ROYAL ENGINEERS

THE ROYAL ENGINEERS JOURNAL

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Guidelines for Authors

The Editor is always glad 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, specially if an article is witty.

Length. Normally, chance of publication is in inverse proportion to length. More than 4500 words (5 pages of text) tends to lose most of our readers. Blockbusters can sometimes be serialised.

Clearance. Opinions are an author's own. The wise man clears an article with his boss on any policy matters. Security clearance must be obtained locally.

Copy. Ideally the text should be double space typed and include the author's pen picture and captions for art work.

Photographs should be black and white. Coloured photographs rarely reproduce well unless they are very good quality with sharp definition. A head and shoulders photograph of the author would also be helpful.

Line drawings, if possible, should be drawn in proportion with the page (5.75in x 8.0in). Size is immaterial.

Rewards, can be generous. The committee has about £250 in prize money to allot for each issue plus the valuable annual prizes. All authors receive £5 to cover costs.

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

Contributions to the Journal should reach the Editor by:

1 June for the August 1990 issue
Early October for the December 1990 issue
Early February for the April 1991 issue

Submissions before the deadline will be particularly welcome.

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1989 Corps Annual General Meeting

ADDRESS BY ENGINEER-IN-CHIEF

Introduction

After a brief introduction the EinC began:

"In last year's report I picked out Support to the Royal Air Force and Bomb Disposal for special treatment. These are still, and will continue to be, extremely important subjects. This year I have chosen two other subjects for 'feature-sections': the Reserve Army because I am particularly keen to raise awareness of its importance and problems at this time; and the Defence Works Services Organisation which will probably be a new subject for many of us.

The Territorial Army

"In some ways it may seem illogical to treat the Territorial Army in a separate section because we always stress that we really are one Corps in one Army, and that the regular element cannot do its job without the volunteer element.

"It is significant that every branch of my London Staff is concerned with the TA, and so are all my command brigadiers. I am discussing the TA separately simply to emphasize the TA aspects of common issues.

"The fact that the TA forms a sizeable proportion of the Corps (some 700 officers and 7500 soldiers, compared with 1200 regular officers and 12,000 regular soldiers) is generally well known even if the implications are not always understood. Certainly we rely on the TA element for the numbers in NW Europe and for Home Defence, but the dependence is not only a matter of quantity. There are skills and special qualifications brought to us by the volunteer officers and soldiers that the regular element lacks in peacetime, but the Corps needs, absolutely, to carry out its war role. I have used the expression 'one Corps', I mean it, but the different parts are not one and the same.

"It is quite wrong, in my view, to think of TA units as mirror images of Regular Units, or even worse as imitations of them. On the one hand the TA cannot hope to achieve the same standards across the board as regulars. The training time is just not available. On the other hand few regulars can match the expertise and experience which TA members have acquired in specialist areas."

Achievements

The EinC then highlighted some examples of the achievements of TA Sappers including:

Recruiting and Retention in the TA

- The Guard provided by the Jersey Field Squadron for our Colonel-in-Chief.
- Renovation by 105 Plant Squadron of the cross-country driving circuit at Leconfield.
- The eighth TA ADR Squadron at RAF Leeming being declared operational.
- 30 Engineer Brigade HQ and 74 Engineer Regiment winning through to Bisley.
- Silver awards for RMonRE in the Cambrian March and 125 Field Support Squadron in Western District Patrol Competition.
- A 120 foot Extra Widened Bailey Bridge (EWBB) at Dorbaum.
- A three-span 28-bay standard Bailey in Holland.

"I shall speak later about the Corps problems in recruiting and retaining regular manpower. I shall have some words about the Army Manpower Manning Initiative (AMMI for short). 'TA 2000' is a counterpart to AMMI but is much wider in scope. It is a concept to improve the total effectiveness and well-being of the TA so as to take it forward through the 1990s and into the next century in the best possible shape. This will be achieved by grouping together, and providing a central thrust for existing and new initiatives.

"TA 2000 is the starting point for a developing and evolutionary process. It will be of limited value without the active support and contribution by all those with a concern for developing the efficiency, effectiveness and well-being of the TA.

"In an effort to improve retention within the TA the MOD is examining the possibility of a committal bonus, since the currently paid bounty is not proving very effective. It costs on average, over two years, nearly £4800 to pay and train a TA soldier. Many leave after that time, so the purpose of a committal bonus is to pay for service promised, paid in instalments as the promise is fulfilled. The

proposal, and I would emphasize that it is just a proposal, is that on re-enlistment for a further three years the TA soldier will receive a lump sum of £300 and get a cash bonus at the end of each further year's completed service, rising to £700 for the third year.

Combat Artisan Troops

"Phase 2 of the TA manpower enhancements included the allocation of 350 RE posts to support the Mobile Civilian Engineer Groups. Authority was given to raise six independent troops. Two plant troops were formed in 1986, and these have been mentioned at a previous AGM. The final four troops have now been raised. The troops will be called *combat artisan troops,* numbered 413 to 416. They will be dependent on a host TA unit for administration and support services. The location of the troops will be Monmouth, Manchester, Stafford and Hull.

UOTC

"'The University Officers' Training Corps is a small but productive part of the Territorial Army. The UOTC have been under scrutiny for the last eighteen months, and one of the measures recently endorsed by ECAB is to restrict UOTCs to a maximum of two special-to-arm wings Oxford and Cambridge, with three each, will be exceptions. Under the proposed implementation plan the Corps would lose Bristol and Queen's University Belfast which will be very sad but against that we would keep Oxford and Cambridge and in comparison with other Arms and Services we have come out best so far.

THE DEFENCE WORKS ORGANIZATION

"IT is some thirty years since we lost the vast majority of our works responsibilities to ADWO, then MPBW, now PSA. The wheel continues to turn, PSA is to lose its monopoly of responsibility for the MOD estate, and is likely to be privatized in 1992. There are strong financial and political pressures pushing in the direction of civilianization and privatization, and away from the employment of civil service or uniformed personnel. Nonetheless the 'Untying from PSA' presents an opportunity for the Corps to increase our peacetime involvement with the maintenance and construction of vital infrastructure.

"We are presenting the case for sappers to be employed more widely, particularly on the principal airfields and key positions within the long L of C between the channel ports and the Central Front. Indeed it is fair to say that we should not put at risk our ability to carry out our responsibilities in war, by denying ourselves the opportunity to gain experience in peace. We also hope to man an important handful of posts in the MOD Defence Works Services Organization which will provide the long-term technical direction for Defence Infrastructure. These posts will lie in the hardened buildings and in the airfields sections, where we need to be represented. But any move into the maintenance and the planning of vital infrastructure will have to be achieved largely within the existing manpower, because we are now well into the era of compensating reductions for every new post proposed.

"There are other pressures caused by the reduction of PSA's hold. Quartering staffs have greatly increased responsibilities and are looking to us for assistance. Also I have to consider the extent to which field units must be provided with technical support to enable them to undertake their share of construction work. This has caused some worthwhile introspection which is continuing.

"Overall it is probable that the next few years will see the Corps placing slightly greater emphasis on construction. We must practise our skills at all levels and I hope opportunities will open up under the new Defence Works Services Organization. It is too early to be able to forecast the eventual shape of things.

Fortifications

"After a long period of neglect the RE Fortifications Steering Group was set up some four years ago to assess our position and, if necessary, to engineer a return to the field. We discovered that there was much work going on at a variety of levels of which we knew comparatively little except in the fieldworks area.

"We have now published an interim policy document which shows the division of responsibility for fortifications between the RSME and Military Works Force. We have developed our contacts with other organizations and are now represented on inter-ministry committees, as we always should have been. We are consulted on transition to war and war engineering

Afghan refugees receiving instruction on mine clearance

aspects of some key civilian infrastructure projects. A Home Defence pamphlet has been produced for UKLF Engineers, and last but not least Colonel Chris Elliott in a general staff appointment in BAOR has turned out the guidance document on barrack protection to meet the current threat.

"Untying from PSA is not going to be easy for the Army as a whole and many staff officers, particularly in Quartering, will begin to assume real responsibility, as Commands take on budgeting for works and will no longer have the luxury of complaining about the PSA, from the sidelines."

The EinC then described the activities of the Corps worldwide. A summary follows.

Worldwide Corps Activities

Norway

"The AMF(L) Troop of 22 Engineer Regiment took part in Ex *Northern Quest*. Tasks included the construction of a reinforced concrete defensive bunker, a timber stores building and a short section of stone track.

Canada

"On Ex *Waterleap 89* 59 Independent Commando Squadron built a 40m EWBB with reinforced concrete and sheet-piled abutments, a range control building and services to bivouac sites.

"25 Field Squadron built a FIBUA village of 30 houses, a church, castle, a road network and two bridges at BATUS. All the buildings are constructed of wood and the roads are graded tracks.

BAOR

"The trials of the new close support concept, mixing armoured and combat engineers in the same squadron were successfully completed and were followed by an equally successful passage of the Corps proposals through the MOD.

"In Berlin 38 Squadron constructed an ingenious anti-tank crib made of three cars chained together in a triangle then filled with rubble.

Gibraltar

"61 Field Support Squadron, from 36 Engineer Regiment deployed a troop to Gibraltar on Ex *Tenth Shot* in the period February/March this year for construction tasks.

"A four month clearance operation in Gibraltar harbour was undertaken by 33 Engineer Regiment (EOD), during which thousands of live and inert munitions ranging from cannon balls to anti-tank missiles were recovered from newly reclaimed land. The Regiment also deployed a detachment further down the Mediterranean to Cyprus for a month for a clearance task on Akamas Ranges.

Pakistan

"In July a nine-man team was despatched to Pakistan as part of the UN programme to prepare Afghan refugees for the problems they will face with mines as they return home.

Hong Kong and Thailand

"Construction tasks by the Queen's Gurkha Engineers include: a fence to contain the unfortunate Vietnamese Boat-People on Stonecutters Island, a wooden pagoda in Sekkong Village Amenities Area and a suspension bridge in Koweai National Park, Thailand.

Belize

"33 Engineer Regiment (EOD) carried out two months Battle Area Clearance of an artillery and mortar range.

"OC 8 Field Squadron with 20 Soldiers deployed from Belize to Montserrat to give engineer advice to the Governor on the repair of electrical and telephone systems, following Hurricane Hugo.

Kenya

"Ex *Larchpole 89* carried out by 32 Field Squadron included the construction of a classroom block, assault course, and sports pitches at the Kenyan Army School of Infantry at Isiolo, and the construction of a three-span reinforced concrete bridge at Nanyuki.

Malawi

"A recce team assessed the problem of mines on

the railway line that links Malawi with the coast through Mozambique and was followed by a two-man team to run mine clearance courses for the Malawi Army.

Zimbabwe

"Fourteen members of 35 Engineer Regiment carried out Ex *Savanna Quadrant*, a four-week adventure training expedition including canoeing on the Zambesi and trekking in the wild country.

Vanuatu

"A five-man management team has continued in Vanuatu in support of the ODA.

Falkland Islands and South Georgia

"At Mount Kent work began on a permanent access track from the main Stanley to MPA road, and simultaneously a fuel pipeline is being laid to the top of the mountain."

(The EinC here showed slides of several tasks in the South Atlantic).

Antarctica

"39 Engineer Regiment sent a 16-man team to Antarctica to assist the British Antarctic Survey construct some new accommodation.

Northern Ireland

"The commitment to send a roulement Squadron to Northern Ireland from BAOR continues. Some examples of construction work carried out this year are the complete rebuild of several OPs on the border by 4 Field Squadron and the short notice emergency deployment of a troop from 51 Field Squadron to build an accommodation complex.

Mainland UK

"Much work was undertaken by 33 Engineer Regiment (EOD) including the following:

"Two 250kg German bombs were rendered safe in the same quarry near St Albans.

