions, and this was the case here. They had a plant and combat engineer capability but negligible numbers of artisans. In short, the French could not build their own camps with the engineers they had in theatre.
- Weather. We were now in early August and could expect dry weather for two more months. October was the wettest month of the year, particularly in the hills and November brought on the severe Balkan winter. Mount Igman was recorded as the coldest place in Yugoslavia and was host to the Winter Olympics in the mid-80s. We could expect no quarter once the snows began and, at best, this was three months away.
- Transport. We estimated that approximately 2000 DROPS-size truck-loads of stores had to be hauled out of Split and Zagreb up the tortuous unsurfaced roads into Central Bosnia, including the infamous Mount Igman log route which, as the only road into Sarajevo, was packed with military, civilian and UNHCR (UN High Commissioner for Refugees) traffic. The overall out-load required an effort similar in proportions to the humanitarian transport requirements of the UNHCR, and was in direct competition with it for truck space.
- Freedom of Movement. Of all the areas of difficulty, freedom of movement and access was the most severe. If we could not recce, nor negotiate for space, we could do little except watch the summer slip away.

Tempting as it was, there was no scope to abandon the problem. For so long as the French held Sarajevo, there would be a need for observers and friendly guns overlooking the city. To remain in winter, they would require support, protection, and the coordinating influence and reactive support of the MNB. In short, we had to attempt to provide winter quarters in Bosnia as all the alternate options involved some degree of unacceptable withdrawal.

As an immediate result of the briefing I was asked to identify a "defining moment" beyond which it was no longer worthwhile looking for greenfield sites above the snow line. I was also asked to present a plan, or at least a statement of what was possible, to a further meeting of the one-star commanders, but this time without General Smith, who wanted the matter resolved at their level.

The Plan

I REVISED the SOR again to be as up-to-date as possible and called a meeting for 15 August in Zagreb to thrash out a plan with the UNPF engineers and G4 staff. This meeting was chaired by Colonel Le Flem and was to include as wide and as influential a representation as possible. It was also the first of many similar meetings which were to take place in Zagreb and Kiseljak.

The aim of the plan was to clarify responsibilities. The FEs were responsible for resources supply, which was to follow RRFOS priorities, and here we had a major windfall.

Following the successful offensive of Federation troops in the NW of Croatia, UN camps in sectors north, south and west were no longer required and the accommodation containers could be released for our use. In addition, it was agreed that a small number of accommodation units would be ordered from Corimec, for delivery in mid to late October. The many other items of miscellaneous stores were to be procured against speculative designs produced by 519 STRE at Sector SW and the small design cell in Sector Sarajevo. Designs had to be speculative as time was pressing and freedom of reconnaissance was not yet secured.

Transport was to be controlled by UNPF through the joint movement control centre (JMCC). However, and understandably, we had to take second place to UNHCR humanitarian convoys. The RRF Logistic Group (RRFLG) would provide vehicles on a top-up basis but controlled by JMCC. A crucial area which could not be addressed was the provision of troops to task. Only the Slovakian Engineer Battalion was controlled by UNPF directly. The French road engineers (BATGEN (Battalion du Genie)) and a new group of Indonesian engineers due in October were controlled by UNPROFOR. All other UN engineers were controlled by the sectors, including the British Engineer Battalion based at Gorni Vakuf. The 35 Engr Regt Gp could not be tasked by the UN as it was under UK national command, deployed for the specific purpose of developing Ploce Dockyard Camp. Similarly, 51 Fd Sqn was still under command of JHQ and unavailable without their authority. Troops to task was shelved until the one-star commanders' meeting to be held on Friday 18 August at Kiseljak.

When that meeting took place, General Pennefather took the chair on behalf of Comd UNPROFOR. The meeting was to discuss the generalities of winter preparations, which included snow and ice clearance (the province of Major Alan Miller, SO2 RE UNPROFOR), the logistic pre-stocking of combat supplies (Colonel Mike Brooke (late RE) Ch G1/G4 RRFOS), as well as my subject of accommodation. Brigadier General

Subaru of the MNB confirmed the requirement as 1066 troops to be based on Mount Igman over the winter (a magic figure for a Frenchman). He also made it plain that he wanted the balance of his 2200 Frenchmen to be accommodated in the Kiseljak/Kresevo area. We were in no position to grant this latter request. A cable factory had been offered by the BiH in Fojnica, which could possibly take 550, and a burnt-out ski village which would need a great deal of development for little reward. One had to add to this the bizarre fact that the HVO objected to the BiH offer of these sites. The reasons were not clearly stated but one suspected it was more to do with rent and a controlling influence rather than with the lame operational reasons mumbled by the HVO. Whatever their agenda might be, we were no further forward in providing accommodation for the French soldiers still in tents on the hills above the Tomislavgrad Plain, and the late August mornings had a distinct chill there now.

Troops to task for the work on Mount Igman was fruitfully discussed. UNPROFOR would provide a company of the French BATGEN for ground works only. Sector Sarajevo would put an engineering team together from French Battalion 5 (FREBAT 5) and other French battalions in Sarajevo. 51 Fd Sqn (less one troop) would be made available by 24 Brigade, provided JHQ agreed. This was volunteered by the OC, Major Dickie Davis, who was keen to get his men out and about, rather than locked into Ploce Dockyard Camp. JHQ's approval of this was swift in coming but it was not going to be open-ended. 51 Fd Sqn had to work on the British camps on Mount Igman only and then only as a secondary priority to the combat support to 24 Airmobile Brigade. This was an understandable means of controlling mission creep and there were enough UK camps to provide a useful challenge (two signals rebroadcasting stations, one Warrior company and a 105mm light gun battery).

It was decided not to ask for local permission to build the camps on Mount Igman. The tide of war had washed over that mountain twice and legal ownership was not obvious. Equally, MNB troops were already there and the provision of winter accommodation was merely an extension of occupancy. Also, to ask the ARBiH for permission invited refusal. We would simply get on with it. In the event, no obstruction was placed in our way. The ARBiH did request compensation for the timber which was being cut but this was countered by presenting a bill for the costs of road improvements and the issue melted away.

Work Progresses

By the beginning of September the winterization programme fell into the following four groups, in priority order:

- Accommodation for approximately 1100 French, British and Dutch troops on Mount Igman. This work began on 4 September using engineers from UK, France, Norway, Indonesia and Slovakia. All work coordinated by two British majors (Tim Randall, SO2 Engr and Tony Moore, SO3 Engr to the MNB).
- Accommodation for 700 UK troops in Sector SW. This work was coordinated by Chief Engr Sector SW (Lieutenant Colonel Mark Mans) and presented no organizational difficulty. The key obstacle to progress here being the slow provision of engineer materiel.
- Accommodation for 2200 French troops elsewhere in Bosnia. No progress made until mid-October.
- The winterization of the 24 Bde and SH (support helicopter) force tented camp at Ploce.

Priority One – 1100 Soldiers on Mount Igman

As a result of the bombing campaign in the first two weeks of September, the UN had gained freedom of movement into Sarajevo and up Mount Igman on the tarmac routes through Hadzici and Krupac. This was the second windfall we were to experience as it meant materials could be hauled up tarmacked routes free of civilian traffic. Although access was no longer an issue, the remaining problems for Tim Randall and Tony Moore fell into three categories:

- The most severe difficulty was associated with a lack of stores and materials. Rock fines were available from a nearby borrow pit but sub-base material had to be blasted by the Norwegian engineers. Timber from the MMU was slow in coming, so French Foreign Legionnaires and Canadian lumberjacks cut timber and fed this, green, through a Slovakian timber milling machine. In addition, the materials which were to be bought through systems contracts were very slow to arrive (mostly plumbing and electrical stores). The best way to speed this up was to go and look for them in the supply chain and arrange reliable transport.
- The second difficulty was a shortage of types of tradesmen. Crane operators were always in short supply, and electricians were all too few. These were the trades that had to be correctly manned, otherwise life was at risk. Initially, the only source of quality tradesmen was 51 Fd Sqn. Later, the French brought out a 40 strong artisan platoon, gleaned from many different

units in France and containing a mix of trades necessary to make good the shortfalls.

- The third area of difficulty was peculiarly French. The Sarajevo Brigade did not see eye-to-eye with the MNB. There were many instances of protective possessiveness with joint equipment and some stealing of stores. In order to support Tim Randall and Tony Moore in refereeing the resultant squabbles, I put my French SO2 onto Mount Igman, permanently, but this never really stemmed this waste of effort and time.

However, the construction on Mount Igman was a tremendous success story. Two Royal Engineers' majors coordinated the work of well over a regiment's worth of engineers from eight separate groupings and five different nationalities in order to produce winter accommodation for over a thousand French, British and Dutch troops on top of a mountain.

Priority Two – Camps in Sector SW

Our second priority was to bed down the 700 or so UK soldiers who had deployed at the start of reinforcement. This was mostly two Warrior companies, which had been displaced by the artillery, plus the armoured engineers and elements of 24 Brigade Logistic Battalion which was deployed to Lipa as a forward logistic base.

This accommodation problem was very much the province of the CE Sector SW and there was little for me to do except maintain close liaison and support, as much as I could, the fair supply of materials in accordance with agreed priorities.

Priority Three – 2200 Displaced Frenchmen

The third priority was accommodation for the 2200 French soldiers soon be frozen out of their camps on the hills above the Tomislavgrad Plain. This problem was extremely difficult to address as it required the Croats and Muslims to offer ground, or at least grant freedom of reconnaissance. I had registered the fact that it was pointless to look for green field sites after the end of August. This was the "defining moment", yet it came and went with no result. Some solution other than an engineering one would have to be found. This impasse continued through September until it was no longer worthwhile looking in Central Bosnia. At the end of September we began looking for camp areas below the snow line in Jablanica, Konjic or Mostar. These were not well placed to serve Mount Igman but the opportunity had gone for closer, and therefore colder, solutions.

After several false starts we were eventually offered two sites in northern Mostar by the BiH. However, unbelievably, an objection was raised by the Western European Union (WEU), who administer and police the Mostar area directly. The objection was due to the sites being within the demilitarized zone around the town. Such an unintelligible position was difficult to fathom. Here we were, in support of the UN, having just taken the robust action which had crystallized a peace after four years of embarrassing shilly-shallying, only to find that our European and NATO partners were blocking a humanitarian requirement for accommodation. I went to Mostar with Brigadier General Lang, the French COS of RRFOS. We had a quiet lunch with the the local Spanish military and then went on to see the HQ of the WEU. I was left outside the meeting but General Lang told me later that he had made the point, as strongly as he could, that we were all pursuing similar aims.

On 11 October authority was granted for the French to move into Mostar and work was well in hand by late October. However, the process of camp construction here, below the snow line, was never likely to have the same urgent imperative as that in Central Bosnia. Building could continue throughout the winter and men would not freeze, as well they might elsewhere.

Priority Four – A Winter Camp for Ploce 12

Ploce camp had been prepared initially for the summer occupation of 24 Brigade at one plus one (one aviation regiment and one infantry battalion) and the support helicopter force, numbering some 3600 troops. However, there was to be continuous upgrading work leading towards a camp capable of housing 24 Brigade at two plus two and the SH Force (4500 men) and further work to winterize a large part of this camp, at least large enough for a capable force to over-winter in Ploce. Initially it was planned to put down concrete bases for the tents, raise the floor with the use of decked-down pallets and provide heaters. Unfortunately, two very severe storms in late August had underlined the need for winterization, perhaps to a greater level of protection than was considered necessary at first. CO 35 Engr Regt Gp submitted a three-option plan to the CE in Zagreb. One was to winterize the tents as described before, the second was to use large communal shelters called Comport shelters (a bit like modern-day Romney huts) and the third was to use Corimec shelters.

The 35 Engr Regt Gp plan recommended the Comport solution, dismissing the tented option as insufficient and the Corimec solution as being in competition with the requirement for Corimecs elsewhere (principally Mount Igman). However, the situation had changed in that more camps were being evacuated in Sectors North and South and therefore more Corimecs could be made available. In this way, the Corimec solution was going to be the cheapest and was therefore chosen by the UN. However, a ceiling on the cost of additional materials was imposed such that the camp was to be for the 2000 British troops and 330 Frenchmen only. 35 Engr Regt Gp used 24 Bde transport and their own manpower and equipment to collect approximately 650 Corimecs. Categorized as "Grade 2" or "Grade 3" used Corimecs, they were in poor condition and considered unsuitable for use in the harsher climatic condition up country.

After the construction programme had been progressing for about three weeks it was announced that 24 Bde would return to the UK for the winter and thus the 2000-man camp was reduced to 500. I visited Ploce a few days after the announcement to see if there were any surplus stores which could be moved to Mount Igman. What I found demonstrated vividly the difference between the capabilities of a British sapper regiment and the shoe-string grouping of UN and multinational engineers constructing camps on Mount Igman.

Because 35 Engr Regt Gp had taken down its own Corimecs, packed them carefully and transported them on UK transport, under control, the Grade 2 and 3 Corimecs were in much better condition than the Grade 1, newer Corimecs which were arriving on Mount Igman. The MNB were relying on UN contractors under UN supervision, or on the leaving forces, to strip out their own camps. Corimecs were arriving on Mount Igman without light fittings or heaters, or with fittings smashed in transit. Also, because 35 Engr Regt Gp was on the ground at source, all manner of useful material was being recovered, which was being discarded under the UN system. Kitchen equipment was being thrown away as no longer sanitary, even though in short supply. 35 Engr Regt Gp personnel were steam cleaning theirs and making several good kitchens out of the recovered residue. It was a comparison between bland bureaucracy and innovative commitment and, although one can argue that such comparisons will provide obvious contrasts, all too often we seem to ignore these lessons as we look for economies.

A further example of commitment can be found in how 35 Engr Regt Gp kept itself supplied with materials even though it was fourth priority (albeit equal second priority for ablutions). Apart from establishing close liaison with the supply chain, staff had made sure demands were below financial authority thresholds and that the material was either in stock at the MMU or available at a systems contract supplier. In this way the paperwork just clipped the surface of the system before the items were in the hands of the user. Other projects on Mount Igman or in Sector SW were covered by a small number of large expensive EWRs which spent months in UN in-trays. Items could be in stock at Split but the system would not marry together a requirement with uncommitted stock and issue it unless some catalyst triggered the process. All too often 51 Sqn, who controlled resources for Mount Igman, had to wait on the natural bowel movement of the system.

Postscript

When I left Bosnia at the end of October, Ploce was virtually complete, the MNB build at Mostar was just beginning, the camps in Sector SW were in hand and Mount Igman was at a stage that could not be halted by weather. Indeed, the whole programme was no longer at risk from the weather, but it had been a close run thing. My job had been as a facilitator, finding nonsenses and sorting them out as best I could. Leaving my appointment to one side, all those who had driven the project through the goo of officialdom, whether this was in the MNB, Ploce or Sector SW, were, almost without exception, British sappers. Perhaps that is the first amongst several lessons. British sappers are the best trained, the most committed and the most self-confident of all the sapper fraternities I met. We should think carefully of why we are as we are and preserve that quality at all costs. But there are less heady, self-congratulatory lessons to be considered.

Some Lessons Learnt

Leading on from the last statement, we should be careful to ensure that our own engineer efforts in support of UN operations are not thwarted by ineffectual foreign staff officers in key positions. An aim should be to have our own men in control, even if this has to be stated as a prerequisite of deployment. What we cannot afford is to risk failure by not controlling the central policy when we may be contributing the lion's share of field effort.

In other words, staff and field should be inextricably linked in a cohesive package, whether the UN likes it or not.

The next point was well illustrated by the success of 35 Engr Regt Gp compared to the difficulties of the MNB. In force projection deployments, where the surge effort is related to infrastructure development, an engineer group must comprise three inter-related parts:

- A competent, soldierly design team, flexible in approach and, above all, able to react quickly. Tomorrow's solution is often too late.
- A proactive resources organization which is part of the team and wants to win, and, in support of that aim, will devil materials out of every UN crevice.
- A self-confident and well led workforce with key artisan skills in place.

Ignore any one part of this trilogy and the remainder suffer. Equally, the CO must command all three parts unequivocally. If there is part ownership, or dual control with the UN, then risk creeps in. Arguably, 35 Engr Regt Gp cracked the system better than the resident UN engineer battalions because the latter had their command and control clouded by UN sector responsibilities.

An abiding lesson I saw illustrated here – and in the Falklands, and in Northern Ireland – is that the Sappers must control their own resources. Resources are the main issue. In the Falklands the PSA (Property Services Agency) controlled them, in Bosnia the UN controlled them and in Northern Ireland we controlled them. Needless to say, I believe that Northern Ireland and 325 Engr Park was the time we got it right. Cost conscious administrations may think it prudent to give separate civilian control to resources but the cost is more in the long run. Soldiers are motivated by a challenge. Get resources right and their work output is governed only by leadership, weather and time. Get resources wrong and the challenge is tarnished. Delays occur, morale is eroded and we face embarrassing results. We must set the rules on resources in operational environments.

Despite everything, I suspect we will never escape from UN resources control. Therefore, we must understand their rules thoroughly and train in their systems before deployment. Admittedly, I deployed at short notice with no briefing but I feel I was not alone in being caught wrong-footed by the rigid UN system.

There were other lessons I had learnt before. For example, why must we always be short of crane operators? Class one electricians seem to be another endangered species. We can make do on some of the trades and risk only a poor visual finish, but the skills of crane and plant operators, electricians and fitters cannot be fudged. Is the RE Employments Structure Review going to give us a robust surfeit of those particular trades whose work cannot be attempted by amateurs?

Our design teams were excellent but a lesson they learned is worth emphasis. We must design with availability in mind. Find out what materials are in theatre before putting pen to paper, even if the resultant design does not fit the Chatham standard.

Perhaps a lesson worth mentioning, even though it is not in our gift to change it, is that the French were much better equipped for deployed field operations than we were. Camp living consists of ablutions, kitchens, accommodation and the utilities to supply these. Their ablution trailers were excellent, as were their kitchen trailers, and their tents were modern. In contrast, we pulled a 2000-man tented camp out of RFA Resource, which was old and tired with tentage dated 1945.

Some materials had infinite flexibility. Wriggly tin was there as always, but Hesco-Bastions looked good too. They are not too bulky to supply and they produce excellent protective walling extremely quickly. Equally, I was impressed by the Slovakian timber milling system. Trees were fed in one end and planks came out of the other. Even though the timber was unseasoned, it was better than nothing and there was a constant supply of valuable building material which did not need to be hauled out of depots hundreds of miles away. We need to be more aware of improvisation and this should be reflected in the training of our troop commanders and SNCOs at the RSME.

To put the previous point into perspective, the final lesson I think I must pin up is that all the excellent efforts I witnessed were produced by men who had learned their business at the RSME. They were self-confident soldiers, proud of what they could achieve. This self esteem seemed to inoculate them against many of the hardships which served to corrode the morale of the infantry I met. Never must we risk our trained skills to the extent that a sapper's pride is no longer guaranteed.

Royal Engineer Boat Club 1846 – 1996

1996 marks the 150th anniversary of the founding of The Engineer Boat Club at Chatham, whose aim was "to encourage sailing and boating among the Officers of the Corps". In 1864 the club was renamed The Royal Engineer Yacht Club (REYC), still combining sailing and boating, or rowing, although the separation into two clubs was about to begin. For the first 20 years the Boat Club was based in St Mary's Creek, between Brompton and Gillingham. Then the Admiralty took the Creek over, and incorporated it into the new dockyard then being built. The yachts moved downstream nearer Gillingham, and the rowing pontoon was moved upstream into Chatham Reach, probably opposite Upnor. Although this was a physical separation, both disciplines remained under one flag until 1950 when the RE Rowing Club came into being in its own right.

The "Lloyds Register of Yachts" lists only 21 yacht clubs worldwide with a date of founding earlier than 1846, and the REYC is shown as the senior Service Yacht Club. Since this auspicious beginning both clubs have had their share of successes.

The REYC played a major part in the development of offshore racing in the 1920s and 30s, and was one of the clubs instrumental in founding the Royal Ocean Racing Club. The REYC is the only service club to have had an entry in every Fastnet Race from its inception in 1925. *Fulmar* was 2nd overall in that year, and *Ilex* won the race in 1926. Since then there has been a sprinkling of successes, with *Right Royal* winning the coveted Culdrose Trophy in 1995 (first Service yacht to reach the Fastnet Rock). The article below on *Avalanche* is a typical cameo of offshore racing.

The rowing fraternity held annual regattas on the Medway, and records show that General Sir Bindon Blood, then a lieutenant, was in a winning crew in 1867, and Lieutenant Chard VC coxed a Sapper four which won the Medway Challenge Cup in 1870. Inter-Corps rowing started with a match against the Gunners in 1869, which has been repeated at irregular intervals since. The club was at its most successful in the 1950s, when coxless fours won the Wyfold Cup at Henley three times, and provided the representative Great Britain Four at the 1954 European Championships.

Both clubs are celebrating their sesquicentenary with a number of events, and details will be published in the *Supplement*. The REYC annual dinner will be held at Chatham on 23 May, when a painting of *Ilex* rounding the Fastnet Rock in 1926 will be unveiled. The Rowing Club's main event will be at Henley on 5 July, when the Stewards have granted permission for a commemorative row past the enclosures. The Corps band will be in attendance to add spice to the occasion.

The Yacht Avalanche – 26 tons

BRIGADIER J CONSTANT

THE REYC sesquicentenary coincides with the 60th anniversary of the launching of *Storch*, as she was named when built in Warnemünde in 1936: one of the 100 square-metre sailing yachts provided for the German Armed Services, and I believe she was allotted to Goering's *Luftwaffe* for the "strength through joy" programme of the officers. She had 10 to 12 bunks and pipe-cots, but no cooking arrangements, as these yachts were sailed in little flotillas of six, with one support vessel to which they rafted up, three a side, for meals; aboard the latter were the professional instructors, navigation equipment, baggage, kitchen, workshop and medical facilities, as well as the crew to man them, and to look after the young officers whose task was limited to enjoying themselves, without chores. The loo emptied into holding tanks in the bilge, to be pumped into a sanitary barge on return from each cruise, as no direct flushing was permitted in those waters.

These 100 square-metre sloop-rigged yachts were all built to the same general design, though those for the German Navy were administratively self-contained for offshore racing, as some older readers will remember in 1938/9. Their layout was absolutely straightforward, with a

Avalanche with reduced mainsail, before we shortened the boom. June 1948.

mast which could be bent into a slight curve, when sailing close hauled, to keep the luff tight. The deck was almost uncluttered, with few hatches or skylights; the halyards and jib-sheets were steel wire ropes, which were cruel on the hands, as were the running backstays. No engine, of course.

When fighting stopped in 1945, these and other German Services' yachts were seized as spoils of war and a number were brought to this country, under Admiralty orders and through the minefields of the North Sea, for fair distribution to the Services here. At a historic committee meeting in early 1946, the REYC Centenary year, it was agreed that our bids for these "windfalls" should include two of the 100 square-metre yachts, one each for Chatham and Marchwood, the one for Marchwood turning out to be *Storch*, the name later changed to *Avalanche* after one of the major amphibious operations of the war.

A word about Marchwood might not come amiss here. During the war the Sappers had had to raise many transportation units to man inland water transport craft being operated on major lines of communication waterways, such as the Nile, Euphrates and Irrawaddy, to name but a few. At the same time, both sea and river ports were liable to enemy air raids and a backbone of disciplined port operating, maintenance and construction troops had to be available. After the war, it was decided to provide a facility for training such specialists at Marchwood Military Port, opposite Southampton docks, where large numbers of the Mulberry pontoons and other parts for the Arromanches operation had been built.

It fell to my lot to be posted to the UK in April 1948 to raise the first port unit in the Regular Army – 51 Port Squadron RE – and the appointment carried with it the task of being Port Superintendent of Marchwood. That involved responsibility for the use and safeguarding of all the 60 odd items of floating equipment, tugs, cranes, lighters, launches, etc, to which four yachts were immediately added; one of these was *Avalanche*. And a very sad sight she was! She had been lying nearby on the mud for many months, during which she had been raided by longshoremen to "win", as the word was at that time of reduced honesty, any removable asset, blocks, winches, shackles and so on. Externally, she was filthy, and down below were mouldy cushions, sail bags and a terrible smell from the sanitary tank in the bilge.

There was no time to waste, as I was told that my duty was to gather together nearly 300 soldiers, many regulars from disbanding parachute sapper units, and weld them into an operational squadron, as well as to run the port, and prepare *Avalanche* for ocean racing; and there was a tide high enough to float her off her mud berth only three days later! Clearly I could expect no spare time in the months ahead, and there was nowhere for my wife, Jay, and two children (with another on the way) to live, so we settled for an empty Nissen hut on the marsh there. The tide came up to expectations and we recovered the yacht and slipped her, immediately building a framework so that a set of tarpaulins could be stretched over her for work to be continued in all weathers.

Readers can imagine the problems then encountered, but we were lucky; a naval architect inspected her hull and found it sound; the mast and boom were serviceable; a reputable sail maker found the sails to be repairable. We got rid of the sanitary tank and put in a "baby-blake"; we burnt off the paint and replaced it with the best we could scrounge, but little money was available to buy yacht fittings. As she was allotted to us for officer training, we

The yacht Avalanch p16

were entitled to use service equipment, and both the Royal Navy and the Royal Army Service Corps were most helpful. By June, we had her afloat and moored in a "one boat marina" for easy access. A well-known ocean-racing designer, Robert Clark, made detailed recommendations for a number of minor modifications, which included reducing the length of the boom by some 4ft, before we took the bold step of cutting the boom itself. A dinghy was found, which could be lashed on deck to cover the one skylight, and a rather clumsy galvanized iron pulpit was constructed. Down below, the varnish was carefully burnt off and replaced; all soft furnishings such as cushions and mattresses were replaced, a galley with a sink was improvised, and a gas cooker in gimbals was installed, along with a new fresh water supply; simple navigation facilities and a wireless receiver with direction finding loop were acquired, but strangely the magnetic compass was still in its binnacle and could be swung to an acceptable accuracy.

Five years of war had deprived many young officers of any chance of learning to sail and my duties extended to every weekend, when a dozen YOs, from a different regiment each time, would appear with their railway warrants and their rations in kind for 24 hours at sea. With no engine, but ample manpower, the programme depended on whether the lads had any knowledge of watermanship; if so, we would sail into Weymouth for the night, wind permitting; anchoring in the open off Yarmouth was an alternative, as was creeping into Keyhaven, if the tide just fitted, towed by two stalwarts rowing the dinghy.

It was on such occasions, when at least one of the officers had some proficiency, that their number included Gerald Hume-Wright, who later acted as sailing-master to Edward Heath MP, in the latter's early days as a yachtsman, and Terry Wade, who so sadly died at the helm of *Avalanche* last year.

On some occasions as we sailed down Southampton Water, it was obvious that none had any aptitude at all, so we sailed right through the night, keeping well out into the Channel, with overlapping watches, and I remained in the cockpit throughout; this precaution was accompanied on the Sunday afternoon by having a tug out in the offing, to help us into our berth if all else failed with a foul tide.

All through that summer we worked on *Avalanche*, each week replacing such gear as we could, while keeping her fit to sail at the weekends; we registered her with the RORC (sail number 454) ready for our first ocean race, Brixham-Santander, sailing away from Marchwood at the beginning of August with Colonel (later major general) Bill Fryer as skipper. We arrived at Brixham in good time for the pre-race dinner, to which many grandees of the ocean racing world were expected; to my surprise and joy, I was handed a telegram to the effect that our family calculations were inaccurate, and my wife, Jay, had entered a nursing home that morning to be safely delivered of a son. With one day spare before the race, I left the final preparations to the rest of the crew and hired a taxi back to the New Forest, to see my wife and the baby. Back in good time for the 440-mile race, the first to that destination for 18 years, we set off happily down channel, but a gale blew up as we were rounding Ushant. I then realized that our preparation of the yacht had not been quite thorough enough for the tempest which raged, as the *Daily Telegraph* reported on 11 August:

> "Yachts' 15-hour fight with Channel Storm"
> "Waves like waterspouts": crew lashed to deck.

I still have the cuttings taken from the press by my wife, who said that the nurses were frightened to show the papers to her.

Captain Illingworth, the doyen of ocean racing skippers at that time, and his crew, were widely quoted for their statements about the severity of the storm, and we were one of six yachts which retired with gear failure. As our vessel was taking it green, the large cockpit filled to overflowing because the self-draining pipes were much too small. Under those conditions it was difficult to avoid being washed out of the cockpit, especially when trying to read the dial of the Patent Log with an electric torch in the night. We rode out the gale clear of Brittany's outlying rocks, then went to a Cornish yard for repairs, and set off again for Santander. This time becalmed off Belle Isle, and too late for Santander's welcome, we cruised back to Marchwood, with a call into Benodet, where the hotel was willing to let the whole crew have a hot bath in exchange for a big tin of American coffee.

Avalanche remained in full commission until October, when we laid her up under her shelter for the winter, and immediately replaced the cockpit pipes; we also built a prototype "push-pit" for safety when reading the log. The yacht was in much better trim by April 1949, when the Easter cruise had to be curtailed, because my squadron was required in the London Docks to supervise other troops unloading perishable food cargoes. Apart from that emergency, we continued to sail her every weekend, taking part in Solent and other local races, but our main target was to be the Fastnet Race at the end of Cowes Week. A fortnight earlier Colonel (later brigadier) Teddy Parker, who was to be skipper for the race, came down to check over the arrangements and supplies, bringing his wife, Bea, in pleasant weather. I had received posting orders to Egypt, and handed over my squadron to Ken Wylie, another well-known ocean racing skipper, leaving my wife to pack up while I completed preparations for the Fastnet.

As the great day approached, all was ready, and our galley equipment had been augmented by one of the newly available pressure cookers; however, at our simple dinner aboard the yacht on the night before the race, it exploded and left little lumps of food distributed all over the walls of the saloon, to our dismay for days afterwards. In spite of every effort of the fit and experienced crew, driven brilliantly by Teddy Parker, one of the best ocean racing skippers of those days, we took 11 days to complete the course! We had three gales, one in the Channel, one in the Irish Sea before the Fastnet, and a third just before Land's End on the way back. In the first we lost our topping lift, and were unable to replace it. In the next we blew out the mainsail, leaving the headboard stuck aloft, so we had to lead the second jib halyard round the mast to hoist the fair sized trisail instead, and rounded the famous rock like that! Donald Ross was acting as cook aboard and, calculating how long our voyage might last, he put us onto short rations, soon accusing my watch, probably with reason, of having consumed one extra biscuit at change of watch in the night.

The crew also included "Al" Clarke, the American Corps of Engineers captain filling the post of Assistant Army Attaché at their London Embassy; showing the resourcefulness of his home on the USA's northwest coast, he realized that our speed under jury-rig was slow enough to spin for fish, which he did, but unsure of being able to bring a sizable catch aboard, he began to assemble supplies of twine with the stated intention of making a fishnet; that kept us cheerful, telling exaggerated yarns of fishing and shooting in India and Oregon. Continuing across the Irish Sea in dead calm and an oily swell, we spent a morning being buzzed by a four-engined bomber; round and round it came, and we feared its propellers would skim the water. We waved madly, but had no means of communicating; we learnt later that the RAF had been asked to search for us and had difficulty in identifying us as our trisail did not have a number on it, and the yacht's name on the counter was only visible when the swell tipped it above the horizontal.

That afternoon watch was calm and we determined to have another try to recover the headboard; the swell was too much to risk anyone climbing the mast unaided, and the jib was just flapping, so we handed it down and used that halyard (the other one was holding the trisail in position, tightly stretched as a steadying sail) for hoisting a man up to the hounds on the bosun's chair; unfortunately he was sickened by the motion before he had succeeded in manoeuvring our long boat-hook into the eye of the headboard. Another "volunteer" was more fortunate, our hitches survived the winching, and down came the headboard, to our intense relief. Of course, even with it in your hand, it is not that easy to secure a worn headboard to the rest of the sail, and it looked terrible, but it worked. When the other watch came on, they were amazed to see *Avalanche* under full sail again and we reached the Scillies in fine style, unscathed by the third gale.

Our finish at Plymouth was not so impressive, being in rain and flat calm, but we had done it in record time: record slow time! Nevertheless, the REYC won the RORC Inter-Club Points Championship that year, because we had amassed so many points by refusing to give up, as the majority of the other starters in that race had. As soon as we came into Plymouth, I had to leave the yacht as I was already late for my posting to the Middle East, and by the time I was in the UK again, some years later, *Avalanche,* had been transferred to Kiel fjord, where she served the Rhine Army well for another 42 years.

Gravity Survey – Operation Bouguer 1995

CAPTAIN PHIL MAYE

Captain Phil Maye has had a long and rewarding career since he joined in 1968 and completed an apprenticeship at the Army Apprentices College, Chepstow. His first taste of overseas deployment occurred in 1975 when he was navigator on the Joint Services West-East Sahara Expedition. This was later followed by two other expeditions, one to the glaciers of Iceland and another to the jungles of Sulawesi, Indonesia.

Survey postings and tasks have taken him worldwide; a six-month tour in Belize, three years with 14 Topo Sqn in Düsseldorf and two years with 512 STRE in Washington DC, USA, as well as a one-year unaccompanied tour globetrotting with 512 STRE.

Commissioned in 1990, he served as operations officer with 42 Svy Engr Gp prior to deploying to the Theatre Map Depot in Bahrain during Operation Granby. *Captain Maye is presently an exchange officer with Mapping and Charting Establishment in Ottawa, Canada, where he commands the Terrain Analysis and Field Survey Sections.*

ARRIVING in Ottawa, Canada, in December 1994, I was greeted with temperatures of –15°C and informed that I would spend the following summer doing a gravity survey in the Canadian high arctic – a chilling introduction to a two-year exchange tour. However, I soon warmed to the challenge of coordinating the gravity survey that was to be carried out over most of Ellesmere Island and Axel Heiberg Island.

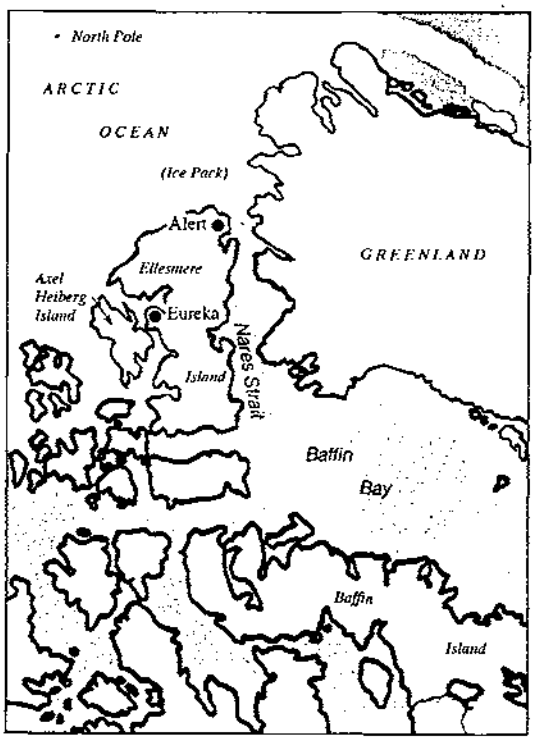
Operation *Bouguer 95* was to be a collaborative operation involving the Geological Survey of Canada (GSC), the Canadian Hydrographic Service (CHS), the Geodetic Survey Division (GSD) and the Danish National Survey and Cadastre (KMS), with Mapping and Charting Establishment (MCE) responsible for overall coordination. The programme was designed to collect gravity data and establish a network of very accurate coordinates using the Global Positioning System (GPS). KMS would operate in northwest Greenland, CHS over the sea-ice of the Nares Strait, between Greenland and Canada, and MCE over the land mass of Ellesmere Island and Axel Heiberg Island, all aided and abetted by GSC and GSD – the abbreviations just fall off the tongue!

Conducting work in the Canadian arctic can only be achieved sensibly using helicopters, so planning had commenced the previous year to ship aviation fuel north. Warrant Officer Bob Smith, a stalwart field surveyor and veteran of ten previous arctic survey campaigns and an ex-exchange NCO to the UK, was already beavering away to determine quantities required and to find suitable fuel cache sites.