"During a prolonged and hazardous operation twenty feet below ground on the Isle of Dogs the fuse of a 250kg German bomb was located and immunized in cramped conditions while the tunnel was crumbling around the Bomb Disposal Officer.

"An unusual armour piercing Esau 1000kg bomb was rendered safe in Stepney.

"During development of a new M25 approach road near the Dartford tunnel two 50kg German bombs were uncovered within two weeks, just 300m apart.

"Normal Battle Area Clearance continued. One thousand hectares having been covered this year with still 40 years more work to go.

MACM

"During the London Transport strike 34 Field Squadron provided two temporary car parks in Hyde and Regents Parks. 160 rolls of Class 30 trackway were required for this."

The EinC also illustrated work by Survey and Postal in BAOR and the South Atlantic.

The EinC continued.

Equipment

"I am pleased to be able to say that in the world of doctrine and equipment we continue to enjoy considerable support from commanders and the General Staff for the equipment we need. Despite the constant pressure for savings it looks, at present, as if none of our major equipments in LTC is seriously threatened. Indeed a substantial increase in the planned quantity of new mines is well up in the list of priority enhancement measures for LTC 90.

"However we can never afford to let these things take their course. I attach great importance to the contribution we make to operational analysis studies: the Divisional War Game at RARDE, and the higher level analysis at DOAE West Byfleet. These confirm to those who listen, the critical importance of military engineering in operations. The work of the Army Doctrine Committees has been helpful. Overall I am happier that there is much more support throughout the Army for mines and fuses than was the case one and a half years ago. Policy papers on mine warfare have been endorsed, as have those on engineer intelligence.

"As to our own equipment, one of my duties is as a delegated sponsor for the purchase of engineer equipment which can be bought from the commercial market without significant alteration to the civilian standards. We have a rolling programme for the replacement of plant and other engineer stores. Over the last few years we have seen significant changes in our fleets of excavators and dump trucks, and improvements in our ability to support airmobile and heliborne operations. Over the next two years we will be moving into a peak for expenditure, and seeing replacements, at

Aftermath of Hurricane Hugo

a cost of some £40 million, ranging from a light wheeled tractor, to replace the now technically obsolete Muirhill A5000, to a new heavy wheeled tractor, which will come into service already armoured, as with the Zettlmeyer in service with the Canadian Army. To accompany the heavy wheeled tractor, and to improve our ADR capability, we are also purchasing some heavy frame Steer dump trucks. These will be partially armoured.

"We will also be replacing our medium wheeled tractors with a new tractor with improved capabilities. thirty four of our graders are due for replacing and we will be taking the opportunity of ensuring that some of the replacements are armoured for airfield work.

Individual Training

"Last year I mentioned that ACGS had set in hand a general staff study to examine the Initial Training Organization (ITO) and suggest a long-term structure which is operationally and financially efficient, effective and gives value for money. The study team has produced only two options for re-structuring, both fairly revolutionary. Option One is based on a 'capbadge' organization where recruits and juniors are trained at their Arm or Service 'centre of excellence'. For nearly everyone but the Corps, who would retain both Minley and Chatham, there would be a single 'centre of excellence'. The Gunners, for example, would lose Woolwich and concentrate all their training functions at Larkhill. The proposal for Option Two is an 'Army Training Centre' concept whereby all basic recruit and junior training will take place at Army Training Centres located at six of the seven current Infantry divisional depots.

"The initial costs of either option are very high I am unconvinced that either will produce a more effective and efficient system. The financial aspects are an essential part of the study and I do not believe that the relatively small long-term savings justify the very high capital expenditure. This is also the general opinion.

"But it has been a valuable study and aspects such as the concept of a Combined Arms School have my support. Within it there are a number of areas which could be followed up to produce savings without detriment to the ITO as a whole. There is a long way to go in this subject and none of us should be in any doubt about the absolute necessity of making savings. Whilst I consider it most unlikely that either of the options I have described will come to pass, I am clear that the shape of the present ITO will have to change significantly to achieve the expected financial results.

Manning and Recruiting

Officers

"Last year I spoke about the threat posed by the Demographic Trough which means that the number of 15 to 24 year olds in the population will decline by about a quarter (24 per cent) between the high point of 1982 and the projected nadir in 1999. This decline in the population available to be recruited, coupled with no tangible reduction in the PVR rate for officers aged 25 to 31, is beginning to be felt. The Corps officer strength is in decline. The trend is expected to continue. We have some serious imbalance in our officer rank structure. Numerically we are short of 60 captains and junior majors. However with one or two exceptions we are manning all our liabilities at E1 and E2 in these ranks. This has been achieved by acting rank and making greater use of our commissioned warrant officers. But we have reached the elastic limit.

"This problem affects the rest of the Army. ACGS has set up a Committee, with various working groups, called The Army Manpower and Manning Initiative - AMMI. AMMI's aim is to 'Establish the manpower and maintain the level of manning commensurate with the resources available to meet the commitments placed on the Army in peace and war'.

"AMMI is developing the Army's response to demography and PVR by three avenues of attack:

"Concurrently with AMMI's work I and my fellow Arms Directors have been actively reviewing self-help measures which we can implement before Army imposed measures are necessary.

- First: achieve manpower targets by improved recruiting and
- Second: minimize commitments, particularly those which are manpower intensive.
- Third: make the most effective use of the available manpower by distributing it to where it is most needed in peace whilst retaining the flexibility to train for war.

"To this end I have formed a committee called the Royal Engineers Organization and Manpower Committee (REOMC). Its task is to be an 'intelligent' mechanism to act as a regulator between potentially conflicting interests, and to give advice. It will report to me and will be responsible for formulating policy proposals involving manpower and organization, regulating manning levels and so on.

"I do not wish to give the impression that all is doom and gloom on the manning front. We continue to recruit good young officers, and look set to continue to do so for a few more years yet. My recruiting staff expect to achieve our target of 100 RCB passes again this year without any lowering of standards. Whilst the signs are encouraging at the moment there is no room for complacency and we must all regard ourselves as specialist recruiters! Equally encouraging are the efforts of COs in persuading SSC officers to convert to Regular Commissions or extend their service.

Soldiers

"Soldier recruiting is subject to the same competition as officer recruiting but nevertheless continues to go well. Overall our targets have been met for adults, though we have had to accept additional combat engineers and drivers in place of some higher ability employments. Junior Leaders are fully recruited but, as with adults, Chepstow has not filled all the higher ability vacancies. Survey trades, both adult and apprentice, are particularly scarce and special efforts are being made to remedy this shortage. The real problem is retention: outflow exceeds inflow. Overall the Corps is in manning deficit, which is likely to increase in some small rosters, which are already in difficulty.

Regimental Affairs

Esprit de Corps

"When I visit HQs and units I am always very conscious of how much is done to prosper the good name of the Corps. Many of these activities do not receive the recognition they deserve, so I hesitate to mention individual achievements. However, three events stand out. First, the Corps was granted '*Les Clefs de la Ville*' of Lion sur Mer. 32 Armoured Engineer Regiment, or more particularly, 77 Armoured Engineer Squadron, have always maintained close links with Lion sur Mer, where on 6 June 1944, 77 Assault Squadron landed during *Operation Overlord*. In June the Chief Royal Engineer accepted 'The Keys of the Town' on behalf of the Corps. I know that General Sir George Cooper was most impressed with the enthusiasm which the local people showed for the occasion and with the great hospitality they gave to our soldiers.

"In turn the Chief Royal Engineer commented on the splendid rapport the Armoured Engineers have established with Lion sur Mer. The memory of the Royal Engineers during the Normandy landings remains strong in many of the French villages. At Graye sur Mer, which 26 Armoured Engineer Squadron have made their own since they landed there in 1944 under command of (then) Major Tony Younger, there were the annual D Day celebrations. You may remember the story of *le pont AVRE*. The Churchill AVRE fell into a hole in 1944 and was then used as a pier for another bridge. 26 Squadron recovered and restored it and mounted it on a plinth last year. Now one of the roads is named *la rue de Royal Engineers*.

"Second, I gave the address at a very well attended service on 14 September in Christchurch Priory Church at which a plaque, commissioned by the Corps in memory of Sir Donald Bailey, was unveiled and dedicated. It was a privilege to be able to take part in this tribute to a remarkable man.

"Third, the Chief Royal Engineer and I were present at a reunion at Woolwich of those who

Disposing of World War Two bomb

were Gentlemen Cadets (GCs) at the Royal Military Academy Woolwich (The Shop) and which closed its doors some fifty years ago on 2 September 1939. Some 650 GCs and their wives were present and thoroughly enjoyed themselves.

"As to the future, in 1990 we celebrate the 50th Anniversary of the establishment of Bomb Disposal Sections. Of particular interest to the Corps at large will be a service in St Paul's Cathedral on 25 May, which I hope will receive widespread support from throughout the Corps. It is planned also to hold a special day at Chatham and to provide an item on Bomb Disposal at the Royal Tournament, and to take part in the Lord Mayor's Show in London. 1990 also marks the 50th Anniversary of Airborne Forces, in whose formation the Corps played such a prominent part. Amongst other events it is planned to have our own RE Airborne Day at Chatham on Sunday 29 April.

The Band

"First, I am delighted to report that Major Evans, the Director of Music, has been selected for promotion to lieutenant colonel in 1990. Second, I want to let you know that the Band will be particularly busy in 1990. In addition to taking part in the Edinburgh Tattoo, the Band will spend most of October in Germany exercising its war role as drivers in support of 4 Division. A considerable period will have to be spent on preliminary training, but I am sure that it is right that our Band should be able to prove its worth in the military as well as the musical sphere.

Corps Property

"On Corps property, it is our policy that we should maintain and indeed strengthen our heritage in the field of silver and paintings. RE 200 was quite an expensive year for the Corps, so recently we have been relatively quiet in producing new items of silver and paintings. However in 1990 the Corps intends to commission a painting to commemorate our long association with the Indian sub-continent and the Indian Sappers. It is planned to incorporate Bengal, Madras and Bombay Sappers in the painting, and we have asked an artist to produce some ideas.

MS Matters

"Whilst two of our general officers retire early next year, two others (John Barr and Francis Sugden) have been promoted this year and we have also received news that Geoff Field is to be promoted next year.

"I am confident for the future too.

"No less than three brigadiers have been selected to attend RCDS starting in January 1990.

"Colonels Elliott and O'Donoghue will attend the Higher Command and Staff College next year. This is pleasing because we were not represented on this year's course, the only officer selected being unable to attend due to the importance of his job.

"This year's out-put from the Staff College has done well. Two are going to be Chiefs of Staff of all arms brigades, and one is going to be DCOS 12 Armoured Brigade. When I took over as EinC I set myself the aim of getting Sappers into colonels' posts at Camberley, Shrivenham and Sandhurst. I am pleased to report that we will achieve the *troika* in December when Colonel Dick Whittington becomes a Divisional Colonel at the Staff College.

"We continue to be well represented and honoured in the Honours and Awards lists. Since January 1989 we have received public recognition by one CB, three CBEs, four OBEs, ten MBEs and fourteen BEMs. In addition we have received three QGMs for service in Northern Ireland.

Sport

"My final subject is sport and once again we have had a very successful year at all levels. It really would be too time consuming to go through all our achievements and although it is invidious to pick some out for special mention, in view of their particular merit, I have selected a few.

"In June a Corps team won the Army pentathlon championship, which had been held by REME for 25 consecutive years. The trophy, initially given by King Frederick of Greece in the late 1940s as a token of his thanks for our efforts there, was presented by his son, King Constantine, himself an Olympic Gold medallist in sailing.

"Corps canoeing goes from strength to strength. This year we won both the team and individual K1 events in the annual Devizes to Westminster race. The individual winner of the 120 mile marathon was Corporal Heath who has also won the Inter Services Marathon Championship for the third successive time. Having represented Great Britain he now has his eyes firmly set on the World Championships in 1991. A sprinter has joined him this year, Sapper Gallagher of 42 Survey Engineer Group, a promising 20 year old who is training hard for a place in the 1992 Olympic team.

"The Junior Leaders Regiment won the fencing championship for the tenth successive year, whilst 25 Engineer Regiment won the six-man event for the third year running.

"21 Engineer Regiment won the swimming championship again for the third successive year.

"In boxing Lance Corporal McLean has hit the headlines many times in his run up to winning at fly weight in the ABA All England finals and narrowly being defeated on a majority decision in the ABA British final.

"In skiing 35 Engineer Regiment won the Princess Marina Cup for the third successive year - itself a most impressive achievement. There were rumours reaching me at the end of the previous contests that people in high places were making noises about us packing. Our answer to that was given in most emphatic terms in this year's Nordic Military Combination - that is 15km, the Biathlon relay, 4 x 10km relay and the Patrol. Of the thirty one competing teams - 35 Engineer Regiment 1st, 28 Amphibious Engineer Regiment 3rd, 26 Engineer Regiment 5th, and 23 Engineer Regiment 12th. If that was not enough, our Junior Leaders Regiment won the Junior Event.

"The fact is that success breeds success and newcomers are encouraged to have a go themselves and later become part of that success. In-breeding would be a better term than packing."

Conclusion

"Chief Royal Engineer and gentlemen, that concludes my report. I could have spoken for twice as long and still not cover everything - but that would have risked boring you all. So I have been selective in the report, but I hope that I have left you with a clear impression of the challenges we face at the higher level, but most important, of the dedication and professionalism of our units which continue to be a great source of pride to all of us."

The Core Business

LIEUTENANT COLONEL L J AYLING TD MA CEng RE(V)

Lieutenant Colonel Laurie Ayling was commissioned into 113 (Cheshire) Field Squadron RE TA in 1964. From 1967 to 1982 he served in 503 STRE BP(V) and 502 STRE BP(V) and then transferred to the ESP, where he served as an SO3 (Petroleum) to CRE (Airfields), a DCRE at Munster and then Eng Advisor to Comd RCZ. He is now Senior Fuels Advisor in RESAT and has just completed a 3-year term on the Council of the Institution.

The Trouble Is ...

'Institutions' conjure up dusty edifices; sleeping relics of the past, which only live on because of our respect for heritage. A reputation which many Institutions rightly earn and, unfortunately, our Institution might well be heading that way too.

Considerable efforts made recently by active members of the Council, have resulted in very exciting developments for the Museum, a new look for the *Journal*, re-organisation for the Library and good fund management also; and yet some rightly question whether the Council and the Institution are adequately qualified to run museums, libraries and journals when clearly we could find a more appropriate and professional management elsewhere. The trouble is that the Council actually has nothing better to do these days and soon it may have nothing to do at all - unless?

It is the same trouble that has developed throughout the Corps and is causing an increasing number of critical articles in the *Journal*. You must have noticed how so many questions have two common themes: 'Who are we?' and 'Where are we going?'

In the Journal of April 1989, the paper published by our President, on the Profession of the Royal Engineer describes us in splendid and glowing terms. Terms which certainly do reflect our past achievements but do not, I suggest, reflect our current abilities. The Royal Engineer, as portrayed in the paper, is how many of us would like to be; the question is: Is this portrayal only a magnificent but historical wax-work? Or is it a vision of our future? Many good but dissatisfied engineers have left the Corps because we are not what they perceived us to be when they joined. The change has been slow and insidious. It is very difficult to grasp the extent of the 'downwave' simply because it has taken more than a lifetime for the trouble to develop. To find what is missing go back to the last century!

The Way We Were ...

Back in 1874 the Institution was, by all accounts, a hive of activity; our engineering was innovative and stimulating; we were the leaders in military engineering. The thirteen papers published in September 1874 and written mainly by lieutenants and captains, described the latest experiments and provided the latest knowledge on construction materials and methods of demolition. The information was at the forefront of general and military engineering.

In those days it took five years to be a fully qualified military engineer; we military engineers were 'looked up to' by Cs, Ms and Es; Woolwich and Cambridge produced results.

I doubt now that even RSME have the technical assets to mount a sensible attack on military R&D anymore - but it **could** be changed, almost overnight,

Lieut Colonel L J Ayling TD MA CEng - The Core Business

if we had the will.

67 years ago we had the will and we obtained a charter to match, which said (and still says!):

GEORGE THE FIFTH, by the Grace of God of the United Kingdom of Great Britain and Ireland and the British Dominions beyond the Seas King, Defender of the Faith, Emperor of India:

To all to whom these Presents shall come, Greeting!

*Whereas it has been represented to Us that..... Our Loving Subjects did in the year one thousand eight hundred and seventy five form themselves into a Society under the name of "The Royal Engineers Institute", and now known as "The Institution of Royal Engineers", **having for its objects the general advancement of Military Science.....***

Now, stand up and be counted, all of you who have advanced Military Science recently!

Well, I am reliably informed that 'the Corps' is very active; we have one 4-star officer with responsibilities for military developments, plus past and present chairmen of important MOD Committees and even recently a President of the Ordnance Board. Indeed one must also be somewhat encouraged by the work done by EinC(A), RARDE (CH), RARDE (FH), the Military Engineering Committee and our own Directorate. But this does not involve the vast majority of us Sappers.

Before the War Office institutionalised these functions, they were not only carried out by RE Officers, but the Institution had direct access to these activities and could carry out its' proper role.

Whatever one thinks of what 'the Corps' is doing, for the vast majority of us, crossing gaps and filling holes by conventional means falls sadly short of a satisfying challenge for a professional engineer. Furthermore the Institution apparently no longer has a role to perform in most of this. How can the Institution continue as a Learned Society if it is to be cut off from the 'Learning'?

Just to ensure that the *raison d'etre* for our Institution is 100% clear, here, in plain English that even the Prince of Wales would approve of, is the whole Object clause that is supposed to govern our actions:

Bye-laws of the Institution of Royal Engineers

I OBJECT

*1 **The Institution of Royal Engineers has been established for the promotion and advancement of the science of military engineering** and to promote military efficiency and particularly the military efficiency of the Corps of Royal Engineers. In furtherance of the above-mentioned objects but not otherwise the Institution may:*

(a) promote education in the said science and the acquisition of historical scientific and professional knowledge;
(b) disseminate information and advice;
(c) co-operate with other branches of the engineering profession at home and overseas;
*(d) **conduct and encourage forward looking research into ways in which the said science and profession can be advanced** for the greater benefit and efficiency of the Armed Forces of the Crown and publish the useful results of all such research;*
(e) initiate, participate in and administer charitable trusts;
(f) take and accept any gifts of property whether subject to any special trusts or not;
(g) raise voluntary funds and receive and accept contributions by way of subscriptions, donations or otherwise;
(h) subject to such consents as are from time to time required by law to purchase, take, lease, exchange, hire or otherwise acquire any real or personal property and construct, maintain and alter any buildings or erections necessary for the work of the Institution;
(i) subject to such contents as may from time to time be required by law to sell, let, mortgage, dispose of or turn to account any of the property of the Institution;
*(j) **do all such other things as shall be necessary for the attainment of the said objects.***

The guts of sappering was military engineering. The *raison d'etre* of the Institution was the

promotion and advancement of the science of military engineering. We had a basic business objective and a very simple, practical and important purpose in life. This is what management schools would call "The Core Business".

The Core Business ...

Fashions and fads come and go in industry. 'Focussing on the core business' came in as a phrase in the '80s to replace 'back to basics' a phrase of the '70s. They both came in to reflect the view that many conglomerates had diversified well beyond the 'business they were in'; a phrase of the '60s. Now, whatever the colour or source of your management training, one thing you do not do is to give up your core business. The core business is the foundation and guts of your business, from which you expand, or to which you contract. It is also the parent of offsprings, which hopefully grow to maturity and leave home! Just as the founders of the RAF, the Royal Signals and the Royal Tank Regiment left the Corps.

Indeed it is probably because we do so little serious engineering that we now hold on so tenaciously to the few assets we have left. We should be engineering the next generation of equipment instead of operating the last.

I submit that we have been neglecting our core business for so long, that we now believe that building bridges, operating plant and filling holes in runways is 'what we do'. If this is the way our masters wish us to continue then please do not recruit any more professional engineers, do not collect £200 and go direct to the last paragraph!

Clearly, most of us, if not all of us, have not been living up to our reputation or our Charter. We should be lucky to get off with a Royal Rebuke; in the past it could have been our heads! How have we let ourselves get into this situation? I am trying to find out and, so far, the answers fall into three categories.

Leave It To Industry ...

The first response is "that sort of thing is all done by industry these days". Now, although this is mainly true, it does not answer 'why' satisfactorily. I am in the hi-tech, front-end part of both the Oil and Defence Industries and I see some brilliant technology waiting to be applied to military engineering; but I can also see that much of it won't be. The reason is that the gap between those in industry and Her Majesty's Forces is already very wide and it is getting wider. Who then is responsible for technology transfer? The answer is the very few. No longer is it the military engineers of the Corps of Royal Engineers, led or supported by the Institution. Now it is only a few elite and mostly senior officers who reflect credit on the Corps but are hardly representative.

Whereas, until fairly recently, we were the main source of innovation in military engineering, we appear to have handed this responsibility over to the MOD and, through the MOD, to Industry. Look at the results! Much of our military technology now lags behind civilian technology, the procurement system is now a tail wagging the dog, and the best available equipment is increasingly foreign. There is a market opportunity here for us to initiate R&D as we did before and to put British Military Engineering back in the lead. If you are sceptical spend time with Doctrine and Weapons. .....or did you really join the Sappers and the Institution to:

- enjoy a reputation for military engineering that you did not intend to live up to?
- hold on tenaciously to certain, so-called 'sapper' tasks that could be better done by others?
- run a museum, a library and a journal without the core business that gave them a worthy and common purpose?

I'm sure you did not! But, we still have keen young officers coming in, prepared to be that last engineer resource when all else fails; prepared apparently to provide that flash of innovative brilliance which will save the day; prepared but not trained - what courage! If we are to continue to be military engineers we must exercise and expand our abilities, we must all practise innovation in peace and we must actually study the Science of Military Engineering - all of us.

Clearly there is a significant difference between being a professional soldier and being the type of professional engineer described in our President's paper.

Don't get me wrong, I do not subscribe to a technical/non-technical split in the Corps - far from it - this has been one of the worst 'red herrings' ever. Our own history shows that military

engineering was frequently more of an art than a science. It is no accident that those who have practical skills sometimes make better military engineers than those who have theoretical knowledge. It depends on what you want. In my view the term PQE can cover a multitude of sins but, above all, it should mean a Professionally Qualified "Military" Engineer.

So that's it! Our profession was, and still could be, Military Science and we should be constantly aiming for excellence in the subject. In particular the learning curve for all SNCOs and Officers should include block release to extensive military engineering courses. Well - we have to start somewhere! The YO Course could be better described as a **Combat Engineer Course** and should be extended to include SNCO's and WOs. (We should all have Certificates saying we passed, which could relate to military qualifications in Europe).

Then we should have a **Military Engineer Course** open to SNCOs and obligatory for all Officers and we should have Diplomas for passing.

Then there should be a **Military Science Course**, in addition to or replacing the Long Civils Course, to Degree level.

RSME should establish these Courses and Qualifications and our Institution should decree the standards to be achieved to qualify for 'SIRE', 'MIRE' and 'FIRE' based on the above Qualifications plus time spent practising our profession in a position of responsibility. We would then have the Mechanicals and Civils wanting to join us, instead of vice versa! Now there is a professional identity which is both appropriate and achievable.

Since writing this, the paper by our Deputy EinC on Professional Qualifications for Military Engineers has been published, the findings of which are a clear indication of how untechnical we have become as a Corps and how urgent it is for us to reverse the trend.