In the UK our field surveyors had been reduced from a squadron to a specialist team, and in Canada, MCE had reduced to four established posts with only one position filled! Thus detailed planning included finding additional personnel to be trained to collect GPS and gravity data, prepare documentation and briefing packages, obtain the necessary land use and research permits, and provide environmental impact assessments.

Within a few short weeks a plan had been made, numerous discussions had taken place, and Sgt Barry Pascoe was recruited to the team and trained to compute GPS observations. Eight personnel remustered as topographical surveyors and underwent on-the-job-training to become observers, four to deploy initially and four to rotate halfway through the survey. Training was undertaken on the Ashtec Z-12 geodetic GPS receiver, for positioning, and LaCoste Romberg gravity meters were borrowed from GSC. To ensure the meters were properly cared for and to assist in the quality assurance of the gravity readings the team also included a member from GSC.

Captain Phil Maye
Gravity survey - Op Bouguer 1995 p19



Map of area covered by article.

Measuring Gravity

A knowledge of the earth's gravity field is fundamental to studies in geodesy and geophysics. In geodesy such knowledge is used to determine the shape of the earth and, in practical applications, to control inertial navigation systems and specify the motion of artificial satellites, which play an important part in current positioning and navigation techniques. In geophysics, knowledge of the earth's gravity field assists investigations into the composition of the earth's crust and is an aid to prospecting for mineral deposits. In order to define the earth's gravity field, surveys are carried out to measure the intensity of gravity at different points on the earth's surface.

Since 1950 most relative gravity measurements for scientific and practical purposes have been made by instruments described as gravimeters, ie gravity meters. Small, relatively robust and easily transportable, these instruments operate on the principle of a spring balance. A small weight, on a beam and supported by a spring, sealed in a thermostatically controlled and pressure-compensated housing, measures minute differences in gravity. In simple terms, the greater the attraction of gravity the greater the gravity value, or, as with pressure based altimeters, an increase in elevation causes a decrease in gravity. The meters are able to measure an increase/decrease of gravity equivalent to a vertical movement of just ten centimetres.

Having collected the gravity data in an area, observations are mathematically reduced to a value known as an anomaly. Two of the more common forms of anomaly values are the Free-air anomaly and the Bouguer anomaly. Gravity decreases with an increase in elevation and the Free-air anomaly ignores the effect of any matter between the earth's surface and mean sea level, producing anomaly lines that closely reflect elevation contours on maps. Gravity also changes with differences in the density of the rock beneath the earth's surface and, assuming an average density, deviations can be deduced which are known as Bouguer anomalies.

Geologists use Bouguer anomaly values to determine the location of subsurface rock strata, underlying caverns, fissures, etc, which data can then be used for finding minerals and oil.

The surveyor, utilizing the GPS, is now able to determine coordinates of millimetric precision in an area of interest. A precise GPS network was established on the coasts of Canada and Greenland that will enable future monitoring of possible vertical and horizontal movements of the earth's crust, ie plate tectonics. The simultaneous collection of GPS data, at a known base station and with one or more moving receivers, can also be used for rapid positioning to achieve sub-metre accuracies.

A new method of data collection called On-The-Fly was utilized throughout Op *Bouguer 95*, entailing just eight-minute occupations at each point. A GPS antenna was mounted on the rear vertical fin of the helicopter, its cable connected to a receiver in the cabin area. Gravity readings were taken under the nose of the helicopter, the ten-metre offset from the antenna, together with the recorded azimuth of the helicopter, ensuring that the requisite accuracy of position was maintained.

The mission was to take gravity readings at 12km spacings, with a positional accuracy of 5m and heights to within 2m. An estimated 1200 points were required to be observed.

The Survey Begins

On arrival in Alert on 18 May, three days of continuous snow ensued, the sky constantly overcast and windy, and the ever-threatening sea fog, which always seems to home in on Alert, rolled back and

forth. While waiting for the weather to clear, time was spent on trying to recover old survey stations around Alert, by now under 3ft of snow, while constantly on the lookout for wolves which in recent months had managed to bite two people.

Soon, however, the teams were in the air and were joined by two park wardens from Ellesmere National Park Reserve. There followed seven days of glorious sunshine (24 hours a day), unlimited visibility and, rare for the Arctic, no winds. The ritual of stopping, punching in a four-letter code to collect GPS data, and moving to the front of the helicopter to take a gravity reading, had begun. For those unfamiliar with Ellesmere Island, it is an area of ice fields at the highest levels, with glaciers spreading from them through deeply incised valleys to the coasts. The ground is mainly permafrost, very loose, unstable or still frozen, or snow covered.

Gravity readings must be taken on exposed ground, and the GPS needed to remain in view of the satellites which, at these high latitudes, are lower in the skies. Finding suitable spots to land was always very difficult. The most common solution was to use a saddle on the side of very steep mountain, requiring not only the skill of the pilots to land but also self-control to keep one's nerve when tiptoeing to the front to take a reading!

No sooner had we completed a 150km swath of points from Alert, and moved most of the team to Eureka, than 1 Canadian Engineer Unit arrived for another of their summer sojourns building, digging and demolishing. I was surprised to meet Captain John Newsome, who was up for the second time as Project Officer, so I wasn't the only Brit sent up north for the summer.

Fort Eureka, on the western shore of Ellesmere, is collocated with the northernmost weather station and is central to all the scientific camps monitored by the Polar Continental Shelf Project, as well as being the satellite telecommunications link which is then beamed by ground transmitters to Alert. Unlike Alert, the weather is much more stable, high enough to avoid the sea fog, it is an idyllic spot; even the wolves are friendly! Eureka has been home to many a survey team from MCE over the years, and a favourite watering spot, as the bar is littered with plaques and memorabilia from several arctic survey campaigns, including the engraved names of past UK exchange officers and SNCOs.

By mid-June the survey was so far ahead of schedule that the work programmed for the following year was being started. The enthusiasm and dedication displayed by both pilots and surveyors was excellent; Sgt Barry Pascoe was kept busy crunching out coordinates, whilst Dave Seemann, our man from GSC, was glued to his computer reducing the gravity data to produce Bouguer anomalies and spotting the odd misreading. On days when flying near the ice caps was impossible due to bad weather, very high winds or just white out conditions, the teams revisited old survey stations and reobserved them with the new, high accuracy GPS equipment.

Mid-July and the task was completed to the immense satisfaction of all concerned. Some 50 survey stations alone had been visited and connected to a new national GPS network of stations. A series of stations along the coasts of Ellesmere Island and northwest Greenland have been so precisely coordinated that future occupations surveys will detect any vertical or horizontal movement of the earth's crust of only a few millimetres.

Finally, the islands now have an additional 1339 gravity readings, providing data which will titillate and delight the geodesists and geophysicists for years to come. For the surveyors, the pleasure of having had the unique privilege of travelling all over these islands, combined with memories of the rugged and inhospitable scenery, the beauty of the Arctic and fleeting sightings of musk oxen, caribou, and arctic hare, will be remembered forever.

This article is based on one which appeared in Ubique, *The Journal of the Canadian Military Engineers, edition 53, page 13, and is printed here by special permission.*

The ritual of moving to the front of the helicopter to take a gravity reading.

Gravity survey - Op Bouguer 1995 p21

Operation Astride or The Operation That Never Was and Other Stories About 32 Field Squadron

MAJOR S McCLOGHRY MBE

Following father's footsteps (Indian Madras Sapper 1876 to 1909), seconded to Queen Victoria's Own Madras Sappers and Miners in 1946. Reverted to British service after Independence to serve as troop commander in Hong Kong, Austria, Korea and Malaya, staff EinC (Room 151 War Office). Camberley "A" staff Near East. Field Squadron, Ripon with tincture of Aden. BM of Engineer TA brigade Liverpool. Received major culture shock on posting to BAOR for first time 1968. Tour stood in good stead for putting goose eggs down on model in Tactics School on posting there as Senior Instructor. Second culture shock on hearing subalterns discussing career prospects at Chattenden bar – in my day Subalterns did not have career prospects! Awarded "Crustie of the Year 1972" by YO course. Final shock to system, a posting to Room 151, Old War Office Building. Rank having its privileges – desk nearest the window. Gratefully received award from Fairy Godmother's Department of the MOD when retired to career in Bloxham School.

I DO not know if Operation Astride *is still classified, or indeed what the classification ever was since the only mention of the following which I have seen on paper is that written by myself at the time.*

MID-MARCH 1963 in Aden, OC 32 Field Squadron. Nothing much on, I think I'll drive over and see how work progresses at Reinforcement Camp.

Arrive at Camp hoping for a cool bottle of stim (sweet orange drink), to be met by frantic troop commander who says that the Squadron 2IC is trying to get in touch with me. Find telephone, to be told that I am urgently required at HQ Aden Garrison.

Arrive at Aden Garrison to be ushered onto upstairs verandah set out like a classroom. At teacher's end is table with Garrison Commander flanked by two staff officers. Facing, at desks, multifarious mixture of army officers with a sprinkling of Royal Navy and RAF types. Salute, apologize, and waved to a table by brigadier.

What's it all about? By listening to the briefing, it appeared that we had a wireless station (civilian) in Berbera where there had been a revolution, and we wanted our station back. The assembled company of men, each with a wad of documents on the desk in front of him, was planning to implement Operation *Astride* which would do the trick. It was to be a tri-Service operation, commanded by a major and consisting of 300 all ranks.

The force would sail in a landing ship tank – useful for loading the generators and transmitters – hence the naval party: the RAF were wingless wonders but knew about transmitters.

I assumed that the Sappers would be there in an electrical/heavy lift role. Sure enough when numbers were discussed I was to put ten Sappers (trade specified) at twelve hours' notice.

But wait! The discussion turned to whether the party should be armed or not. The intelligence briefing had not been too specific as to who was now in charge in Berbera and it also appeared that we had not actually been invited to take our wireless station away. Looking straight at me, the brigadier asked "What do you think? Do you want to take weapons with you." Heavens, I was to command this Fred Karno's army! The rest of the meeting went by in a daze. At the end I approached the senior staff officer to ask for a copy of the operation instruction as my squadron had not received a copy. He appeared flabbergasted

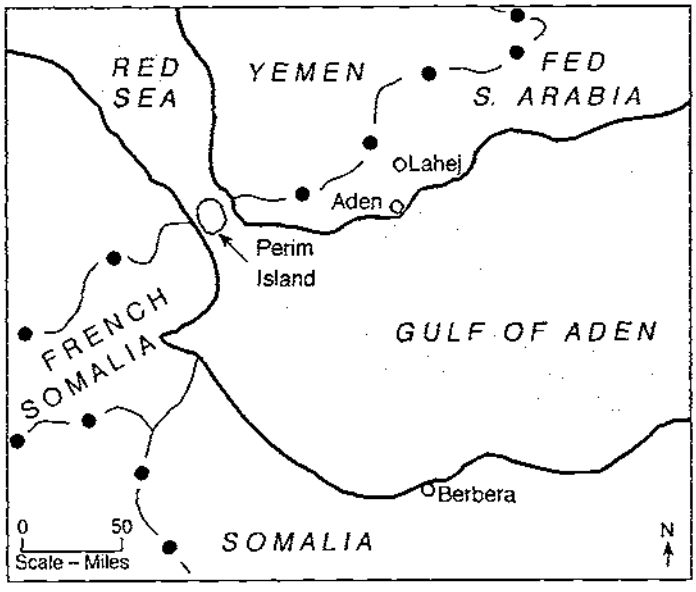
and said one would be sent on. It never was.

Luckily for England, the Somalis, and me, in that order, the revolutionaries decided that British soldiers were *personae non gratae* on their soil but that a civilian contractor would be. This was communicated to me over the telephone in guarded conversation by someone from Aden Garrison whilst I was still suffering from shock.

However I was to report to room xx at a hotel in Aden that night when I would be briefed on another job by a VIP who was flying in to speak to me. I arrived at room xx at the time specified to be greeted by someone I had known when serving in Cyprus. We had been friendly and my wife and I had dined with his wife and him, and vice versa. "Hello Harry." I said "Are you here to meet this VIP too?" "I am the VIP." Harry replied. It transpired that, although we were not to go to Berbera, there was a chance that the squadron would be told to build a new wireless station on Perim Island. And so I flew to Perim Island to do a recce. The island was a piece of history frozen in time. During the days of coal-fired ships, it had been a refuelling point. The coal bunkers still stood, as did an enormous rest-house where passengers would stay to get away from the dirt of coaling.

Back to Aden to dredge from my mind facts from my supplementary course at Chatham. Helped by tradesmen from the squadron I prepared a plan, together with a bar chart works table, for building a wireless station. Meeting up again with Harry I was told once again that if the station was to be built, the work would be carried out by contractors. However Harry said that he would be grateful to have my plans.

Sometime later, after I had left the squadron, my wife and I were invited to lunch with Harry and his wife and I was able to ask if my plans had been of any use. "Yes certainly," said Harry "I used them to check up on my contractor when the new station was built."



Map of Aden area in 1967.

It never ceased to amaze that the Corps was expected to turn its hand to any task without thought of special training. The next story describes a "request" typical of the period:

Bomb Disposal By a Field Squadron

Saturday was just a normal working day for the squadron. However occasionally we joined the rest of the Army and enjoyed a "stand down." It was on such a day that a message arrived from the duty officer at HQ Aden Garrison, reporting that a bomb had been seen "dropping from a British aircraft" somewhere near Lahej. The acting ruler considered this to be "an unfriendly act." The duty officer added the welcome news that the RAF and the Royal Navy had been contacted; both hotly denied ever flying over this particular area, and certainly neither had any bombs missing. There was obviously no percentage in ruining the "stand down", so an ad hoc specialist team of OC, 2IC, acting SQMS (he had actually served in a bomb disposal unit), Chief Clerk and OC's driver set out, complete with standard recce kit. Contact was made with an arab police officer (badge of rank an arab-type crown) in Lahej Police Post, who led us out to a dusty plain not far from some irrigated fields, and we were shown a rabbit hole by a local villager who then made himself scarce.

Taking my second favourite reconnaissance tool (rods, common, measuring, 6ft), I inserted it into the rabbit hole. Horror began to dawn when the rod continued to be swallowed up by the hole, at an angle of some 80° to the horizontal, without bending. This brought back vague memories of "Reconnaissance Handbook No 9(?) – Bomb Disposal." So favourite numbers one and three of the recce kit were off-loaded (levels, field service; and white tape). A square was carefully laid out with the rabbit hole/rods, common, on one side, the idea being to dig down alongside the rabbit hole till the "bomb/gopher/coney" was reached. My least favourite recce tools were then off-loaded – picks and shovels. The police officer retired some distance to a piece of shade; an entrepreneurial shopkeeper arrived with bottles of iced stim. Digging began on an equally shared system, although slight resistance was offered by the OC's driver who maintained that he only drove and was not responsible for other tasks.

Six feet under was reached with the "rabbit hole" clearly showing down the wall. Due to the wariness of the operators and the unrevetted sides of the hole, the size of the floor was reduced and digging resumed by hand rather than by shovel. Metal appeared; work ceased; cigarettes produced and thought taken. The site was evacuated, and digging, by one officer only, resumed. After a considerable period the whole of one side of a small bomb was revealed. I can confirm that, like the drawings in the manuals, a bomb does turn upwards at the end of its burrowing!

The bomb casing had burst and it appeared to be filled with a white substance which would not burn and did not explode if struck with metal. Uncovering more of the bomb *in situ* showed that there appeared to be no fuse pockets. The bomb was then moved by remote control – attached to a length of signal cable and tugged clear. Another cigarette; then inspection showed the other side/underneath of the bomb had no fuses either, so it was picked up and lifted out of the hole.

The police officer approached and with extreme difficulty conveyed the knowledge that the acting ruler wished to see us. No one claimed to speak English and we all sat in the palace sipping fruit juice. I think the visit was just to prove that there actually had been a bomb because when we returned to the Landrover, the policeman guarding it had let the world and his wife in to see, he probably charged for the viewing.

Still there was one last problem – what to do with the bomb? Did I take it out into the desert and blow it up? What did I do with it in the meantime? Flash of genius! The duty officer had given me the problem. Neither the Navy nor the Air Force admitted to dropping bombs, but I had the evidence. We drove to HQ Aden Garrison. The duty officer was not in his office so, depositing the bomb on his desk together with a handwritten note, we silently stole away. I never heard another word.

However the next day! I quote from a DO letter to my CO in Ripon:

> "You can warn 12 Field Sqn to expect any type of job out here. On 1 June we had to turn out a party to go and look at an unexploded bomb with NO warning. Saturday was a "stand down" and a gallant party of OC, 2IC, SQMS, and Chief Clerk laboured down seven feet or so to find a British practice bomb. The aches and pains amongst some of the diggers the next day were indescribable!"

The last story is of a scenario which I am sure many will recognize.

Sapper Davies, the Lance Corporal, the OC and the Brigade Major

One of the biggest disappointments in raising a field squadron from scratch whilst undertaking a major works project, is that it takes a long time to get to know your men. I first met Sapper Davies across a desk when he was standing rigidly at attention and I was sitting with my hat on and Army Form 252 in my hand. The witness for the prosecution was a rather wet, well educated but unintelligent lance corporal. The charge was one of good order and military discipline involving a compressor hose. The hose had been lying on the verandah of a half-built Twynham hut in Little Aden and the lance corporal decided that it should be coiled up. He picked up one end and Sapper Davies, seeing what was happening, raced around the hut and picked up the other end. The lance corporal tugged and Sapper Davies dug in his heels until the lance corporal went round to see what was happening.

"Put down the hose Sapper Davies, or I will put you on a charge."

"Charge me? You could not charge a f***ing battery!"

And so we met for the first time. I cannot remember what I awarded Sapper Davies, but I

do not think that it was more than an admonishment so that the lance corporal's authority could be upheld. I watched Sapper Davies thereafter. He was ex-Junior Leaders and so full of beans that he was streets ahead of most of my junior ranks, but whenever I wanted to give him a stripe, he would get involved in some minor infringement and the chance was gone.

We were relieved in Aden by 12 and 48 Field Squadrons plus a Tactical HQ of 38 Engineer Regiment, and returned to our base in Ripon. There a very understanding 2IC, temporary CO, said "get on with training your squadron but RHQ must have use of your transport when it wants it."

Pretty soon Sapper Davies showed that he was more than able in another sphere – potholing. Over the winter there was many an occasion when I saw his face on television in the forefront of the rescue team, after some potholing party had got into difficulties. On Monday the squadron office would get a telephone call from him to say that he was sorry to be AWOL but that he would be back as soon as the rescue was finished. The squadron duly covered the absence.

Came the Fitness for War Inspection. In their wisdom Brigade HQ staff decided that one day of hell was not really sufficient and that we should really show our fitness for war in a fortnight's time by flying out to deal with an emergency in "Uganda". (Readers of *Private Eye* please note that this is NOT a tale of "Uganda Discussions".) Lots of the work to be done required playing games such as the filling in indents for tropical clothing, mepacrine, salt tablets, etc. We were bombarded with the latest intelligence on Uganda and a scenario was built up; come the day, we would actually be flying from RAF Dishforth (UK) to RAF Leconfield (Uganda) complete with vehicles and G1098.

The day dawned with the arrival of staff officers to watch every move. The brigade major, a trifle pompous and with little sense of humour, attached himself to the OC. Mid-morning when things were a little slack the OC ducked into a nearby convenience, waited a bit and then, in his turn, followed the brigade major's progress. In the barrack area Sapper Davies was seen to round the corner of a barrack block, no doubt for a crafty fag, the brigade major was in hot pursuit.

"Sapper!"

"Yes Sir." Smart salute with right hand; fag still lit cupped in left.

"What are you on?"

"Chalk 10, Sir. Waiting to embus."

"What is this exercise all about?"

"The squadron is flying to Uganda, Sir."

"What has your OC told you about Uganda?"

"Sir. My OC has told me everything that a Sapper should know about Uganda."

Exit brigade major, enter OC.

"Sapper Davies, you are now LCpl Davies whether you like it or not."

"Yes Sir. Thank you, Sir."

I wonder how LCpl Davies did in the Corps after that.

Lights on in Sarajevo – Preconditions for a Cease-fire

MAJOR A M O MILLER

Major A M O Miller published an account of his experiences with the Spanish Military in the August 1995 edition of the Journal. *After the Spanish Staff course Major Miller volunteered for UN service in Bosnia and had a fascinating six-month tour as the Deputy Commander Engineers HQ UN Protection Force in Sarajevo, June to December 1995 – a period of great change – hostage crisis, NATO bombing and the peace agreement, and Implementation Force. This article is an account of the restoration of electrical power to Sarajevo in early October 1995.*

Introduction

Control of public utilities and especially electricity had always been an important weapon in the war between the various warring factions (WF) during the three-year war in the former Yugoslavia, and it suddenly assumed a more immediate and compelling importance at the beginning of October 1995. The restoration of electricity and gas became a precondition for the cease-fire being brokered by the US Special Envoy, Richard Holbrooke. Without it there would be no cease-fire and therefore no subsequent chance of a more lasting peace.

The situation became clearer to me on 5 October as I started to examine various possibilities for the repair of the main 110 kVA electrical power line which had carried power from Kiseljak into Sarajevo. It had been damaged along the confrontation line (CL) in the area of Kokoska Hill, a few kilometres to the west of Sarajevo, by the Serbs during the hostage crisis at the end of May 1995.

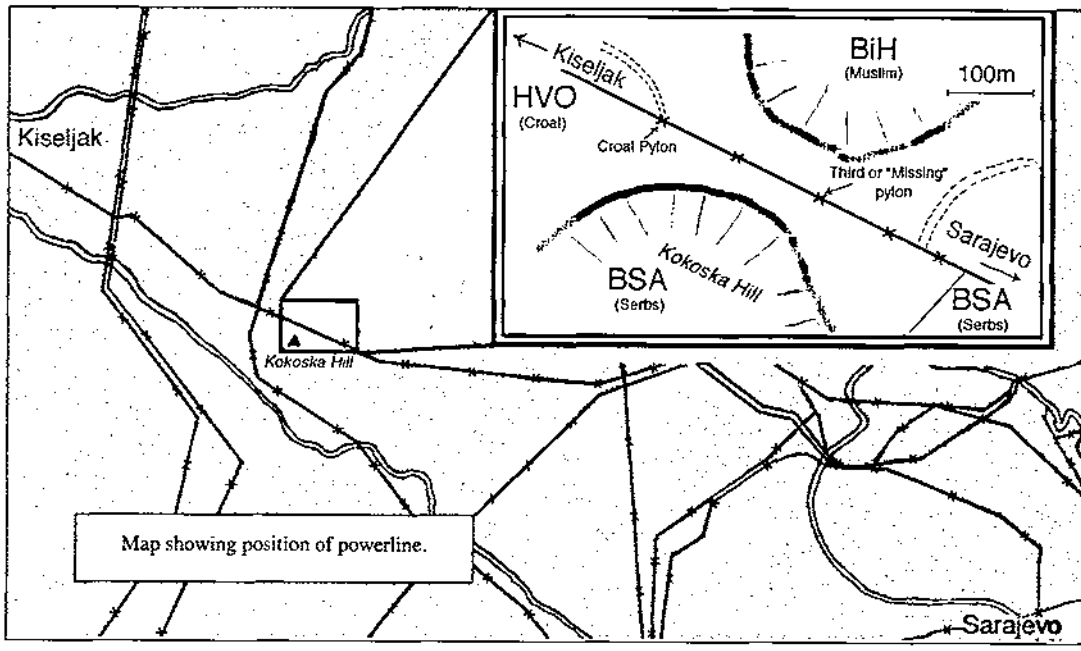
Mission

The main problem to be considered was how to secure access to the 2000m of damaged power line and five pylons which were in an active battle area. The cooperation of the WFs was essential as was the participation of civilian electrical engineers who would carry out the actual repair work. Also a problem was the surrounding minefields and unexploded ordnance. I suggested that the only sure way to guarantee access was for UNPROFOR to clear a path along the power lines, which would take anything up to two weeks. The speedier alternative was for the WFs to carry out their own mine clearance.

My job as UNPROFOR Engr Staff Officer was to plan and command this mission. General Smith, the UNPROFOR Commander, made it quite clear to me that its success was my responsibility and left me in no doubt as to its importance. I had a small team to assist me, consisting of Tom, one of General Smith's interpreters, Sasha, my Ukrainian bodyguard and driver, and a signaller with secure radio communications. The UN would provide an enabling role to "facilitate" the WFs to carry out the repair and mine clearance.

It was 6 October and I had three days to complete the mission.

Major A M O Miller
Lights on in Sarajevo p26



Difficulties

There were a number of difficulties:

- The WFs had to attend a meeting of all parties at Sarajevo Airport to give security guarantees that there would be no combat activity in the area of Kokoska. They also had to undertake to lift their minefields.
- Command and Control by the UN was more complex than normal as the area was split by two UNPROFOR sector boundaries: Sector Sarajevo and Sector South West. Coupled with this was the fact that the Kokoska area was fought over by all three WFs; Bosnian Croat Army (HVO), Bosnian Muslim Army (BiH) and Bosnian Serb Army (BSA). All three armies converged within a few hundred metres of each other on and around Kokoska Hill. This combination of factors was very unusual and further complicated the control and coordination of an already difficult operation. I did not fully appreciate the full impact of this at the time.
- I had not seen the ground and had not met any of the UNPROFOR troops who were to carry out the mission, nor had I met any of the WF commanders. No one had seen the complete problem from both ends of the power line and no one really understood the whole situation. This was true for the WFs as well as for UNPROFOR.
- The deadline was in three days time.

Orders were finally approved (having been sent to Sector Sarajevo for vetting by the French first) and faxed to the two sector HQs late on 6 October. The next step was to assemble representatives of the WFs and UNPROFOR to hammer out the local cease-fire agreements. A meeting was arranged at Sarajevo Airport the following morning.

Day One – 7 October

The meeting at the airport did not go well. Representatives from all three WFs were expected to attend, together with UN officers from the two sectors, to receive formal orders. The meeting was delayed until 1100hrs as there were no HVO representatives present. It was later established that this was due to a breakdown in communications and the fact they had to travel from Kiseljak to Sarajevo via Mount Igman, a journey taking at least three hours. The meeting therefore started without them. The BSA representatives promised every assistance; the BiH stated that as their nearest troops were 1500m from Kokoska there was no requirement for them to carry out any mine clearance. Knowing no better and not having seen the ground I took this all at face value.

Having received security assurances from the BiH and BSA that there would be no combat activity in the Kokoska area, and after a frank discussion with the Canadians from Sector South West about the imperatives of the mission, my team left Sarajevo heading towards Kiseljak.

Kokoska Hill

Kokoska is situated 10km northwest of Sarajevo. When I saw it I understood its tactical significance

as it lies a kilometre or so to the north of the road between Sarajevo and Kiseljak, dominating the area. I wanted to visit the Croat side first as I was concerned about the lack of a HVO representative at the airport. We arrived on the forward edge of the HVO position at about 1700hrs where we enjoyed an excellent view of Kokoska and the power line.

The power line started on the HVO side, ran up a valley and over a saddle between Kokoska Hill and a smaller hill to the north and then disappeared into BSA territory to the east. It was not possible to see the far end of the power line from the HVO position. The ground was open fields for the first 600m giving way to steeply wooded hillside further on.

Power Line Damage

Although the repair work was not particularly complicated it involved lowering some of the conductor (cable) onto the ground in order to join the damaged sections together. The conductors had been cut by shrapnel in about eight places along the 2000m section of power line which needed repair. There was also a number of insulators damaged on the pylons themselves. A typical span between pylons was about 500m. The cable had a steel core for strength and an outer sheath of aluminium which acted as the conductor. The repair procedure was to find both ends of the severed conductor, square them off and join them together using a compression joint. The conductors would then be raised and tensioned using an armoured personnel carrier pulling from either end of the power line. Although the pylons had some bullet holes and shrapnel scars they were structurally sound and serviceable. It was calculated that the repairs would take about two days.

Croat Positions

Shortly after we arrived on site the commander of 94 Regiment HVO based at Kiseljak turned up. He was about 25 years old, large, thick-set, and obviously the product of three years of fighting. We discussed the various concerns he had. It was at this stage that I first learnt that the BiH (or *Armija*) had positions 50m from the power line on the opposite hill. He asked, with righteous indignation, why the Muslims were not helping the operation and assisting with the mine clearance? We were finishing our meeting when a couple of rifle shots rang out nearby. The HVO commander sneered and muttered something about UN guarantees. I had no answers to his questions about the BiH and only knew that I had to return to Sarajevo to find out. Without these answers the operation had no chance of success.

I returned to Sarajevo and a meeting was arranged at the BiH First Corps HQ. Here we saw the same two officers who had assured us that there were no BiH within 1500m of the power line. After they were informed about the facts on the ground they promised full cooperation and a liaison officer for the morning.

Day Two – 8 October 1995

Early the next morning we set off for Kiseljak to rendezvous with the BiH Liaison Officer (LO) a resourceful and helpful man called Zlatan. He spoke excellent English and was a graduate of English Literature from Sarajevo University. He was accompanied by Afan, the BiH electrical engineer whose nickname was "Mr Megawatt" – an expert on all things electrical. Afan also had radio communications to both the Croat and Serb electrical repair teams, giving me another means of communicating across the CL, which was to prove most useful. Communications and the personal rapport established between me and the various parties in this repair operation were to be fundamental to the success of the mission.

After explaining the problem to Zlatan, and the imperative of getting BiH soldiers to start clearing mines, I left to call in at HQ 94 Regiment HVO, to confirm security guarantees and assure the HVO commander that the BiH would do their part of the clearance. He was very upset because Serb television from Pale had reported that the HVO had obstructed the repair operation the previous day and deliberately held things up. I attempted to assure him that this was not the opinion held by UNPROFOR and arranged to meet him on the HVO position one hour later with the BiH LO. It was only then that I realized that there was no military liaison or contact between HVO and BiH on the ground. The HVO Commander was very suspicious of the BiH and only allowed Zlatan onto the HVO position in a UN vehicle.

My job was rapidly becoming one of a diplomat shuttling between the three sides assuring, persuading and cajoling them to carry out their part of the mission.

Serb Position

Having secured the cooperation and promise of further action from the HVO and BiH, I travelled to the Serb side which was in Sector Sarajevo's

area of responsibility, controlled by French troops. We drove up winding farm tracks, through orchards and small farms to higher pastures and beech woods until we reached Serb positions and the Serb end of the power line. This was held by a series of interlocking heavy machine-gun bunkers protected by minefields. Above Kokoska hill the Serb tricolour flag fluttered defiantly.

Things seemed to be going reasonably well on the Serb side and indeed the French had assisted with mine clearance around the second pylon and had found three antipersonnel mines, PMR-2As, a type of stake mine working off a trip wire. The mines had been placed around the pylon, presumably to protect it or because it was an obvious rendezvous point. The French demining sergeant had one tucked into the front of his flak jacket and looked very pleased with himself.

Before I left I had another meeting with the senior Serb officer responsible for the brigade area in which Kokoska fell. He was a grey-haired colonel, obviously ex-JNA (Yugoslav National Army), and friendly. He informed me that the Serbs had cleared their protective minefields and therefore had completed their part of the bargain. Unfortunately there remained over 1000m of no-man's-land still to be cleared. While a large part of this was theoretically a BiH responsibility, it was becoming increasingly obvious that there would be about 400m of ground in the middle which no one owned and was referred to as the "ambush area" – the key to the operation here was "who would clear these mines."

Missing Pylon Syndrome

Whilst talking to the Serbs, the French engineers and the local civilian repair team, I asked them to confirm where the pylons were on the map. This everyone attempted to do and started what I then called "the missing pylon syndrome." I became convinced that the last pylon clearly visible on the Serb side was not the middle pylon as the Serbs and French were saying but only the second one. Eventually they accepted that the middle pylon was another 500m further on and not visible from where we were standing.

Returning to the Croat side I met up with Mr Pedauye, the UNPROFOR Head of Mission, and gave him an update on what was going on and what the UN was doing to help this vital repair work. He was very grateful for this information; it was later incorporated into his report which was sent to New York that night.

Slow Progress

My next visit was to the BiH area of the power line and I was disappointed to see what painfully slow progress they had made. By the end of the afternoon the BiH had only cleared about 300m and were nowhere to be seen. I could see it would require saws and axes to clear a way through the woods towards the middle or "missing" pylon.

Concerned, I made my way back to the Canadians some 800m to the west, on the HVO side. It was now 1700hrs on 8 October and there was one full working day left before the deadline at midnight on the 9th. I radioed Zlatan, the BiH LO, and discussed the problem with him. He asked if we could lend the BiH some chain-saws which I instructed the Canadians to provide. To ensure no foul play the Canadians then prepared to picket the position for the night. This they did by establishing an armoured laager under the power line with a set of powerful arc lights illuminating the safe lane through the mined area. The French did the same on the Serb side. To leave an UNPROFOR unit isolated in the middle of Serb territory was an unsettling experience as memories of the hostage crisis of May 1995 were still fresh.

I decided that the most important thing to do was to ensure that the BiH was going to be ready the following morning. I had arranged to meet Afan at the petrol station outside the Hotel Dalmacia and together we went to Zlatan's house in Visoko, 10km away along route *Dove* to the east. We eventually tracked Zlatan down and over a traditional Bosnian coffee and a couple of cognacs we sorted out the arrangements for the following morning. I gave Zlatan a Motorola radio as I considered it essential that I should be able to communicate with him at all times as he would be critical to the success of the mission the following day.

I returned to Kiseljak and reported via secure telephone to General Smith in Sarajevo on the days events and my assessment of the situation. This was vital as the political pressure and demand for accurate reports increased. Also, the fact that I had direct access to the UNPROFOR Commander gave me considerable credibility, as well as the power and influence necessary to get results from both the WFs and also from the UN troops under my command. In particular, I was able to reassure the WFs that their concerns were being communicated to the General in person.

Day Three – 9 October 1995

The mission had to be finished in time for the midnight deadline. At this stage I did not think that this was possible. The French were getting very excited about the completion time as more and more pressure was applied by their command system. However, we were dependent on the civilian teams to carry out the actual repairs, and they were going at their own pace and did not take much notice of what French generals said. To reach the "missing" pylon was critical. We had to gain access from both sides as quickly as possible. Crucially this would involve continuing the mine clearance from where the BiH had stopped the day before, and also scrub cutting from the second pylon up the hill through the thick undergrowth to the "missing" pylon.

We arrived on the HVO forward position shortly after 0700hrs. The arrangement from the night before was that the chain-saws would be ready at the first HVO pylon for the BiH to pick up. I found nothing happening and, seeing the chain-saws on the ground, sensed a certain lack of urgency. It was at this point that another aspect of the differences between UN countries became apparent. The Canadians were working to very strict safety rules. No more than one person at a time was allowed forward along the cleared path through the mined area. This was quite understandable in some ways but in this particular situation it was frustrating. I decided we had no time to lose, instructed my team to pick up the chain-saws and petrol and, together with the Croat company commander, we moved up the safe lane towards the planned rendezvous with the BiH.

We stopped at the first pylon. There was a thick early morning mist and I could hear voices to my left coming from the BiH trenches. It suddenly struck me that we were in an exposed position, in the middle of no-man's-land in a sensitive area. I started one of the chain-saws and holding it up revved it to let everyone know we were there. There was no sign of the BiH and I was very keen to get some kind of clearance started. Unexpectedly the Croat company commander volunteered to proceed up the valley to the end of the cleared path. I readily accepted his offer and with Tom, my military interpreter, we carried on up the valley, each of us carrying a chain-saw and hoping that the BiH would appear shortly.

Route Clearance Bosnia Style

We reached the end of the white mine tape marking the limit of the previous day's clearance. To my surprise the Croat started to make his way up the line of the pylons cutting his way through the scrub using a machete. Impressed by his example I started the chain-saw and set to with gusto cutting down trees as fast as I could. Tom was struggling, having flooded his engine, but after sorting out the choke we soon had the second saw working. Now I was more worried about Tom cutting his leg off as it was the first time he had ever used a chain-saw!

After about 20 minutes the BiH turned up with Zlatan, and they quickly took over, proceeding apace up the power line. They were a scruffy looking bunch but were adept at handling chain-saws. Tom and I left them to it and returned to the HVO position. I spent the rest of the morning moving between the WFs to maintain their sense of urgency and to sort out any difficulties between them and the UN troops.