Talking of professional identity, there is a clear indication that sappers should not try to live up to the civil, mechanical or electrical institutions' own particular requirements for qualifications and experience, which, although useful, are not entirely relevant to a technical military Career. It is also evident that civilian members of these Institutions could be far more interested in hearing about military engineering in JPM's (Joint Professional Meetings), rather than attempts to show how good we are at pure civil, mechanical, or electrical engineering, which generally speaking, we are not. Surely JPMs on the RE Core Business would also draw in more support from our own ranks as well as from all those who have retired.

Yes, it will take time by serving members of the Corps to prepare presentations and this will require the approval of higher authority; but reviving our core business is vital to our future, isn't it?

The one thing, (and perhaps the only thing), that we can be good at is Military Engineering. When we prove it again, we will be accepted again and, when that happens, a suitable MIRE will warrant a CEng or EurIng. Look at history. A hundred years ago the military engineer was the Cream of Engineers not the Pauper.

Both our training and our professional practice should include R&D and full-blooded projects in cooperation with industry. Joint industry projects in military engineering would surely be far more productive than what we have now; the job satisfaction would be tremendous, the kudos great for the Corps and the results would soon show that we were 'back in business'.

Lastly, if we continue to leave it to others to advance military science, the Institution has really no future. The three committees currently work very hard but without a common purpose; the logical outcome is for the Council to launch the Museum, donate the Library, *Journal* and funds to it and wind up the Institution and the Council since they will have ceased to have any other significant purpose. Unless?

Insufficient Funds ...

The second response that I get is "We don't have funding for that sort of thing" - recognize it? In industry, if you don't have funding, it is either because your products are no good, or your marketing is at fault. I reckon the sappers were never much good at marketing but their products were so damn good, they sold anyhow. The trouble is that we do not produce new products anymore (with one or two minuscule exceptions).

The market is still there. Even with glasnost, the national and export markets may be different but

not diminished. No, the problem is that, despite our illustrious past, the world does not owe us a living. We will diminish and, sooner or later, go out of business, unless we successfully develop and market good new products. Even if we are fortunate enough to see a trend away from winning wars to winning the peace, the need for engineers to develop new equipment and methods will persist. It is up to us; funds **do not** come first. First you need vision with direction and purpose, then you must sell each concept to create a potential demand and above all attract initial funds for concept development.

Even the defence industry itself must first sell a concept to MOD before any funds materialise, but then, if we don't apparently want to live up to our reputation, or our Charter; if military engineering no longer features in our future vision; if we do not wish to run ourselves as a modern business; then there is not much future for Sappers. We can go on complaining about the wrong equipment, manpower cutbacks, mundane tasks, competition from other arms, lack of professional recognition, etc. These are all symptoms of the same trouble - we are not going anywhere without our core business and good business management.

Not My Job ...

The third reason given for inaction is the response 'it is not my job' or 'it is not your job'. Most of us want to believe that someone up there cares about us, cares enough to want to steer the Corps in a direction to survive and succeed at what we do best. Don't tell us we aren't needed anymore because MOD can do it better - we don't agree. Don't tell us we don't have funds when we know we have no discernible R&D marketing strategy. Don't tell us we are terrific military or professional engineers when we know we are not.

Tell us we are all going to contribute our abilities to developing new products and services and we are going to market them in such a way that we will stimulate a new demand nationally and internationally. Tell us we can expect to be lead in the best of business management traditions into the twenty-first century as a successful and growing, fundamental and vital element of Her Majesty's Forces.

As it is, the only contribution most PQEs make is that brief opportunity to demonstrate innovative brilliance in the final paper on the long civils course; even so, most believe these become dust gatherers in some remote and forgotten archive. This being the general impression it is no surprise that a modicum of depression sets in! Many now consider being a PQE to be a distinct disadvantage in today's Royal Engineers!

Tell us it is still our job to be the best damn military engineers in the World and it is still our job to make it happen.

Time For Action ...

So, let's decide to be phoenixes, not dodos; what medicine should we prescribe for ourselves? Where do we start our journey back to a future?

Consider what the following say about themselves:

RSME - "Is the focal point of military engineering knowledge and is responsible for developing military engineering techniques" - Brig J M Lucken BSc (1989).

MWF - "The main engineering consultancy organisation in the Corps of Royal Engineers" - Col R Jukes-Hughes MBE CEng (1983).

RESAT - "Source of highly qualified specialists in a wide range of engineering or engineering related skills" - Col E P F Rose TD MA DPhil (1988).

Impressive statements! But how true are they? I feel sure that our technical assets, in all three, are continuing to dwindle for lack of engineering challenge.

Regarding the Serving Corps a timely and ideal opportunity presents itself with the recent publication of the Design for Military Operations - The British Military Doctrine. The gauntlet is down - I look forward to reading the 'British Military *Engineering* Doctrine', on which subject I am indeed encouraged by the noises from RSME and D&W, that the response will be at least a ten year look, with innovation in military engineering as the key ingredient, in which we sappers will play the lead part - or am I hoping for too much?

I should confine my comments to the Institution

and beware of criticising the Serving Corps - I am told! The trouble is that we, in the Reserves, identify almost completely with the Regular Serving Corps. This is entirely to the credit of the Regulars who, these days, make us so welcome and so very much at home in the one army concept. Nevertheless I would not presume to suggest what the Corps should do but I can and will comment that, whereas we do not expect you to be fantastic E, M or C engineers or expert in IT, Systems, Biotechnology, Avionics etc etc etc, we are going to get very concerned if you really want to drop Military Engineering. We in the TA do not mind in the least if we are not able to qualify for full membership of an Institute of Military Engineering - That is **your** job. Clearly the subject of Professional Qualifications for Military Engineers is anything but dead - Unless you in the Regular Serving Corps want it to be.

Wither the Institution? ...

Now, whatever the Serving Corps does, the Institution has a Charter and, with or without the patronage of our Generals, the Council has an obligation to lead the Institution. First we need a Military Engineering business plan for our Institution Council and our Masters to approve. To achieve this a Committee reporting to the Council, should address the topics of Purpose, Ethos and Strategy, and present a Corporate Plan that will accord with the Charter. Ideally this should be in cooperation with the Serving Corps, but this is **not** a prerequisit. The Council already has the remit to go ahead on it's own initiative and task a special committee to generate a corporate plan that will advance military science in our time.

Without anticipating it's findings, such a Military Science Committee (MSC) could identify and submit concepts to the EinC (A) and MEC. The MSC could delegate specific research topics to small study groups which would co-opt contributions from MWF, RESAT, STREs(V), Engineering Staff Corps etc. RSME should play a strong practical role and D&W should play a strong systems role and the Institution should do everything that we would expect of a vibrant learned society! It is up to the Council to initiate the reaction and continue to be the catalyst.

Probably the most rewarding work, apart from dreaming up concepts, is feasibility engineering, outline design and concept development to computer modelling, scale modelling, prototypes and trials. This was, and still is, the best way possible for us to stimulate and develop the muscles of our young engineers.

Our young engineers not only need a better engineering challenge, they must have encouragement and scope for developing their own ideas, however lateral or even outrageous at times. The balloon corps did not have official backing to start with but it was 'allowed' to happen none-the-less. The torpedo trials in 1889, which upset the local Medway fishermen, were run by, and written up in the *Journal* by, Subalterns with enthusiasm and eclat. Those were the days!

What we have now is a large number of bright young officers mostly with undeveloped potential, fighting tomorrow's war with 60's technology; (although, thinking of the excellent Voyager performance we are probably still in the '50's' or '40's'!) Our young officers deserve better (and so do we older and bolder ones!)

Although some of the brightest ideas will rightly 'disappear' into MOD, many concepts will lend themselves to joint development between industry and the Corps at large to produce and trial prototypes on a commercial basis, guided and monitored by the Institution's Study Groups. If the Institution is to remain a 'Learned Society' it must continue to learn at the forefront of knowledge. Dynamism is required! Merely recording and storing records is what dusty institutions do!

Let's get back in there to develop and sell concepts which will attract support and funding, for the whole of the Corps. Above all let us all develop and exercise in peace the very capabilities that the Services still rely on us having in war. Let us live up to our President's portrayal of the Royal Engineer. For real, in war, the buck continues to stop with the engineer. Are we going to drop it in future?... Or pass it?... Or run with it?

I challenge the Council and those responsible 'upstairs' to rid us of this lethal stagnation and revive the flames of military engineering in us and in our Institution. The same military engineering that was responsible, in the past, for our excellent

reputation and the laurels on which, for the present, we are so uncomfortably resting.

THE CHOICE ...

- Either we return to the promotion and advancement of the science of military engineering which could do so much good for all of us, the Corps, the British Forces and Britain:- In other words, be truthfully a Royal Corps of Professional Military Engineers.
- Or we continue to drift away and, as far as I am concerned, the Corps of Royal Engineers will cease to exist, as the World still remembers it, for want of its Core Business:- In other words, own up to being at best a Corps of Military Technicians and Operators.

RE 200 Centrepiece

This centrepiece was designed and manufactured by Michael Sutty 1987-1989 and first displayed at the Corps Guest night 9 March 1989. Based on the design of the gift to HM The Queen which Michael Sutty made in porcelain.

The centrepiece bears the following inscription:

On the 15 April 1787, the Corps of Engineers
received a Royal Warrant from King George III
authorizing the style and title of Royal Engineers.
This centrepiece was commissioned by the Officers of the Corps
to mark the 200th Anniversary of the granting of the Royal Title.

RE 200 Centrepiece

Operation Tantalus

CAPTAIN N G BAVEYSTOCK

Nick Baveystock joined the Army in January 1985 and attended No 88 YO Course. His first tour was as a troop commander with 1 Field Squadron in Nienburg. He then moved to 4 Field Squadron as Operations Officer for their 1989 Operation Descant *tour. In December 1989 he took over as Adjutant of 3 Training Regiment.*

Introduction

4 Field Squadron deployed to Northern Ireland on 17 March as the Roulement Engineer Squadron. The Squadron's primary task during the four-and-a-half month tour was to undertake the planning, mounting and execution of *Operation Tantalus*, in support of 3rd Infantry Brigade.

Background to the Operation

In 1985 a series of observation posts were built to overwatch the border areas of South Armagh. These were initially regarded as a temporary measure but were so successful at countering PIRA operations in the area that the decision was made to refurbish the posts. 4 Field Squadron was given the task of constructing underground accommodation at three of the sites in the Crossmaglen area. These bunkers needed to satisfy two main requirements. They had to be able to withstand a direct hit from a Mark 10 mortar and to require minimum maintenance.

A detailed design was produced by the DCRE (Works) Northern Ireland with support from the Military Works Force, Chilwell. The end design consisted of ten Prefabricated Accommodation Units (PAUs) encased in a concrete shell with a number of exit points.

The initial stores bids were submitted in late 1988 and logistic and tactical planning started in early 1989. It was clear that the operation would require a considerable element of infantry support and 3rd Infantry Brigade decided to create a Crossmaglen Battalion Tactical Area of Responsibility (TAOR). 32 Heavy Regiment RA, which was already deployed in Northern Ireland, was selected to hold this TAOR and to dig in around the three observation posts. In addition to this further companies were deployed to secure the main supply route to the sites. The transport for moving the stores to South Armagh was provided by 60 Squadron RCT, together with heavy engineer vehicles with protection to the convoys being given by B Company 3 Battalion The Queen's Regiment.

Mounting Phase

The mounting phase started in April 1989 with the arrival of the first individual reinforcements to the Squadron. These specialist personnel were necessary to allow the Squadron to undertake construction at all three sites concurrently.

Concurrent with the arrival of the reinforcements was the arrival of the majority of the engineer material for the operation. This included 3000 tonnes of hardcore and a further 3000 tonnes of assorted stores. Three areas were cleared in the mounting area (MA) each of about two acres, and one of these was allocated to each of the three

Captain N G Bayeystock
Operation Tantalus

sites. All the stores were then checked, colour coded, labelled and serial numbered. This proved to be a vitally important part of the preparation. Having checked that all the required stores were in the MA a detailed convoy loading list was produced. This allocated every item, down to the last nut and bolt, to a specific cargo vehicle.