Final Effort

By lunchtime things seemed to have slowed down and I visited the HVO end to see what the problem was. They needed to get a vehicle down to the first pylon to act as an anchor for the tensioning of the power line cables on the HVO side. The Canadians were unable to move the specialist Mine Protected Vehicle through the safe lane due to the steepness of the slope. The French volunteered the use of one of their armoured recce vehicles, called a VBL, to do the job. First it was necessary to bulldoze earth into the HVO communication trench with one of the Canadian armoured vehicles. Once this was done the VBL was able to drive along the safe lane to the first pylon. On the way it had to cross a small stream and while doing so the French found another tripwire mine, luckily before it was activated. The VBL was ideal for tensioning the repaired cables and the Croat repair team soon had the job finished.

Once the tensioning was complete I suggested to the Croat and Muslim repair teams that they follow me up to the next pylon and from there to the third or "missing" pylon as Afan had just reported the path cleared. We all picked up pieces of repair equipment; the heavy hydraulic crimping machine was slung on a pole and carried between two men.

As we passed a ruined house I mused on what the Croat company commander has said to me that morning. He had cut the telephone wires to the house in 1992 and had lost three men and five wounded while taking Kokoska Hill from the Serbs who were to retake it some time later. I felt a twinge of guilt as we passed a large plum tree I had cut down in my enthusiasm that morning. It

was a hard slog up past the second pylon and towards the third. Here we passed into the real no-man's-land, what Afan called the "ambush area." The trees were shattered by shrapnel and there was evidence of war lying around – the tail fins of rifle grenades, recently opened ammunition boxes and, wedged in the fork of a tree, an unexploded 82mm mortar round. My EOD experience told me that we would be OK provided we did not disturb anything. My heart stopped as I trod on a branch and the tail fin of a rifle grenade two metres to my right, moved. I froze, only to the laughter of the Croat behind me who simply picked it up and threw it away! We were all very worried about mines and religiously placed our feet in the footsteps of the man in front.

Meeting – No-Man's-Land

At 1400hrs we pushed through the last patch of undergrowth into the small space beneath pylon three. We had reached the missing pylon. Almost at the same time Captain Gravethe, of the French Engineers from the Serb side, arrived with the Serb repairman. Within a few minutes we were all there under the pylon – Zlatan, the civilian repair teams from the HVO, BiH and BSA, UNPROFOR troops from Sector Sarajevo and my team, in all fifteen of us. We stood around slapping each other on the back and shaking each other's hands. Afan produced a bottle of brandy which was rapidly passed round. The civilians had all worked together before the war and the animosity and accusations of previous days were forgotten as they chatted in-between taking large swigs from the bottle. The electricians soon started to rig up the pulley to lower the broken insulators and severed conductor. We all helped to heave on ropes to raise equipment to the top of the tower and two Croat repair men climbed up onto the pylon arms to rig the necessary pulleys. They were obviously very exposed to any snipers and Tom, without being asked, climbed the tower to be with them and stayed up there throughout the repair which was to last for the next 90 minutes.

Afan and one of the Croats had found the severed end of the broken conductor. It had been cut by flying shrapnel and had torn through the insulator connection with impressive results stripping the outer aluminium conductor like banana peel. Luckily not too much cable was lost and a compression joint was possible by pulling some cable from the Serb end. It was at this point that I witnessed the most moving sight of my time on Kokoska. It took three men to operate the heavy hydraulic crimping tool and there, working together, were a Croat, a Muslim and a Serb; a memorable image which stayed in my mind for many days to come.

It was now time to raise the conductor and we all helped pull on the rope. It was an incredible experience as everyone struggled to get the heavy cable into place.

Once it was up I decided to join Tom and the two Croat workers at the top of the pylon. Climbing up I noticed the bullet marks and the occasional larger bits missing due to mortar or grenade fragments and hoped the pylon was not going to topple over. The view was impressive looking back down the power line to Kiseljak in the west and Sarajevo in the east. Immediately to the south was Kokoska Hill with the Serb flag flying. At this point they started to tension the cable from the Serb side using an APC over a 1000m away, and the pylon shuddered alarmingly as the conductor sprung free from the undergrowth. The repair was finally complete.

We were all standing around smiling and congratulating ourselves when a couple of shots went off nearby. The atmosphere was instantly shattered. We were in a heavily fought-over place where many men had died. We had enjoyed a temporary local cease-fire and it was now time to leave this exposed place which, for very good reasons, was called the ambush area. We quickly collected the tools and, after saying very brief farewells, turned downhill and went our separate ways. There was a wonderful feeling of elation and suddenly, *en masse*, we all simply started running, leaping down the hill to the stream at the bottom, heedless of any mine or EOD danger. Common sense soon reasserted itself, however, and we retraced our footsteps carefully past the cut down fruit trees, the ruined house with its ghostly memories, past old haystacks from 1992 and back to the first pylon.

Electricity Restored

I reported the good news that we were all clear on the HVO side. The French answered that they were leaving the Serb side. I left the Canadians to pack up and drove to the Kiseljak electrical substation with Afan and the Croat repair team. It was from this substation that the power line would be energized.

My next mission was to act as the International Observer to witness the reinstatement of electricity

to Sarajevo from the Croat side. A French officer went to the Serb controlled Vogosca substation to carry out the same task. I got to the Kiseljak substation at about 1800hrs and reported that I was in position and waiting to see what would happen. Both the HVO and the Serbs had to convince each other that they were going to energize their respective power lines at the same time. This took some time to organize as it involved switching off power to Central Bosnia in order to connect up the Kokoska power line safely. The telephone did not stop ringing for about 30 minutes as the various technical procedures were arranged. The substation was a mass of banks of switches and dials mounted on large grey metal cabinets with various wiring diagrams and charts showing the electrical grid of Central Bosnia.

Suddenly the lights went out and the klaxons sounded indicating that the pylon line carrying power from the Neretva hydroelectric plants to the coal-fired plant in Kakanj had been switched off. This was necessary as the Kokoska power line fed off the Neretva line and both had to be properly earthed prior to the actual connection process. The connection of the Kokoska power line took place on pylon number 62 where both power lines intersected.

Our repair team had to carry out the actual earthing process, and Pylon 62 was somewhere high on a hillside above Kiseljak. It was now completely dark, Afan and the Croat repair team had been drinking brandy at a steady rate since we arrived at the substation, and we set off at a breakneck speed. We arrived at pylon 62 and three repairmen were soon stretched out on the pylon arms reconnecting the bridging bars which would link Sarajevo to the Central Bosnian grid. The connectors were rapidly bolted into place and ten minutes later the job was complete. At 2000hrs the power line was re-energized and energy flowed across Kokoska into Sarajevo for the first time since the end of May 1995. I reported the successful energization to HQ UNPROFOR and, after shaking hands with all the repair men and taking yet another drink of brandy, we returned to Sarajevo.

The atmosphere in the HQ was one of elation and relief. I reported to the General's office where a festive atmosphere was in full swing. Mr Pedauye, the Head of Mission, was there with Mr Eagleton, the Special UN Representative for the redevelopment of Sarajevo. Together with General Smith they had just given a press briefing reporting the successful completion of the mission to restore electricity to Sarajevo.

Reasons for Success

The main reasons for success were that all three WFs needed and wanted the cease-fire and were therefore prepared to allow the repair mission to succeed. While this was true, however, some of the WF local commanders had their own agendas and were very suspicious. The UN's role was essential to enable the mission to work. While the UN had a strict mandate to work to, it was necessary to prompt, cajole and threaten the WFs, and sometimes UN troops, to achieve the mission. It was fortunate at Kokoska that no one was hurt. A lesson for anyone engaged in UN operations is that the UN organization can often be as severe a handicap to the very mission it wishes to achieve – in some cases almost as much – as the WFs! This limitation must be taken into consideration during any commander's appreciation.

As in any war, communications are essential for the obvious reasons of command and control. In peacekeeping operations they are also vital to enable the truth to be known by all parties and shown to be known. Personal contact and individual rapport with all parties, leading to mutual respect and trust, are also of great importance often resulting in surprising and remarkable results.

Postscript

The October 1995 cease-fire lead to the signing of the Dayton Agreement seven weeks later and in December the Paris Accord. This was the precondition for the deployment of the Implementation Force and 20,000 American troops. While this cease-fire is the 37th in Bosnia's bitter and bloody war there is now a real chance it will hold – as long as the Americans stay.

Under the Dayton Agreement the Kokoska Hill area is due to be handed over to the Muslims.

Plus Ca Change ...

MAJOR P J FRANCIS BSc

After graduating from Southampton University with a civil engineering degree, Major Peter Francis was commissioned into the Corps in 1978. Tours with 21, 22 and 39 Engineer Regiments were followed by attendance at the Staff College and then a posting to the MOD, working for the Adjutant General. He escaped back into uniform to command 5 Field Squadron, before moving to the British Army Training Unit Suffield as SO2 Engineer. During his two-year tour in Canada he has set up the opportunity for a larger, more balanced engineer organization to train at Suffield from 1996 onwards, as described below.

Introduction

1995 was a period of considerable change at the British Army Training Unit Suffield (BATUS), with the introduction of tactical engagement simulation (TES) and the further development and refinement of the existing live-fire exercises. TES has been described by Roger Fawcus in an article in the December 1995 *Journal* which gave a well balanced view from the user's perspective. In 1996 and beyond, BATUS will have the capability to train an enhanced engineer orbat. This article explains the changes which are taking place and highlights some of the advantages which will be gained by those able to deploy.

Background

The engineer orbat which has exercised at BATUS as part of each battle group (BG) over the past few seasons has been a composite armoured and field engineer troop, with a small echelon in support. Last season this "troop" consisted of three armoured vehicle-launched bridges (AVLB), three armoured vehicles RE (AVRE), three combat engineer tractors (CET) and two field sections. The composite troop organization was originally created in parallel with the close support trial conducted by 23 Engineer Regiment several years ago, and consisted then of 2 AVLB, 2 AVRE, 2 CET and 2 field sections. This has gradually been increased to the current size because of engineer A-vehicle unreliability. However when Option W orbats were confirmed, with separate armoured and field engineer troops, the BATUS organization remained largely unchanged because of resource limitations and a general reluctance to agree an increased engineer commitment.

There are a number of penalties associated with the composite troop orbat, and these are explained below:

- It is unique to BATUS and does not reflect current doctrine or organization.
- The manpower for the troop, when deploying from Germany, has had to be drawn from separate armoured and field engineer squadrons which are not geographically collocated. Usually the first time the separate elements train under the single troop commander is during pre-BATUS training. Therefore throughout the BATUS package half of the troop is not working to its normal commander.
- The BATUS composite engineer troop gives BGs a misleading impression of the engineer support normally available to them and therefore false lessons are learned because the composite troop does not exist elsewhere.
- A single troop commander in charge of the composite engineer troop has often struggled to control this very large organization and therefore full training value has not been achieved. Many of the comments arising

Major P J Francis
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in the evaluation process would probably not have arisen if the correct command structure had deployed.

1996 Engineer Orbat

THE new engineer organization to be trained at BATUS has been introduced to conform with that in place in Germany and the United Kingdom and will therefore allow engineer doctrine to be practised and developed to a far greater degree. It enables all elements of both a field and armoured engineer troop to deploy and superimposes a tactical squadron headquarters to assist with command and control. There is also a small enhancement to the engineer echelon. The orbat therefore reflects the engineer support that a BG might expect to receive when it is the brigade main effort. The new organization is shown in detail in the table below, and the additional vehicles and crews for 1996 are indicated (*).

As can be seen from the table below, this is a sizeable enhancement, with the number of exercising personnel increasing from the current 86 up to 121. However close scrutiny of the new organization shows that the majority of the enhancements, as mentioned earlier, are made by inserting men into the command structure (a second troop headquarters, a support troop commander and a squadron tactical headquarters) and therefore whilst there will be several more chiefs, there are only a few more indians! It is appreciated that with current operational commitments, some units will be unable to meet the full manpower total, and therefore BATUS will tailor each *Medicine Man* exercise to the size of engineer organization able to deploy.

Vehicle		Crew in each vehicle	Function
• Squadron Tactical Headquarters:			
Spartan CVR(T) (combat vehicle, reconnaissance (tracked)	*	3	Sqn Comd
FFR (fitted for radio) Land Rover	*	2	Sigs
AFV (armoured fighting vehicle) 432	*	4	Sqn 2IC
AFV 432		4	BGEOO
• BG Close Recce Troop:			
Spartan CVR(T)	*	3	Engr Recce
Spartan CVR(T)		3	Engr Recce
• Armoured Engineer Troop:			
Spartan CVR(T)		3	Tp Comd
Spartan CVR(T)		3	Tp SSgt
Spartan CVR(T)		3	Recce Sgt
3 x AVLB		3	
3 x AVRE		4	
• Field Troop:			
Spartan CVR(T)	*	3	Tp Comd
AFV 432	*	3	Tp SSgt
2 x AFV 432		8	Fd Sects
AFV 432	*	8	Fd Sect
8-tonne	*	2	G1098
• Support Troop:			
Spartan CVR(T)	*	2	Sp Tp SSgt
3 x CET		2	
Medium wheeled tractor		1	
Light wheeled tractor		1	
4-tonne		1	
Self loading dump truck + Tilt Trailer		1	
Crane	*	1	
• Squadron Echelon:			
FFR Land Rover		2	Ech Comd
FFR Land Rover		2	Ech Comd Veh
3 x 4-tonne		1	
2 x 8-tonne	*	1	
8-tonne Unit Bulk Refuelling Equipment	*	1	
• REME Fitter Section:			
FFR Land Rover		2	Fitter Section Comd
AFV 432		3	
AFV 434		3	
AFV 434	*	3	
Challenger recovery vehicle		4	
GS Land Rover		2	

Benefits

CLEARLY there are many advantages to this enhanced organization and importantly it will resolve the penalties of the composite troop described above. Most significantly, however, a squadron commander and **both** troop commanders will now have the opportunity to deploy and train with their men and have a direct bearing on the training.

There will be occasions when it may be appropriate for a squadron commander to form composite armoured/field troops from the resources available to complete allocated tasks. It is not suggested that there is anything wrong with forming composite troops when appropriate, and this will allow squadron commanders to tailor their task organization as required.

BATUS has always been the principal focus for training for both the armoured

corps and infantry, and a troop of engineers in support has always been viewed by them rather as a side show. Whilst training for high intensity operations is a high priority within the Corps, the organization and resources necessary to provide the most value from it have received insufficient attention in recent years. However the deployment of the squadron commander in future will raise the profile of the engineer contribution within BG operations, and should ensure that we as a Corps are able to play a more significant role in the development of BG training and doctrine.

There may be some readers who recall a time when squadron commanders used to deploy to BATUS regularly ... **PLUS CA CHANGE, PLUS C'EST LA MEME CHOSE.**

Journal Awards

The Publication Committee announces the following awards for articles of special merit published in the December 1995 *Journal.*

A Mine Rescue Officer on the Western Front
by Simon Jones – **£75**

Management Theories, Long Shots and Safe Betts
by Major D W Taylor – **£75**

Birth of a Regiment
by Lieutenant Colonel N A Sutherland OBE – **£50**

Did I Really Get Paid To Do All That?
by Second Lieutenant R D Platt – **£50**

TES: A New Type of Medicine
by Lieutenant R C D Fawcus – **£25**

Wireless in the Boer War
by B A Austin – **£25**

Annual Awards

The Publication Committee announces the following awards for articles of special merit published during 1995.

Montgomerie Prize
Engineer Operations in Support of Humanitarian Operations – Rwanda, Operation Gabriel August to November 1994
by Major I S James MBE – **£75 or a set of Corps History**

Arthur Ffolliott Garrett Prize
Management Theories, Long Shots and Safe Betts
by Major D W Taylor – **£100**

Best article of the year
A Mixture of Endurance, Humour and Gory Too, but this is War
by Sapper W G Hughes – **£100**

Best junior officer article of the year
Did I Really Get Paid To Do All That?
by Second Lieutenant R D Platt – **£50**

Roles of Sapper Geologists in the Liberation of Normandy, 1944

Part 1. Operational Planning, Beaches and Airfields

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

Ted Rose served for nearly 30 years in the Territorial Army, the last 21 in the Corps as a military geologist, the last three additionally as Commander RE Specialist Advisory Team, before transfer to the Regular Army Reserve of Officers list in April 1990. He has contributed 13 articles to the RE Journal *between 1978 and 1994, and enough pen pictures to document his increasing venerability. In May 1994 he represented the Corps at the inaugural celebrations instigated by the University of Caen in Normandy to commemorate the 50th anniversary of the D-Day landings. He dutifully diminished the University's generous champagne supplies whilst once more in uniform – appropriately his service dress bought hastily in 1965 for Operation* Hope Not, *the state funeral of Sir Winston Churchill, in which he had slow marched (sword reversed) from Whitehall to St Paul's and then the Tower as a subaltern in Q (Queen's Own Oxfordshire Hussars) Battery, 299 Field Regiment RA(TA), a unit with strong Churchillian associations.*

Claude Pareyn is professor emeritus of geology in the University of Caen. He began as an assistant lecturer in 1945, helping to revive the University and its geology department following destruction during the battle for Normandy in 1944. After successive promotions and award of a D-ès-Sc degree in 1957 he became professor of geology in 1961. In 1966 he was honoured by appointment as Officier dans l'Ordre des Palmes Académiques, in 1982 Chevalier dans l'Ordre du Mérite, in 1987 Chevalier dans l'Ordre du Mérite agricole, and in 1992 he was granted an honorary doctorate by the University of Würzburg in Germany. From 1954 to 1961 he was also active in developing a geology department in the prospective university at Rouen. From 1962 to 1965 he was similarly involved at Le Mans, and from 1950-1955 and again from 1963-1986 he participated through numerous expeditions in geological exploration of the Sahara Desert. He retired from teaching in October 1987, but is still active as a consultant geologist, with particular interests in the environmental geology of Normandy and in hydrogeology.

Introduction

On 24 May 1994 the Université de Caen, Basse-Normandie, inaugurated a programme of events spanning the 50th anniversary of D-Day on 6 June, by two tributes to the Corps:

- a public lecture by Professor Claude Pareyn on "Des plages de la retraite de Dunkerque aux plages du Débarquement de 1944 : le rôle des officiers géologues du Royal Engineers Corps de l'Armée Britannique", subsequently published as a presidential address of the Haute et Basse-Normandie section of the Association générale des Hygiénistes et Techniciens Municipaux (Pareyn, 1994);
- an exhibition in the University's scientific library compiled by Dr Michel Rioult and a group of students on "Le rôle de la géologie dans les opérations du Débarquement et de la Bataille de Normandie."

Both were unusual in that they focused on the role of geology and Corps geologists – aspects of sapper activities little documented in proportion to other more major engineering achievements of the time. Some background information had been published earlier, by Colonels E P F Rose and N F Hughes (1993a) and by Rose and Major M S Rosenbaum (1993b). Correspondence between Pareyn and Rose stimulated a search for more. In consequence, with the then Engineer in Chief's approval, Rose accepted an invitation to represent the Corps at the lecture and associated functions. Thus began a collaborative study which has so far generated two geotechnical accounts (Rose & Pareyn, 1994; 1995) and the two-part role summary initiated here.

Operational Planning

Detailed planning for the invasion of northwest France in 1944 began approximately a year before D-Day. The planning staff contained a geologist – Major (later Lieutenant Colonel) W B R King OBE MC RE, in civilian life Professor of Geology at University College in the University of London. Bill King had considerable experience as a military geologist in both world wars (Rose & Hughes, 1993a, b; Rose & Rosenbaum, 1993a, b) leading to his appointment effectively as geological adviser to Chief Engineer 21 Army Group, and to the Engineer in Chief (Pakenham-Walsh, 1958, p323). Geological information together with King's advice were to be "one of the main factors which led to the selection of the beaches eventually used" (Inglis, 1946 p178). The original plan, once Normandy rather than the Pas de Calais had been selected as an invasion site, was to land on the beaches of the Cotentin peninsula with the immediate objective of capturing the port of Cherbourg – deemed essential as a supply route. But air superiority and therefore a dozen temporary airfields to sustain it were also deemed essential – and it was King who pointed out that for geological reasons the region best suited for rapid construction of airfields was

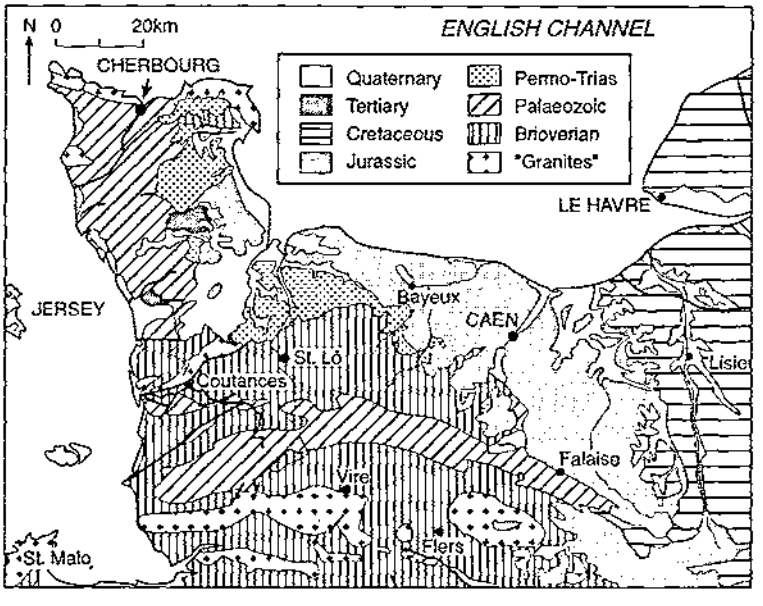

Figure 1. Simplified geological map of Normandy. The rocks of the Cotentin peninsula, south of Cherbourg, form part of the Armorican Massif which extends westward into Brittany. They are relatively old (Pre-Cambrian (Brioverian) and Palaeozoic in age), deformed, and strong (including intrusive "granites", as well as metamorphosed or well-cemented sediments) and give rise to a hilly if low-lying (<117m) terrain, full of woods and small fields separated by banks and hedges – the bocage. In contrast, the rocks of the Calvados plateau between Bayeux and Caen to the east of this area form part of the western margin of the Paris Basin. They are relatively young (largely Jurassic and Cretaceous in age), sub-horizontal, and weak (predominantly limestones and clays), and covered by superficial deposits of Quaternary age, most extensively a wind-blown loess (only some 2-3 m thick, so not shown on the figure). These features give rise to a gently undulating topography, farmed in large open fields without banks and hedges. (From Rose & Pareyn, 1995; after Doré et al., 1987).

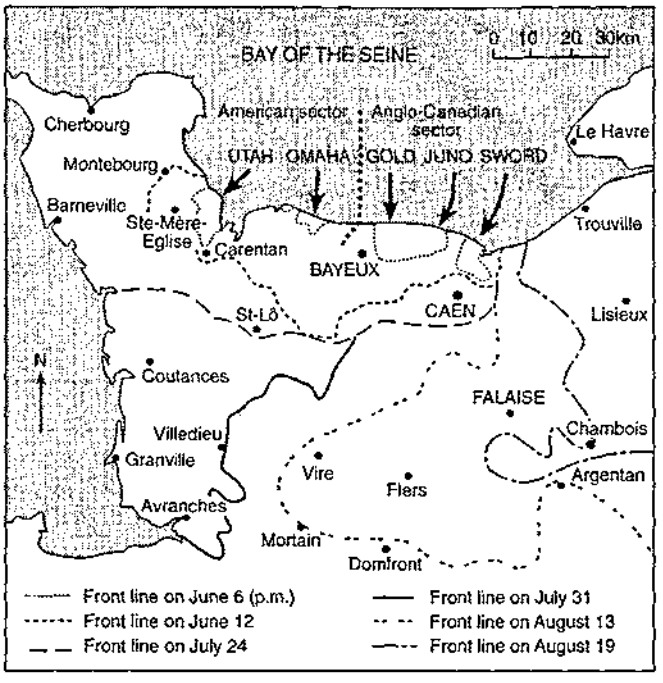

Figure 2. Map showing location of the American (Utah, Omaha) and Anglo-Canadian (Gold, Juno and Sword) beaches for D-Day, 1944, and the subsequent Allied advance through Normandy.
(From Rose & Pareyn, 1995; after Desquesnes, 1993).

not the Cotentin peninsula south of Cherbourg but the Calvados plateau between Bayeux and Caen *(Figure 1*, previous page*)*.

King was released from the army in October 1943 to take up appointment as Woodwardian Professor of Geology in the University of Cambridge. His role passed to a protégé, Captain (later Major) F W Shotton RE, recalled to the UK from active service in North Africa – and postwar himself to become a professor of geology, first in the University of Sheffield, and soon afterwards in the University of Birmingham (Rosenbaum, 1990a, b; Rose & Hughes, 1993a; Rose & Rosenbaum, 1993b). Fred Shotton joined a team on the 21 Army Group planning staff led by the distinguished physicist and crystallographer J D Bernal, Professor of Physics at Birkbeck College in the University of London but seconded as Scientific Adviser to the Chief of Combined Operations despite his earlier anti-war and extreme left-wing views (Kendrew, 1986). Geologist tasks at this time included library and photographic study of the cliffs of the proposed invasion areas; the provision of information on the foundations of enemy defences for their effective bombing; the preparation of water intelligence maps; information on sources of road metal, sand and gravel, and on the submarine geology of ports; and the detailed study of certain rivers with a view to assault crossings (Shotton, 1947). However, the two most important tasks were the study of potential invasion beaches, and the soil conditions of possible airfield sites.

The work of this team was complemented by that of the Inter-Services Topographical Department, a unit which by 1944 contained several geologists, at least three of them sappers: Captain (later Major) J L Farrington, a graduate of the University of British Columbia, who had considerable experience of air photographic interpretation through pre-war geological employment in southern Africa; Lieutenant T C Phemister, in civilian life already Professor of Geology and Mineralogy at the University of Aberdeen but formerly an Associate Professor at the University of British Columbia; and Captain (later Major) D R A Ponsford, an experienced exploration geologist who postwar was to become a District Geologist with the British Geological Survey (Rose & Hughes, 1993a, b; Rose & Rosenbaum, 1993b). Phemister in particular is known to have made contact with geologists in France, notably at the University of Rennes, where there was support for the Resistance (Tait, 1984). The University awarded him an honorary Doctorate soon after the end of the War, in 1947.

Beaches

It was important that vehicles followed firm routes over the landing beaches on D-Day. Accordingly, the Normandy beaches *(Figure 2)* were analysed in detail not only with regard to configuration and slope, but also to the distribution of the patchy peat, clay, sand and shingle known to form the surface. Geological expertise was brought to bear in a number of ways:

- **Detailed literature searches.** Publications, some in obscure or very specialized journals, were located and studied for information on the position of erratic blocks of rock and patches of sub-surface peat. Some of these potential obstacles were only

intermittently exposed by storms and exceptional tidal conditions and so were not actually visible in the months prior to the invasion.

- **Aerial photographic interpretation.** Aerial photographs, some taken obliquely by aircraft flying along the beaches at altitudes as low as 50ft (16m), provided information on natural as well as man-made obstacles. Shotton recounted after the War how patches of dark peat could be recognized after storm movement of the lighter-coloured sand; how the load-bearing properties of some beach areas could be estimated from the depth of wheel marks left by German carts transporting defence stores; and how he himself had made personal observations from the copilot's seat of low-flying aircraft.
- **Covert beach sampling.** Midget submarine X-craft operated by COPP (Combined Operations Beach Reconnaissance and Assault Pilotage Parties) carried specially trained volunteers close to the beaches. Scott-Bowden (1994) has described from personal experience how their task was to swim ashore, and to auger soft sediment and collect samples of stone" as well as to make observations on obstacles to cross-beach movement and exit. Beach samples were sent to the British Geological Survey for analysis (Evans, 1945).
- **Beach-process laboratory study.** According to Bernal (1955), beach processes were studied in numerous laboratories – and particularly by R A Bagnold, who had served as a sapper officer in World War One but subsequently transferred to the Royal Signals, before retiring (as a Major) in 1935 to undertake research at Imperial College, London, on the physics of sand movement. He rejoined the army in World War Two, founded the Long Range Desert Group in North Africa and subsequently became Signal-Officer-in-Chief, Middle East. Bagnold was released from the army in 1944 (as a Lieutenant-Colonel, Honorary Brigadier) to continue research on sand and (marine) wave movement – fields of research that distinguished him as a scientist, and as a prizewinner of the Institution of Civil Engineers (Anon., 1990).
- **Training ground selection.** Testing of plant and equipment, and troop exercises, were carried out on the beaches near Brancaster in Norfolk, where similar Quaternary geological conditions to those in Calvados had been identified.

Figure 3. Looking down on vehicles leaving a Landing Ship Tank as they make for the beaches, 7 June 1944 (D+1).
(Copyright The Imperial War Museum, London: Photo B5127)

Geological expertise thus contributed to planning of the invasion, preparation of the 1:5,000 scale beach-head maps which guided the D-Day landings, and training on appropriate ground conditions – contributing to the success *(Figure 3)* and largely avoiding the potential disasters *(Figure 4)* of vehicular movement across the landing beaches. Bill King had also provided advice on the nature of the sea floor beneath the English Channel which guided the laying of pipelines for fuel supply as the campaign progressed (Sutton, 1978).

Figure 4. Normandy beach, shortly after the D-Day landings, showing bogging of a loaded lorry which had left the route across firm sand and become entrapped in the peaty clays of a submerged Pleistocene forest.
(From Anon., 1949; Crown Copyright)

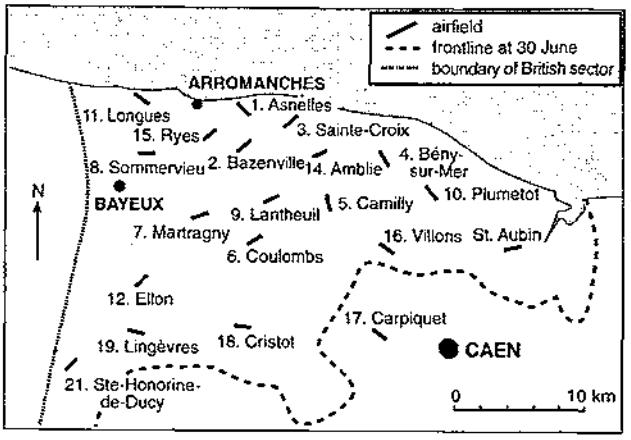

Figure 5. Map showing position and orientation of British airfields in Normandy, 1944. See *Table 1* for lengths and completion dates. (After Rose & Pareyn, 1995; Anon.,1945c; Rioult et al., 1994).

Table 1. British Airfields in Normandy 1994

Code number	Locality name	Length (metres)	Completion date
B1	Asnelles	550	7 June
B2	Bazenville	1520	13 June
B3	Sainte-Croix	1100	11 June
B4	Bény-sur-Mer	1100	15 June
B5	Camilly	1520	17 June
B6	Coulombs	1520	16 June
B7	Martragny	1100	26 June
B8	Sommervieu	1100	21 June
B9	Lantheuil	1100	21 June
B10	Plumetot	1100	24 June
B11	Longues	1100	26 June
B12	Ellon	1520	18 July
B14	Amblie	1100	3 July
B15	Ryes	1100	6 July
B16	Villons-les-Buissons	1100	31 July
B17	Carpiquet	1600	8 August
B18	Cristot	1100	6 August
B19	Lingèvres	1520	8 August
B21	Sainte-Honorine-de Ducy	1520	13 August

Additionally, an unnumbered 1000 by 100yd (915 by 92m) airstrip was completed at Saint Aubin d'Arquenay by 19 July for the removal of gliders used by 6 Airborne Division on D-Day. B13 was not built by UK forces; B20 was built by First Canadian Army.

See Figure 5 for diagram of airstrip orientation and geographical position.

A second (untracked) strip was constructed parallel and adjacent to the first (tracked) strip at B3, B5, B6, B7 and B10, to preserve the tracked strip for use in wet weather, provide a wider strip for quick take-off when urgent scrambling was necessary, and make it more difficult for bombing to put the airfield out of commission.

Data are from Panet (1945); also Anon., (1944; 1945a-d) and construction reports of 12 AGRE preserved in the RE Library. They slightly amend those given by P Bauduin in Florentin and Boussel (1994).

Airfields

Much of the bedrock of the Calvados plateau is covered with a 2-3*m* thick deposit of loess – an unstratified wind-blown dust with particle size between 1/16 and 1/32mm, blown between some 130,000 and 10,000 years ago from the vegetation-free areas which surrounded the glaciers then covering much of northern Europe, during the Pleistocene "Ice Age". Bill King and Fred Shotton recognized that the loess provided the key qualities required for rapid construction of military airfields in 1944: excellent drainage in wet weather; firm even surface in dry weather with lower shrinkage and cracking than a "true clay"; and development of a widely-consistent, homogeneous soil cover (King, 1951). Ways in which their geological expertise contributed to the development of operational airfields included:

- **Site selection.** A (1945) report by Brigadier H de L Panet, Deputy Chief Engineer Airfield Construction, records that "The value of detailed topographical and geological study in selecting airfield sites in the beach-head area was fully proved ... The most valuable forms of specialized Int[elligence] were 1/100,000 geological overprints ... prepared by the Geologist." Twenty airfields were successfully completed in the British sector of operations between 7 June and 13 August 1944 *(Figure 5)*. Lengths ranged from 1,800ft (550m) to 5,000ft (1,520m) *(Table 1)*.
- **Stores prediction.** "Geological study enabled calculated risks to be taken in forecasting the rate of import of airfield surfacing stores. Based on geological information provision was made for surfacing only 50% of the airfields in the British sector as against 75% in the US sector, where more clay was expected. This enabled the stores demand in the British sector to be reduced by over 400 tons a day for the first 30 days of invasion, when every ton was of great importance. Even with this 50% reduction, airfield stores made up nearly 25% of the total planned tonnage of Engineer stores to D+30" (Panet, 1945). By the end of August twenty-three airfields were in use, ten of which had runways made with Square Mesh Track *(Figure 6)*, two with Prefabricated Bitumenized Surfacing *(Figure 7)*, two with repaired concrete, and nine without any special runway material *(Figure 8)* (Buchanan, 1953). The loess, deposited by wind activity during the Weichselian phase of the Quaternary (Pleistocene) "Ice Age," easily re-converted to dust

when agitated, so was stabilized by spraying with oil or water (Mitchell, 1994), or by retaining a grass or crop cover whenever feasible (Anon., 1945d).

From D-Day to 5 May 1995 about 125 airfields were either constructed or repaired, with total combined length of some 2,020 miles (3,250km). Approximately 17,000 troops of all ranks were employed almost continuously on airfield construction in 21 Army Group, 6,000 in Army units and the remainder in RAF works units (Anon, 1945a). The air supremacy over the battlefield thus facilitated was a major factor in achieving victory.

Conclusion

As the battle in Normandy developed, so did geologist roles with respect to quarrying, water supply, bombing and cross-country movement – but these are activities to be described in the sequel to this article (Rose & Pareyn, in press), where further information sources will be acknowledged.

Figure 6. Sappers surfacing a temporary airfield in Normandy with Square Mesh Track (SMT). (Copyright: The Imperial War Museum, London; Photo CL468)

Figure 7. Sappers using a "stampicker" to pave a temporary airfield in Normandy with Prefabricated Bituminized Surfacing (PBS). Developed by the Canadians from a British origin, PBS gave a better surface than SMT but was slower (and in high winds more difficult) to lay and was therefore less commonly used. (Copyright The Imperial War Museum, London; Photo CL468)

Figure 8. Rocket-armed Typhoon taking off from an airfield in Normandy. The ground is so dry that a dust cloud is generated from the loessic soil – a hazard to pilot visibility and to engine wear. (Copyright The Imperial War Museum, London. Photo CL147).

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A Gigantic RE Task: 20 Airfields in Two Months!

Aerial Photos Discovered – A Contribution To History

PHILIPPE BAUDUIN AND JOHN C WALDRON

Philippe Bauduin was fourteen when he first met Royal Engineers on the Normandy battlefields. He served three years as photo interpreter officer in 2/33 Squadron of the French Air Force before beginning a civil career in 1958 as a research engineer in solid state physics, optics and microwaves. In 1974 he was in charge of the Great National Heavy Ion Accelerator project in Caen. In 1980 he joined the French National Agency for Research Development, where he led the Innovative Engineering and Technology Transfer Department.

Now retired, he lives in his country cottage, an ex-Royal Engineer pump house, where he spent a large part of his time preserving the name of the Royal Engineers and writing about their works in Normandy.

Philippe Bauduin, who has published papers about airfield construction, has been awarded the Legion d'Honneur.

John Waldron holds a Master of Arts in International Affairs at the Elliott School of International Affairs, George Washington University, Washington DC. He works as a researcher in Washington DC and most recently served as Programme Coordinator for The Jean Monnet Council.

The Greek Inscription

In pleasant countryside, just a few miles from the Normandy beaches, stands a stone pumping house with a Greek inscription carved on its gable. The building was erected by Royal Engineers during the Normandy campaign of 1944. It was used to supply water to the airfields built nearby and is all that is now left to represent the tremendous effort put into supplying the needs of the invasion force during that hot dry summer.

The Enigma

The question arose as to exactly who went to such lengths to create and maintain these airfields which had been so important to the success of the invasion force in 1944. Here was an enigma that lead to a 20-year search for aerial photos of the lost landing strips of 1944. Recent evidence, uncovered in the National Archives of the United States in Washington, shed new light on the labours of these military engineers, labours which proved so vital to winning the war in western Europe.

1942 to 1944

The western Allies began searching for potential airstrip sites as early as 1942, when the second front was being planned. Aerial photographs taken from RAF reconnaissance aircraft were studied by geographers and geologists, and military and civil engineers. Plans were drawn for each site selected, and materials and equipment stockpiled. The scheme depended on converting cultivated fields in Normandy into airfields for Allied planes to use, and the task was given to 12 Army Group Royal Engineers, under command of General G N Tuck. Construction was undertaken by five Airfield Construction Groups: 13th, 16th, 23rd, 24th and 25th, each with sapper and pioneer companies and attached squadrons of electrical and mechanical engineers.

Plans for 45 Airfields

The plans, drawn up in 1943, envisaged the construction of 45 airfields for the RAF alone, but as the British front line stabilized around Caen,

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A gigantic RE task p43.

RAF airfields Normandy 1944		German photographs Dick Tracy Files National Archives Washington			
Serial No	Exposures Location	Data sheet No	Date	No	Date
B 1	Asnelles	W 10-3 63 A	15-06-44 02-08-44		15-06-44 02-08-44
B 2	Bazenville				
B 3	Ste Croix sur Mer				
B 4	Beny sur Mer	W 10-12 W 10-12 A W 10-12 B 93	16-07-44 16-07-44 16-07-44 02-08-44		06-07-44 16-07-44
B 5	Le Fresne Camilly	W 10-30 W10-30 A W10-30 B	16-07-44 16-07-44 16-07-44		16-07-44
B 6	Coulombs	127 W 10-18-19	12-08-44 12-08-44		12-08-44
B 7	Martragny	W 10-109 A 124 124 A W 10-9 A W 10-50	28-06-44 12-08-44 12-08-44 12-08-44 12-08-44	49/0 W	12-08-44 12-08-44
B 8	Sommervieu	W 10-10	28-06-44		28-06-44
B 9	Lantheuil				
B10	Plumetot	W 10-23 A W 10-23 B	07-07-44 02-08-44		07-07-44 02-08-44
B11	Longues	63 W 10-20	02-08-44 02-08-44		
B12	Ellon	W 10-9A	12-08-44		12-08-44
B14	Amblie				16-07-44
B15	Ryes				
B16	Villon Les Buissons	W 10-28 W 10-28 A 133	16-07-44 12-08-44 12-08-44		16-07-44
B17	Carpiquet	94 W 10-4	04-08-44 04-08-44		04-08-44 04-08-44
B18	Cristot	130 W 10-51	12-08-44 12-08-44		12-08-44
B19	Lingevres	W 10-9 A	12-08-44		
B21	Ste Honorine de Ducy				

Table giving precise details of photographic material available.

(Interested readers may like to note that M Bauduin was kind enough to donate copies of a number of the above mentioned photographs to the Corps Library at Chatham.)

(unexpectedly short of projections), and remained there for six weeks, only 20 were actually built over a period of about two months from 7 June to 8 August 1944.

Construction techniques were simple. The predetermined site was prepared and levelled, and square mesh netting was rolled out and secured with metal pickets. The mesh employed was of the same variety commonly used to reinforce concrete, but the sappers used no concrete; the mesh was laid onto bare ground.

Over that summer, as hundreds of planes rolled over these sun-baked fields, a problem was caused. Clouds of dust were raised which could be seen for miles; the clouds obscured the airfields from the pilots and, at the same time, created easy targets for enemy gunners.

Where were they Laid?

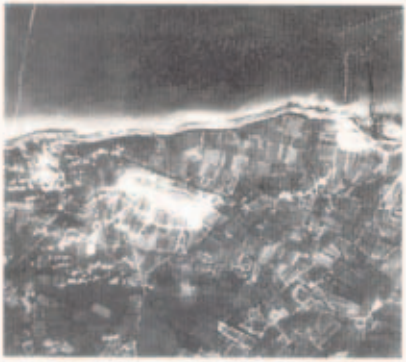
Despite the crucial role played by the airfields, little evidence of their existence remains today. The 20 fields were quickly returned to cultivation as the battle lines swept north and eastward.

French sources were of little help in locating the fields, and the postwar IGN (Institut Geographique National) map surveys revealed no details. Some of the mesh can still be seen, but only where it has been used to block a hole in a farmer's fence or to render a thinning hedgerow stock-proof. A great deal of information is available but must be gleaned from war diaries and personal accounts.

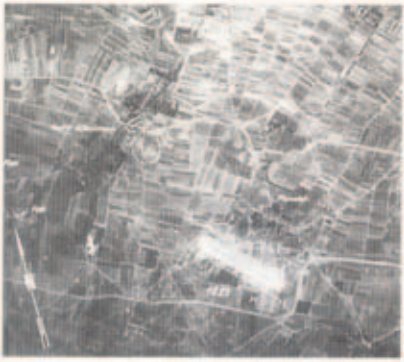
Aerial Photographs

Many official records have been released over the years but existing aerial photographs of the airfield sites are of limited value. Taken by the RAF in 1943 (when reconnaissance of prospective sites occurred), these can be found at Keele University, UK, in the Air Photo Library of the Geography Department. Only a few vertical and oblique photos, most of poor quality, were taken once the airfields were actually constructed; this should come as no surprise however as the RAF had no interest in taking pictures of their own fields once the front advanced.

This left only one possible source – the *Luftwaffe* Air Photo Library. Early in August 1944, the *Luftwaffe* brought out the world's first jet reconnaissance aircraft: the Arado 234, one of which made the first jet reconnaissance over Normandy in the summer of 1944; some veterans may still remember the familiar whistling sound this aircraft made. Was it possible that some of the reconnaissance photos survived the war? The US Army did in fact capture a great deal of photographic material from the *Luftwaffe* archives in 1945, but it was



B11: Longues. Probably the first photos taken by a jet.



B10: Plumetot.

believed lost when the barge carrying the material burned to the water-line that winter. However, pre-existing sharing arrangements with the British had obligated the US to make copies of the material for British use. Apparently duplicates were made, but after the originals were destroyed these remained in American hands and were discovered by John C Waldron, co-author of this article, in the summer of 1995.

The table shown on the previous page, details precisely the photographic material available. Two photos in particular are of interest: numbers 63 and 63A. These were probably among the first ever taken from a jet plane. The pilots of the craft from which these photos were taken, *Oberleutnants* Götz and Sommer, also coveted other targets, notably the Mulberry Harbour at Arromanches and the British pipeline terminal at Port-en-Bessin. The discovery of this photo archive sheds new light on the Normandy campaign, and from the photographs it is possible to develop a sense of the the enormity of effort required to produce these airfield bases within such a short period, and to imagine the determination of the men behind that effort.

Greek inscription still visible on gable of pump house

House Warming Visit

Many years later, General Tuck and a number of his old sappers joined Philippe Bauduin at the old stone pumping house, now converted into a cottage. As house-warmings go, no "warming" was necessary; it was a summer's day and there were cold drinks. The event recalled the vital role of the pumping houses in keeping the airfields moist to suppress the telltale dust clouds which would otherwise have marked the arrival and departure of every aircraft.

Of the thirsty housewarming guests however, it must be said that they totally disregarded the Greek inscription still visible on the gable. Pindar's ode is, of course, still as appropriate now as it had been in his day and in 1944:

"OF ALL THE ELEMENTS, WATER IS BEST"

A gigantic RE task p45

The Battle Group Engineer Operations Officer Within Framework Operations in Bosnia

CAPTAIN D J DIGBY

After having spent four years as a soldier in the 3rd Battalion Royal Anglian Regiment, serving in Minden and Colchester and rising to the faint heights of private, Captain Dominic Digby was commissioned into the Corps in 1991. Following 106 YOs' course he was posted to 48 Field Squadron (Construction), which later became a field squadron (air support), and while at Waterbeach completed construction projects on Exercises Pinestick *and* Waterleap 93. *Prior to a posting to 21 Engineer Regiment, he spent a further period on the Falkland Islands, this time as the Field Squadron Operations Officer.*

21 Engr Regt deployed to Bosnia in March and April 1995 on Operation Grapple 6. *During this tour the author was the Battle Group Engineer Operations Officer for the British Cavalry Battalion based in Zepce.*

Recently the Battle Group Engineer Operations Officer (BGEOO) appointment title has been changed to Battle Group Engineer (BGE).

Introduction

For the Op *Grapple* 6 tour three battle group engineer operations officers (BGEOOs) were to be detached from the regiment, one being placed under operational control (OPCON) of each of the three British battle groups (BGs) employed on framework operations. This task organization (TASKORG) was similar to that of previous Ops *Grapple*, and the BG missions were likewise the same, with the main effort directed towards G5 assistance.

Framework forces were redesignated as first echelon troops following the deployment of the Rapid Reaction Force (RRF) in June. The RRF, sporting their own indigenous berets and camouflage vehicles, were designated as the second echelon force with a war fighting capability. This organization is shown at Figure 1.

Primarily because of this split, the BGs, and therefore the BGEOOs, found themselves with diverging missions. BRITBAT 1, based on 1 Devon and Dorset (1 D & D), was retitled UN Task Force Alpha (UNTF-A) and was chopped to under command of the Multinational Brigade (MNB), as was their BGEOO, Captain Jim Weeden. The majority of BRITBAT 2, based on 1 Royal Welsh Fusiliers with Captain Dave Jackson as their BGEOO, was based in Gorazde. Although they were actually a first echelon force, their location and the warring faction (WF) situation ensured that they were almost completely divorced from framework operations as experienced within central Bosnia. BRITCAVBAT, which was the third British BG, was a rather unusual amalgamation of cavalry due to the lack of medium reconnaissance regiments. It was based around a RHQ and weak echelon of the 9th/12th Royal Lancers, extracted from Bovington, where they were serving as the current Royal Armoured Corps Centre Regiment. The two sub-units consisted of C Squadron Queen's Royal Lancers and C Company 1 D & D, the latter reverting to command of UNTF-A in May. BRITCAVBAT was the only British BG to be fully employed within framework operations in central Bosnia for the duration of Op *Grapple* 6, from April to October 1995. The BG area of responsibility (AOR) was significantly enlarged to reflect the loss of UNTF-A to the MNB.

Aim

The aim of this article is to detail the role and responsibilities of the BGEOO employed within framework operations in central Bosnia.

Captain J Digby
The Battle Group Engineer Operations Officer p46

Roles and Responsibilities

The BGEOO is the BG CO's engineer staff officer and it is to his CO that the BGEOO's loyalties must lie initially. Engineers are a highly sought after and versatile asset and as such the BGEOO has a wide-ranging portfolio. His main responsibilities can be summarized as follows:

- To advise the CO and officers commanding subunits, of the capabilities of engineers and of the engineering implications of their plans.
- The identification, recce and planning of tasks from the requests of the BG or from any one of many other sources.
- The compilation of initial recce (IR) reports and appropriate stores demands. The BGEOO is responsible for justifying and staffing these reports up the engineer chain so that the BG receives the necessary level of support.
- The BGEOO is the link between the BG and the RHQ of his parent regiment, in this case BRITENGBAT (21 Engr Regt).

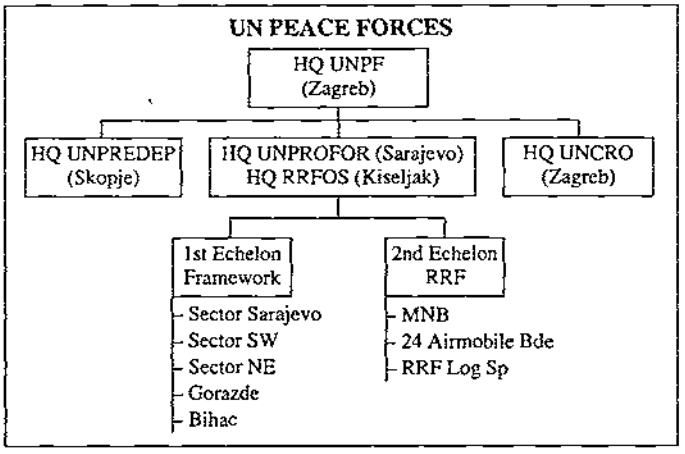


Figure 1. United Nations Peace Force organization.

These main responsibilities are common to all BGEOOs but to degrees which vary greatly. There is also a plethora of minor tasks and responsibilities, many of which are specific to the particular BG. The balance developed and emphasis placed on all these are dependent upon factors integral to the BG and its AOR and external influences such as the relationship with BRITENGBAT and the Sector. Of the former, the following are the main influencing factors that determine the prevailing routine of the BGEOO:

- Differences in the individual styles of the respective BG COs and the inherent differences in the BGs themselves, ie infantry or cavalry, tracked or wheeled vehicles etc.
- The WF activity in the BG AOR and its attitude toward UN' forces.
- The deployment of the BG within the AOR.
- The extent of the existing infrastructure and essential services.
- The physical geography of the AOR.
- The locality of the field squadrons to the BG.
- The extent of the G5 and aid agency network within the AOR.

Method of Work

As the BGEOO is under OPCON of the BG, this will be his primary chain of command. He must also keep a number of other agencies abreast of events without becoming totally immersed in BG affairs.

Loyalties and Communication. The BGEOO clearly works to at least three agendas: that of the BG, that of the field squadron responsible for the BG's AOR and that of RHQ BRITENGBAT. He has a direct link to CO BRITENGBAT who, being double-hatted, is also the sector chief engineer and therefore the sector agenda has to be taken into account.

The BGEOO, being the "middle man", requires a degree of tact and diplomacy whilst attempting to deconflict differing priorities. When briefing engineers, the BGEOO should show loyalty to the BG and express its requirements. Conversely, he must show loyalty to the engineers and express their concerns and more pressing commitments when briefing the BG. This unique position places the BGEOO at the intersection of a number of lines of communication with access to information that, for various reasons, may not officially reach either the BG or engineers for some time. Such information may usually not be engineer-specific and have wider G3 implications. Therefore the BGEOO must effectively and frequently communicate to all the relevant agencies or units, notwithstanding the very occasional restrictions of operational security.

Priorities and G5. The most common concern was the prioritization of tasks between the BG and the engineers. BRITENGBAT work to priorities as set by the chief engineer, in accordance with the sector commander's main effort. Throughout the Op *Grapple 6* tour there was only one change to the sector engineer priorities and this followed the

deployment of the RRF. The post-RRF priorities were as follows:

1. Security of UNPROFOR lives including quick reaction EOD tasks.
2. Construction and maintenance of UNPROFOR/UN High Commissioner for Refugees (UNHCR) routes.
3. Monitoring mine clearance/marking and collation of mines information.
4. Construction and maintenance of camps and services in conjunction with UN engineer support services organization (main effort for reinforcements).
5. Support to key G5 infrastructure projects.

The list shows the low priority that is understandably allotted to G5 infrastructure tasks. This conflicted with the mission of BRITCAVBAT, a specified intent of which was "to enhance the development of humanitarian assistance in support of the UNHCR and by undertaking G5 projects." Engineers did undertake a considerable number of G5 infrastructure tasks, mainly associated with roads, however the distinction between G5 and G3 tasks on this larger scale is vague. Many tasks render the UN susceptible to local blackmail and during planning of what appears to be a simple task, complex layers of local politics can be revealed.

Apart from infrastructure tasks, the main engineer G5 effort lay with mines awareness training (MAT) for local school children. Neither infrastructure tasks nor MAT was reflected in the BG's G5 main effort. Normally BGs are more interested in smaller tasks that benefit local communities and enhance BG civil relations whilst usefully employing otherwise redundant soldiers. However, although this was the common G5 aim, BRITCAVBAT, being a medium reconnaissance regiment with only one subunit[1], did not have the manpower available to undertake these. Additionally, unlike the relative peace of the previous tour, the WF situation and restriction on the freedom of movement (RFoM), ensured that work on G5 projects was suspended for much of the time. When work is ongoing however, as it will be if any peace agreement is reached or when the usual winter lull in fighting begins, the tasks are normally collated by the BG G5 liaison officers (LOs). The LOs trawl the multitude of aid agencies, either governmental organizations or non-governmental organizations, to encourage one of them to undertake the project. The aid agencies vary in size, competence and funding. Certain aid agencies have their own engineers but those that do not, provide only the funding and seek assistance and advice from the BGEOO or, more usually, ask for artisan reconnaissance and a subsequent stores list. It is often possible for RE artisan tradesmen to undertake certain tasks or supervise a works party from the BG. The issue of stores and funding for G5 is still not clearly understood by the BGs, albeit straightforward. The UN Engineer Support Service, which controls the resources budget, does not provide money or stores for G5 tasks.

Planning Cycle. In a theatre where the situation can change rapidly and unpredictably, no plan remains valid for very long with the exception of the engineer project planning cycle. Although this was described in the August 1995 issue of the *RE Journal*, in an article by Captain Ty Urch, on page 190, it is an invaluable guide and is worth re-emphasizing. The full cycle is shown at Figure 2 but the following points are particularly relevant for the BGEOO:

- **Statement of Requirement.** The BGEOO is responsible for producing the initial statement of requirement (SOR) for any major task – usually associated with the creation, relocation or expansion of camps within his AOR. The SOR is ostensibly a shopping list of the client's requirements. If the project is approved, it is from this document that the necessary information for the reconnaissance can be extracted and the planning started in earnest.

  An SOR concerning camps and locations, generally covers the following:

  - Troop and vehicle numbers and any planned increases. It is upon these figures that the scale of the requirements below are based:
  - Accommodation and ablutions.
  - Protection.
  - Office space.
  - Storage space.
  - Kitchen facilities.
  - Workshop facilities.
  - Communications (Communications Centres usually require suitable sites).
  - Vehicle hardstanding.
  - Recreational facilities.
  - Electrical load and supply.
  - Water and sewerage.
  - Any miscellaneous points such as helicopter landing strips, unloading bays, blinds pits, mobile bath and laundry unit, etc.

  Planning figures for an SOR can be gained from the UNPROFOR engineering SOPs (Standard Operating Procedures). These provide such detail as the allocation of numbers of officers and soldiers to accommodation and ablution units. It also specifies entitlement of other resources from transit accommodation to septic tanks. The SOPs themselves remain in draft format and therefore can be used for nothing more than

[1] BRITCAVBAT's total, augmented establishment was 206.

guidance. Although BGs have been known to cram soldiers into accommodation units to create spare containers for use elsewhere, it is only sensible that the BGEOO bases his SOR on the figures given within the SOPs.

- **Resources/Funding Check.** This is the fundamental factor that will dictate the timescale for the completion of the task. Once the initial reconnaissance has been completed, a thorough check on the available resources or funds is essential as this often shapes any emerging design. Should the stores be readily available, the task may then only depend upon the availability of manpower and the consent of any local agencies. However, should the stores require demanding or a request for funding, it is likely to be a task that at best can be included in the longer term works programme only, or even the handover programme, or at worst never progress any further. A thorough check will usually prevent considerable wasted effort although a current lack of resources must not prevent the need for long-term planning, indeed it should drive it.
- **Preliminary Design and Initial Report (IR).** The BGEOO's main role within the planning cycle culminates with his initial design and IR. Design assistance can come from a number of sources. For many, the initial point of reference is the STRE, based in Gorni Vakuf, which possesses a design capability unique in theatre and is therefore kept extremely busy. There is a tendency for engineers to be too reliant on the STRE when plenty of helpful reference documents are available. I kept contact with the STRE to a minimum primarily because I endeavoured to design tasks myself based on existing reference material and the experience gained from a construction squadron at Waterbeach. Although I deployed with a full set of pamphlets the following were the most useful:
  - *Op Grapple Hardening* Aide Memoir, edition 2 dated 15 April 1995 (this does require amending).
  - ME Volume II, Pamphlet No 1, *Basic Field Engineering*.
  - ME Volume V, Part 1, *Roads*.
  - ME Volume II, Pamphlet No 8A, *Roads*.
  - ME Volume II, Pamphlet No 7B, *Classification of Bridges*.
  - ME Volume II, Pamphlet No 3, *Obstacles*.
  - *Basic Structures for Operations*, April 1986 (now republished as Pamphlet 10).

The STRE is an invaluable source of advice and it is not suggested that it be ignored. Once a preliminary design has been committed to paper, if any doubts exist, it may be wise to invite them to make any suggestions or recommendations. Occasionally the STRE designs, based on British Standards, lack the flexibility that must be applied to projects in Bosnia. For instance, a plan to stabilize a landslip using a geotextile "carpet" fastened to the slip with anchor earth holdfast pins, failed to realize that the pins were, in the eyes of the locals, particularly useful items better serving as fence posts for their goats. Likewise the use of pierced steel planking (PSP) at locations not permanently manned are likely to result in the theft of the PSP. The combat engineer solution, whilst less satisfactory than the STRE design, is usually not as resources intensive and is therefore more likely to be approved by the UN ESS (Engineering Support Services). This compromise of standards must be assessed for each project depending upon its priority and the availability of resources.

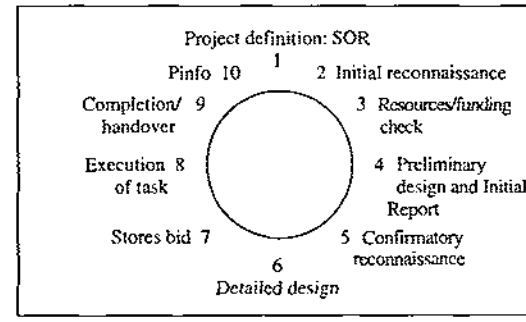


Figure 2. Project planning cycle.

- **Stores Bid.** Each IR must include a supporting stores bid, of which there are three main types: Field Defence Stores (FDS), Engineer Works Request (EWR) and a Detailed Design and Estimate (DDE). The FDS bid is the most straightforward entailing nothing more than a written bid to the appropriate field squadron, which submits a monthly demand to replenish stocks. FDS include geotextiles, ISO containers, Hesco-Bastion concertainers, OP towers and spotlights, besides the usual wire, corrugated galvanised iron and pickets, etc. Unlike all other theatres, FDS are demanded through the engineer resources system and not through the G4 chain. The EWR is submitted for stores or funds for any UN G3 engineer project encompassing construction, repair and maintenance of all UNPROFOR routes, camps and locations. They are based on the systems contracts[2] set up by the UN ESS for each mandate period. Each BGEOO has a copy of a stores catalogue listing all the resources available, and EWRs are submitted up the ESS chain, total cost determining the level at which approval can be given and therefore how long the process is likely to take. This system has too many failings to mention and is heavily overloaded. Under this system field squadrons and Regional Engineer Units[3] (REUs) are not officially allowed to hold resources in stock, therefore all tasks are prone to lengthy delays. It is not uncommon for approval and subsequent delivery of stores to take over six months. Unlike an EWR a DDE is a single sheet of paper submitted to request funds from the UNHCR, primarily for the repair of UNHCR aid routes. The procedure is simple and if the request is suitably justified and

[2] Formerly Bulk Purchase Agreements.

[3] There are four REUs within Sector SW coordinating the EWRs and resources for specific areas.

the UNHCR fund can support it, the DDE is usually met. If not, an immediate answer is given which ensures the status of any request is quite clear.

- **Execution of Task.** Most of the BGEOO's work is completed with submission and approval of the IR, however, there is always a need to liaise with the BG and the local civil and military agencies once the work starts. Liaison with local WFs and *Opcinas*[4] can be difficult especially if they see no benefit to themselves from the project, therefore all projects, to some degree, require close liaison. As with any project, the BGEOO is required to arrange the administration of the tasked troops, although this may be done by the parent field squadron if they are located near to the BG.

Command and Control of Engineers. The BGEOO may control, but does not command, the engineers in his AOR. To do so would detract from his primary role of advising the CO and planning for future tasks. To this end any grouping of engineers greater than section strength must be accompanied by some element of troop management. Without this, the supervisory tasks, quality control, site clearance, maintenance of discipline and general troubleshooting, falls to the BGEOO. Even though field squadrons are stretched and troop management provides extra recce and planning ability, it is not the job of the BGEOO to get involved in this. Field squadrons must realize this and, however difficult, resist the pressure to over commitment that invariably leads to a lessening of standards of work.

Engineering Emphasis. The Engineer in Chief, in his annual report to the Corps, mentioned briefly the emphasis now placed on construction engineering. Framework operations are a prime example of this, particularly as the infrastructure development capability of the Muslim-Croat Federation is now relatively advanced, especially on the Croat side. Not only are effective repairs to roads being carried out but road signs and markings are in place in many of the Croat areas. This has created a demand for UNPROFOR to mirror these higher standards thereby further shifting the construction/combat engineering balance. This does not require BGEOOs to be engineering graduates but previous construction experience, either from a field squadron (air support) or one of the many construction exercises such as *Waterleap* and *Pinestick*, is invaluable.

Reports and Task Planning

Due to the excessive lead time required for stores, IRs need to be sufficiently detailed in case they are handed over to successive field squadrons. That said, BGEOOs and recce sergeants may not have a great deal of time to compile them, either because they are reacting to events or the IRs must be submitted quickly to reduce lead times, or usually both. Additionally, although time may be short for the author, the troop and section commanders are often able to carry out their own confirmatory reconnaissance and work out their own refined cascade plan. To balance this detail/time trade-off, the format of the IR must be a compromise. The traditional Detailed Reconnaissance and Planning Report (DR&PR) is too complex and time-consuming; however, site plans and site drawings, preferably to scale, are essential as are correctly completed, stand-alone stores bids. I found the following headings for the text of the report included all the essential and relevant information:

- Introduction.
- Aim.
- Reconnaissance.
- Proposed Work.
- Priority of Work.
- Method of Work.
- Transport and Plant.
- Stores and Resources.
- Specialist Equipment.
- Liaison and Contracts.
- Safety and Security.
- Conclusions and Recommendations.

Each identified task was included on a task list from which I briefed the CO each week before the main, weekly orders group. This document was a useful planning tool that reflected the status and priority of each task. My aim was to ensure that the CO's priorities were realistic and matched those of the Sector where possible. If the task could then be justified successfully and staffed to the field squadron and placed high on their priority list, it would receive prompt attention. If the CO's priorities, through poor briefing by the BGEOO, were unrealistic and matched neither Sector's nor the field squadron's priorities, considerable delays usually ensued.

The three areas requiring constant review were: routes, camps and protection. Once the UN resources system, local engineering standards and the local mentality are understood (or in the latter case, taken into account) the planning for these tasks is relatively straightforward. It is worth examining each area in more detail:

Routes. There are three categories of routes within Sector SW: blue routes that are UNHCR primary aid routes; green routes that are secondary aid routes; and red, UNPROFOR or G3 routes. Funds for repair of blue and green routes are requested on a DDE from the UNHCR road fund. Blue routes,

[4] The local municipality or town council equivalent.

which terminate at the main aid distribution points, have a maintenance budget which is allocated annually. EWRs are used to request material or funds to repair red routes. As with all other EWRs, the process is long and slow therefore long-term planning is essential. There are a number of thriving construction and engineering companies, such as Doboj Putevi[5] based in Tesanj, to whom the work may fall. In this event it will normally be the BGEOO who drafts the contract on behalf of either the UNHCR or UNPROFOR. A standard format is followed with payments staged to reflect progress.

Specifications used for the repair of roads for the UNHCR are the minimum that can be applied, and works must be inspected weekly by the BGEOO or a plant SNCO. Company directors have a tendency to meet in smoke-filled cafes and therefore on-site meetings, where progress, quality and site diary can be examined, are encouraged. Standards produced often depended on the quality of aggregate available. BRITCAVBAT's AOR lacks good quality stone, but river gravel is in plentiful supply and is used extensively by Doboj Putevi, which sells it at DM5m^3.

Poor drainage is the underlying cause of most of the damage to roads, and flash floods compound this problem. In more mountainous areas landslides are a constant threat especially during Autumn rains and the Spring thaw. Two further factors, specific to the theatre, contribute to the problem. First, the locals do not adhere to western safety standards and regulations governing vehicle weight limits and therefore the majority of lorries and coaches are grossly over-laden. Warnings to reduce vehicle loads go unheeded. The overloading not only ruins the weak, river gravel pavements, but because of it engineers must be wary of the rapid assessment method of classifying bridges using the figures given for the MLC (military load classification) of civilian vehicles[6] in the pamphlet. Second, most landslips occur where adjacent land has been deforested and therefore much of the soil's cohesive strength lost. As felling and transportation of timber are vital to local communities, warnings for them not to log problematic areas also go unheeded.

Camps. The basics of camp layout and planning are taught on YO courses. Overlay these with information from the standard resources and staff tables contained within the UN ESS catalogue and UN Engineering SOPs, and a simple, comprehensive camp layout can be worked out. When planning a new location, based on the SOR and with assistance from the STRE if required, the following must be considered:

- **Essential Services.** The availability of any existing services and facilities will ultimately shape the site layout. Many sites will offer these either intact or damaged.
  - **Electricity.** The mains electricity supply cannot be relied upon and standby generators are necessary. If these are British contingent generators instead of the UN automated ones, they normally require external fuel tanks, elevated for gravity feed, and must be accessible by the refuelling tankers. If space is at a premium and they must be sited near to accommodation, Hesco-Bastion walls significantly reduce noise. Although design of the electrical distribution system should be left to a clerk of works (electrical), for relatively small camps of less than 100 personnel, it can be worked out with the help of an electrician and reference to the UN SOPs for the correct cable and fuze sizes.
  - **Water.** As with electricity, the mains water supply is not reliable in either supply or quality. The environmental health team (EHT) carry out fortnightly tests on the water source of each camp. Any new source must be brought to their attention. Even if there is an existing mains supply, a second source is normally required. If the geological conditions are such that water is likely to be found sub-surface, a request for a borehole to be drilled is the most practical option. Currently 521 STRE (Well Drillers) are in theatre. The borehole pump will feed into an in-line chlorinating unit producing potable water. When siting water tanks, consideration must be given to the problem of overflows or the ground will quickly turn into swamp. Alternative sources of water supply are available, from the standard water purification unit and the nuclear, biological and chemical water purification unit, to a local contract with the town's fire brigade. In all cases the need for the EHT to check quality on a regular basis is essential.
  - **Sewage Disposal.** As with many aspects of life in Bosnia, western European standards are somewhat alien. If a prospective location appears to have existing sewerage a thorough investigation is still required as the system may be incomplete, damaged or simply a storm water system. Local sewage disposal contracts are worth arranging. However this does not always solve the problem, primarily due to the local definition of "disposal." The recent expansion of the B10 checkpoint, following the targeting of the Maglaj School base, necessitated the installation of septic tanks. Following the UN ESS rejection of the STRE weeping-pit design, as it was too resources intensive, it was decided to drain tanks into the adjacent stream. A contract was set up with a local company to dispose of the sludge every month. If the "honeysucker" operator was working to local standards, once he had emptied the tanks, he would drive a few kilometres before emptying the sludge into the stream or onto waste ground. If he decided not to adhere to these standards he would simply drain the tanks and then, without moving his tanker, empty the load directly into the stream.
- **Drainage.** Drainage has a major impact on all tasks as explained earlier. BGEOOs must therefore include

[5] Putevi meaning "road company".

[6] Table 3-1, ME Vol 2 Pamphlet 7B, *Classification of Bridges 1994.*

drainage plans in everything they design. Prefabricated land drains are not available in the UN ESS catalogue but are simple enough to improvise using drilled drainage pipes wrapped in a filter membrane or using an open brick channel. It is worth revising the method of drainage and culvert calculations. BGEOOs need to be aware of the consequences of erecting Hesco-Bastion around the camps, especially on concrete hard-standing. They must not cover drains or manholes. Frequent heavy rain gradually washes the fines out at the bottom, but this can be prevented by lining the bottom of each cell with a layer of filter membrane and although time-consuming, if the concertainers are semi-permanent it is worth the effort.

- **Accommodation.** UN allocations for accommodation are found in the UN Engineering SOPs. For initial planning purposes it is assumed that 25 per cent of personnel will be housed in existing buildings, the remainder usually in prefabricated, flat-packed units. Flat packs can be erected in multiple storeys although thought must be given as to whether this is a good idea in areas where the WF situation may make them difficult to protect. Units should be conservatively sited, ideally in a continuous terrace or blocks, to minimize space used, thereby allowing for future expansion.

Protection. As with many other subjects covered in this article, protection warrants a separate feature. Following the direct targeting of the Maglaj School base by a Bosnian Serb T-55 tank, the protection of the school was closely examined and the most common forms of protection and the lessons learned from this unfortunate incident will be covered briefly.

- **Hesco-Bastion Concertainers.** Hesco-Bastion concertainers[7] are prominent in almost every UN location and being a FDS item can be demanded quickly, with field squadrons being able to hold them in stock. If plant is available for their construction, they are the most efficient method of protecting camps and personnel against small arms fire and shrapnel. They are simple to erect and very versatile, but are too frequently erected incorrectly. Besides the drainage problems that they can cause if badly sited, they are frequently over-stretched thereby reducing the width of each cell by up to 0.4m. This in turn greatly reduces stability especially if a second layer is placed on top. Improperly constructed Hesco-Bastion cells are easy to identify. Properly built, they are hexagonal in shape with a width of 1.4m. If this shape is lacking and the sides of the cells are almost flat, they are unstable and incorrectly constructed. The Military Works Force hardening aide memoir is an excellent document but has only a limited number of designs. The uses for Hesco-Bastion and off-cuts are endless, ranging from incinerators and rubbish bins to formwork and reinforcing mesh for concrete. Included in the aide memoir is a design for a collective protection (COLPRO) shelter, again using Hesco-Bastion. When concertainers are used for COLPROs they are required to bear a substantial vertical load. In this situation the fill material, (which can be of poor quality for free standing walls), needs to be reasonably good quality up to 60mm aggregate. The booklet states that sizes greater than 25mm should not be used; however it also states that concertainers are not to be built more than two tiers high. Both these recommendations can and have successfully been exceeded providing the fill material is suitably compacted and a Cobra is the easiest piece of equipment with which to do this. Hesco-Bastion concertainers also require firm foundations. Any top soil must be removed and a well-compacted, graded aggregate base, no less than 0.3m deep, must be laid. This adds to the construction time and should not be underestimated. The self-loading dump truck is best for filling more than a single tier; however even with this, it is a time-consuming task.
- **Maglaj School – Lessons Learnt.** For all the merits of Hesco-Bastion it is only designed to stop small-arms fire and shrapnel. The Maglaj School incident showed that it is no barrier to a large calibre, direct fire projectile such as the 100mm T-55 fragmentation round. Three rounds, of different types, were fired at the school on two separate occasions. The first two came as a pair, one hitting the second floor OP in which the tactical air control party officer had observed the rounds being fired, and the second hitting the upper tier of the frontal Hesco-Bastion wall. The first round penetrated two reinforced concrete walls, each 0.225m thick, and a single sandbag wall of headers and stretchers before entering the OP. The damage caused to the Hesco-Bastion cell by the second round was extensive. Fired from a hill over 2.5kms away, it had entered and exited the cell leaving it completely empty of fill, had been deflected off the tiled patio floor, leaving shrapnel lodged in the adjacent Hesco walls.