During the fortnight preceding deployment the Squadron undertook a number of trials to test suitability of plant and equipment. These trials were carried out at Ballykinler Training Centre and involved digging test slots to ensure that the heavy crawler excavators were capable of manoeuvring the PAUs. It was discovered they were not and as a result cranes were used to position the PAUs on site. As well as the digging trials, troops experimented with equipment they were likely to use on site. This was carried out in the MA under the supervision of the troop command structure.

In the last week of April operations rooms were set up in the MA with representatives from the Royal Engineers, Infantry and the Royal Corps of Transport. Bessbrook was used as a helicopter airhead with a Squadron tactical HQ to control aircraft movement to site. Liaison officers from brigades and units appeared at various times and subsequently disappeared and finally a number of rehearsals and CPXs took place.

Execution

On 1 May 1989 the infantry were flown from their barracks through the forward airhead to their positions. They then started to dig-in in preparation for the first convoy. The first convoy left the MA at midnight carrying field defence stores, road expedient, combat supplies and hardcore. Plant was also inloaded to assist with the strip-out of the old slot. A total of 20 convoys were run to the sites. These became larger as the outload progressed and reached a peak of 45 vehicles.

Soon after the operation started it became the target for terrorist attacks. On the night of 3 May one of the sites was attacked with a radio-controlled tractor. The tractor guidance system failed and the terrorists detonated the device 400 metres from the site. The next morning an NCO from The Worcestershire and Sherwood Foresters was sadly killed when a landmine detonated as his patrol moved past it. The next attack occurred on 6 May as a convoy was returning to the MA. A few hundred metres from the site a device in a derelict building exploded, severely damaging a land rover and injuring an NCO from the Royal Corps of Transport. This was followed 12 hours later with a device beside the convoy route which exploded, damaging another land rover. On 13 May the Glassdrumman site was attacked using a new type of mortar. Four rounds were fired at the site, three of which exploded. The fourth was made safe by the Ammunition Technical Officer. The final attack on the operation was carried out on 1 June when 50 rounds were fired at the Creevekeeran site. These were returned with interest (500 rounds returned).

One of the major factors affecting the critical path was the Irish weather. We had always been aware of this and had made detailed plans to cope with the possibility of poor site conditions. As a result we built a series of expedient roads, one of which was nearly 250 metres long. In the event the Squadron was incredibly lucky, there was almost no rain during the construction phase. Indeed for most of the time the troops were working in blazing sunshine and site conditions were excellent. It is clear that the operation would have taken much longer had it rained.

Once the stores had been inloaded the construction began in earnest. Having stripped out the old slot, a new excavation was started using a variety of heavy crawler excavators and medium crawler tractors. Land-drains were then laid in a hardcore base of 300mm. A blinding layer of fine sand was laid and the concrete units were moved into position using Coles 315 cranes. To ensure that waterproofing was maintained the concrete units were pretreated with a bituminous paint. They were then positioned and the joints were sealed with a compressible bitumastic insert and covered with a bitumastic strip. Expanding foam was then used to fill any voids in the shell. A layer of Filtram was stapled to the external walls of the slot. Attached to the bottom of this was a slotted pipe which collected any water stored in the Filtram and fed it into the land-drains.

As the shell was constructed the internal units were moved into position. PAUs were taken down to the sites during the convoy phase and

Fuel resupply to the sites during operation

were positioned using the Coles 315 crane. The units were then bolted together to form an internal accommodation unit.

Services

There was a large number of services to be installed in the new slot. In addition to power for the operation equipment we needed to provide water for the kitchen, showers and ablution units and heating and light to the accommodation units throughout the slot.

Water. The existing mains water supply was upgraded. Water is now pumped from a break tank at the bottom of the hill to a storage tank at the top. From here it is distributed throughout the slot by a low pressure distribution pump.

Electrical. The existing electrical supply provided insufficient power to the slot. Squadron electricians tapped into an overhead line at 11 KV and laid a high voltage cable to the top of the hill, where a 100 KW substation was installed inside the observation post perimeter. From here power was run into the slot through a standard 240 V distribution.

Sewage. The sewage system was refurbished during the operation. The existing septic tanks were emptied, repaired and cleaned where necessary before connection to a full range of domestic systems.

Plant

A variety of plant was used during the operation. Serviceability was vital and a plant SNCO and a Class 1 Fitter RE were deployed to each site. By and large the vehicles performed extremely well. Early in the operation we had decided to deploy with a strong reserve of plant to each site. This proved to have been a wise precaution and by the end of the operation we had used all of the plant extensively. Medium crawler excavators were used to lift concrete units as well as for excavation. This was particularly useful in areas where the crane had difficulty in setting up. Kubota light tracked dumpers were used through the operation to transport stores, equipment and personnel. They are excellent machines, very versatile and real work horses. Nissan light crawler excavators were also used on site to dig service trenches. It was found that they were better than the in-service light wheeled tractors because of their better off-road capability. They were also used for backfilling more delicate areas where a more robust machine would have caused damage.

Resupply

Resupply was carried out entirely by air. Most of the stores required for the operation were inserted on the convoys, but fresh ration supplements, mail and spares were flown from Bessbrook. On a project of this size it proved impossible to predict exact stores requirements and some stores inevitably had to be flown in as new construction problems emerged. Fortunately these were kept to a minimum by careful and detailed planning at the start of the operation.

Extraction

The operation was eventually completed four days early. While the operation was underway detailed planning for the extraction phase went

Construction team inside accommodation unit

Operation Tantalus (1)

Plant working to excavate the old slot and prepare the new slot

The finished roof prior to backfilling

on. The bulk of the material to be backloaded at the end of the operation consisted of scrap pierced steel plank (PSP) and other site scrap. There was also a considerable amount of repalletised stores. For tactical reasons only two convoys were used for the backload. This meant that extra 35-tonne Scammels had to come from the mainland for the backload in addition to those held in Province. As well as engineer plant and some unused stores there was a large amount of general site rubbish which had to be collected and loaded by hand.

Command and Control

The Squadron Main HQ was located at the MA. The Tactical HQ, consisting of the Signals SSgt and two signaller/drivers, was located at Bessbrook. Its main function was to coordinate all helibids from the sites and from the Squadron Main. The on-site command structure consisted of the site tactical commander (the BC of the Battery defending the site), the engineer troop commander, Troop SSgt, Plant Sgt and two section commanders with the OC visiting each site every two to three days.

UHF radios were used by all personnel working at the MA and were particularly useful for marshalling the convoys. VHF radios were used for monitoring movement around the Province and for control on site. Each site was equipped with ten personal radios. These were used on a local frequency to give a secure chat net for site control. In addition a dedicated engineer link was set up from the sites back to the MA. Finally, facsimile was installed at the MA. This proved extremely effective in speeding up the stores acquisition process.

Lessons Learnt

No tolerances had been specified in the design of some adjoining components and these were therefore fabricated to normal construction practice. This caused many problems during construction and, in particular, the fitting of steel blast door frames into the concrete sections took an extra day of cutting and welding. The main concrete units were also cast to inadequate tolerances causing problems in levelling and matching up. In any future operation all interlocking components must be designed with adequate tolerances specified.

To aid vehicle movement on site a series of expedient roads were built. Their value cannot be overstated. For loaded stores vehicles, PSP on its own was found to be insufficient and it had to be laid on top of "Lotrak" geotextile and picketed every plank. Another method of roadway used successfully was "Tensar" SS2 plastic netting, covered with Lotrak, covered with 75mm of 40mm to dust hardcore. This latter method had the obvious disadvantage of requiring a large amount of hardcore. Where Class 30 trackway was used for turning, it often split if vehicles had 4-wheel drive engaged. It was very important to ensure all drivers engaged 2-wheel drive before going onto the trackway. Once again we learned that Class 30 trackway is ineffective when laid on any sort of crossfall.

Operation Tantalus (2)

The amount of plant taken to each site was determined on the principle of redundancy so that even the catastrophic failure of one machine could be overcome by use of another. This redundancy in plant was proved necessary on many occasions. The lead time on spares was such that every piece of plant was used at some point during the operation. The extra plant gave an added flexibility and ensured that whatever piece of equipment broke down the task could be undertaken by an alternative machine.

The likelihood of terrorist attack made it essential to wear INIBA protective jackets and helmets at all times when working above ground level. The only exception to this occurred when soldiers used certain power tools when helmets had to be removed. The wearing of full protective equipment did, in the very hot conditions experienced, significantly affect the performance of the soldiers working on site.

For a task of this complexity a troop HQ on each site was essential. The dedicated engineer net was busy and essential. The OC was best located at the MA with access to all communications and HQ facilities, when he was not visiting sites. The tactical HQ at Bessbrook was essential for control of helicopter tasks. It did not need a 24 hour manning capability.

Conclusion

Operation Tantalus was concluded successfully, four days ahead of schedule. It was a major operation, both for the Squadron and for many other soldiers in the Province. It provided a very worthwhile challenge for all members of the Squadron and, at the same time, proved to be most effective training for all concerned.

Royal Military Academy Woolwich - The Shop

It should be noted that the brief history of *The Shop*, printed in the December 1989 *Journal*, was compiled by Lieut Colonel L V McNaught-Davis.

An Initiation to the Survey of India

MAJOR GENERAL R C A EDGE CB MBE

General Joe Edge retired from the Corps in 1960 following a distinguished career in Survey. After his retirement he wrote an account of his initiation into Survey using diaries he had kept at the time. The full account is held in the RE Corps Library. We now have pleasure in publishing the last section of the article as an appetite whetter.

In the earlier part of the article General Edge tells of his pleasure at being posted to the Royal Bombay Sappers and Miners in 1936 after his early training, having held fond memories of India since living there as a child. However his ambitions to serve on the North West Frontier had met with a rebuff and as a ploy to avoid the more sedentary life to which he had been assigned, he applied and was accepted for the Survey of India.

His training was to take place at Dehra Dun and after making preparations which included parting with his recently acquired horse, he and a brother officer, Richard Gardiner, who was similarly under instruction found themselves in the hands of the highly experienced Mr Wyatt, learning the art of triangulation and later in the foot of the Himalayas, plane tabling.

"We had been thus pleasantly engaged for about a week when Richard ... noticed that a fixing he had made close to our camp had a height of 2980ft. He had earlier made a study of our allowance regulations and realized that, if our camp could be raised another 20ft, we should qualify for the "hills" rate of field allowance which was 50 per cent better than the "plains" rate. In next-to-no-time we had shifted our camp half-a-dozen fields up the terraced hillside and made our financial position much securer for the next few weeks."