  At the time it was not possible to destroy the tank or vacate the school so work began to isolate the OP from the accommodation in the rooms behind as this was considered to be the most likely target to be revisited. As the OP was on the second floor the only practical solution was to build a sandbag wall against the rear OP wall. The height to the ceiling in the OP was over 3.5m. This meant that for the sandbags to provide the minimum 0.65m width at the top, the base had to be 1.5m wide with a total weight of almost 65 tonnes. Considerable shoring to the floor therefore took place and it was whilst this work was ongoing, four days later, that the third and most damaging round hit the school. Sadly casualties were caused including to Corporal (now Sergeant) Trevor Walker, a plant section commander from 4 Field Squadron, who received severe injuries to both legs and has since lost one below

[7] A concertainer consists of nine hexagonal cells linked to produce a 9.5m length, 1.37m high.

the knee. This round hit the school building centrally on the first floor. As the school was an open plan design, the round reached the furthest side before ricocheting off the balcony and breaking up. Shrapnel managed to exit the rear entrance, passing completely through the building, and injuring personnel in the vehicle park to the rear of the school. The COLPRO for the base was two ISO containers tucked up against the rear of the building protected by the overhang of the first floor above and by a Hesco-Bastion wall on the open, vehicle park side. The incident occurred without warning so no one had taken to these shelters which was fortunate because, during the clear up, it was noticed that a piece of shrapnel had not only passed through the building but had also passed through the ISO container and was lodged on the inside of the Hesco-Bastion wall.

Sixty-six 30mm rounds and six Canadian antitank missiles failed to kill the tank, the school was then vacated by all non-essential personnel and the CO capped manpower in the location to a maximum of 35. The engineer plan was quickly and radically reviewed with the new situation rendering the ongoing work redundant. The main problem remained the danger inherent in the open plan design. To this end the atrium was placed out of bounds and work concentrated on creating a single, living and sleeping area hardened, as far as possible, from direct and indirect fire. Again the emphasis was on sandbagging and shoring with a minimum requirement of one Hesco-Bastion wall, one 0.65m wide sandbag wall and two internal reinforced concrete walls as protection against the direct fire threat. It was assessed that the two storeys above would be adequate sacrificial protection although more shoring and a spall liner were installed in the ground floor COLPRO. A timber and sandbag-filled wall was built to separate this area from the atrium and additional internal Hesco-Bastions were erected and filled by hand.

- **Sandbagging.** The Maglaj School incident highlighted the minute attention that must be applied to a structure to ensure every nook and cranny is sealed and hardened. Sandbagging remains the only thorough method of doing this. The UN issue white, nylon sandbags are of a particularly poor quality and do not easily bind together. This fact is compounded by the difficulty in obtaining sand. Local sand is 0–4mm grit which must be mixed with cement before filling, for it to bind. If this mix is used and each layer sprayed with water, a solid, stable structure can be produced.

Summary

The BGEOO's role is vital although it is only after a number of weeks in theatre that BG staff begin to realize this. This could be rectified in pretour training when a visit to the BG must be arranged. The emphasis during the visit should be on briefing the BG headquarters' staff on the engineer support they are likely to receive, and on engineer capabilities. Time spent ensuring the BG quartermaster is fully aware of these resources, and camp maintenance procedures will prevent unnecessary confusion later on. Likewise the adjutant should include the BGEOO on the staff list. Joint training is desirable, though education of the BG and subunit commanders is the priority.

A standard design COLPRO. This Hesco-Bastion fill has settled due to poor compaction causing the roof to sink. Note the small gap between the fill and the roof timbers – there is a roof support beam that has sunk, between them.

The effectiveness of the BGEOO can depend largely on his ability to work with other units and departments, many with little or no knowledge of engineers and their scope of responsibility. Constant liaison will help to achieve some of these vital links and contacts with the BG although a measure of tact and diplomacy, especially when dealing with aid agencies or WFs, often needs to be exercised.

The position of the BGEOO is interesting because although his links to BRITENGBAT and the field squadrons are close, he is still sufficiently divorced to gain an outsider's view of the Corps in an operational environment. There is no doubt that this view shows the Corps in a very favourable light and for those within the BGs, who are the beneficiaries, it is the best form of education as to the role and capability of the Corps. It is also satisfying to hear, countless times, officers and soldiers of all departments from all AORs, commenting on the contribution and the hard work of sappers. There is no doubt that the BGEOO is of significant value to commanders as is the Corps to central Bosnia.

The Battle Group Engineer Operations Officer p53

The Role of Hesco Bastion in Gorazde's Collective Protection

CAPTAIN D R A JACKSON

Captain David Jackson graduated from the RMA Sandhurst in April 1989 and spent two months with 28 Amphibious Engineer Regiment prior to attending 98 YO Course. Posted to 32 Armoured Engineer Regiment in 1990, he took part in many command and field exercises in Germany before deploying to the Gulf in 1991 with 31 Armoured Engineer Squadron, (and the antique Centurion tank). An abiding memory of the last deployment was taking part in the clearing of the Mutla Pass after the land war.

At the end of 1991 he served briefly with 1 Training Regiment and then went to the newly formed Army Training Regiment, Bassingbourn.

Joining 21 Engineer Regiment in 1994, he deployed with them to Bosnia on Operation Grapple 6 *as the Battle Group Engineer Operations Officer supporting British Battalion 2 (1 Royal Welsh Fusiliers) in Gorazde.*

His interests include offshore sailing, in which sport he has represented the Corps, and downhill skiing.

Introduction

For over three years the Muslim enclave of Gorazde, in eastern Bosnia, was totally isolated from the remainder of central Bosnia. The small town, surrounded by the Bosnian Serb Army, had received very heavy shelling and the locals were living in appalling conditions with very little protection. Mortar and artillery positions on the high ground around the town regularly pounded its outskirts.

When 1 Troop, 1 Field Squadron arrived there at the beginning of March 1995 it quickly became apparent that the physical security of the UN camp was inadequate. Since the Cessation of Hostilities Agreement (COHA) was signed at the end of 1994, little work had been done to maintain and develop the physical security of the camp, and collective protection (COLPRO) consisted of a few trenches which were in a very poor state of repair with limited overhead protection (OHP). These were highly unlikely to provide protection against mortar or artillery attack, and were later filled in.

Requirement

A complete rebuild of the Gorazde Camp COLPRO was necessary and a new design was therefore drawn up, which included easy access and which could comfortably accommodate approximately ten people for long periods of time, and fit up to 40 people for a few hours.

One of the more common methods of constructing COLPRO is to make use of ISO containers either buried in the ground or with Hesco Bastion concertina baskets built up around the outside. OHP is often made up using massive timber baulks, timber dogs, hundreds of sandbags and good quality hardcore. In this case, however, due to the heavy restrictions on movement imposed by the Bosnian Serb Army, engineer stores were in very short supply with no ISO containers available, no good quality hardcore, no wood, and very few sandbags. However there were a number of pallets of Hesco Bastion.

What is Hesco Bastion

Hesco Bastion was first used during Op *Granby* but has really come into its own during Op *Grapple* tours, as the standard method of constructing rapid and effective blast walls. In Gorazde, much of the camp perimeter fencing was built by placing a single row of Hesco Bastion on top of a double row, providing good protection

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The role of Hesco Bastion p54

and keeping intruders out too. In Bosnia other uses have been as bases for sangars or OPs.

The basic Hesco Bastion unit consists of nine individual wire basket cages lined with a tough geofabric. They are joined together with spiral ties and can be split, or have further baskets added as necessary. Arriving folded flat in concertina fashion, to open them out, one end is grasped by two men who pull as they walk backwards; the baskets then unfold to the vertical position and are self-supporting.

Although the bases of the baskets are square, two of the sides are hinged to create a hexagonal shape *(see Figure 1)* and allow concertina packing. The dimensions of each basket are 1050mm x 1050mm x 1370mm, and the overall length of a section of nine Hesco Bastion baskets is approximately 9m.

The most efficient method of filling the baskets is to use a S-26 self-loading dump truck. The preferred fill material is crushed rock, however this is not always available so stone or earth sometimes has to be used with consequent loss of effectiveness. Each basket should be filled and compacted in layers, which reduces settlement at a later stage. The width of each basket should be 1400mm so that the hexagonal shape is well defined. Often a second layer of baskets is constructed on top of the first to create a more effective blast protection wall. Ideally the spiral ties joining each basket together should be slid down to overlap those of the lower baskets to ensure that the baskets sit correctly and do not become unstable or start to lean.

The Design

The Battle Group Engineer Operations Officer (BGEOO) and the Assault Pioneer Sergeant came up with a design for COLPRO which utilized available materials including, of course, maximum use of Hesco Bastion. Also around camp were numerous old sandbags that could be re-used, and a good supply of river stone, albeit ungraded, could be obtained from the nearby River Drina.

The basic concept was to take two sections and place them parallel to one another with a gap of 1.5m between *(see Figure 2)*. At each end would be a four-basket section to protect the entrances.

Something had to be found to support the OHP, which would consist of 650mm minimum of compacted fill. In a small scrapyard by the River Drina, a quantity of old railtrack track was discovered to do the job and its purchase was

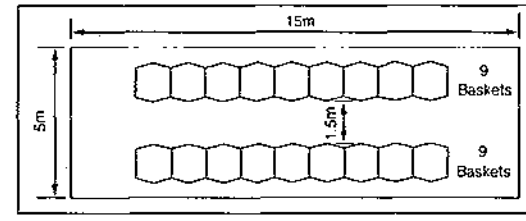


Figure 1. The two rows of Hesco Bastion laid out on an excavated site ready for filling. Each row is approximately 9m long when full. The two rows are placed 1.5m apart when building COLPRO.

negotiated. Of varying lengths, between 4 and 7m, there was a plentiful supply and it could be cut to exactly the right length.

Enough Hesco Bastion sections were available to build about five shelters, able to house up to 40 men each for short periods of time.

Construction

A number of important factors must be taken into consideration when constructing Hesco Bastion. The first is to ensure that ground preparation is carried out properly. It is vitally important that the foundation is made firm and level, because Hesco Bastion can be very unstable if not properly supported; for instance, building on frozen ground which then thaws rapidly can present quite a problem. If a construction materials technician (CMT) is available then his advice should be sought. The ground should be excavated to a depth of 500mm, levelled and ideally have a geotextile (eg TERRAM) placed on it to prevent any interaction of fill with the ground subsoil.

During the task we were carrying out, speed was important, because as the end of March got nearer so the threat of shelling became more imminent. This was because it was becoming obvious that the COHA was soon going to break down as relations between the Bosnian Serbs and Muslims worsened. Due to this lack of and resources, plant work was limited to using the Volvo medium wheeled tractor (MWT) to level,

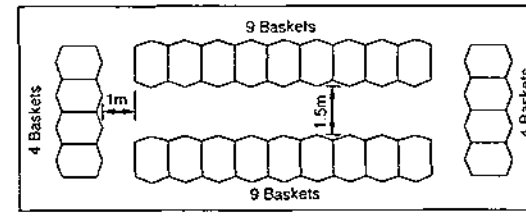


Figure 2. The Hesco Bastion laid out with the two blast walls at each end with empty space between the two rows.

Figure 3. The Hesco Bastion filled and compacted with two layers of sandbags at the entrances.

roughly, the ground, and no geotextile was laid. (Note: due to fuel restrictions we were limited on plant movement. The Volvo was used because it was quick and it was an excellent workhorse.)

The second factor, for those inexperienced in filling Hesco Bastion, is that it is important to set the baskets out properly. The first attempt at building the Gorazde COLPRO left the shelter rather narrow at one end. It was found by using 1400mm lengths of 14 gauge wire fixed across the inside of each basket that the correct hexangonal shape could be kept throughout the construction phase. (Note: the wire is tied across the inside of the basket at the top and bottom. This prevented the basket from bulging out excessively). Often it was better to fill the two end baskets before the centre ones. This prevented the rows from going off centre. It is recommended that the end of each row is tied off to suitable anchor points, such as 6ft pickets, which will help keep the section straight.

The third factor is that it is best to fill the baskets in 300mm stages if possible so that the fill can be compacted. This reduces the likelihood of leaning later on. A plate compactor would greatly assist in this task, and a CMT could offer advice on the grade and suitability of fill material. As time was short, our baskets had to be filled in one go, but as they were only to be single storey, as shown in Figure 3, this was not considered a problem.

Overhead Protection

Once the side and end walls were in place the OHP could be constructed. The rail track was cut to specified lengths and a layer of sandbags was placed on top of the baskets to ensure a level base. The figures opposite show the final construction sequence.

The rail track was put on with little difficulty other than the fact that it was very heavy – certainly a section lift.

It was necessary to have something to support the fill to go on top of the rail track, and old cut up scrap sections of Hesco Bastion proved to be ideal for this. A layer of plastic acted as a form of waterproofing, secured with a row of sandbags. The sandbags were then built up to 650mm to act as a wall for the fill, which the medium wheeled tractor hauled afterwards, by numerous trips to and from the River Drina.

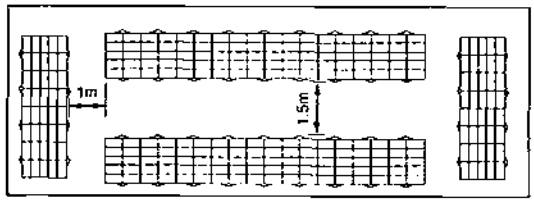


Figure 4. The sandbags are used to level the top of the baskets and act as a solid base for the railtrack.

The Finished Colpro

Once the initial teething problems were ironed out it was possible for a section of eight men and a medium wheeled tractor to construct a COLPRO shelter in just over two days.

It was considered that these COLPROs would offer good protection against small arms and heavy machine gun fire and shrapnel, but were unlikely to stand up to any direct hit from a mortar with a delayed fuze or an artillery round.

In Gorazde the last shelter was completed on 20 March 1995 and first used in earnest on 25 March 1995 following the breakdown of the COHA. This was when the town received its first multiple shelling of artillery and mortar rounds since before Christmas, some of these landing within two hundred metres of the camp.

Fortunately the COLPRO received no direct hits although a number of small arms rounds and heavy machine gun fire caused negligible damage to the Hesco Bastion. On one occasion an 81mm mortar landed in the camp and detonated about 5m away from a section of Hesco Bastion, resulting in many shrapnel marks but minimal penetration; some of the metal bars on the cages were cut through, however the geofabric contained the fill and prevented spillage.

Hesco Bastion is versatile, and proved economical both in time and manpower. Using it, two sections of engineers and pioneers constructed enough COLPRO in just two weeks to accommodate a complete infantry battalion and all attached personnel for short periods in relative comfort.

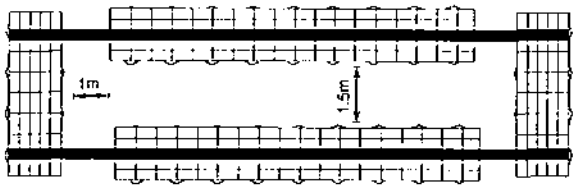
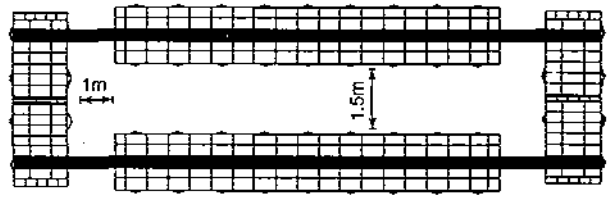


Figure 5. Placing of main beams along the length of the Hesco Bastion. 250mm wooden beams could also be used.

Figure 6. Sandbags are then built up around the rail track to secure it.



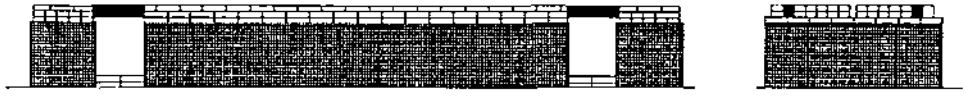


Figure 7. The two end sections should be at the same level.

Figure 8. The 32 short beams are positioned over the width of the COLPRO.

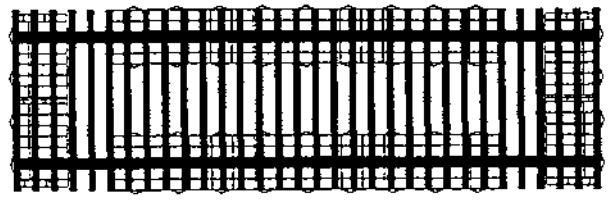


Figure 9. Sandbags are placed between the beams to secure them.

Figure 10. Stripped down baskets are placed on top of the crossovers. Plastic sheeting is laid over the top of these and secured with sandbags.

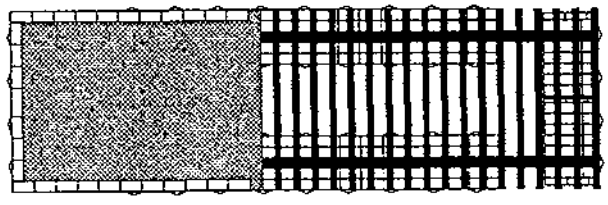


Figure 11. Sandbags are built up on top of the railtrack to contain the fill. This should be to a depth of at least 650mm.

Overbridge, Underbridge: Bridge Repair in Bosnia on Operation Grapple 6

LIEUTENANT T P CLARKE BEng

The author graduated from Newcastle University with a civil engineering degree, and passed out of Sandhurst in 1992. An attachment with the Allied Command Europe Mobile Force (Land) Troop 22 Engineer Regiment, was followed by 109 Troop Commanders' Course. After that fine experience, he was posted to 1st Field Squadron 21 Engineer Regiment with whom he served for two weeks in Sardinia and six months in Bosnia.

In November 1995, he was posted as a troop commander in the Apprentice Training Wing RSME (Minley).

Introduction

On the road between Prozor and Jablanica, in the gorge where Route *Square*, a key MSR (main supply route) linking central Bosnia to the coast, crosses the river Rama, is a bridge known as Crni Most. It is classified as a reinforced concrete, open spandrel, fixed arch bridge, which spans a gap of some 160ft. The bridge was damaged during the civil war when one of the warring factions tried to demolish it by placing antitank mines loose against the structure. Although the demolition was unsuccessful, three out of seven of the spandrels at the north end of the bridge failed and the arch was left with three, metre-sized holes punched through it. However the abutments and deck were undamaged and the bridge continued to be used by local traffic and UNPROFOR convoys.

In an effort to minimize the damage caused by vibration of traffic, a Hesco Bastion chicane was erected at each end of the bridge but despite this measure the damaged sections deteriorated, leading to fears that the bridge might collapse. 522 STRE (Wks) was therefore tasked to produce a report recommending a method of repair.

Problem

The problem was how to repair a reinforced concrete bridge *in situ* whilst keeping the bridge, and the route, open for all users. The idea of diverting traffic during repairs was swiftly discounted because the narrow valley was only large enough for Route *Square* and a lengthy detour would be unacceptable for UN convoys. The only answer appeared to be to construct an overbridge. Overbridging the structure would ensure that traffic loading was transferred straight to the abutments without bearing on the spandrels or arch, thus allowing repairs to be undertaken.

Overbridge

The building of an equipment overbridge with a span of 160ft on a busy UN MSR would involve a temporary route closure and large amounts of bridging stores. It would not be a simple undertaking. The class load required was MLC 40 and as there was insufficient Bailey in theatre to construct the 160ft "treble treble" overbridge, Mabey Johnson equipment was used instead. Mabey Johnson is similar in configuration to Bailey, with virtually the same construction principles. The

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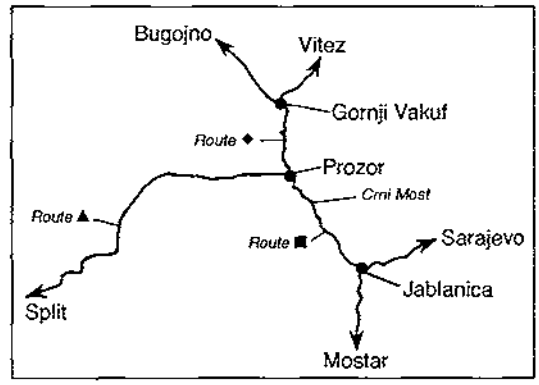
Overseas Development Agency (ODA) owned sufficient Mabey Johnson to build to MLC 70 and a loan was negotiated with them. To keep disruption to a minimum, the task would be carried out on a Sunday night with the route closed from 1800 to 0800hrs the following morning.

As timings were tight and previous experience of building the bridge limited, rehearsals were absolutely vital. Out of the whole troop only a lance corporal and a sapper had ever built a Mabey Johnson before. Rehearsals took place on the Engineer Resources Park in Split where the troop carried out three complete builds. The equipment turned out to be very uncomplicated, but extremely heavy to build by hand. In addition to the 160ft overbridge, 30ft ramps were built at each end, making a total bridge length of 220ft. At the conclusion of the rehearsals the troop was thoroughly familiar with the construction sequence and had completed a night build in under nine hours. A crane was only used for repalletization and assistance with jacking up and down. DROPS (demountable rack offloading and pick-up system) pallets were used for transporting the bridge components to site where they were offloaded by hand. Eleven DROPS racks were loaded with 16 bays of Mabey Johnson bridge and two ramps and the racks configured and numbered so that they would be called forward in the correct sequence on the night of the build. The racks were subsequently moved from the Engineer Resources Park in Split to the Precision Factory camp in Gornji Vakuf (GV(PF)).

The worsening tactical situation in Bosnia caused the construction date to be slipped to 25 June which caused a few problems. Many of the trained workforce were away on leave and so hasty refresher training took place using the Mabey Johnson bridge that had been moved to GV(PF). Although not ideal at least everyone knew how heavy it was.

On 22 June all commanders involved with the operation were shown the ground, and formal orders were issued by the troop commander. This ensured that everyone understood the overall operation rather than simply their small part in it. Prior to the build 11 DROPS racks were placed in the pallet dropping area (PDA) in a herring-bone arrangement adjacent to the site, and at 1800hrs Route *Square*, from Prozor to Jablanica, was closed.

Construction began as planned. The crane was used to lift the overbridge for the first 11 bays to save time on jacking, but after 11 bays the weight



Sketch map showing position of Crni Most bridge.

of the bridge was too great and hand operated hydraulic jacks were used instead. Construction was delayed when one of the only two jack handles was dropped into the gap, never to be seen again. This doubled the time taken to fit the packing and did not endear the culprit to other sappers, many of whom felt he should have followed the handle. Despite this the bridge was completed in 11 exhausting hours.

Underbridge

Repairs to the substructure of the bridge could now begin. The plan was to break out the remaining damaged concrete and reinforcing bar, and tie new reinforcing bar into the remaining bar. "Readymix" concrete would then be poured to the original dimensions of the bridge. The weight of the formwork containing the "Readymix" and the new reinforcing bar would be carried by timber falsework.

Foundation

For the falsework to support the formwork properly, a stable foundation was required because any significant movement of the formwork while the concrete was setting would mean starting again.

The foundation area for the falsework was under a metre of water from the river Rama, and a coffer-dam was therefore built using sandbags and local fill to extend the riverbank to beyond the damaged arch and spandrels. This work was done by hand as the steep and rocky nature of the riverbank prevented access by plant. Once the bank had been redefined it was backfilled, again by hand, and compacted.

Once this part of the foundation was complete mass concrete levelling caps were poured. The levelling caps were designed to distribute the

Side view of the bridge showing the damage to the three spandrels and arch. The original extent of the river below can be seen clearly.

weight carried by the falsework evenly so that no movement would occur during the pouring of the concrete.

A total of eight cubic metres of concrete was to be poured, but access remained a problem. The solution was to batch the concrete at a level area 100m downstream, transport it in the bucket of a light wheeled tractor to the top of the bridge abutment and deliver it by means of a CGI chute. Proper formwork was used for the levelling caps and the concrete compacted using a vibrating poker.

The damaged concrete was then broken out leaving a 2m wide central strip of the arch. All three spandrels were completely stripped of their concrete, but on closer inspection the reinforcing bar was found to be in better condition than at first thought and so as much as possible was left in position.

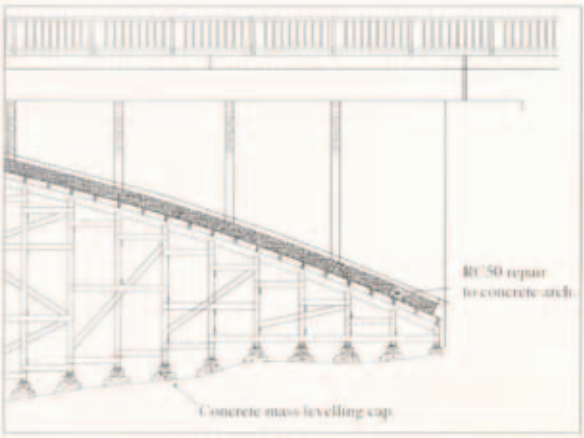
Conclusion

The main difficulty involved with the overbridge construction was the change of build date and the corresponding loss of trained manpower on leave. Having the Mabey Johnson bridge held at GV(PF) helped overcome this to a certain extent by enabling the replacement workforce to conduct limited training prior to the actual build. Progress on repairs to the underbridge was hampered by delivery of stores provided by the UN. The cascade diagram for the works diary was forever being altered as deadlines for the delivery of correct building materials were repeatedly missed.

The site was handed over to 5 Fd Sqn for completion of the task. The concrete had by then been broken out and the arch shored up with timber baulks as an additional safety measure. The timber for the falsework had also started to arrive and work on the formwork and falsework commenced.

Reclamation of what turned out to be 100m^3 of river-bed to an average depth of 1m was no mean feat, as all the borrow and fill was transported and placed by hand, and the delivery of batched mass concrete for the levelling caps using a LWT bucket via a CGI chute was an example of sapper resourcefulness.

From a professional point of view the task was both frustrating, and extremely satisfying. Frustrating because the erratic supply of stores meant that it had to be handed on for completion, but satisfying because it had a clear aim in helping to maintain a vital MSR in Bosnia, and clearly sapper skills were demonstrated in a physically and technically demanding troop-sized task.



Part of the formwork built to support the new arch.

Overbridge, Underbridge p60

Feasibility, Design and Construction of Gravity Flow Water Systems in Nepal

MAJOR T R URCH BEng

Major Tyrone Urch was commissioned into the Corps in 1984. Since then, a varied and extremely enjoyable 12 years has seen him serve in Germany, the United Kingdom, Hong Kong, Northern Ireland and Bosnia-Herzegovina (Former Republic of Yugoslavia). The author is a civil engineer graduate who attends the Joint Service Command and Staff Course in 1997. He is currently undergoing Professional Engineer Training (Civils) at the Royal School of Military Engineering, Chatham with the aim of sitting the Chartered Professional Review in October 1997.

This article is based on an essay written as a submission for the Institution of Civil Engineers Papers Competition 1996.

Background

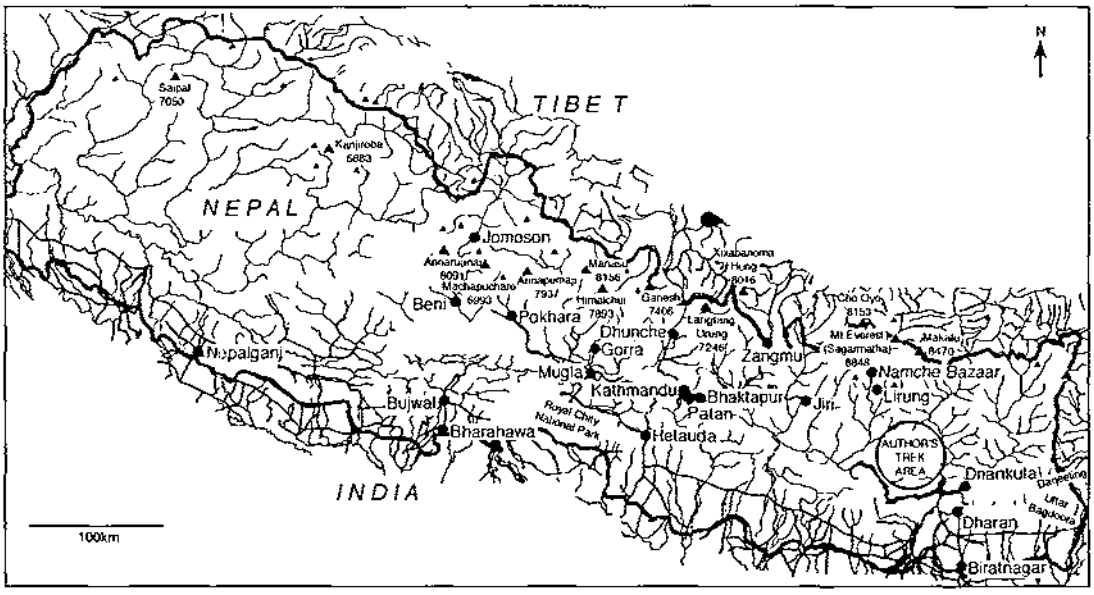
Whilst serving with The Queen's Gurkha Engineers (QGE) in Hong Kong, I was fortunate enough to be selected to undertake an "engineer trek" in the Himalayan foothills of eastern Nepal. The requirement was to determine whether it was feasible to supply drinking water to the three isolated villages of Temma, Kudhung and Pantadha. This unique opportunity offered me the chance of a lifetime to see at first hand the hardships experienced by the people living in this enchanting country and to make a worthwhile contribution towards improving the living conditions of the villagers concerned.

General

Nepal is an independent kingdom on the southern flanks of the Himalayas sandwiched between Tibet to the north and India to the south, east and west. Although relatively small, being only 800km long and between 160 and 240km wide, Nepal is naturally divided into three parallel bands running northwest to southeast. From the south, the "Terai" is a 30 to 40km wide plain of fertile alluvial soils. The second band comprises the foothills of the Himalayas which rise 3500m up to the snows. These hills are the home of the Gurkha soldier and are intensely cultivated wherever there is water. The third strip, in the north, is the main Himalayan range where the average elevation exceeds 4570m. Of the ten highest mountains in the world, including Sagarmartha (Mount Everest at 8848m), nine are located entirely or partly within Nepal's borders. On the Terai and in the Kathmandu valley, the winter is sunny and dry, followed by spring temperatures rising to 45°C in April and May. Summer is both hot and wet with monsoons lasting from June to September.

An undeveloped country, Nepal has the fourth poorest economy in the world. Its land-locked, mountainous terrain has contributed to its isolation, and tourism is the only major source of income. Although Nepal has approximately the same land area as England, its population is about 19 million or approximately that of the Home Counties. Only 20 per cent of the country is available for agriculture, of which a mere 10 per cent is assured natural irrigation. Due to

Major T R Urch
Feasibility, design and construction of gravity flow p61



Map of Nepal showing author's trek area.

the very poor economy, water treatment is a problem. With only 15 per cent of the population having access to safe drinking water, nearly two thirds of illnesses in Nepal originate from infected water which occurs as a direct result of poor sanitation and hygiene.

Treatment of those infected by water is a problem, which is hardly surprising when there is only one doctor for every 26,000 people. Astonishingly, 15 per cent of children die before reaching the age of one and the life expectancy for males is 45 years (approximately the same as for Scotland in 1880).

Of the community project funding received from the Overseas Development Agency, water aid has, not surprisingly, received the highest proportion. In addition, basic education on health and hygiene, environmental sanitation, construction of pit latrines and project maintenance is provided, backed up by continued water quality monitoring and hygiene surveys. Since 1989, 122 water systems have been constructed and plans are in hand to construct a further 100 in targeted areas, with a focus on maximizing community responsibility.

Project Feasibility

My first task involved carrying out an evaluation of the villages from which followed project feasibility studies. For those projects considered feasible, a topographical survey was carried out.

Evaluating a village is both an objective and subjective process. Objectively, villagers had to be questioned about such things as what they thought the population of their village was and where construction materials could be located. An assessment had to be made of the extent to which skilled labour was available in the area. Subjectively, the feelings of the villagers had to be determined. For instance, I needed to find out who the influential people were; what the villagers' reaction and attitude towards the project was; whether they realized how much work they would have to do and whether they would do it; how real the need of the village was and who stood to benefit most. It was clear that projects could only be considered feasible if both the technical and human factors indicated success.

To get accurate and reliable answers, I involved myself in discussions (with the assistance of a QGE soldier!) with as many villagers as possible, and this fact-gathering process, coupled with the topographical survey, was never completed in fewer than three days. Before leaving, I had to be absolutely sure that I was in possession of every fact required to design and advise on the construction of the project, especially bearing in mind that construction might not commence for a further five years.

An accurate population survey of the village was absolutely essential since population determined the amount of water required. Experience had shown that villagers usually had a very poor idea of their own population size and tended to overestimate greatly. Two simple techniques were found to be useful depending on the size and scatter of the village. In some, visiting every house and recording the number of occupants was possible. If this was not feasible, then the total number of houses could be multiplied by an average occupancy figure of ten. Next, the estimated water demand had to be calculated, taking into account the design life of the water supply system and the population growth forecast. Depending on the location of the village, a design life period of 15, 20 or 25 years has traditionally been used (ie the more remote the village, the longer the system must last). A percentage population growth figure, which varies from 12 to 170 per cent[1], was then applied to the current population. The final projected water demand could thus be calculated by adding the per capita demand and special needs (such as for schools and aid posts). A figure of 45 litres per day per person (or 230 litres per household per day as a minimum) was allowed for[2]. For the projects described here a 20-year design life with a 34 per cent growth rate was used.

Source investigation was the next area to be considered. All possible water sources had to be looked at and not merely the nearest or most convenient. Quantity and quality of the flows had to be determined, means to develop the intake works studied, and water rights established. Whenever possible, springs were considered first since they generally produced water of better quality and were easier to protect against contamination. Measuring the yield can be done in a number of ways, the most common of which is the "velocity-area" method (ie playing Pooh sticks!) or by using a vessel of known volume and a stopwatch. Due to the lack of water during my trek, at the height of the dry season, the latter was the only appropriate method. Consideration was also given to seasonal variations and the necessity to construct simple earth banks to ensure steady-state flow conditions.

Water quality and source development were the last areas to be considered at this stage. Assuming water treatment schemes are not practical, simpler methods such as slow sand filtration and aeration towers can be incorporated to improve turbidity and taste/colour problems[3] but I found that in this location these were not required due to the acceptable quality of sources at such altitudes.

Before departing the source, consideration was given as to how the intake works were to be built and detailed notes were made. Methods of protecting the structure against erosion, floods and contamination were also recorded, as was what excavation would be called for; whether dams or channels would be required and what protection against animals (and curious villagers) would be needed. Keeping an accurate and detailed field log was vital; with so much data to be recorded for each village, it was important to record it at the time and not leave it to memory later on.

A topographical survey along the proposed pipeline route was the next job to be undertaken. For reasons of simplicity, and ease of transportation, this was carried out by means of an Abney hand-held level (clinometer), together with a prismatic compass, a calculator, a 30m tape measure and makeshift target staff. A camera, short wave tranny, second compass and spare calculator batteries also proved invaluable. Using basic trigonometry, the bearing and vertical distance between stations were calculated and recorded, along with other useful information such as type of terrain, soil conditions and reference landmarks. It was essential for me to remember that at some time in the future someone would be digging a trench for the pipe along the route selected. The exact route had to be marked on the ground using a system of 2ft stakes driven into the earth, painted rings on trees, and marked boulders.

A minimum of three people are required to conduct a survey but as the whole village turned out to "assist" finding help was not a problem; trying to find two reliable people to help with recording data and checking readings, however, proved much more difficult. Instrument accuracy was important and the following standards were

[1] Handbook of Gravity Flow Water Systems UN International Children's Emergency Fund (UNICEF) – by Thomas D Jordan.

[2] World Health Organisation (WHO), Water Demand Guidelines.

[3] Water Supply for Rural Areas and Small Communities (WHO) – Lanoix & Wagner.

One of my survey teams.

adopted; vertical angle: plus or minus 0.5 degrees, ground distances: plus or minus 10cm, elevations: plus or minus 0.5m.

Finally, logistic information had to be recorded so that final costings and planning for the projects could be completed, and included details such as: distances to nearest road heads and airfields; availability of local resources (such as sand, aggregate, slate, wood); portering time and wages paid; availability of tradesmen (especially masons and carpenters); and location of the nearest medical facilities.

Technical Design

Gravity flow water system types are, rather simplistically, divided into two general categories, namely "open" and "closed"; open from the concept that taps could be left open while still providing a constant and steady flow of at least 0.225 litres per second at each tap; closed meaning that the safe yield of the source could not provide continuous flow to all taps and that a reservoir would probably be required to meet peak demand. Open systems can be designed with and without taps. Clearly any system without taps would have a longer life because there would be fewer components to wear out or be abused. If the water yield was insufficient to meet village requirements, then a closed system using a reservoir would be adopted, the reservoir filling overnight to meet peak daytime demands.

The decision on which system to build cannot be made until a host of other factors such as pipeline profile, safe yield, design population, availability of construction materials and village enthusiasm has been established. Also the direction of village expansion must be known so that allowance can be made for additional taps to be added later. Branch point tees and control valves must be included, and marked by permanent reference points on the surface, where future expansion is expected.

Due to the relative isolation of the villages being looked at, a conscious decision was made to design simply, and therefore open systems with taps were chosen for all three villages. From the villagers' point of view, the only drawback to this was that the number of tap stands would be less than they actually wanted because of the limitations imposed by water volume and pressure.

Fortunately the design of gravity flow water systems is a relatively straightforward process. The only materials required are: high density polyethylene (HDP) pipes of two grades (Class III – maximum pressure rating of 60m of head and Class IV – maximum pressure rating of 100m); galvanized iron (GI) pipe with a pressure rating of 250m; purpose-made items such as control valves, and other normal construction materials such as sand, stone and Portland cement. Simple hydraulic theory is then applied to each reach of the pipeline profile. The "Continuity Equation" is used to calculate water-flow, knowing the cross-section area of pipe chosen and the flow limits (maximum: 3m per second, minimum: 0.7m per second). A simplified Bernoulli's equation was then applied (knowing pipe characteristics such as frictional headloss constants and geometry) to determine the hydraulic grade line (HGL) and to ensure that sufficient head was maintained, and yet no excessive tap pressures experienced.

In summary, the entire procedure was based on dividing the route into reaches and determining the amount of head that had to be lost in the form of friction within the pipe. Several pipe combinations and permutations were required, and in extremis, frictional diffusers were located just above the tap where necessary.

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In an ideal village, with uniformly sloping topography plus a small elevation drop and a clean source with sufficient yield, an open system with a few taps would suffice. Unfortunately I encountered no such villages, and a vast array of minor design problems were encountered.

The first point of flow in a water system is at the source, where water is collected at an intake and funnelled into a pipeline. Due to the uniqueness of each source there could never be a standard design but the principles of water catchment, sedimentation and contamination prevention are always observed.

Because treks are normally carried out during the dry season, it is most important not to forget the problems caused by monsoon season flooding. Intake structures have to be located at points where they would not be threatened by flood waters (such as in gullies) or by erosion over the years; a typical notebook sketch can be seen at Figure 1. Detailed questioning of villagers generated hours of "debate" over the exact route of monsoon water flow. Screening, dams and structure protection (such as fencing and roofing) were all taken into account, and sedimentation tanks constructed for all stream sources and for spring sources which appeared dirty or cloudy.

If the ground between source and taps is extremely undulating, problems with air blocks or sedimentation can occur. If no alternative pipeline route is available then air valves or manual air releases have to be installed. A much simpler solution but one with obvious maintenance drawbacks was to puncture the pipe and seal it off with an aluminium or brass screw, thus allowing air release by the simple use of a screwdriver. Although not normally a problem with water taken from springs or small streams, sedimentation sometimes requires the use of washouts (manually operated valves allowing sediment to be flushed out of pipe) at the bottom points of "U" profiles.

The inclusion of break-pressure tanks at regular elevation interval drops (60m recommended) was necessary to stop pipe ruptures and limit the amount of Class IV HDP and GI pipe required. This was achieved by allowing the flow to be discharged into the atmosphere, thereby reducing its hydrostatic pressure to zero and establishing a new static level. These structures could literally have been holes in the ground constructed of masonry and covered with corrugated

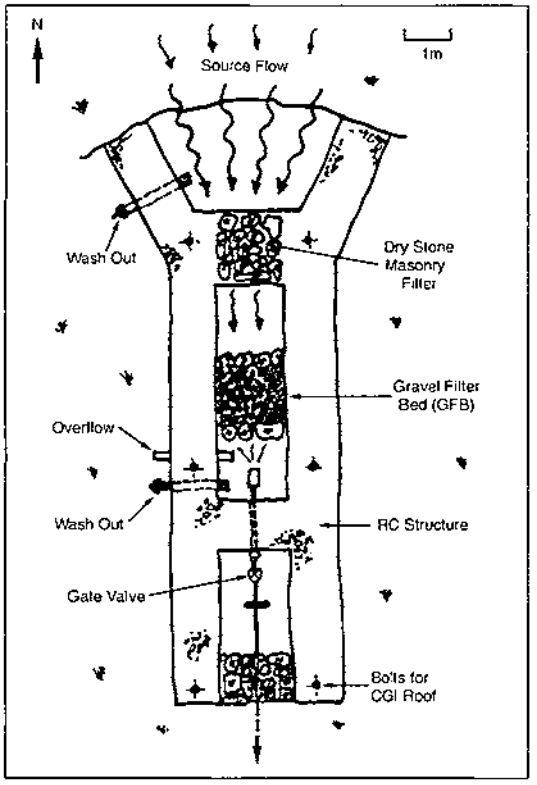

Figure 1. Field notebook sketch of typical intake works.

iron sheeting *(see Figure 2a)* or more elaborately, perhaps, prefabricated from HDP pipe *(see Figure 2b)*. The latter had the advantage of being lightweight and easy to install but were not as sturdy and long lasting as masonry tanks. Finally tap stand areas had to be carefully designed. They needed to be clean, hygienic and inviting places where villagers could gather to gossip, collect water, wash clothes and bathe. It was soon apparent that nothing else would cause such heated debate amongst the villagers than the exact location of each stand! Schools, medical outposts and village elders, were generally allocated their own taps. Other taps were placed where most convenient: for instance sites near the main route were beneficial for all.

The number of tap stand designs is limitless and depends on available materials. Combinations of masonry, timber or dry stone variants proved the most popular.

The removal of overflow water had to be designed at this stage; a watering hole for animals, or a crop irrigation system were usually the most appropriate uses for this.

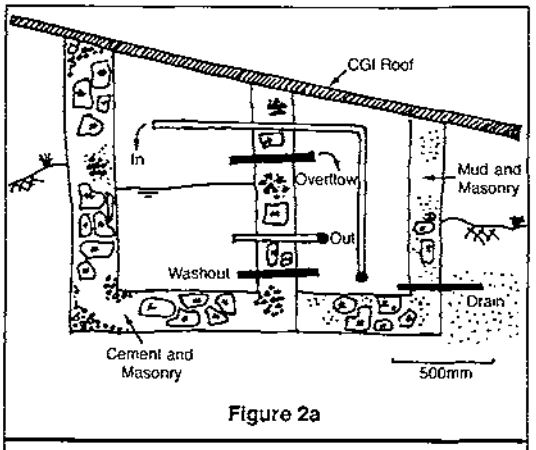

Figure 2a

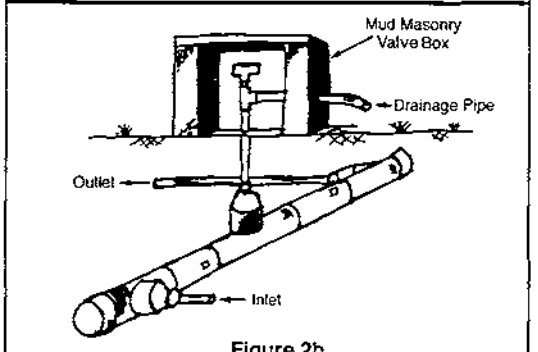

Figure 2b

Figure 2a and b. Field notebook sketches of HDP (top) and masonry (bottom) break pressure tanks.

Construction and Management

The opportunity for a designer to be the project construction manager as well is remote, but I was fortunate enough to assist, albeit only for a short period of time, with the construction of another project being undertaken along the trek route. Many difficulties were apparent and were confirmed at a later stage by officers who had overseen numerous projects of this kind. What the experience made clear was the importance of accurate field notes and a detailed final report drawn up by the designer.

Having arrived at the construction site, which can be a major logistic operation in itself, the project manager has to be careful not to over-involve himself in the detailed nitty-gritty of running tasks. His primary role is one of project supervisor or technical consultant to the villagers. He has to apply his expertise to planning the overall construction schedules and must leave the villagers to decide on foremen and gang-team composition. Capitalizing on the initial enthusiasm of the village is essential. Continuity is equally important and the more difficult sections can therefore be left until last in order to allow the villagers to build their own "construction familiarity" and also to let them see results as soon as possible. Work has to be evenly distributed amongst the villagers and it is advisable to complete the main line before starting branches so that nobody's line is finished at the start which may result in the villagers "downing tools" as their own branch section was completed. The project manager is responsible for establishing procedures and maintaining standards; on occasions this could involve inspecting every metre of trench before pipe is laid. His job will be made considerably easier by good communication; villagers are much more receptive and willing if they are told not only what to do but why it has to be done. Usually there is no crisis management, and no critical deadlines have to be met. An assessment of the "cost-time-performance relationship" will quickly lead to the conclusion that the emphasis is very much on performance and cost, with the only time constraint being to complete projects before the monsoons start. This does not mean, of course, that projects will be entirely problem free and many unforeseen circumstances may arise requiring improvisation and new designs. For example, additional sections of suspended GI pipe may well be required to cross gullies that did not exist during the initial survey.

Future project managers should remember that their workforce will have no experience of the work they are about to undertake and therefore nothing should be taken for granted. Simple tasks such as the correct procedure for uncoiling HDP pipe and the required method of back-filling trenches will have to be explained in some detail. Also, other potential difficulties frequently encountered in the villages of Nepal are curious children, strangers passing by and adult water buffaloes!

Required maintenance of community water systems after completion should be minimal. The materials and components provided are generally fairly robust and capable of withstanding the majority of hardships that Nepal offers.

Summary

An opportunity to visit Nepal is one not to be missed. To provide some form of personal

assistance which improves conditions in that country is truly a unique experience. Trekking offers enormous opportunities for broadening personal horizons; and assisting local community aid programmes by designing and constructing water systems, for instance, provides benefits for all. Unfortunately the author has not been able to revisit Nepal to see his completed projects. It is extremely gratifying to be informed, however, that all were completed as designed and within budget.

Designing and constructing gravity flow water systems is not difficult. More difficult is to grasp the immense significance of such a project to the villagers and to be able to analyse an array of design combinations in an attempt to produce the most effective solution for each particular location. Each village population's individuality must be fully appreciated and every attempt made to produce a design which is both acceptable to the inhabitants concerned, and yet simple and robust enough to last 20 years in extremely hostile conditions.

The key to the long term success of a water system project, or any project in a similar location, is the designer offering a simple, well considered solution for use by the future project manager.

One of the completed tap stands – a dream comes true.

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Irresistible Temptation

MAJOR D J G WOOD MBE

The author joined the Corps in 1962 as a junior leader at Dover. A varied and interesting career has included tours in the Christmas Islands, and Canada, and as RSM of three different units including the multinational force in the Sinai Desert. Regimental duty took him on active service to Northern Ireland in various capacities, and the Falkland Islands on Operation Corporate *as SSM 11 Field Squadron.*

Commissioned in 1987, his first tour as Chief Instructor, 28 Amphibious Engineer Regiment, was followed by service with 3 Field Squadron in the Gulf War and as Technical QM 35 Engineer Regiment in Bosnia on Operation Grapple 1. *His last appointment was as OC of the Combat Engineer Training Centre in Germany.*

He is not unknown in the Army as a cartoonist and has decided to cut short an unpromising further career in a shrinking Corps in favour of a life as a commercial artist and journalist. He has for some years been an enthusiastic sports diver and has lead a number of diving expeditions including this last one.

On 25 May 1915, HMS *Triumph*, an old first class battleship of 11,985 tons, was providing gunfire support to the Allied army locked in battle with the Turkish garrison on the Gallipoli Peninsula of Turkey, when she was torpedoed and sunk by a German submarine, U21, just off the coast at Kaba Tepe near Anzac Cove. Two days later HMS *Majestic*, an even older battleship, was sunk by two torpedoes from the same submarine whilst operating in shallow water in the Aegean entrance to the Dardanelles Straits and whilst supporting the British troops who had been landed at Cape Helles.

The sinking of these two ships occurred after the bulk of the fleet supporting the army ashore had been withdrawn a few miles to the island of Imbroz as a safety precaution against submarine attack. The combination of the fleet sailing over the horizon and the death of these two old ships caused a drop in morale amongst the watching troops ashore that nothing again could restore.

In May 1995 the Hameln Sub Aqua Club (HSAC) set out to locate these ships with the intention of diving them on the 80th anniversary of their sinking but were thwarted in this aim by the Turkish authorities who, unknown to the British Embassy, had denied permission to the expedition to dive these particular vessels. On arrival therefore the original plan was considerably modified! The trouble with the authorities probably stemmed from the fact that we were all servicemen and women and the Turkish government agencies were suspicious of any activities involving groups such as ours.

The HSAC team, composed mainly of advanced and experienced divers from several British army units in Germany, were based in Canakkale (Chanak on older maps) at the narrowest part of the Dardanelles and dived with a charter dive operation called Neptune Diving, which operates out of the Truva Oteli (Trojan Horse Hotel). The outfit is run by the one time breath-holding diving champion of Turkey, a bear-like individual named Yavuz Deniz Yilmaz or Yavuz Bey for short. He runs a fairly basic hard boat but when catering for large groups sub contracts for a variety of small to medium-sized fishing boats. All diving in Turkish waters has to be under the auspices of a Turkish license-holding operator and Yavuz Bey provided a complete package including transfers to and from Istanbul airport (a five-hour journey by minibus), hotel accommodation, and all diving services.

Too close an interest (in our plans and activities) by the local coastguard led Yavuz to take us to some pretty average dive sites at first and this, combined with having to dive from a weird assortment of boats and a truly Mediterranean reluctance to achieve anything much before midday,

Major D J G Wood MBE
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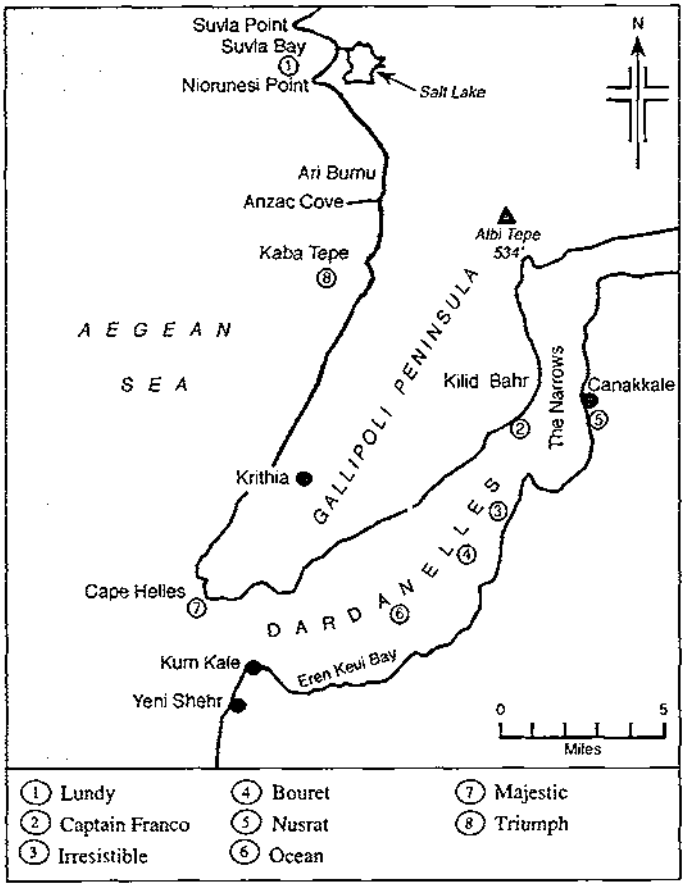
produced a rapid rise in the team's frustration levels. By about the middle of the fortnight however, with the help of the local representatives of the Commonwealth War Graves Commission whose diplomatic and translating skills were our saviour, we came to a reasonable arrangement with the coastguard and got some fair diving in.

The eastern Aegean has clear visibility and by May the spring storms are over, affording excellent clear water diving. For five days we dived sites along the west coast of the peninsula and amongst these the wreck of the *Lundy* a steam trawler sitting upright in 28m of water off Suvla Bay and a wrecked lighter and other wreckage off Anzac Cove were really memorable. The lighter is home to a number of large conger eels and we found brass fittings, ammunition in near perfect condition and the remains of hobnailed boots in the sand around her. Visitors must remember that the small area of the Gallipoli Peninsula and the really minuscule Anzac Cove area were the sites of some of the fiercest close quarter fighting of the First World War and small reminders of this, including occasional human remains, are still to be seen both on the battlefield and on the seabed, particularly close inshore in the landing areas. At Ansac, many of the trench lines can still be followed and some, mainly on Chunuk Bair, the key position held by the Turks for most of the campaign, have been partially refurbished for the benefit of visitors. It is a sombre yet peaceful place and a visit to the battlefield makes the modern soldier and indeed ordinary visitor wonder at the fortitude and endurance displayed by the soldiers and sailors who clung on here being shelled day and night and living in trenches and dugouts. The fighting was relentless in its intensity and eventually a quarter of a million men on both sides became casualties during the ten months of the campaign.



Map of area dived, showing positions of vessels mentioned.

The teams also dived in the Dardanelles Straits, a great contrast to the Aegean. In the middle of the straits there is a constant southwest-setting surface current with very many confusing back eddies inshore. As the World War One submarine crews also found out, there were (and still are of course) varying degrees of salinity making buoyancy trimming very difficult. The speed of the current makes drift diving a very exciting experience, particularly along the shores where the speed of up to six knots, allied to constant changes of salinity and underwater back eddies have the disconcerting effect of trying to "tumble" one through the water. Along the shores the sandy/rocky bottom is covered with an almost solid mat of large mussels and there are a few large fish about. In the middle of the deeper channel the effect of the current is much less noticeable below about 10 to 15m and is almost negligible below 30m.

The *Captain Franco*, a very large bulk carrier-type vessel, lies on her port side not far from the fort at Kilid Bahr on the European side. She was rammed just abaft the bow and is a large and

Captain A Reid, a British Sub Aqua Club advanced diver and the sub-aqua diving supervisor, exploring the deck of HMS Lundy.

impressive dive lying in 39 to 59m of water. The depth to her side at the point of ramming is 28.9m.

Some of the largest wrecks in the straits are those of the Allied battleships sunk by mines and shell fire during the disastrous attempt to force the Dardanelles on 18 March 1915. Amongst these are HMS *Ocean*, HMS *Irresistible*, and the French ship *Bouvet* (which sank with 640 men aboard), all of which sank after hitting mines laid by the Turkish minelayer *Nusrat*. A replica of the *Nusrat* stands on the shore at the Naval and Military Museum at Cannakkale, which is well worth a visit.

We found the people of Canakkale extremely helpful and friendly. Used to tourists passing through to visit either the Gallipoli battlefield or the ruins of the ancient city of Troy on the Asiatic side, rarely staying longer than one night, they treated us almost as long lost friends once we had been in the area for a few days.

On the final day of the expedition we managed to locate, and grapple onto, the wreck of HMS *Irresistible* which is lying on her side in an average depth of 59m, in Eren Keui Bay. She was shattered by shellfire before she sank and is now in two parts with the top of the wreck at 44m. She is an impressive and challenging dive. There is a strong current for the top 15m over her and she lies uncomfortably close to the main shipping lane for Marmara-bound traffic. Much of her superstructure has collapsed into an unrecognizable heap on the seabed, and her propellers and shafts have been salvaged but her gun turrets are still in place. With a depth to the gunwale of about 50m we had little time to explore and the wreck deserves much more attention than we had time to give to it.

Deep diving cannot be approached in any other than a disciplined and careful way. At 50m, which is the BSAC recommended maximum depth for air breathing divers, nearly everyone experiences nitrogen narcosis which produces similar symptoms to those of drunkeness. The great volume of air needed in the lungs to counteract the pressure on the body of six times atmospheric pressure (about 30 litres per breath) uses the available supply of about 1800 litres per cylinder frighteningly fast! Add to these facts the effects of cold and darkness and the need for a gradual ascent to avoid decompression sickness (the bends) and you can see why these dives call for careful planning and precise execution.

On the last dive of the expedition the profile for the *Irresistible* was: descent four minutes (including two minutes to fight down through the surface current); time on wreck three minutes; ascent six minutes (including a two-minute safety stop at 6m where a fresh supply of air was available for those running low).

Every diver makes his own calculations from dive tables and these are double checked by his buddy and by the supervisor. In addition most advanced divers wear dive computers which monitor rate of ascent to avoid injury.

Technical diving involves the use of oxygen enriched air and gas mixtures, such as a mix of helium and oxygen to minimize the risk of decompression sickness and give longer bottom times. Although these specialist forms of diving are common in the sport diving world, they do require very rigourous training and additional equipment, neither of which were available to the team.

There is much of interest to divers in the area which, underwater, is relatively unexplored by westerners. Many of the really large World War

One wrecks are just out of reach for air breathing divers, and this is one area where technical diving could really pay off. It is worth knowing that the nearest recompression facilities are in Istanbul about two hours away by helicopter.

An added complication to diving in this area is that many of the wrecks are war graves and the Turkish authorities are particularly protective of these even though they have all been salvaged to some extent.

The trip was a dream come true for at least two people. Major Chip Wood who led the HSAC team and Captain Gordon Sochon, REME, who led a similar team from the UK. Both had the same brainwave about three years ago and both teams were in the area at exactly the same time (the only other Sapper in the team being 2nd Lieutenant Liz Moss). What started off as an attempt at a Majestic Triumph became, in the end, an Irresistible temptation.

HMS IRRESISTIBLE

HMS *Irresistible* was, with HMS *Ocean*, bombarding the forts at the Narrows during the afternoon of 18 March 1915 whilst an abortive attempt to clear the mines was made by trawlers acting as mine sweepers. At 1615hrs she began flying a green flag meaning "I have been torpedoed" on her starboard yardarm. She was very close to the Asiatic shore and at once the Turkish guns began to concentrate on her.

The destroyer HMS *Wear* was sent to her assistance and took off 600 of her crew including several dead and 18 wounded. At that time the senior officers and ten volunteer seamen stayed aboard to prepare the ship for towing. She remained drifting and under fire and at 1720hrs when the *Wear* again closed with the vessel there was no sign of life aboard and the ship which had been hit repeatedly was in a desperate condition. HMS *Ocean* had been ordered to take her in tow but before she could do this she also hit a mine and was damaged by shell fire, her crew being taken off by destroyers.

HMS Irresistible.

After dark the destroyer HMS *Jed* was sent back into the Kepez Cove area to torpedo the *Irresistible* and salvage the *Ocean* but could find no trace of either vessel both of which had presumably sunk. HMS *Irresistible* now lies in a general depth of 57 to 61m at 40° 04.6′N 26° 20.5′E and is broken in at least two parts, the stern third lying some 15 to 20m from the rest. The depth of this wreck and the surface current over her make HMS *Irresistible* a challenging dive for which good skills, planning and preparation are needed but she is just within reach.

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62 Cyprus Support Squadron – A Window on the Corps?

MAJOR S A WRIGHT BSc(H) MSc

Major Stuart Wright was commissioned into the Corps in 1981. After a tour at 1 Training Regiment, he was posted to the Royal Military College of Science (Cranfield) and graduated with First Class Honours in Civil Engineering in 1986. Tours followed with 35 Engineer Regiment as a troop commander and squadron operations officer, 72 Engineer Regiment (V) as Adjutant, HQ 4th Armoured Division as SO3 and, eventually, SO2 Engineers. In 1993 he was selected for staff training and attended Division One (MSc) of Army Command and Staff Course 28 at Shrivenham, followed by Part 2 at Camberley. He assumed command of 62 Cyprus Support Squadron in April 1995.

Introduction

62 Cyprus Support Squadron is based, as its title suggests, in Cyprus, and provides Royal Engineers support to the island. The squadron has a wide-ranging role covering the full spectrum of sapper capability, a role which is perhaps not widely known or understood across the Corps. The aim of this article is to define this role, describe the organization, and outline the tasking and capabilities of the squadron.

Background

Cyprus is located in the eastern part of the Mediterranean Sea, 100km South of Turkey. It is half the size of Wales and is the third largest Mediterranean island after Sicily and Sardinia. A Crown Colony since 1925, Cyprus became an independent republic on 16 August 1960. The UK retained full sovereignty and jurisdiction over two areas, generally called Sovereign Base Areas (SBAs), around Akrotiri/Episkopi and Dhekelia. Following political unrest leading to intervention on Cyprus by Turkish forces, the island was divided north/south in 1974. Currently 38 per cent of the land area is in the "Turkish Republic of Northern Cyprus", a "state" only recognized by Turkey. There are approximately 4000 military personnel stationed on the SBAs and these areas also provide training facilities for land forces from the UK. Finally, there is a UN force on Cyprus, mandated to prevent the recurrence of fighting and contribute to the maintenance of law and order between the lines of Greek Cypriot National Guard forces and the Turkish/Turkish Cypriot forces along the north/south divide. The main contributors to the UN Forces in Cyprus (UNFICYP) are Argentina (475), Austria (250) and the UK (475).

Command Perspective

The major concentration of British forces in Cyprus is in the two SBAs, Eastern SBA (ESBA) and Western SBA (WSBA). A number of outstations exist in the form of retained sites but these will not be considered further. The WSBA is centred on Episkopi Garrison and RAF Akrotiri. Here are based HQ British Forces Cyprus (BFC), a resident infantry battalion, and the infrastructure and support necessary for an air trooping RAF station. The ESBA is centred on Dhekelia and Ayios Nikolaos. Here are based the second of the resident infantry battalions, 9 Signal

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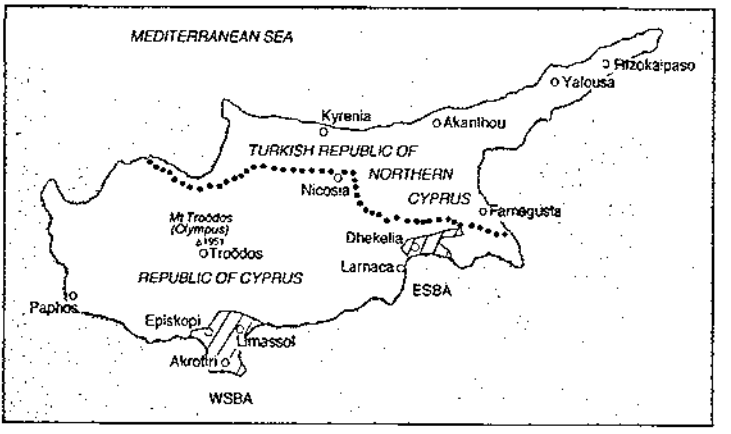
Regiment (Radio), 16 Flight Army Air Corps and 62 Cyprus Sp Sqn. The geographical separation of ESBA and WSBA is only 80 minutes by road and 30 minutes by helicopter but the practical and perceived separation is considerably more.

62 Cyprus Sp Sqn is an island asset, being Commander British Forces (CBF) Cyprus' only resident Royal Engineers capability. Engineer tasks are carried out in both SBAs and within the Republic of Cyprus. The squadron provides no support to the UN's contingent.



Map of Cyprus showing Western and Eastern Sovereign Base Areas.

It would seem sensible for there to be a clear chain of command direct to CBF and, in general, this almost exists. However, due to disaggregation of budgets, and geographical factors, in CBF's management plan the squadron is placed under full command of HQ BFC but under **operational command** ESBA. Interestingly HQ BFC retains tasking authority over the squadron and, for those disciples of ADP Command, here is a clear dichotomy. The solution is a flexible response to tasking requirements and a clear understanding of CBF's priorities. Serving many masters has long been the lot of a sapper OC and will continue to be so.

This article will not generally consider other sappers working in Cyprus or deployed here for training although there is a significant number. In HQ BFC, there are tied sapper posts in the J4 Works branch and a number of E2 posts are filled by sappers and military survey maintain a small map supply team. In each of the two garrisons there are clerks of work and JNCO tradesmen employed in the essential services groups, and Akrotiri has a garrison engineer. 9 Signal Regt (Radio) has a small artisan section, headed by a clerk of works, for high security tasks. A Royal Engineers section of one officer and 12 other ranks is permanently deployed from 36 Engineer Regiment in support of the UK element of UNFICYP and roulements with this force. The squadron provides resources and RE Inspectorate support to this section but no other assistance. The main deployment of sappers for training is the annual 10-week visit of a Royal Engineers' support squadron on Exercise *Pinestick*. Projects are executed in support of J4 Works and J3 Training and once again 62 Cyprus Sp Sqn provides resources support. The island hosts a series of exercises each year for all-arms training known as Exercise *Lion Sun* for regular units and Exercise *Lion Star* for the Territorial Army. Few sapper units have time to take part; none are forecast for 1996.

Squadron History

THERE is evidence of a RE contingent on Cyprus as long ago as 1882 but 62 Cyprus Sp Sqn cannot claim such ancestry. The squadron was raised in 1914 as 62 Field Company and served in France until disbandment in 1919. Reformed as 62 Chemical Warfare Company in 1940, the unit deployed to France and India until 1943. Then in various guises it saw service in Burma, India, Egypt and BAOR before a second disbandment in 1957. The first evidence of the squadron in Cyprus was in 1961 when the unit was reformed as Cyprus Park Sqn based in Dhekelia. Redesignated to its present title in 1976, here it has remained to the present day.

Current Organization

THE squadron is small, consisting of 74 military and 46 civilian personnel. The outline organization is shown in figure 1 on next page. The current organization is well suited to non-operational working but, as will be seen later, creates problems during operational tasking. Plant troop and engineer resources are worthy of note. Plant troop effectively runs a regiment's worth of plant including the last remaining deployed Black Top Paver and the only Heavy Crawler Excavator (Rope) in the Corps. This is a tall order and plant

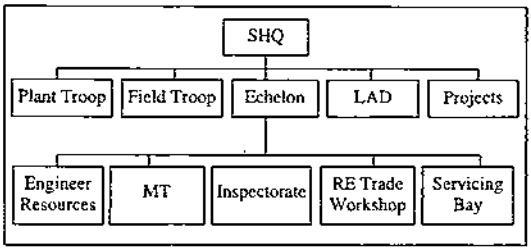


Figure 1. 62 Cyprus Support Squadron peacetime organization.

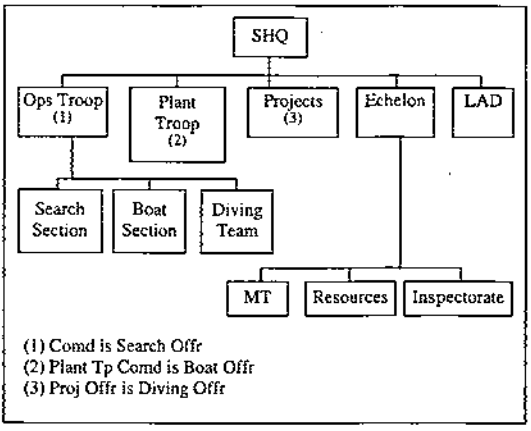


Figure 2. 62 Cyprus Support Squadron possible operational organization.

maintenance has a high priority. The engineer resources cell runs all engineer resources for the island, it is the Cyprus Engineer Park and once again suitable priority has to be afforded this essential island facility.

Operational Role

62 Cyprus Sp Sqn is the only permanent Royal Engineers unit on Cyprus. The role of the squadron is to perform a number of operational tasks laid down in clear priority in CBF Cyprus' Operational Directive. It is tasked with search, diving and small boat support together with a commitment to limited emergency infrastructure work, protection tasks and tasks essential to the operational effectiveness of BFC. Soldiers are kept at various notice-to-move times to meet these commitments which are considerable for a small unit. Although not organized as such, an operational squadron orbat could be as shown in figure 2. The first thing to strike readers should be that the squadron priority one operational tasks are based on specialist qualifications and not career employment qualifications – a nightmare for the squadron 2IC! In effect, about 50 per cent (30 to 40) of squadron personnel are qualified to "search", "dive" or "boat". They are employed as such purely for operations and training for those operations. The table opposite shows a summary of operational and training tasks conducted during the last six months. It should be noted that few members of the squadron are normally employed in their primary trade; search, diving and small boat skills are second or third caps!

The squadron provides high risk search support to HQ BFC. The OC is the Formation Search Advisor and maintains a number of Royal Engineers Search Advisors and Royal Engineers Search Teams trained and in date. Boat support is provided using the army work boat and includes internal security patrol tasks, support to the SBA police and to SBA Customs. A Royal Engineers diving team is kept on permanent standby. Other operational taskings make use of the normal distribution of useful tradesmen in an engineer support unit such as electricians, carpenters, bricklayers, plumbers, welders, fitters, specialist drivers and plant operators. Duties range from plant tasks for defensive works to mechanical engineering and electrical trades for maintenance of essential services in an emergency. The squadron has two forecast routine operational tasks: dredging the three moles required for boat operations and support to snow clearance. For three months of the year, a plant section deploys to the Troodos mountains to maintain access to the retained sites during the winter snows.

Training Role

All good quality training is of value and should in some way contribute to operational effectiveness. The training role is separated from the operational role because for the most part the squadron enables others to train and acts in a supporting or

Role	Operational Tasks	Training Tasks
Search	4	5
Small Boat Support	5	8
Diving	6	5
Plant Support	4	16
Emergency Services Restoration	0	2

Operations and training for operations April to October 1995.

"field" role. This aspect of the squadron's work is important to units on the island and to those visiting for training but is relatively low on the list of squadron operational priorities. Training support provides the bulk of activity for Field Troop. The full range of combat engineer and some artisan skills are required. In 1995, the Field Troop deployed to Jordan in support of 1 Royal Green Jackets and to Kuwait in support of 1st Bn The Royal Gloucestershire, Berkshire and Wilsthire Regiment. In addition, small sections supported company-level exercises in Jordan, Kuwait and Morocco. The tasks undertaken followed the best tradition of the "live, move and fight" triad, where we provided camp facilities, range construction and combat engineer support. On-island activity is no less frantic with all *Lion Sun* exercises (15 in 1995) requiring battle simulation, small boat support and various other skills and engineer resources. The resident infantry battalions (RIBs) have a full programme of regimental and company-sized training on the island, including battle group trainers. Liaison for the RIBs is provided by plant and field troop commanders in a "battle group engineer operations officers" role (admittedly with more limited experience) and the RIBs are encouraged to involve engineers from the beginning of planning for their training.

Island Tasks

In addition to a full programme of IS (Internal Security) exercises and training support, the squadron completes many tasks for the military in the SBAs and on behalf of the SBA Administration in the Republic of Cyprus. Many of the tasks are plant led but there is still a demand for artisan and combat tradesmen. Tasks vary and fall into two main categories: Military Aid to the Military Community (MAMC) carried out on the SBAs, and Military Aid to the Civil Community (MACC) carried out on the SBAs and in the Republic.

MAMC tasks generally consist of priority work which for various reasons is not carried out using normal J4 Works procedures.

MACC tasks are carefully selected and prioritized by HQ BFC and are designed to foster good relations with the Cypriot community and so enable a greater variation of terrain to be used for training. Ultimately a large part of the responsibility for selection of tasks falls to the OC and decisions are based on obtaining maximum training value and variety in employment of tradesmen. Of course the squadron also responds favourably to the hundreds of requests for a "dumper of sand" there, and "a tradesman" here, which come in on a daily basis.