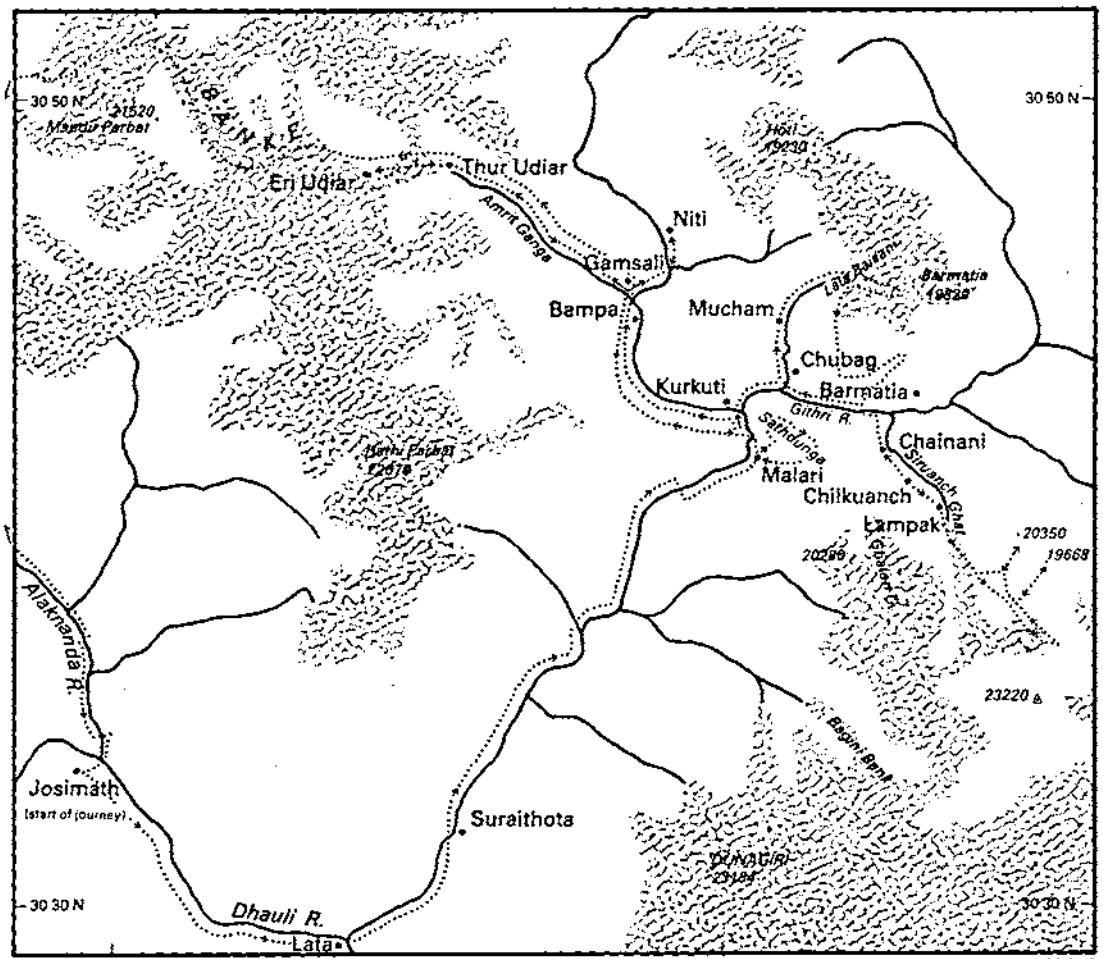
Life became more earnest early in 1937 when they started their two years of practical work with the Survey Party based at Mussoorie, No1 Party under Major Gordon Osmaston, an experienced mountaineer. Their first destination was in the area of Niti, a village on the Tibetan border at about 12,000ft, a journey which took about a month by metre-gauge railway, lorry, taxi and on foot. Their stops for various administrative purposes included Ranikhet where they received "the last civilized meal we were to have for three months" from Mrs Brown, wife of the Secretary of the Club who looked after most expeditions passing through. By the time they reached Niti they had each acquired a team of 11: three Garwhali Khalasis of the Survey of India, two Sherpas and six Garwhali coolies.

There they joined Fazal Ellahi, a very experienced Himalayan Surveyor, who was to demonstrate mountain surveying before they went off on their own. After many adventures learning how to cope with both climate and the daunting terrain as well as with the problems of survey they split up for their own areas of operation.

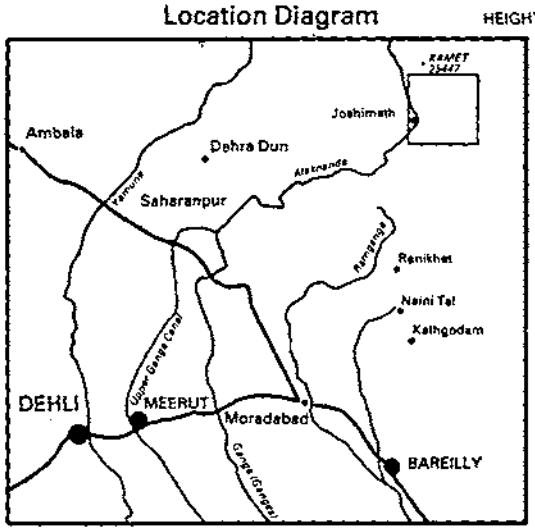
I started work at a HS called Sathdunga and, for the next few days, made little progress, experiencing for the first time the full effects of "surveyors' blues". Nothing seemed to be where it ought to be and the scale of the country was so vast that definable detail seemed to be almost totally absent. The trig points were few and far between and,

Major General R C A Edge CB MBE
An Initiation To The Survey Of India

AN INITIATION TO THE SURVEY OF INDIA – ROUTE MAP



Location Diagram



HEIGHTS IN FEET

MILES

0 1 2 3 4 5 6 7 8 9 10

Legend

- Glacial Areas
- 21240 ▲ Spot Ht Trig
- Lata Village
- Single journey
- Return journey

being derived from reconnaissance triangulation of the 1850s, not entirely reliable. Moreover my squad also was new to the job and, except for the Sherpas, unversed in mountaineering. So progress was frustratingly slow and, although I much enjoyed myself (and incidentally learnt a number of useful things such as that wild rhubarb was abundant and delicious and that nettles and other plentiful plants made excellent veg) I had little actual mapping to show for my week's work when my OC, Gordon Osmaston, arrived to inspect me. Seeing my difficulties, he robustly told me that my troubles were due to my not getting high enough and arranged for Rinsing, one of his Sherpas (the other was Tensing, later of Everest fame) to pitch a light camp above 16,000ft on the Chubag glacier, which fed into the Girthi on the north side; that is on the side opposite to Shiruanch Gal, the main glacier in my area. We worked our way up to this camp with some difficulty owing to persistent snow. During the night, strange sounds coming from Gordon's tent indicated that all was not well and, next morning, it was obvious that he was suffering from some stomach complaint and we decided that he should go back to base, with Tensing to accompany him. Alone once more I struggled to continue work on the Chubag glacier for a few days before deciding, with Gordon's agreement when I passed through his camp, to switch my efforts to the main glacier until the weather was more favourable. This meant crossing the Girthi. A rather precipitous descent took us to the bottom of its gorge, where we made camp and next morning crossed by an enormous snow bridge. After a hard climb we emerged by some ruined huts on a pleasant grassy alp near a large herd of Bharal. We spent a few days in these agreeable surroundings and suddenly plane tabling didn't seem so bad after all. Apart from the sunshine and spring flowers, the valley was much wider and one could at last see what one was doing. After this pleasant interlude, I continued working along the western side of the valley of the main glacier for a few days and in the process learning something of the ways of man and of Nature in this strange environment. It was all too much for some of my squad, of whom three presently announced that they would go no further. I said that, in that case they had better leave, which they forthwith proceeded to do. Luckily I had an excellent man at my dump, an ex-soldier of The Royal Garwhal Rifles by name Gopal Singh, who appealed successfully to their better nature so that the deserters returned, all smiles, next day. For good measure they gave me a Hindu blessing, imprinting a "tika" on my forehead. This may have had the desired effect: for, next day, a gigantic ice avalanche roared down to the glacier, obliterating the tracks which our party had just made along the lateral moraine. Some of the lumps of ice that came down were about the size of a house and it was awesome to watch these colossal pieces being tossed like a child's bricks right across the main glacier. Another interesting (though less alarming) experience was to see the chukoor, or Himalayan black partridge, unable to take off from the ground owing to the rare atmosphere. They could land but, to get airborne again, they would first have to leg it downhill until they found air which was dense enough. A better known phenomenon of the mountains is the difficulty of cooking owing to the lowered boiling point of water. In the absence of pressure cookers (our equipment was very basic) it often took several hours to cook our dhal (lentils) and rice causing much frustration. This nearly led to a serious accident when Ingung, one of my sherpas, devised his own pressure cooker for heating my midday Oxo, using a golden syrup tin with the lid rammed well home. One day, of course, the contraption exploded with an alarming report and showered poor Ingung with its scalding contents. Luckily he suffered no permanent damage.

Since the start of our trip, I had cherished the rather childish ambition of standing on the top of at least one peak of more than 20,000ft. As my work progressed, I noted one such that appeared to be climbable and I determined to tackle it. We established our base camp on a tributary glacier at just above 17,000ft and, at dawn next morning, set out on our climb. The party consisted of myself, the two Sherpas and three local men. At first the climbing was over broken rock and quite simple; but presently this changed to interminable step cutting up a dome of ice which we thought led to the summit. But, alas, when we surmounted this we found we were separated from our goal by a very dangerous-looking corniced

My area as seen from Richard's

ridge with sides of a sickening steepness. Left to myself, I should probably have called it a day; but my Sherpas laughed at the idea. Roped together we stepped boldly out on to the vertiginous snow slope below the cornice. To my surprise, I felt quite safe: the compacted snow provided a firm foothold and progress was simple - provided one didn't look down! Some fifty yards of this and we had reached the rocky summit: my first 20,000ft peak! I set up my plane table and quickly worked out our height: 19,668ft!

The disappointment of us all was exacerbated by pangs of mountain sickness which, to an increasing degree, was affecting most of the party, including myself. With aching head, I finished my plane tabling, becoming dimly conscious the while of an anxious murmur emanating from the direction of my squad. When I eventually stopped work and announced that it was time to descend, the reason for this anxiety became apparent. While I had been working, the burning sun had got to the snow and ice of our ascent route, turning its easy surface into an impassible mixture of slush and treacherous ice with the threat of an avalanche at any moment. A new way had to be found down the precipitous flank of the mountain, using a route that had remained in the shade. We had not enough rope to allow us all to be securely roped up as we traversed difficult stretches and we had to proceed by using two men as anchors while the others gripped the rope between them as a handrail. My heart was in my mouth several times; notably when one mountain-sick man allowed the rope to slip from his grasp and started to slither sideways down the rock face. Luckily, as he fell, the rope caught in his armpit and we were able to haul him to safety. After about two hours of this frightening descent, we reached easier ground and made our camp without further difficulty. We were all thankful to be alive and I at least, felt I had learnt a little about mountains!

Next day we counted the casualties: one Sherpa, Gyalgen, was snow-blind and one man had frost bitten feet. To add to our troubles, next night there was a howling blizzard which almost blew our tents away; and on the day following I fell into a crevasse, fortunately with no worse result than

An Initiation To The Survey Of India (1)

Gordon Osmaston

a considerable shock - and a salutary lesson on the folly of walking unroped on glaciers, however innocent-looking; a lesson which was reinforced next day when we learnt that a surveyor had fallen down a crevasse on the Kosi glacier and been killed.

In a few days we reached the upper end of the main glacier and climbed to the col at its head. We now stood on the main watershed of the Himalayas, the roof of the World. The height was just under 19,000ft and the view stupendous: gigantic peaks rose on every side and in the distance were discernible, to the North, the brown Tibetan plateau and to the South, the plains of India. It was an awe-inspiring place, with an enormous wind-blown cornice overhanging the cliff below us. We were quite alone except for the choughs playing in the strong up-draught at the top of the cliff. We watched with rapt admiration the amazing aerobatics of these birds, whose zest for enjoying themselves, it seems, is never diminished, no matter how high the mountain or how cold and thin the air.

I still had that rather unworthy ambition to climb a 20,000ft peak and had my eye on a handsome specimen (named, as I found out later, Uja Tirche or "High Mountain"), whose height of 20,350ft had been fixed by triangulation and could not be in serious doubt. I determined to attempt it and a few days later, established a light camp at its base. Next morning we set off before sunrise; it was a bitterly cold but, mercifully, windless day and we made good progress over steep but easy rock. Then came an ice ridge up which we had to cut steps, a wearisome business taking us over two hours; and finally the summit, which proved to be so narrow that we could only just squeeze our party of five, all still roped up, on to it. There was no room to set up a plane table and, moreover, we were enveloped in thick cloud. Work was out of the question and so we descended cautiously until the ice ridge gave place to a rocky shoulder bathed in warm sunshine. In this delectable spot I set up my plane table and worked for an hour or so while my squad lay down and had a well-deserved sleep. We all felt satisfaction in having broken the 20,000ft barrier.