Resources

Royal Engineers resources support to BFC is provided by the squadron. It is easy to overlook the importance of this role despite the large volume of materiel involved. The resources cell is, in effect, a field park for Cyprus and has all of the accompanying inspectorate-related responsibilities. Support is provided for Exercise *Pinestick* (the annual deployment of a UK field support squadron for project work), all squadron projects and for all Island training requiring RE-supplied stores. This area of the squadron's responsibilities is mainly manned by locally employed civilians (LECs) without whom the squadron could not function.

The Future

The role, capability and composition of 62 Cyprus Sp Sqn was recently validated and is likely to remain unchanged for the foreseeable future. Current training is aimed at reinforcing the squadron's position in IS operations. Some of the equipment used for such operations requires improving and plans for this are in hand. The squadron will remain, as now, a vital resource for Commander BFC.

Conclusion

The title of this article: *62 Cyprus Support Squadron – A Window on the Corps?* poses a question. I firmly believe that the squadron does mirror, on a micro scale, most of the activities of the Corps worldwide. The squadron has field, field support, field park and plant squadron capabilities and it therefore provides a full contribution to the military role on the island. Individuals are in constant demand for their artisan trade skills, combat engineering capabilities and specialist qualifications which complete the range and spirit of the term "military engineer".

The secret is balance, that vital ingredient which allows a multi-roled and skilled squadron to remain busy, happy and successful. And remember – an extra attraction after a hard day's work – one is on a holiday island in the Med!

Reinforced Soil Design and Construction with Particular Application to Bridge Abutments

CAPTAIN A H HAY BSc(H) CEng MICE

Captain Alec Hay was commissioned into the Corps in 1989. He joined 35 Engineer Regiment after his YO Course and has served in Northern Ireland and Bosnia. In October 1995, he completed Professional Engineer Training in Civil Engineering.

Introduction

The scene is central Bosnia in late autumn. Following heavy fighting a semi-permanent bridge is required over a river to reopen a main supply route to a principal aid distribution point. The water level in the river is low but is expected to rise within the next two to three weeks. A Bailey bridge has been authorized by the United Nations' representative, but the existing concrete abutments have been effectively demolished. The reconnaissance sergeant decides to build new reinforced soil abutments alongside the existing ruins and completes the report and stores demand. Three days later, a plant sergeant arrives with two field sections, some plant and an ISO-container. He has the bank excavated down to firm ground, opens a borrow pit nearby and lays the abutment formation. Working in shifts, the first abutment is completed within 36 hours and the men then move to the far side to repeat the process. A further field section lays a thin concrete screed over the abutment top surface and constructs timber bank seats for the Bailey bridge rollers to sit on. Once the home bank preparations are complete and the bridge construction and off-loading areas are set out, the section moves to the far bank where the construction team is just finishing that abutment. Within 96 hours of the first sections' arrival on site, new abutments are in place and Bailey bridge construction can begin.

The scenario described above may sound unfamiliar, but is already within the scope of the Corps' construction abilities. Reinforced soil has been used by Royal Engineers since Bishop Gundolf's time, but by the 1970s the Corps had stopped using it structurally.

In contrast, French, Canadian and American engineers continue to use it to this day. In the last twenty years, reinforced soil design has become simpler and its construction faster, making its use increasingly popular in industry for both temporary and permanent structures.

Geotechnical Engineering

There is a mystique about geotechnical engineering that frightens people off and tempts many designers to over-design foundations rather than risk making a mistake or appearing not to understand the discipline. Much like the ground paragraph in formal orders, geotechnical engineering is the combination of science and judgement rather than any pure application of mathematical theory.

In many of the foundation and bridge abutment design calculations that I have had to look through, I have noticed that designers complete

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pages of sometimes complex calculation and modelling only to round up the bearing area by anything up to a factor of three in addition to the factors of safety used in the calculations. The principal reason for this belt and braces approach is that one can never be absolutely sure how the soil is structured in detail without digging it all up.

It is this element of doubt that usually leads designers away from using soil as a structural building material, which is a shame because it is cheap and readily available in almost every theatre of operation.

Early History

Engineers of the past used soil as a building material and built extensive military and civil works with it. Quite early on in history, engineers realized that soils were not very good at retaining a vertical face or indeed supporting concentrated loads. The answer they came up with was to reinforce the soil with ropes, vines or, in later years, metal. The oldest surviving intact reinforced soil structure is the ziggurat of Agar Quf, in Iraq. It was built over 3000 years ago using sandy clay and vines with brick facing. The Romans built reinforced soil aqueducts and ravelins where the reinforcing vines slowed the rate of erosion caused by water flow. With the advent of the cannon, engineers quickly discovered that reinforced soil structures could take more direct hits than either brick, timber or unreinforced soil. More recently the engineers of the last century used iron reinforcing mesh to strengthen the railway embankments at bridge abutments and today it is increasingly used in bridge abutment construction as a cheaper alternative to concrete.

Characteristics

The slope stabilization application of soil reinforcement is regularly used by members of the Corps. However there appears to be limited understanding of the structural use of reinforced soil beyond basic road construction and local hardening. As military engineers we must be capable of adapting to our surroundings and utilizing what is locally available to complete tasks. Structural soil construction has many advantages over other methods. For example, compared to structures using more conventional materials, it has good blast resistance, is low cost, can usually be constructed speedily, uses *in situ* material and has a low manpower and skill requirement. It is, however, plant intensive and requires good planning, co-ordination and plant management.

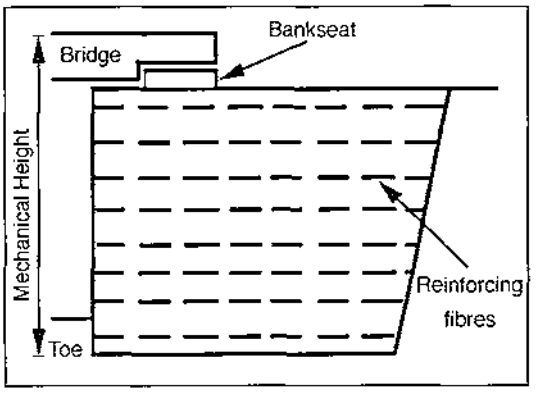


Figure 1. Schematic cross section through reinforced soil abutment.
(Reproduced by permission of Reinforced Earth Company Ltd.)

To understand the concept of reinforced soil it is simplest to consider soil as being either cohesive or cohesionless. A cohesive soil is sticky and retains water. Clays are cohesive soils. A cohesionless soil is made up of granules which results in voids between the particles, and it is these voids which allow water to pass through the general soil mass. Sand is a cohesionless soil. The soil in each area of the world has its own peculiar characteristics, but they are always predominantly either cohesive or cohesionless and it is this basic classification which will determine the method of design and construction.

Soil is reinforced by including layers of reinforcing fibre between the layers of soil so that the whole structure is built up like a sandwich. *(Figure 1).* The reinforcement is laid in the orientation of the tensile stress so that the soil is only subjected to the compressive stresses. For example, in a bridge abutment the vertical stresses are taken by the soil itself, but the associated horizontal stresses will be taken by the reinforcement with the compacted soil weight providing the reinforcement's frictional anchorage. The reinforcing fibres can be either vegetable, metal or plastic whose selection depends upon soil type and that fibre's stress characteristics: strength, durability and elasticity. Steel and geotextiles are most commonly used because of their predictable behaviour. Whilst the reinforcement gives the structure load-bearing strength, a facing is required to retain the soil fill in position. Selection of the facing material is normally determined by the anticipated conditions of use. For example, a steel facing would give rise to increased shrapnel under blast conditions but provide good

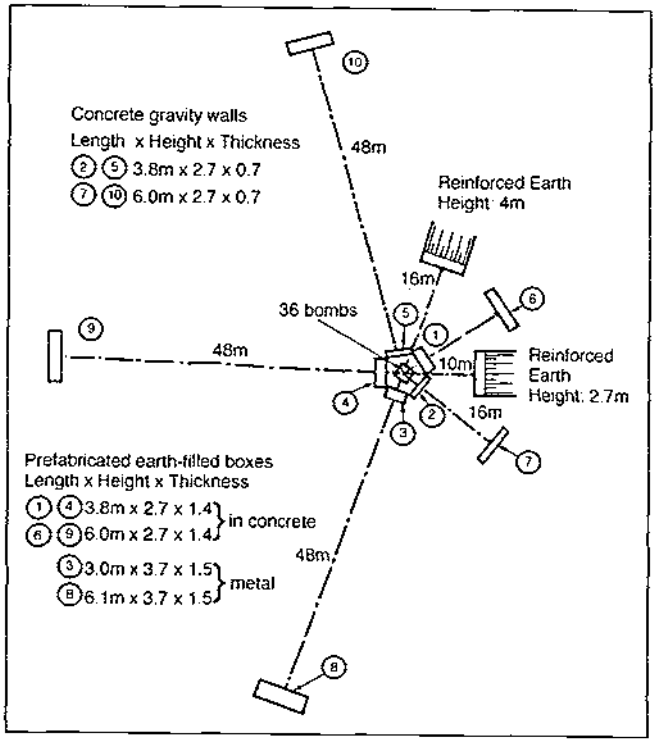


Figure 2. Plan of the Woomera test arrangement.
(Reproduced by permission of Reinforced Earth Company.)

protection against erosion. To a lesser extent, the design method employed will also affect the selection of facing.

As mentioned above, reinforced soil has very good blast resistance characteristics. A recent traverse trial at Woomera, in Australia *(Figure 2)*, showed that an eight-tonne TNT blast at 10m stand-off only resulted in surface damage to the facing and a maximum of 30 per cent soil displacement. (Traverses are the protective walls placed around dispersal zones where aircraft are resupplied and rearmed.) It is interesting to note that whilst traverses must be designed to produce no secondary shrapnel, the RAAF have used concrete facing panels in a steel reinforced cohesionless soil structure. Ballistic energy absorption is also well documented from as far back as the late 17th century by the Ulm Ingenieurs Schule. The basic soil types behave differently under these conditions. Cohesionless soils have better blast resistance and are easier to reinstate following blast damage whereas cohesive soils have better ballistic energy absorption, though their reinforcement is generally more difficult to repair.

The cost advantages of reinforced soil are best illustrated with a comparison of equivalent load capacity bridge abutments. A typical concrete abutment will cost in the region of £240/m^2 of facing, timber £180/m^2 and reinforced soil £50/m^2. These values allow for the increased size of foundation. Within the reinforced soil category, cohesionless soils will provide a greater load-bearing capacity than cohesive soils, depending upon the reinforcement used, and will not be as susceptible to settlement. Speed of construction varies with conditions; however, reinforced cohesionless soil can be constructed at a rate of 10m^2 (of facing)/hour and reinforced cohesive soil at 2 to 5m^2/hour. This is against a rate for equivalent concrete abutments of 0.5 to 3m^2/day. The reason for cohesive soils being slower than cohesionless soil is that the construction process must allow for more layers of fabric to achieve similar strength and allow pore-water pressure dissipation during construction. It should be noted that the equipment requirement is within the scaling for a field support squadron and there is no specialist manpower required *(Table opposite)*. The basic working unit of a combined field and plant section under the command of a plant sergeant provides the necessary manpower for two construction teams.

Design and Construction

In each application the reinforced soil structure is adaptable to its environment with the local soil type usually dictating the construction material and method of design. The methods of design generally used work on basic principles rather than absolutes. Since 1965, when Henri Vidal published his paper on reinforced cohesionless soils, an enormous amount of research has been carried out which has made the design process simpler rather than more complex. The three most commonly used methods are Coherent Gravity Method (CGM), Tied Back Wedge and Anchored Earth. The last two are described in existing military engineering pamphlets, whereas CGM is still relatively new to the construction industry and is described in BS8006: 1995. The theory behind

CGM is by no means simple but, with a few conservative simplifications it has been possible to produce a design system[1] which is no more difficult than a Bailey bridge design. The principal difference between CGM and the other two methods is that CGM requires relatively inextensible reinforcement, which makes it unsuitable for use with most geotextiles, and it is modelled on cohesionless soils only.

Of the proprietary soil reinforcements available, one can consider these to be either geotextile or steel. The designer must be fully aware of the relative merits of both reinforcement types so that he is able to improvise when necessary. Steel reinforcement is relatively inextensible with high strength, durability and longevity characteristics. (Galvanized steel reinforcement is being used for 120-year service life structures, whereas untreated mild steel will generally only last up to 20 years in well-drained cohesionless soils.) Its behaviour is predictable and it lends itself most suitably to improvisation. More important in an operational theatre, it is simple to repair following blast damage. The most common proprietary steel reinforcement is the High Adherence Strap *(Figure 3* over the page) which achieves its impressive anchorage characteristics through a method called "soil dilation."[1] These straps are typically between 7 and 11m long and 15mm x 60mm in cross section. Their spacing would be in the region of one for every $0.5m^2$ of facing. The simplest way to improvise these straps is to use steel weld mesh. The surface area of the steel bars should be at least 1.2 times the surface area of the straps for equivalent anchorage. The sheets of weld mesh can either be welded direct to the facing or fixed using 25mm high strength polypropylene rope or an equivalent steel wire rope. Steel reinforcement should, in practice, be limited to cohesionless soils.

MANPOWER – TEAM 1	MANPOWER – TEAM 2	PLANT
Plant Sergeant or above to command/control both teams		
Section Commander (Field)	Section Commander (Plant)	
Plant Operator	Plant Operator	D6/FL5B/Hydrema
Plant Operator	Plant Operator	10t Hamm Roller
Sapper	Sapper	Pedestrian Roller and Wacker Plate*
Sapper x 2 (laying reinforcement and fixing and filling at facings)	Sapper x 2 (laying reinforcement and fixing and filling at facings)	
Drivers	Drivers	Dump Trucks

* The 10t Roller cannot be used within 2m of the facings for cohesionless soils (4m cohesive soils). The Pedestrian roller is suitable up to 1m from the facing after which only the Wacker Plate or Cobra compactor is suitable adjacent to the facing. Use of compaction in cohesive soils is in similar proportions.

Typical manpower and plant requirement for two shift construction. Associated activities have not been included as this is dependant upon degree of improvisation and nature/location of available fill.

Geotextiles are far more versatile and can be used to dissipate water as well as provide reinforcing strength. They are mass-produced to fixed quality standards of strength and longevity, typically 20 to 120 years. They are cheaper and lighter to transport than steel though many more are required, typically one layer for every 150mm rise in height of the abutment as opposed to 500mm when using steel reinforcement. Their principal drawback is that they are not very durable during construction because they tear relatively easily and are very difficult to repair without digging out the abutment and replacing the sheets. By contrast, steel mesh can be welded *in situ* and the displaced soil backfilled.

Geofabrics and steel mesh can be used for both cohesionless and cohesive soils, but their big advantage is that they can make even saturated silts and clays (up to 5 per cent above optimum moisture content) structurally sound. Furthermore, if an impervious geomembrane is used in conjunction with a geofabric between thin layers of fill, the construction process will not be hindered and

[1] Further information on bridge abutment construction using cohesionless soils can be found in the paper, *The Use of Reinforced Soil for Bridge Abutment Construction in the Royal Engineers* 41PET[C] April 1995 by Captain A H Hay.

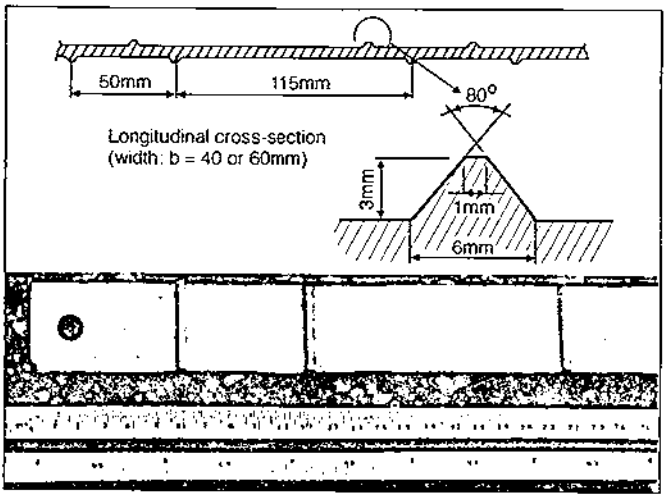


Figure 3. The high adherence strap.
(Reproduced by permission of Reinforced Earth Company.)

there is reduced concern over the integrity of the facing. For example, it would be sufficient to construct an abutment in the method described and simply lap the geofabric into a gabion basket wall, lined with a permeable membrane such as hessian.

It is difficult to improvise geotextiles, although the Normans had very real success using bundles of sticks (faggots) to act as load spreaders and water carriers. This would be quite adequate for basic corduroy road construction. If one considers the origins of geotextiles, layers of carpet would perform equally as well as the more orthodox approach described above.

Where geotextile facings are used, there is no secondary shrapnel in a blast, although this factor may be considered inconsequential given that the blast from exploding artillery and mortar shells tend to produce more than enough shrapnel as it is.

The facing is required to retain the fill which surrounds the reinforcement. In cohesionless soils the facing must be fixed directly to the reinforcing straps *(Figure 4)*. It can be either flexible/modular or stiff. The former is preferable, although when forced to improvise the designer may well elect to use vertically placed timber spars with walings (horizontal beams which retain the vertical facing members in position) at each reinforcement layer. Gabion baskets and HASCO™ baskets are unsuitable for cohesionless soils since a sound fixing to the reinforcement can rarely be guaranteed due to the basket mesh being too weak. The facings for cohesive soil construction have a less structural role as the geomembranes (at 150mm spacing) will retain most of the inter-layer soil fill. Their main function is to protect the vulnerable geomembrane and to provide a drainage sump for dissipating pore water. When particularly saturated cohesive soils are used, the designer must consider the associated settlement and how this will affect connections with the facing. In a similar way to the anchored-earth method, one can use vertically placed timber spars with walings as a facing, but a drainage blanket of geofabric or sand must be placed between the facing and soil fill to prevent soil erosion.

Stability of the Structure

So far, only the construction of the abutment has been discussed. The designer must be aware of the overall stability of the abutment with respect to effects such as overturning and formation failure. The overturning effect can be calculated by determining the pressure exerted by the fill behind the abutment. The design guide and tables[1] for CGM make this a simple calculation of opposing moments, otherwise it is as described in existing military engineering pamphlets. All the other stability checks can be effectively negated through the use of simple conservative rules of thumb at the initial stages of the design. For example, it must have at least 10 per cent of the mechanical height of the abutment below the forward ground level (i.e. the toe) to stop the abutment sliding away. The mechanical height is the equivalent height of the abutment soil mass which can be taken as the distance from the bottom of the toe to the top of the bridge deck. *(Figure 1)*. Similarly, if one uses a minimum reinforcement length of 7m, an imposed (bridge plus traffic) load limitation of 200KN/m^2 through the bank seat and at least a 10 per cent toe then the abutment is highly unlikely to slip because all the probable failure lines pass through the reinforcement of the structure and are no longer critical.

Settlement and failure of the formation are largely factors which are best judged by an experienced eye – typically a plant sergeant or military plant foreman – who would be looking for an equivalent of 30+ per cent California bearing ratio. The ideal would be for a California bearing

ratio of 50+ per cent, although harder to achieve. The formation should be as level as possible to within 0.1 per cent. Levels of 0.004 per cent are considered the norm for most motorway abutment constructions in industry, but this would not be practical given the time and resources that would be operationally available. It becomes evident that the formation is the most critical aspect of the construction and it is not unusual for civilian companies to take as long on the preparation of the formation as in the actual construction of the abutment itself. There are other rules of thumb which further simplify the design and improve construction tolerances so that when the reconnaissance sergeant completes the report proforma he only needs to check the requirements against tables and determine the overall quantities so that a stores bid can be initiated. The design then becomes a matter of extracting values from other tables and following a simple design guide to confirm reinforcement spacing.

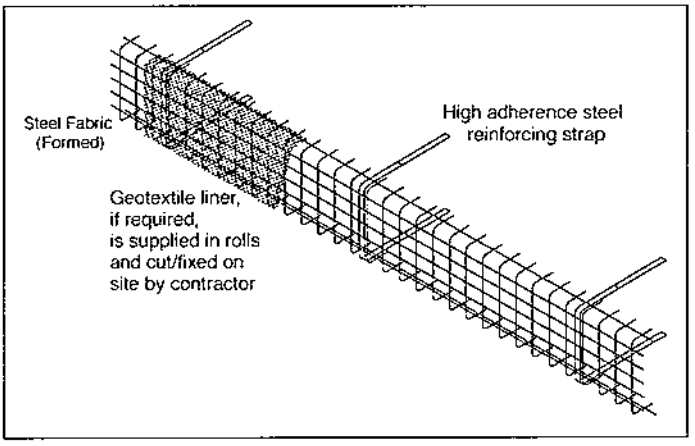


Figure 4. Modular facing detail. Taken from TERRATREL™ details. (Reproduced by permission of Reinforced Earth Company.)

Proprietary Products

THERE are numerous proprietary systems on the market for both steel and geotextile reinforcement systems. Of particular interest in steel reinforcement is the TERRATREL™ system *(Figure 4)* developed by the Reinforced Earth Company Limited. This is a lightweight and flexible system that has been extensively proven in the construction industry in very high load applications such as the Severn Crossing caisson launching ramps. One standard sea container can carry a standard 240m^2 pack of facing with a generous scaling of 11m long galvanised High Adherence Straps at a total pack cost of £12,000. There are other facings available, such as concrete and steel, although the cost increases dramatically for what is effectively only of cosmetic benefit. By comparison, there are many geotextiles on the market of which the TENSAR™ SR geogrids appear to offer the best value for money with cohesionless soils. In cohesive soils the selection is too varied to recommend a good general purpose geotextile, though several firms produce an excellent range of products. The Resources local purchase cell must take care with cohesive soil reinforcement as it is very easy for the incorrect geotextiles to be delivered which would be hard to adapt on site. It is therefore recommended that a single individual, familiar with the design and reported site conditions, is used to select and purchase a suitable product and to check it on delivery.

Expert Advice

THERE are many sources of advice open to the designer in the field. The first and most obvious is the theatre Specialist Team Royal Engineers (Works). In addition there is a lot of information available from Military Works Force at Chilwell, Construction Wing at the Royal School of Military Engineering and the Engineer and Transport Staff Corps. Most reputable commercial companies will gladly send their product and design literature by return of post.

Conclusion

IN reinforced soil, the Corps has a versatile and effective construction method which is ideally suited to operational infrastructure works. Its low relative cost, simplicity of design, speed of construction and low skill requirement bring it within the capabilities of field units. It is recommended to the Corps as a realistic alternative, which Royal Engineer officers should be aware of and consider for bridge abutment construction.

Grapple 6

Bosnia in the nineties – the most desolate of places,
Of world renown for cruelty between its warring races,
Serb versus Croat and Crescent versus Cross,
No faction yet the winner in this war of mutual loss.
Ignore the fact each army thinks that "God won't let us lose",
As history is the reason and religion the excuse.

* * *

The hatred in this region lies just beneath the crust,
Stemming from a civil war of neighbourly mistrust.
Every few kilometres a devastated village,
Ethnic Cleansing but a modern phrase for systematic pillage.

The tinder-box of Europe is a good name for this land,
Sarajevo 1914 and the death of Ferdinand,
And the trials the French are facing are surely nothing new,
Do they know that Sarajevo is now twinned with Dien Bien Phu?

And Ethnic Cleansing – no surprise to this divided realm,
Utashas murdered Chetniks with Hitler at the helm.
And in the Middle Ages, when Ottoman held sway
Persecution of the infidel was normal in their day.

The Seeds of ethnic conflict have since been sown elsewhere
And Western Serbs taste bitter fruit of Bosnian warfare.
So the Krajinians are defeated now – a lesson for its Teacher:
"Hit us and we will hit you back" ... like Zepa and Sebrenica.

Yugoslavia in Tito's time a distant memory.
Can a Bosnian today define "Racial Equality"?
If your home town is reminiscent of Berlin in forty five,
And you are the only member of your family left alive.

Would you settle for a cease-fire ratified and sealed,
When the pastures where once you played are one unmarked minefield?
Grateful to the UN in their luxurious Land Cruisers?
When you know that in this conflict it's the Bosnians who are losers.

You drive the UN MSRs, strewn with Bosnian litter,
See black-toothed women staring back, do wonder that they're bitter?
They know our time will soon be up, they'll not see us again.
Until the tour returns to Dog and we're back on Grapple 10.

TPC

(Dog – slang for 1st Field Squadron)

Memoirs

LIEUTENANT COLONEL C A BIDDLE MA FRICS

Born 4 April 1909, died 1 February 1995, aged 85.

CHRISTOPHER Arnold Biddle MA FRICS died at home in Lymington, Hampshire on 1 February 1995 at the age of 85. Born on 4 April 1909, Biddle won a scholarship to Charterhouse and a prize cadetship at the Royal Military Academy, Woolwich. He was commissioned into the Royal Engineers in January 1929, and won an exhibition to Trinity College, Cambridge where he read mechanical sciences, graduating with First Class Honours in 1931. In 1933, having been posted to the Bombay Sappers and Miners, he was seconded to the Survey of India. Some early teaching experience was gained during a period as Officer Commanding the Survey of India Training School before he was promoted Assistant Director Survey with the rank of lieutenant colonel and, by the time that he left the Survey of India in 1948, he had become Director of the Southern Circle, Bangalore.

Biddle's next 24 years were spent at University College London (UCL) where he was appointed Lecturer in Surveying in the Department of Civil and Municipal Engineering in 1948. Well deserved promotion to Senior Lecturer followed in 1960 and to the Readership in Surveying in 1967. His appointment at UCL coincided with the early specialist courses in surveying, soon to be formalized as the College postgraduate Diploma in Surveying which, in 1966, was upgraded to the Masters degree. Throughout this formative period, Christopher Biddle guided students from all parts of the world and they will have fond memories of an outstanding teacher. His main involvement with undergraduates was through the University of London intercollegiate course in mathematical geography. Unlike the postgraduate surveyors of the time, these groups contained female students and so were always referred to as "girls", irrespective of gender!

Biddle was elected to Fellowship of the Royal Institution of Chartered Surveyors (RICS) in 1949 and was an examiner in Land Survey for RICS from 1953 to 1966 and for the Incorporated Association of Architects and Surveyors from 1959 to 1966. He was Chairman of the RICS Land Surveyors' Examination subcommittee in 1962-63 and he sat on the Land Survey Divisional Council from 1962 to 1966. During the 1950s and 1960s, he wrote many land survey correspondence course papers for the College of Estate Management. His best known publication was *The Text Book of Field Astronomy* (HMSO, 1958) which became a standard work in the English-speaking world. Apart from writing for military manuals in India and Britain (such as "Traverse and base measurement" in *Military Engineering*, Volume XIII (Survey), Part IV, 1965), other publications included "Heights by aneroid barometer" for Tellurometer Ltd, "Standard practice in field astronomy" (RICS *Journal*, 1953), "Design for a topo beacon" (*Empire Survey Review*, 1956), and sections on astronomy and aneroid heights in *Hints to Travellers* (Royal Geographical Society). Survey beacons of Biddle design are still in regular use at UCL. His work on aneroids resulted in a redesign of the Wallace and Tiernan instruments. After retirement from UCL, his sailing interests enabled him to revise *The Biscay Pilot.*

Extramural activities were concerned with racing. Biddle developed a love of motor cars while at Cambridge and later he drove at Brooklands. In the 1960s, his students would scan the small print of Monday's sports pages to discover how he had fared in the weekend yacht races. Sailing was the main holiday pastime and "no useful address" was a typical summer destination. There are still some members of UCL who remember his anchor role in the Engineering Society tug of war matches in the college quadrangle.

To many, both staff and students, Christopher Biddle may have seemed shy and aloof but deafness did not make it easy for him to mix with the crowd. On an individual basis, the gruff exterior and efficient manner could melt to reveal genuine kindness and thoughtfulness for others. With his passing, the Department of Photogrammetry and Surveying at UCL has lost the only remaining survivor of the academic staff with which E H Thompson inaugurated the separated department in 1961.

KBA

LIEUTENANT COLONEL D G B BOYD

Born 22 October 1913, died 2 September 1995, aged 81.

DEREK Gerald Burdett Boyd was born in Dublin on 22 October 1913, and was the elder son of a distinguished officer of the East Yorkshire Regiment, Major General Sir Gerald Boyd KCB CMG DSO DCM (plus Legion of Honour and Croix de Guerre) whose career spanned from fighting as a sergeant in the Boer War (whence the DCM) to becoming Military Secretary where he died "in harness" in 1930. Derek grew up in Ireland where he developed a great love of open space and country pursuits, which he retained throughout his life.

He was educated at Winchester College, the RMA Woolwich and Queen's College, Cambridge. His Cambridge friends still remember him with much affection for his natural charm, humour and sense of fun. He rowed and played squash for his college. He was commissioned in September 1933, and this was followed by Cambridge and three years in 33 Fortress Company in Cork – still one of the Treaty Ports, handed over to the Irish government in 1938. Derek was left to close the unit down (he recalls parting with a steam-roller for 10/-) and in 1939 he embarked for India to join the Madras Sappers and Miners, where he became Adjutant of 4th Indian Division Engineers. The division was sent to the Middle East at the outbreak of war. Derek was involved in much fighting in North Africa, and while 2IC of 12 Field Company, which he had joined in mid-1940, was wounded by an anti-personnel grenade, thus (almost) fulfilling the prophesy of an Indian soothsayer who had told him, long before the unit knew where they were to be sent: "Sahib will soon go to Egypt and be wounded in the left knee near Port Said." He recovered in the theatre.

It was in the Middle East that his potential as a staff officer was noted, and after attending the Staff College he held a number of general and engineer staff posts in the Middle East which took him round Palestine, Syria, Lebanon, Jordan and Iraq before joining Eighth Army headquarters shortly after the battle of Alamein, remaining with them until after the subsequent defeat of General Rommel. After a spell commanding a field company in Sicily with 51st Highland Division he returned home and became a staff officer in the planning of the invasion of France. He crossed to Normandy on D+3 with Headquarters Second Army, witnessed the capture of Caen in July, and remained with Second Army throughout their advance across Europe to Brussels. After a short spell in the UK he returned to Brussels as GSO1 (SD) 21st Army Group at the age of 31.

Shortly after the war he was brought down a rank, and appointed OC 1st Field Squadron in BAOR. These were difficult times with soldiers' minds on demobilization, few training facilities, a "non-fraternization" policy which separated the Army from the local population and a generally chaotic situation. He recorded his impressions of this time in his memoirs which are in the RE Library. He is remembered as an OC who spared no effort to maintain an efficient, well disciplined and happy squadron, displaying at the same time an infectious cheerfulness and a ready Irish wit. After this he attended the US Armed Forces Staff College, which was followed by a term in the War Office with MO1, where he did not take happily to the life of a Whitehall warrior. In a subsequent tour in the Field Engineer School he will be remembered by the early postwar RMA batches when doing their YO training. He was a prominent member of the RE Drag, and won the George Master Horn in the RE Point to Point in 1952.

In 1953 he married Ann, and shortly after decided on a new career. He retired and became a successful breeder of pedigree pigs in Bentworth, Hampshire. He immersed himself in local affairs, becoming a churchwarden, chairman of the local British Legion and of the Conservative party branch and secretary of the Hampshire British Field Sports Society. Shooting and fishing were his main recreation. He and Ann made many new friends, and were popular and hospitable members of the community. He also turned his hand to writing, and published two detective novels, a history of the Gordon Boys' School and a condensed history of the Corps. A former EinC says that Derek's Corps history "was such a welcome alternative to poring over the volumes of the official history, and that the whole Corps should be very grateful to him for that."

Some ten years ago he was struck down by Parkinson's disease, which took an increasing toll on his physical, and latterly his mental, health. It was particularly cruel for a man who had led such an active life. He was marvellously uncomplaining and was enormously supported by his beloved Ann. Derek died on 2 September 1995. His warm smile and natural charm remained with him to the end.

RWML

LIEUTENANT COLONEL GEORGE DONALD MBE

Born 3 April 1936, died 30 August 1995, aged 59.

THE death of George Donald, after a long struggle with cancer, robs the Sapper world of one of its great traditional Quartermaster figures. He was liked and respected by a very wide circle of friends and comrades, many of whom owe their own success at least in part to the unswerving loyalty and determined support offered by George Donald.

George Donald was brought up in Aberdeenshire, where his father had a croft and worked on farms. His early life was austere but happy, and his schooling often had to be sacrificed to help with the ploughing and harvesting, which was done with a pair of Clydesdales. It was characteristic of a lifelong readiness to embrace new technology that he won the district tractor ploughing competition at the age of 14.

He joined the Army at the age of 15 in 1951 moving to adult service at Aldershot in 1954. He was always fit and keen on sports, and in those early days he was an aggressive and skilful boxer though a special "gnat weight" had to be invented for him to box for the Regiment, as all his life he remained whippet thin. During this period he was one of the soldiers who lined the route for the Queen's Coronation (he was the youngest member of the regiment on parade), and some 25 years later he received the Jubilee Medal whilst serving as a captain with 4 Field Squadron at Nienburg.

After his training at 1 Training Regiment he was posted to Germany to 29 Field Squadron (of which he became Sergeant Major in 1970) and retained many happy memories of BAOR not the least of which was that the exchange rate was DM12.75 to the £1! Later he was posted to 34 Field Squadron where he undertook tours to Kenya, Cyprus, the Oman and Aden where he worked with the SAS in the desert and met the young Peter de la Billière – they met again in the autumn of 1990 in the Gulf on Operation *Granby*. In 1962 George began a series of tours as a training NCO at Farnborough and Chatham and with these posts he became very well-known to many officers and future senior NCOs. His time as a field troop staff sergeant with 48 Squadron at Ripon was amongst the happiest of his tours. He was always fiercely competitive, and it was this tour which first saw him embrace his beloved basketball as player, coach and organizer, a passionate interest which he retained for the rest of his service. The squadron undertook tours in Aden, New Brunswick and Malta, and George's aim was always simple: to ensure that his troop was the best!

In 1968 he was promoted to warrant officer class 2 and posted to Edinburgh University OTC and then to a TA squadron at Swansea, where he trained the military contingent for Prince Charles' investiture at Caernarvon. Following this he assumed the appointment of SSM at 29 Field Squadron and then RSM at the Depot Regiment in July 1972. He enjoyed a particularly full life there, with 25 other warrant officers at Brompton, running the SNCOs courses, the Corps Veterans' Weekends and getting to grips with the whole range of important *esprit de corps* activities for which the Depot was then responsible. He made a particular impact on the Sergeants' Mess, then as now the largest in the Corps, which needed and received from him firm, clear leadership and a very active and committed social life – and there was always the basketball.

In October 1975 George was commissioned and posted to Nienburg as Administrative Officer to

Lt Col George Donald MBE (p85)

4 Field Squadron. He moved on quickly to be an assistant instructor at the Field Engineer Wing at Chattenden and then in 1978 to be Quartermaster of 32 Field Squadron at Ripon.

RJDR writes to say how, on their tour in South Armagh: "George soon welded the troops into a very close knit team, confident and well prepared for the challenges which lay ahead. In the province he displayed all the sterling qualities for which he was so well known: loyalty, determination and a burning desire to ensure that no stone was left unturned to provide everything that was required for the efficient administration of the squadron and the well being of every individual."

He was appointed MBE in January 1981.

From Ripon, George moved on to Osnabrück, initially as Quartermaster of 73 Independent Field Squadron but on the reformation of 23 Engineer Regiment, he became Regimental Quartermaster. JML writes to say how George "Had the wealth of knowledge, experience and firmness of mind required to make the quick decisions that were needed at the time, and to guide a new CO in the right direction. He planned everything from the Sergeants' Mess to the bedding store and from the Christmas dance to the divisional FTX. He left his stamp on every aspect of the regiment, not least in generating a highly successful basketball team from scratch. Whether it was the soldiers themselves, or their families, all had reason to thank him for his care and attention. George was a soldier through and through with real steel to his character and his influence will long survive him."

From 1985 until his retirement from the Army in 1991, George served as Regimental Quartermaster at 39 Engineer Regiment under three commanding officers who successively appreciated his unique contribution to the working of the regiment, the never ending series of projects to improve the living conditions of the soldiers, all fought through and justified with the District Staff who became only too well aware of George's persuasiveness.

The culmination of his service in the Corps and the Army was on Operation *Granby*. RP writes: "Our deployment came within two months of his retirement, a time when he might reasonably be expected to be sorting out his future in the civilian world. But when the call came, there was absolutely no doubt as to where his loyalty lay. His enormous experience and abundant energy and drive ensured that the British deployment to the Gulf went as smoothly as it did."

George retired into a post as Golf Club Secretary at Edgbaston but his illness started to affect his work and he was forced to give it up. He and Mary moved back to Tarland in Aberdeenshire where he spent his last few months quietly watching the roses, which he had planted in November 1994, blossom and flourish. The last occasion that most of his brother officers saw him was in October of that year when he attended a reunion of 23 Engineer Regiment at a Corps Dinner Night at Chatham, resplendent in full highland ceremonial dress.

So what of Lieutenant Colonel George Donald MBE? He was fit, determined, ambitious not just for himself but for the group of which he had charge, slightly earnest, a setter of an excellent example, a loyal comrade and a highly competent Sapper. He enjoyed a 40-year career with the Corps. The Army offered him a great opportunity, which he seized. He leaves behind him his adored family, wife Mary, and children Rosemary, Graeme, Gordon and Helen.

RP, RJDR, RAB, JML, MG, RP, NJE

LIEUTENANT COLONEL G J J HOUGHTON

Born 4 July 1923, died 22 December 1995, aged 72.

ALTHOUGH born in England on 4 July 1923, Jimmy Houghton spent almost all his first 14 years in India, where his father was serving in the Army. He went to the Bishop Cotton Schools at Simla and Bombay and was a chorister at Bombay Cathedral.

On 1 January 1938, whilst on leave from India with his family, he enlisted as an apprentice boy soldier in the Corps and went to Kitchener Barracks, Chatham. It was some weeks before he could appear in uniform as everything had to be specially made for him because he was so small.

On entering "man service" he had several short stays in various stations ending up in Cairo and then Baghdad. He applied for an Emergency Commission and was selected for OCTU training in Palestine. He was commissioned from 140 OCTU at Newark in April 1945 with 187 Class.

1945 saw him back in India, attached to a Royal West African Frontier Force Engineer Company and when hostilities ended he was posted to Nigeria where he was in charge of the demobilization of his West African Sappers.

He came back to the UK in 1946 and was posted to the RE Courts Martial Centre at Barton Stacey. It was there that he met Vera and they were married in October 1947. After the long Aerial Photographic Interpreters course, Jimmy and Vera went to Malaya where he served with Air Photograph Interpretation Unit and Army Photographic Intelligence Service for almost three years. When they came home, just in time for the Coronation in June 1953, they had two young sons.

Jimmy had his Short Service Commission extended whilst the Corps got sterling work out of him, largely as a Garrison Engineer, in Bulford, BAOR, Cyprus, Singapore, Kenya, Chatham and BAOR again.

He converted to a Quartermaster Commission in 1963 and from then on his career was largely dedicated to serving in the RSME and HQ EinC, with one tour in BAOR; all concerned with administration and resources. Everyone who knew Jimmy recognized his three outstanding qualities: integrity, loyalty and concern for others; and therefore successive Engineers in Chief, Commandants RSME and Chief Instructors left the relevant problems to Jimmy, confident that he would sort them out in the best possible way. He was one of those men who work efficiently and effectively behind the scenes not looking for praise, and who have always been the backbone of the Corps.

He left the active list as a Lieutenant Colonel in 1978 and immediately became an RO at the RSME, until he finally retired in July 1985. He continued for those seven years to work tirelessly behind the scenes organizing the resources for the RSME.

Jimmy bought 8 Mansion Row in Brompton in 1969 and that remained the family home. Many young readers will know Jimmy best from those days because he took a major interest in all things Sapper, Sailing and local to Brompton. He was for some years the Chatham Secretary of the RE Yacht Club and he was always an active and keen sailer. He was for years Chairman of Governors of Brompton-Westbrook School, Coordinator of Neighbourhood Watch, and a strong and diligent supporter of the RE HQ Mess, Brompton Conservation Association and his Masonic Lodges. He always had a special interest in the young and was a great mentor to many.

Throughout his life he was a dedicated and devout Christian, and when the family took up

permanent residence in Mansion Row, both Jimmy and Vera became very active supporters of the Garrison Church. Jimmy was Church Warden for many years and was also Treasurer for some time, Vera was Secretary of the Guild of St Helena for a long time.

Because of their wide interest, their circle of friends was large and came from all walks of life, and 8 Mansion Row became an open house for visiting friends, and with their rapport with young people, they were always welcome.

Jimmy nursed his wife through leukaemia with great devotion before she died in August 1995. He remained indefatigably cheerful in the face of rapidly progressive lung disease and died three days before Christmas having just arrived to spend a few days with one of his sons and his family in Devon.

GBS

COLONEL W H HOOPER OBE TD

Born 18 March 1903, died 26 December 1995, aged 92.

ALTHOUGH Colonel Bill Hooper was never a regular soldier he served four Monarchs through a military career spanning very nearly 40 years. The first uniform he wore was that of the Red Cross when, aged 16, he helped unload hospital trains from France and to ferry the casualties to local hospitals in South Wales. Somehow he had learned to drive by then.

He started his military career as the second soldier to be recruited into the Glamorgan Fortress Company RE when the TA was reformed after the First World War and was always a bit miffed that a bugler had beaten him to the distinction of being the first recruit! He worked his way up to Staff Sergeant with the Fortress Engineers before a civil employment move forced him to leave the TA for a while.

In 1938 he re-enlisted and was commissioned into the Corps as a subaltern in 562 Company and had the unusual distinction of going to war with the company as a subaltern and staying with it until he eventually commanded it in the Middle East and North Africa where it was part of 8th Army. He was Mentioned in Despatches at El Alamein and took the company to Sicily and Italy where he was again Mentioned in Despatches.

Bill eventually left 562 Company on promotion, to be CRE 2 GHQ Tps Engrs in Italy, where building amazing Bailey bridges was the accepted norm. One of these he felt merited the name of Twazzabugga and it was so named. Another one the Army Commander christened Barry Bridge when he visited it and found out where Bill came from. Bill was then promoted to colonel as Commander 16 AGRE and later served in North West Europe which he did not consider half as much fun as Italy.

After the war, although he was offered a regular commission, Bill rejoined the Austin Motor Company where he had worked before the war but was very soon back in uniform as he was asked to form a TA regiment in Bristol which he did, forming 110 Regt RE TA. Very shortly after this he was asked to form another regiment this time for the Supplementary Reserve. Having handed over 110 Regt he got on with his new task with his usual skill and energy.

Col W H Hooper OBE TD (p88)

At this time Bill was a lieutenant colonel and was appointed OBE and was also made ADC to Her Majesty The Queen, an appointment he held for seven years being promoted again to colonel in mid-tour. He had the honour of being on duty as an Aide when Her Majesty visited Chatham in 1956 when the School of Military Engineering became the Royal School of Military Engineering. Bill then served until his military retirement in the Supplementary Reserve while continuing to work for the Austin Motor Company where he became Fleet Sales Manager and later a director and stayed with the company during its various amalgamations until his retirement from business.

After retiring from both the Army and civilian employment Bill served as chairman of the Roads and Bridges Committee of the Worcestershire County Council. He was instrumental in setting up the Droitwich Amateur Dramatics Society (which very soon got its own theatre) served on the Droitwich Council and became Deputy Mayor. He found time to get people interested in clearing the Droitwich Canal and led them in the enterprise until it was again opened up to traffic after many years of neglect. In the process he found some challenging work for the Army Apprentice College, Chepstow in making lock gates for the canal as well as pedestrian swing bridges which where later erected by 225 Fd Sqn of the Royal Monmouthshire Royal Engineers (Militia) so he kept his TA links going even after retirement! In addition to all of this he fitted in regular attendance at the local Probus Club, meetings of the Masons, raising money for charities and working for the Conservative Party.

Bill died on Boxing Day 1995 two months short of his 93rd birthday, after a very short illness.

JHH

Memoir in Brief

A brief memoir is published below on an officer whose death was notified recently in the national press and who served in the Royal Engineers and the Royal Air Force.

Major (local Lieutenant Colonel) Gilbert Cole died on 13 November after bravely enduring many years of disability. Commissioned from the RMA on 26 January 1939, he served and was Mentioned in Despatches in the retreat to Dunkirk. He was one of five sappers who volunteered for service with the RAF (the others were George Young, Tony Davis, A E J M Perkins and Basil Clapin), became a bomber pilot, was shot down and spent four years as a POW. Back in the Corps after the war, he retired in 1959 and became a director of Balfour Beattie. He married Iris Fisher in 1949 who he leaves with a daughter and two grandchildren.

LIEUTENANT COLONEL R E YOUNG DSO DFC BSc

PLEASE note that in the memoir for Lieutenant Colonel Young, printed in the December 1995 issue of the *Journal*, an error was made. Lieutenant Colonel Young graduated from Edinburgh University and not George Watsons College which is where he went to school. We apologize for this error.

Correspondence

Royal Staff Corps 1800-1837

From: Lieutenant Colonel A D E Curtis MC MA

Sir, – In the grounds of the RMA Sandhurst there is a bridge over the Wish Stream which is named in an old Ordnance Survey map as the "Royal Staff Corps Bridge". The map in question, published at about the turn of the century, is in the Surrey Heath Museum.

The use of this name for the bridge has fallen into disuse many years ago. I would like to suggest that it be revived.

During its short life the Royal Staff Corps gave the army much distinguished service and particularly so during the Peninsular War. Even if only for its achievements in planning and supervising major fieldworks and for its pioneer work in improvised bridging our Corps, in my opinion, owes a great debt to the work of the Royal Staff Corps. The Staff College was also a considerable beneficiary – the major part of the early syllabus adopted by the Staff College related to Royal Staff Corps experience.

These achievements were well reported by Lieutenant Colonel Garwood in a two-part article in the *RE Journal* (Part 1 June 1943, Part 2 November 1943).

I suggest that the debt owned to the Royal Staff Corps both by the RE and by the Staff College might be recognized by a joint effort to revive the old name on this bridge and that a suitable plaque be erected thereon. Yours, – Derek Curtis.

Liberation of the Channel Islands 1945

From: Colonel D C S David MC MA

Sir, – In his "Personal Reminiscence of the Liberation of the Channel Islands" published in the December 1995 *Journal* Captain H W Beckingham referred to the demolition of a section of the sea wall at L'Ancresse Bay, Guernsey, which was built by the German garrison to prevent tanks and wheeled vehicles from moving inland from the beach. He attributed the demolition to 259 Field Company; the unit responsible was in fact 618 Field Company which I commanded at the time. 259 Field Company was in the part of *Force 135* that liberated Jersey.

The obstacle in question, known as the Wacker Wall, had in the weeks before VE Day been the subject of intelligence reports, air photographs and a much rehearsed demolition scheme. The task of blowing a gap in it had been given to No 3 Platoon under Norman Hannigan, but when the company landed at St Peter Port on the morning of 12 May we were met by H H Edwards, a subaltern from company headquarters who had come in the previous day with a small recce party, with the news that he had already blown a gap in the wall using Tellermines and a working party of German prisoners. Hannigan's chagrin can be imagined, but he got on with the task of widening the gap and improving beach exits with a good grace. When the LSTs came in next morning the worst obstacle to discharging them was the heavy trailers and sledges loaded with Sommerfeld track which were among the first loads ashore and which immediately got stuck on the beach. Bulldozers pulling and pushing eventually shifted them out of the way. Yours faithfully – D C S David.

Rhine Crossing 1945

From: Lieutenant Colonel J A B Darlington

Sir, – My attention has been drawn to a factual error at the end of General John Woollett's article on "The Rhine Crossing 1945" (RE *Journal* April 1995, page 28) when it says that semi permanent bridges were built by German contractors and remained in use for two or three years.

I write because in the first winter after the war I was the Adjutant of 12 Corps Troops RE (CRE Lt Col (later brigadier) L F Heard CBE RE) who built Montgomery Bridge, the all-weather Bailey bridge over the Rhine at Wesel. This bridge used a greater tonnage of Bailey equipment than any other bridge in the world. The bridge was designed in HQ 12 Corps Troops but design was helped by Major Ralph Freeman (later Sir Ralph Freeman and senior partner of the consulting engineers Freeman, Fox & Partners) of CE Branch, HQ 21 Army Group/BAOR. Many special parts were needed and these were made at Christchurch by the Experimental Bridging Establishment under Sir Donald Bailey, who took a keen personal interest in the bridge.

Construction began in October 1945 and went on to the end of January 1946. 12 Corps Troops worked very long hours, often in difficult winter conditions and were helped for night work by the use of artificial moonlight provided by the Royal Artillery. They were also helped by detachments of IWT (Inland Waterway Transport) and mechanical equipment companies. The Germans provided two *Dienstgrappen* units and the German contractors, Frankipfahl, were responsible for the piles in mid-river.

The bridge was officially opened on 5 February 1946 by Lieutenant General G I Thomas, Commander 1 British Corps, as Field Marshal Montgomery was ill.

After the opening, the bridge which had two carriageways was further strengthened to allow for possible bunching of heavy traffic. It remained in use until replaced by a permanent bridge, I believe, in the 1950s. Yours faithfully – J A B Darlington.

General Chun-Po Tang

From: Lieutenant Colonel E L V Wall

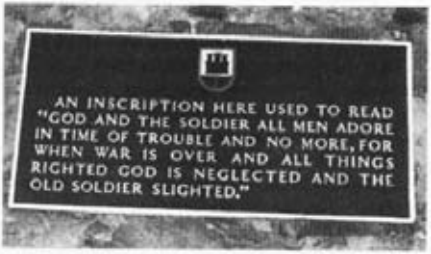
Sir, – In November 1995, during a visit to Taiwan, I was privileged to be able to deliver a letter and small gift from the Council of the Institution to General Chun-Po Tang, formerly Chief Engineer to Generalissimo Chiang-Kai Shek and a most distinguished Honorary Associate Member of the Institution. General Tang, now 86 and head of a remarkable family, is still active as a Special Advisor to the President of Taiwan. Inviting me into his house for tea, the General read the letter from the Council with care, accepted a small statuette of a Sapper in combat uniform and questioned me about the present activities of the Corps. We talked of his time at Cambridge, which he and a second Chinese officer attended together with the batch of RE officers of 1923. The General himself had been at Trinity College and both he and his colleague had gained first class honours degrees in engineering. The General asked me to thank the Council and the Institution for their good wishes and in turn to deliver his best wishes to the Corps in all their endeavours. Yours sincerely – Edward Wall.

Gibraltar Statue

From: Major J West

Sir, – The Institution may care to know that the new Sapper statue is much admired by visitors. It suffers from occasional graffiti in the dark hours; but this is promptly seen to the next day. I suspect the Captain Alastair Balgarnie RE, the Headquarters British Forces Public Relations Officer, keeps an eye on it. However the hackle was taken from the hat on the first night of the statue's sentry duty and, if replaced, will need to be welded in place!

Far above him and a little to the South, there is a quiet road where Town Range leads to one of the lesser gates in the city wall. There is a long abandoned sentry box there, an empty niche in the stone wall; and next to it on that wall is the tablet in the enclosed photograph. Members may like to know (or be reminded) of the tablet. Sincerely, – John West.



Major General R W T Britten CB MC

From: Lieutenant Colonel G E P Mulhern OBE
Sir, – Having already read the *Daily Telegraph's* memoir of Major General Britten, the reprint in the December *Journal* prompted me to add the following which may be of interest.

When I enlisted at Chatham as a fourteen year old boy soldier in 1922, Bob Britten was a babe in arms being pushed around Mansion Row, Old Brompton, by his nanny, in a pram. His father, Captain (much later colonel) Britten, as OC "M" Company, was my first commanding officer.

As indicated in the *Telegraph's* account, Bob's distinguished career overflowed with the most light-hearted variety of incidents and activity.

We first became firm friends when he was OC 21 Fd Pk Sqn with 23 Fd Engr Regt at Dortmund, BAOR. I was 382 DCRE Mulheim and together we set up a camp for a Rhine Army Bisley-type rifle-range event involving 4th Guards Bde, 5th Inf Bde and 6th Highland Bde – all in the most appalling weather, to an almost impossible target date. 23 Fd Engr Regt was then commanded by the larger than life Corps character, the swashbuckling Lieutenant Colonel (later brigadier) Arthur Morris. Bob showed me his annual confidential report which Arthur Morris had just written. It read "I tolerate this officer because his father tolerated me"!

Then, much later in 1967, when serving as a RO to the CE Western Comd, the Military Secretary, Roy Davies, in the absence of the CE, rang to ask if I knew anyone named Britten and my reply was that I knew two, the stentorian-voiced RSM at Sandhurst and, of course, Bob who, at that time was a lieutenant colonel at JSSC Latimer.

Roy Davies then said that it was the latter who was to be my new chief engineer in relief of the late Ian Sturrock. To my delight he said that Bob was not yet aware of this jump in promotion and that I was free to tell him, which I did. He recognized my voice immediately and it took me quite a while to convince him that my news was not a leg-pull. His eventual gasp was followed by "Myst are Chryty."

His tenure as Chief Engineer was a delight and I'm sure he enjoyed it vastly especially as, soon afterwards, he wore the second hat as Commander 30 Engr Bde TA.

To have had no less than three appointments as major general after leaving Western Command, plus a post retirement career of prestigious civilian appointments is additional testimony of his abilities. One last tribute to this jolly soldier is that he became the 38th chairman of that happy band of warriors, The Blythe Sappers who, without doubt, will miss him sorely as will his lovely family and all others who knew him. One thing is certain, the angels will be giving this golden boy the "Big Hello". – Yours faithfully, George Mulhern.

873 Movement Light Squadron RE(V)

From: Lieutenant Colonel H P Munro TD
Sir, – I regret that there are two errors of fact in Capt Moore's article about 873 Movement Light Squadron:

In the period 1961-67 it was under command of 27 Engr Gp/Bde (TA), not 29. Secondly it moved to Acton well before 1967, possibly in 1961. It was certainly there in 1966, because, when the TA "Decimation" was announced, as CO of 114 (1 London) Engr Regt (TA), I wrote to all the Members of Parliament in whose constituencies we had Drill Halls, and also the Minister of State for the Army (Mr Gerry Reynolds), in whose constituency (Acton) contained 873. Yours sincerely, – Patrick Munro.

Reviews

MUSCAT COMMAND
PETER THWAITES

Published by Leo Cooper, London – Price £17.50 ISBN 0 85052 411 3

"MUSCAT Command" will appeal to all those who served in the Middle East, and in particular during the campaign in Dhofar. The author, Peter Thwaites, commanded the Muscat Regiment from 1967 until 1970. This was the very early part of the eight-year long struggle against Communist insurgency which was supported by Aden in the wake of the British withdrawal. At that time, the SAS had not yet been deployed to Oman on Operation *Storm*, nor had squadrons of the Corps of Royal Engineers gone on Operation *Tenable*.

In his foreword, the Duke of Norfolk recalls Peter Thwaites' energy, efficiency, mischievous sense of humour and unquestionable thirst for adventure, but that he found life in the Grenadier Guards based in BAOR tedious, and public duties boring. By contrast, his exciting experiences on active service in Dhofar are graphically related in "Muscat Command". The immense challenge of leading the polyglot force which comprised the Muscat Regiment at that time, combined with the physical hardships they endured – there were no support helicopters then, and moving on foot was slow but the safest means of covering the *jebel* – is described from the outset. In the initial chapter, he describes his first battalion operation. It was the search of a remote village whose inhabitants were suspected of harbouring *adoo* (enemy). After locating ammunition and weapons, Thwaites was immediately confronted with the dilemma of burning the dwellings, in accordance with the policy of Sultan Said bin Taimur, or following the principles of the "hearts and minds" campaign he had learnt in Malaya. He directed that a compromise should be implemented; one in four houses was burnt. In a fire fight that ensued as they withdrew, the battalion took casualties, and he was faced with coordinating their tortuous evacuation on stretchers back to Salalah Plain. Effective control of close air support by Strikemasters was not easy either. In short he was faced by many challenges, and service was a far cry from the more formally structured way of life he had known in the British Army! He goes on to relate other demanding operations in such places as Mughsayl, Taqa and Wadi Sayq. Mughsayl was the base from which, some years later, Sappers on Operation *Tenable* were to construct the Hornbeam Line through inhospitable "moon country", as part of the plan to cut the *adoo* lines of communication.

The book is not intended as an authoritative account of the early stages of the Dhofar Campaign. It is a series of anecdotes which provide a fascinating view of life on active service in that remote corner of Arabia, almost 30 years ago. There are descriptions, too, of his travels around the rest of that beautiful country, and an account of the pitiful state of the people of Oman at that time. Furthermore, the author gives the reader an interesting description of some of the realities of the British withdrawal from Aden.

Sadly, Peter Thwaites died in 1991 before he finished writing his book. It was completed by his former Adjutant, Simon Sloane, who had served on secondment from the Argyll and Sutherland Highlanders. The book is a fitting tribute to a colourful and gallant officer.

RJDR

GALLIPOLI
MICHAEL HICKEY

First Published 1995 by John Murray (Publishers) Ltd, 50 Albemarle Street, London WIX 4BN – Price £19.99 ISBN 0-7195-5550 7

ANOTHER book on Gallipoli? After Alan Moorehead's excellent book and "that film", not to mention the Official History, endless regimental accounts and personal memoirs, one is entitled to ask "Why?". After all, the whole campaign only lasted some ten months, but Gallipoli has held a fascination which has drawn countless readers back to those barren hills and gullies that make up the Gallipoli peninsula.

Colonel Michael Hickey is one of those fascinated by the story: his father served on the Western Front in the Cheshires and three battalions of the regiment found themselves at Gallipoli in 1915. All were volunteers – few returned. While Alan Moorehead, in 1956, was still able to interview many of the survivors and wrote a detached history of the campaign, Michael Hickey, 50 years later, has sought to present the

tale from the viewpoint of individuals at all levels. He has had access to many diaries and memoirs which has enabled him to write an exciting narrative that brings many of the engagements to life, but it cannot be said that the stories of Private Fox, landing at Anzac Cove, or Private Morton of the 7th Manchesters at Helles, have added much to the historical perspective of events.

The author sets the scene in an admirable fashion, clearly describing the strategic background and the efforts of the British and French navies to force their way into the Sea of Marmora. Though repulsed with heavy losses, the Turks were actually on the verge of despair with many of their defences destroyed, and if only the Allies had resumed the attack next day, they would almost certainly have succeeded. Instead, General Hamilton decided on a double landing on the peninsula itself, with the mainly regular British 29th Division, under Major General Hunter-Weston (a Sapper), leading the landing at Cape Helles and the Anzacs landing further up the coast.

Michael Hickey brings out the appalling lack of planning, the dearth of logistics and the totally inadequate arrangements for casualties. Despite all this, there were unprecedented acts of bravery: the Lancashire fusiliers, with their "six VCs before breakfast", Brigadier Scott-Moncrieff (a name with many sapper connotations) personally leading the last reserves of his brigade to certain death in the struggle for Gully Ravine. Then there is the appalling mismanagement at Suvla where the commanders failed to press on after landing and showed a total lack of leadership, with disastrous results.

That Gallipoli was a ghastly failure was not entirely due to Allied incompetence and this is well brought out: the Turkish forces were commanded by a remarkable person, the German General Liman von Sanders. Without his leadership, it is doubtful if the Turkish leaders like Kemal Ataturk would have ever come to the fore. The Gallipoli campaign led to the birth of modern Turkey.

If one is to be critical of this very readable book, one has to say that, on occasions, it betrays the author's extrovert, not to say rumbustious, nature, such as when he tells the story of Private Fox who, "on 'God's Good Sunday' ... birds singing all round him ... 'one of my friends dropped; a sniper had got him ... off we rushed again ... shell burst overhead, killing the soldier on my left and hitting me full in the right knee ... the pain was excruciating' ... eventually, weak from loss of blood and with his uniform cut to shreds by bullets," (but apparently not actually hitting him!) "he collapsed unconscious ...". All good stuff, but more Hollywood than history. And one could have wished for an epilogue, drawing out some of the lessons learned, though it is not too difficult for the reader to draw his own conclusions. Nevertheless, a good read, especially if one's knowledge of events at Gallipoli is limited.

GLC

TOPEES AND RED BERETS
SAGA OF A SUFFOLK OFFICER 1914-1975
SILVANUS BEVAN

Published by Square One Publications, The Tudor House, 16 Church Street, Upton-on-Severn, Worcs, WR8 2HT Price – £12.95
ISBN 1 872017 96 7

MOST people whose parents are dead must wish that they had known more about them. Silvanus "Bertie" Bevan has saved his children this problem by writing the story of his life, or at least up to when he reached his early sixties. It covers his service in India between the wars and on the North-West Frontier, his wartime adventures with the Suffolk Regiment and the early days of parachute forces. It concludes with various postwar experiences and his time with the British Oxygen Company and the death of his beloved wife, Murna, whose life was so inextricably linked with his.

Do not be put off by the title: this is a straightforward account of life as a regimental officer and they did indeed wear topees, right up to 1943 and even later. Colonel Bevan does not aspire to write "literature", but his story is none the worse for that. He writes in plain English using simple words with little punctuation, and it is extremely readable. He makes great use of the "dash" – that refuge for those not taught punctuation at school!

The regimental officer is the backbone of the British Army and the guardian of its traditions. "Bertie" Bevan was the last Commanding Officer to command the old Twelfth of Foot on active service in Cyprus and he is a worthy chronicler of its final years before amalgamation. He also saw action on the North West Frontier with the Hyderabad Regiment as well as his own before joining 50 Indian Parachute Brigade for service in the Middle East and in the battle for Imphal.

Undoubtedly happiest at regimental duty, his tours on the Staff were not so congenial and it was

always with a sigh of relief that he returned to the Suffolks. Sapper names appear throughout his story, his cousin being General Sir Clarence Bird who lived to be a hundred, and on leaving the Army he found that his first civilian boss was another ex-Sapper, Colonel Tommy Cochrane.

This book is full of nostalgia for a way of life that is now sadly past, and will bring back many memories for those of an older generation who were fortunate enough to indulge in big-game hunting and to spend their leave in Kashmir. There is much, too, for the younger generation, but the reader should be warned not to be irritated by the all too numerous printing errors and minor mistakes. It is, after all, a "vanity" publication with cost kept to the minimum: without such cost-cutting, we would be unable to indulge in tales of a bygone era and we would all be losers.

GLC

BLOODY RED TABS

FRANK DAVIES AND GRAHAM MADDOCKS

Published by Pen & Sword Books Ltd, 47 Church Street, Barnsley, South Yorkshire, S70 2AS – Price £17.95
ISBN 0 850502 4636

WE have all heard the tales of how the generals of the First World War sat in the safety and comfort of grand French chateaux whilst ordering the PBI to storm across waterlogged and cratered ground which was swept by German machine-gun fire. It is still a fruitful source of humour by the success of the TV serial *Blackadder Goes Forth.* The authors also quote a scathing comment by the present Deputy Leader of the Labour Party, though, being a political survivor, his words taken literally do not match the impression that they give.

The authors have taken many groups on battlefield tours of the Western Front. It was the grave of a general that inspired them to test the truth of the perceived wisdom. The result is a very readable discussion of the facts and figures followed by potted biographies of 232 general officers who were casualties from enemy action during the war. The authors investigate the sources of the myth, citing various authorities who have laid the accusation; the further the authority was from the front line, the stronger the accusation. There follow examples of generals who were seen in the front line, some of whom lived to tell the tale, including two distinguished Sappers, General Elles who led the Tank Brigade in person into the battle of Cambrai, and General Coffin who earned a VC as well as a DSO and bar, but emphasis is put on the need for the generals to have remained at their HQ where they could exercise command. The potted biographies are, perforce, brief but give an outline of how the general became a casualty. There must surely be a story to tell about the Infantry Divisional Commander who was captured by an Austrian submarine.

Much research has gone into the production of a book which shows understanding of military problems and methods of working. The authors achieve their aim of proving that the generals were a remarkable body of very gallant men. If there ever was a less lethal method of waging war, given the state of the art at the time, it was not adopted for want of bravery amongst the red tabs.

CTPH

BRITAIN'S MODERN ARMY

TERRY GANDER

Published by Patrick Stephens Ltd, Sparkford, Near Yeovil, Somerset, BA22 7JJ, – Price £19.99,
ISBN 1 85260 428 X

FIFTEEN years ago, this publisher introduced *Encyclopedia of the Modern British Army.* This new volume is effectively the fourth edition. The change in title reflects the extent and pace of change for today's Army which is quite different from that of 1980.

The book is in two parts: Part 1 – *Organisation and Roles*, and Part 2 – *Weapons and Equipment.*

Part 1 covers the chain of command, formation organizations and commitments very succinctly. Each arm in turn is then described in some detail, infantry first. The Corps is well-covered and, for once, its work in the Balkans is properly acknowledged. Part 2 has a section on mine warfare which describes the current and future family of mines, the Giant Viper and mine ploughs. The section on armoured fighting vehicles includes those of RE interest and there is a comprehensive section on bridging.

Terry Gander is an experienced defence journalist and the book is well-written and illustrated with a good selection of modern photographs and detailed line drawings. It is a timely book for readers who have not been able to keep abreast of "Options for Change" and "Front Line First".

JEN

BRASSEY'S COMPANION TO THE BRITISH ARMY

ANTHONY MAKEPEACE-WARNE

Published by Brassey's, 33 John Street, London, WC1N 2AT – Price £30
ISBN 1 85753 175 2

THIS reference book covers the British Army from 1660 to the present day. Topics are dealt with in alphabetical order and include all aspects of the campaigns, battles, dress, weapons, equipment and histories of British regiments and corps. The book reflects all the post – Cold War changes.

Generally this is a very useful book. Most entries are concise and accurate although the treatment of matters of engineer interest is rather variable. "Airfield Damage Repair" is defined as Rapid Runway Repair only. "Amphibious" relates only to sea operations. "AVRE" is defined as Armoured Vehicle Royal Engineers and Assault Vehicle Royal Engineers. "Bailey Bridge" earns only 20 words and "Mulberry Harbour" just 25. The Engineer in Chief (Army) is the only arms director to appear and although the Master Gunner at St James' Park is in, the Chief Royal Engineer is not. Kitchener is acknowledged as a Sapper but Glubb, Gordon and Napier are not.

There is an extensive bibliography for further study and strangely the sole reference to the Corps is The Royal Engineers by T J Gander, 1985. Nevertheless, the book is a useful first point of reference. JEN

A PHOTOGRAPHIC STORY OF WAR TIME BOMB DISPOSAL

COMPILED BY LIEUTENANT COLONEL ERIC WAKELING

Published by B D Publishing, 6 Wendover Road, Bourne End, Bucks, SL8 5NT – Price £7.00
ISBN 0 9525799 0

THIS book amounts to a potted history of the Bomb Disposal Service during the Second World War from its earliest beginnings to the very end. A wide selection of photographs has been gathered, mostly from private sources. The extensive text describes the development of Royal Engineers Bomb Disposal, German bombs and fuzes, mines, our own equipment and the battle of wits which developed between German designers and the BD Service. A4 size in soft covers, the book will appeal to a wide readership and is obtainable from The Royal Engineers Museum at £7.75, including postage and packing. JEN

Short Reviews

PERHAPS it is an indication of the increased leisure time becoming available that several books dealing with local history have been received for review recently. All hold interest for Sappers who live or have served in the areas covered.

The first is "Our Hampshire Cove" by Arthur Lunn. The author served in the Corps throughout the Second World War but has spent most of his life in the village of Cove. The book is a series of reminiscences about Cove and its people. It mentions places dear to a Sapper's heart such as Southwood Camp, Morval Barracks, Laffan's Plain, Gibraltar Barracks and Minley Manor. It concludes with a discussion of the author's theory, that in prehistoric times, Cove rivalled Stonehenge in importance! This very readable book is available from the RE Museum at £6.45, including postage and package.

The second is "Aldeburgh 1939-1945" by Geoff Dewing. The book studies the early preparations for war in 1939 and traces the defensive measures taken against a German invasion. It records the training and preparation for the Allied assault on Normandy and covers the results of Hitler's V-weapons campaign in the area.

Of particular interest to Sappers, it records the work of 558 Fd Coy RE in coastal defence, the development of the Churchill AVRE and the formation and training of 1st Assault Bde RE.

Copies are available from the author at: 89 Kings Chase, East Moseley, Surrey KT8 9DG.

A third title is "Prepared for Battle" by Michael Hodges. This book covers military activities in and near Christchurch over the last three millennia. It is highly detailed and is clearly the result of much research although Christchurch Barracks and MEXE receive only a passing mention.

Copies are available from the author: Caderyn, 12 Ashton Mead, St Catherine's Hill, Christchurch. JEN

Abbreviations Used in This Journal

2IC ..... Second in Command
ACRE ..... Acting CRE
ADP ..... Army Doctrinal Publication
AWOL ..... absent without leave
ARRC ..... A (Allied Command Europe) Rapid Reaction Corps
B&Q ..... a store specializing in the supply of "do it yourself" materials for home-owners
BAOR ..... British Army of the Rhine
BM ..... Brigade Major
BRITBAT ..... British Battalion
CGI ..... corrugated galvanized iron
cm ..... centimetre
CO ..... Commanding Officer
COS ..... Chief of Staff
CRE ..... Commander RE
D ..... Director
DD ..... Deputy Director
DM ..... deutschmark
DO ..... District Officer
DROPS ..... demountable rack offloading and pick-up system
DS ..... Directing Staff
Ech ..... Echelon
Engr ..... Engineer
EOD ..... Explosive Ordnance Disposal
etc ..... et cetera
Fd ..... Field
FR ..... French
FTX ..... field training exercise
G3 tasks ..... Operation/Training
G5 tasks Civil
Gp ..... Group
HQ ..... headquarters
ie ..... *id est* that is to say
IFOR ..... Implementation Force
ISO ..... International Standards Organization
JHQ ..... Joint HQ
JNCO ..... Junior Non-Commissioned Officer
JSSC ..... Joint Services Staff College Course
km ..... kilometre
KN ..... Kilo Newton
LAD ..... Light Aid Detachment
LCpl ..... Lance Corporal
Luftwaffe ..... Air Force
m ..... metre
ME ..... Military Engineering
MEXE ..... Military Engineering Experimental Establishment
MLC ..... military load class
mm ..... millimetre
MT ..... Motor Transport
MOD ..... Ministry of Defence
NATO ..... North Atlantic Treaty Organization
NAAFI ..... The Navy, Army, and Air Force Institute
NCO ..... Non Commissioned Officer
NW ..... northwest
Oberleutnant ..... First Lieutenant
OC ..... Officer Commanding
Op ..... Operation
OP ..... observation post
OTC ..... Officer Training Centre
PBI ..... poor bloody infantry
POW ..... prisoner of war
QMSI ..... Quarter Master Sergeant Instructor
RAAF ..... Royal Australian Air Force
RAF ..... Royal Air Force
R&R ..... rest and recuperation
REME ..... Royal Electrical and Mechanical Engineers
RHQ ..... Regimental Headquarters
RMA ..... Royal Military Academy
RO ..... Retired Officer
RSM ..... Regimental Sergeant Major
RSME ..... Royal School of Military Engineering
SAS ..... Special Air Service
SHQ ..... Squadron HQ
Sigs ..... Signals
SNCO ..... Senior NCO
SO ..... Staff Officer
SQMS ..... Squadron Quarter Master Sergeant
Sp ..... Support
Sqn ..... Squadron
SSM ..... Squadron Sergeant Major
STRE ..... Specialist Team RE
SW ..... southwest
TNT ..... trinitrotoluene
Topo ..... Topographic
UK ..... United Kingdom
UN ..... United Nations
UNPROFOR ..... UN Protection Force
US ..... United States
USA ..... United States of America
vip/VIP ..... very important person
Wks ..... Works
WO2 ..... Warrant Officer Class 2
WW2 ..... World War Two
YO ..... Young Officer

The Kipling Society

This literary and historical society, founded in 1927, is for anyone interested in Rudyard Kipling's many volumes of remarkable verse and prose, with their vivid reflections of his life and times (1865-1936).

The society arranges regular lectures, holds an annual luncheon, maintains a research and reference library, and sends the *Kipling Journal*, quarterly, to subscribers around the world.

New members are always welcome.
Enquire of the Secretary,
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