With these excitements, my work in the valley of the main glacier was nearly finished. We spent a few days filling up gaps and gathering names from a local man before leaving for our base camp at Malari. The final day was strenuous: from our camp at about 12,000ft, we climbed to a fixing at 16,039ft, slid down to a valley at 13,500ft, climbed to a pass at about 16,000ft and finally had what my diary describes as "a very tiring toil down to Malari at 10,000ft". The coolies and with them my food boxes, had failed to arrive; and so it is not surprising that my diary records show that I lost my temper. Luckily the resourceful Gopal Singh was able to scrounge "a meal of fried alu (potato) and rice pudding and tea"; so the day finished happily.

At Malari I made arrangements to evacuate my base and then started work again on the Chubag valley which I had had to abandon earlier in the season. It was much easier now; the weather was warmer, the snow was less deep. We had no problems of sickness and, most of all, we had all learnt a lot. We had to get to the other side of the Girthi River but could not use our earlier route because, by now, the snow bridge would have melted. We therefore crossed by the bridge at Kurkuti and headed for our camp below Mucham on the right bank of the Chubag River. We worked on up the valley until we reached the head of the Chubag glacier. Although warmer than it had been in April, it was still very cold, especially in

An Initiation To The Survey Of India (2)

the wind which was often of gale force. On one occasion my "Height Card", an important piece of equipment, blew away to lodge in a crevice in the cliff a few hundred feet below me: it was only retrieved with some difficulty - and danger. The terrain was much more eroded and complex than that of the main glacier and this made it more difficult for plane tabling. Nevertheless, we made good progress with the upper end of the valley and planned to cross a pass over a ridge called Lala Baisani to get to the Barramattia area; which was all that remained to be surveyed. But, alas, we found the pass impracticable and decided to descend about 4000ft and follow a goat track running along the 13,000ft contour. This seemed a most promising route until we suddenly found ourselves standing on the top of a cliff and gazing out upon an astonishing complex of steep ravines that stretched ahead for a mile or more. There was nothing for it but to descend to the Girthi, where we camped in an enormous water-worn cave in the cliff beside the river. The floor of this was covered with the droppings of bats, goats and sheep which must have accumulated for thousands of years. The smell of this, together with the heat which, at this low altitude of about 10,000ft, was considerable in mid-June, and the incessant roaring of the swollen river, made sleep very difficult. Our route had successfully by-passed the complex of ravines; but at a cost of several thousands of feet of height lost. We set out to regain these next morning, climbing about six and a half thousand feet to a fixing at about 16,500ft. The coolies performed nobly, obeying my injunction to pitch camp above the snow-line and achieving a 5000ft carry in the process. It had been a hot and exhausting day, during which I had slaked my thirst very effectively by chewing wild rhubarb, of which there was plenty about.

The next morning I finished off my area by surveying the boulder strewn slope of Barramattia. I noticed that my final fixing, when plotted, was close to an intersected point of the 19th century triangulation called "Barramattia Hill Pole" which I had never managed to identify. I laid my sight rule on the plotted position and, sure enough, a few hundred yards along the line, I came upon a collapsed cairn with a weather-beaten pole lying beside it. This was a satisfactory note upon which to complete my work, providing a very independent check upon it and confirming that the surveyors of eighty years before, men like Godwin-Austen, really did know their stuff.

We raced down the scree to our camp a few thousand feet lower. This is always great fun; though it becomes a bit hair-raising as the small scree becomes large boulders near the bottom. We made preparations to leave next day and, at dawn, set out to join Richard Gardiner who had yet to finish his area. We had earlier agreed by letter that, together, we would attempt to leave by crossing the pass at the head of the Banke Glacier, dubbed by Richard the Zaskar Pass but later officially named Gupt Khal. The existence of this pass, which linked the Dhauli and Alaknanda valleys, had been suspected by Dr Longstaff in 1907 but Smythe, on his 1931 expedition to climb Kamet, had found no sign of it. Our survey offered a fine opportunity to settle this question.

We set off on the 21 June, reached Gamsali that afternoon and next morning set forth to look for Richard. We walked up the right bank of the Amrit Ganga, the river that rose at the snout of the Banke Glacier. We eventually spotted him striding down the opposite bank and retreated to a place where we could cross by a rock bridge. We spent that night in Richard's camp on the left bank: our numbers had been increased by two sheep which my men had acquired at Gamsali to supplement the rations. Next day we all marched up to Richard's base camp at Thur Udiar, a march which entailed the fording of a fast-flowing, quite deep and very cold stream. We got our coolies over somehow with the aid of a rope and also dragged our unfortunate sheep across through the freezing water. That evening we rewarded them for their pains by eating them. But the sheep got the last word, as their meat was tough and evil-tasting: it

Mount Uja Tiche (from South)

An Initiation To The Survey Of India (3)

19,000ft camp on Banke Plateau

gave such tummy trouble to the men next day that our progress was threatened.

For the next few days Richard continued his work while I and my squad explored. We moved camp up to about 19,000ft and I went on to reconnoitre a 21,500ft peak which Richard and I had agreed to climb a day or two later. I saw that it was very easy - nothing more than a steep walk over snow - but I resisted the temptation to climb it and rejoined Richard in camp. There was a violent snow storm that night which put paid to all possibilities of mountain climbing and, moreover, I was again suffering altitude sickness; so we decided to descend to a camp at 16,000ft and make our preparations for crossing The Pass. We pitched our final camp at a height of 17,700ft on the last day of June and, next day, set forth along the main glacier. We had to abandon some of our stores but, even so, some of the coolies found the going, in soft snow at an altitude of about 18,000ft, too much for them. Richard had had to go ahead to reconnoitre the route; and I soon realized that I would have to form a stragglers rear party if casualties - fatalities possibly - were to be avoided. Accordingly my Sherpas, Gyalgen and Ingung, and I held back and took the loads of those who were close to collapse. It was slow and weary work staggering along under an increasingly heavy load, doing what one could to encourage coolies whose morale was collapsing with every step. Gajay Singh, who had nearly killed himself once before by slipping on the way down our 19,668ft peak, was in a bad way: with each painful step he uttered the Hindu imprecation *Hey Ram*, the mournful repetition of which I found depressing. At one point I saw a coolie disappear up to his armpits through the snow; he was about to fall into a deep crevasse which the lead party (which had all the rope) had failed to mark. We managed to rescue him and eventually got all the stragglers to the foot of the final ascent to the pass. Gyalgen came galloping back to relieve me of my enormous load and I quickly climbed the last 500ft to the col. We all seemed to be in reasonably good shape; but I felt some concern for Gajay Singh and gave him a swig of brandy to pull him round. The effect was remarkable: he changed from an inert lump of total exhaustion into a hyperactive stage drunk, swearing eternal devotion to myself, no matter where I went or how high I climbed. He floated down the pass on the far side, arms and legs out of control (we dared not give him a load to carry), with carols of happiness issuing from his lips.

The descent was straightforward until we found our way barred by a precipice. We decided to camp and tackle this next day. We spent an uncomfortable night: we had had to jettison all our firewood and kerosene and, still above the snow-line, could not gather any wood: so we had no effective way of keeping warm or of cooking. Eventually we dossed down in such tents as had not been jettisoned and did our best to sleep. The noises coming from the coolies' tent indicated that exhaustion and, I suspect, the after effects of tough mutton were taking their toll. There was a snowstorm that night; but by morning everything was much better. We continued down the glacier, after lowering the loads down the precipice by rope. We selected a beautiful grassy site for our camp and Richard and I went on to reconnoitre while the tents were pitched. We had to cross the Saraswati River to gain the track to Badrinath and we saw that this could be done by a rock bridge or by a snow bridge which had survived the spring. Next morning we set out for the rock bridge but decided that this involved climbing which was too difficult; so we crossed by the snow bridge which, happily, did not collapse. It was then plain sailing to Badrinath. We spent some time admiring the astonishing gorge below Mana, cut by the Saraswati in the smooth face of an ancient waterfall. One can hear, but not see, the river which enters

An Initiation To The Survey Of India (4)

the canyon a hundred yards or more upstream: the cleft, caused, it seems, by an earthquake in ancient times, is nowhere more than a yard or so in width and here and there, great boulders have become lodged between its sides. One peers down into blackness relieved only by the occasional shaft of light which catches the birds as they flit about in the cavern and illuminates in a magical way the great stands of maidenhair and other ferns which decorate the rock face. All the while the roar of the river far below drowns other sound and its spray envelops everything in soft mist.

We stayed a night in the Dak Bungalow at Badrinath but did not think much of the charms of this holy village, especially at the height of the pilgrim season. Next day we got to Joshimath once more, completing our circuit of the Dhauli and Alaknanda - Saraswati systems: the first people (as far as I know) to do so. Once again we were thwarted in our intention to cross the Kuari Pass on our return to Gwaldam because the mule contractor would not consent to his animals being used on this route. So our trip was a rerun in reverse, of our outward journey, with the difference that it was now the height of the pilgrim season and, moreover, the monsoon was starting. Neither of these factors made for comfort; but we did experience some impressive thunderstorms and I saw an amazing collection of insects attracted by the light of my Petromax. Luckily, it was a fine day when we reached Gwaldam and we were able to stroll in the garden of the Forest Bungalow. Richard inspected the sundial, comparing it with his watch (which he swore was infallible) and noted with a snort of disapproval, that the former was three quarters of an hour fast; he seized the stone on which the dial was inscribed and yanked it round until the shadow was where his watch said it should be. We got to Ranikhet next day where an invitation to dinner from the Browns awaited us. We had time to shave and tidy up before getting a tonga and driving round. We found that our hosts had finished dinner and were going to bed. We had been invited for 8.45 but their clock showed nearly 10. Alas! Richard's infallible watch had let us down!

The Browns were forgiving and gave us a good dinner; our first for three months. They were most interested in our adventures; and conversation continued late. Next morning we started home the way we had come; by bus and train. We parted sadly with our Sherpas at Kathgodam and got to Dehra Dun after a night in the train. After that it was work as usual. Both Richard and I felt sure that there could be no better job than the Survey of India and that our manner of introduction to it could not have been improved upon.

Sherpa Ingung

Sherpa Gyalgen

An Initiation To The Survey Of India (5)

4000 Miles of Tubes, Transporters of NATO's Lifeblood

LIEUT COLONEL M G LE G BRIDGES BSc(ENG)

Lt Col Meryon Bridges is a PQE (E&M) Officer who has served in a variety of appointments overseas in recent years, including 1 Fortress STRE, CRE Works FI, MES Works Hong Kong, and most recently with NATO as Chief, POL Section (Infrastructure), at HQ AFCENT. In this job he became the primary authority for the planning, programming and control of all projects for restoration and improvement of the NATO pipeline network in Central Europe, which he considers his most rewarding job so far.

COINCIDENCE is one thing, but this is going too far. Rolled into one issue of the *Journal* (Aug 89), I find Major Croft recalling early wartime work with No 1 Welding Platoon, which gave rise to the earliest parts of the military pipeline system in Europe; we have Lieut Colonel Mike Reynolds discoursing on the generally little known topic of NATO Infrastructure; and we have Colonel John Nowers reviewing the demise of the HQ AFCENT tower, a feature of the landscape at Brunssum since the coal mine was in operation. Having myself just reached the end of a tour at AFCENT, working in NATO Infrastructure, and concerned wholly with the Central Europe Pipeline System (CEPS), I could not resist such a positive prompt to inform those who don't know about it, how fuel gets to all the Corps and ATAFs of NATO forces in Central Europe which have for years been consuming enormous quantities of the stuff, keeping chaps like me in business.

Firstly to set the scene, and in line with government policy, a few statistics: did you know that the CEPS is the largest pipeline network in the world? Were you aware that it can deliver upwards of 30,000 tons of fuel per day into the combat zone? Can you envisage a storage capacity sufficient to fill up the tanks of somewhere in the order of 45 million family cars? Like Rome, this system was not built in a day, (even if Nero would have had a field day burning it).

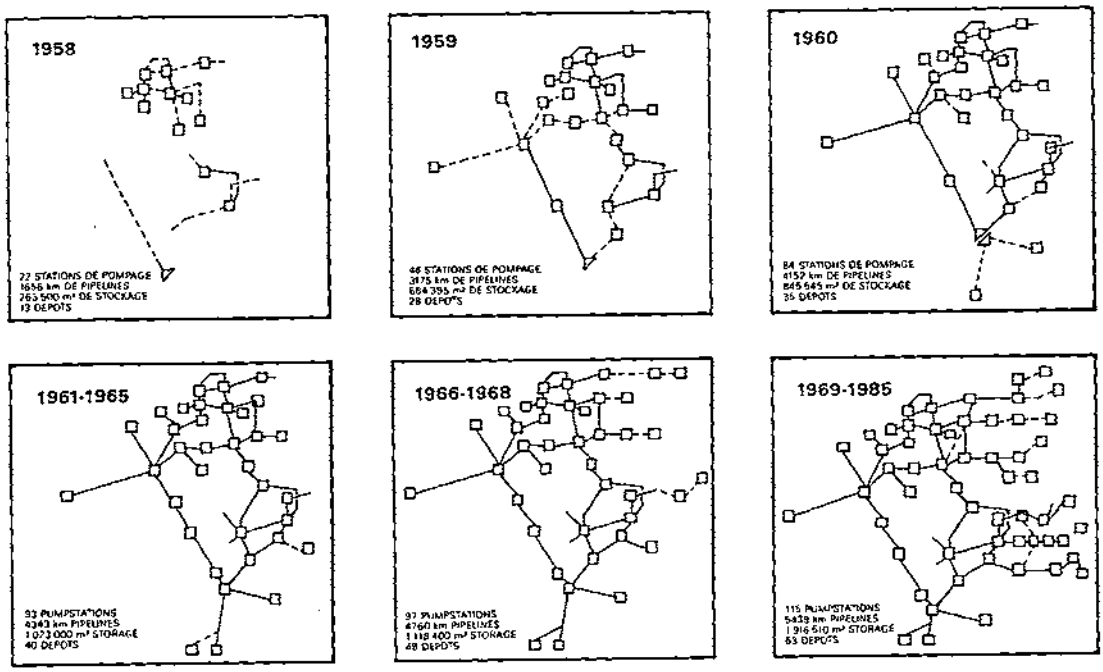
OUTLINE HISTORY

As described by Major Croft, the first allied pipelines were run out very quickly, with the aid of a Citroen truck, in 1944/45. It was not, however, until 1957 that anything more permanent came of this initiative, when the firs elements of the CEPS began to appear. The original purpose was to provide a secure fuel supply system for NATO airbases. Back in 1957 the fuel consumption in NATO airbases could, in modern terms, be described as "trivial", particularly when put alongside the almost grotesque greed for fuel exhibited by the supersonic gas-guzzling combat aircraft deployed today. Consequently those early lines tended to be of small diameter, and are fast becoming an unwelcome inheritance, inhibiting present-day throughput requirements. Initially the storage depots too were fairly small. By the end of 1958, 20 per cent of the present depots existed but with only 13 percent of today's storage capacity. However, these could be extended simply by adding tanks.

A schematic showing the evolution of the system is shown at *Figure 1*. It can be seen that initially the system grew very rapidly, with over

Lieut Colonel MGLeG Bridges B Sc.
4000 Miles 0f Tubes, Transporters of NATO's Lifeblood

EVOLUTION OU CEPS DE 1958 A 1985



DEVELOPMENT OF THE CEPS 1958-1985

1000km of pipelines being added each year. Another problem coming from those days is that both the technology and expertise of pipeline construction, and the experience of pipeline management, evolved only as the pipeline network expanded. As a result the construction standards of some of these early pipelines were, in modern terms, deplorable, and the effectiveness of the corrosion protection applied to them was very poor in certain cases, necessitating expensive remedial work today.

Recognition of the merits of supplying ground forces with fuel from forward storage depots was late in coming. The first of today's forward depots was not constructed until 1967, although a line leading towards it was started in 1958. Most of the rest followed over the next ten years. Not all the pipeline network was actually built by NATO from NATO funds. Some sections, most notably the Zweibrucken - Bellheim - Huttenheim pipeline with its storages, rail, truck, and barge loading stations, were taken over from national ownership, in this case the United States. (I hesitate to suggest that it would have been cheaper for NATO to have built its own pipeline in this area rather than to fund the restoration that subsequently proved to be essential for the ongoing use of this facility, but that's another story).

What exists now is an immense system consisting of 64 storage depots, 116 high pressure pumping stations, connected by 6500km of pipelines ranging in size from 4 to 14 inches in diameter. This system supplies a large number of NATO airbases and is connected to 55 refineries and other storages. It stretches from Le Havre to Hannover and from Marseilles to Munich. It is worth noting that the linefill of all those kilo-meters of pipeline amounts to over a quarter of a million cubic metres. This fuel is owned by the Central Region nations, costs quite a lot of dollars, and once put in, can never be got out! The exception would be a last ditch effort in which water would be pumped into the system to expel remaining stocks of fuel, but thereafter the system would effectively be unusable.

Operation

The aim of the CEPS is to satisfy the fuel supply requirements of the eight Central Region member nations, (Canada, United States, United Kingdom, France, Belgium, Luxembourg, The Netherlands and West Germany), and they operate on a fuel banking system. This means that if a United States tanker ties up at Lavera, near Marseilles, and pumps 5000 cubic metres of F34 into the CEPS, then the United States has a credit for that amount and can draw on it where and when she wants. With eight members, three different fuels, dozens of entry points and 64 potential delivery points, it is evident that a fairly elaborate control and management system is required. This is the responsibility of the Central Europe Operating Agency, (CEOA). CEOA is a NATO agency which provides overall co-ordination, and delegates detailed operation to the seven pipeline divisions; (three in France, one each in Belgium and The Netherlands, and two in West Germany). Each month users submit input and uplift intentions, and a monthly pumping plan is developed on a central computer. This is broken down into more detailed plans and elaborated at divisional Headquarters until each has a series of daily pumping schedules worked out to plus or minus a few minutes.

Fuel may either be pumped from depot to depot, and run off into a tank on arrival, or it can be through pumped; so a batch of, say, 5000 cubic metres of Diesel can be pumped from Marseilles all the way to Strasbourg without stopping. However 5000 cubic metres in a 12 inch pipe adds up to about 20km of Diesel, and as the last of this reaches the pump at Marseilles, the whole lot would stop unless a further batch was fed in behind it to push it up the line. The CEPS is a multi product system, which means that three military fuels, Jet, Mogas and Diesel, all pass along the same lines. Provided that certain conditions of pressure and velocity are maintained in the lines, it is perfectly feasible to push a batch of Diesel with a batch of Mogas, with nothing physically separating the two fuels.

The amount of mixing that takes place is marginal, related primarily to the distance moved. The mixed fuel is called the interface, and might typically amount to between three and ten cubic metres. As the fuel arrives at Strasbourg, the manifold valves are set to run the Diesel off into a Diesel storage tank. An interface detector, usually operating on ultrasonic detection of a change of fuel density, detects the incoming interface and signals the operator. He knows from experience that the interface will reach his manifold in, say, three minutes, and he resets his valves to run the interface into a contamination tank. As clear Mogas is signalled, this is then run into a Mogas storage tank. When this fuel is eventually due to be pumped onward, the mixture in the contamination tank is re-injected back into the batch, making sure that permissible contamination limits are not exceeded, but in this way almost no fuel is wasted.

At all stages, quality control is of key importance. Every batch entering the system is tested and logged. When fuel is run into a tank, even a partially filled one, samples are taken after a 24 hour settling period and these are subjected to laboratory analysis. Only when a tank test certificate has been issued for that fuel can it be either re-entered into the system for onward pumping, or issued to a user. All aircraft fuel leaving the CEPS is passed through filter water separators before issue, and users repeat this exercise once or twice more before fuelling the aircraft. Water collects in the fuel primarily from condensation in tanks, but this settles out at the bottom and is drained off. Additives such as icing inhibitors, anti-static, and corrosion proofing for the lines are injected as required during CEPS custody of the fuel.

Fuel is usually issued via truck, rail, or barge loading stations, or in the case of connected airfields, it is pumped directly onto the base where it then comes under the base control and issue system. Once the fuel is issued to the user, responsibility for quality control, accounting, and distribution is passed over with it.

In wartime, the entire network of the CEPS is designed to be capable of manual operation, with local control exerted by each depot manager on the basis of issued pumping schedules. In peacetime however, the capacity of the CEPS exceeds the normal military requirements, and so CEOA is empowered to enter into contracts with commercial users to transport civil fuels, and to use the revenue so generated to offset the cost

of operation and maintenance (0&M). To make this peacetime operation as cost effective as possible, and thus to minimise the O&M bill, the Central Region nations have jointly funded automation measures aimed at reducing as far as possible the peacetime manning levels required. As a result, most of the network can be operated remotely from the seven divisional control centres with minimal manning of depots. Pump motors can be started, valves opened or closed, pressure and flowrate controlled, and tank levels, safety systems and circuits monitored, all by remote telemetry from several hundred kilometres distance with, in some cases, no one on site at all. The amount of data to be handled is vast, and very sophisticated (and expensive) computerised control systems have been installed to handle it. The overall result is extremely impressive.

Costs

The CEPS annual O&M costs run to about £60 million per year, and of this, about two thirds are recovered from revenue income from handling commercial fuels. The remainder is contributed by the Central Region member nations. In addition NATO Infrastructure spends just over £50 million every year on the pipeline network in the Central Region, covering both new construction (improvements) and restoration. For the moment the division between improvements and restoration is about 50/50, but since the system is now mostly 30 years old or more, restoration is foreseen as becoming an ever heavier burden on the available funds. Complete replacement of pipelines has now been initiated, with work about to start on the first, and a second major system programmed for replacement, but this is extremely expensive - up to £75 million for a 200km line and the related airbase connections and high pressure pump stations. However since the overall value of the CEPS Infrastructure is currently reckoned to be about £5 billion, an annual nett expenditure of £25 million on restoration and £20 million on 0&M is perhaps not unreasonable.

Technical Aspects

All reasonable measures are taken to protect the network from offensive operations in time of war. All the pipelines are buried; all valve pits are surrounded by concrete walls and have steel covers to inhibit sabotage attacks; all tanks are semi-buried, and mounded over; all surface installations such as pumping stations and manifolds are protected, and minimum distances between the various parts of installations are laid down in construction criteria. Thus the facilities are all dispersed and hardened, and, superficially at least, concealed, and thus present a fairly unpromising target.

The network is a high pressure system, the main lines operating up to a nominal 100 bar (1400 psi) but in reality limited to 80 bar. Within depots the system is low pressure, limited to about 18 bar. Incoming fuel passes through a pressure regulating valve before direction to a particular tank. Outgoing fuel is either pumped out of tanks or run out by gravity, boosted by low pressure booster pumps to the high pressure pumps which require a minimum positive suction pressure to avoid cavitation, and thence boosted to main line pressure. In each depot there is both a high and low pressure manifold, the latter for routing fue around the depot between tanks, truck and rail loading stations, high pressure pumps, etc, and the former for routing fuel at high pressure either outgoing from the high pressure pumps to an outgoing line, directly from an incoming to an outgoing line, or incoming to the depot or the high pressure pumps for further pressure boosting.

To ensure security of the system, all pipes are welded by certified welders, and all joints are X-Ray tested, in addition to initial and periodic pressure testing. During operation, the quantity of fuel being put in at one end of a line section is continuously and automatically compared with the quantity coming out at the other end, with compensation for changes in temperature, pressure and density. Thus any leak will show up as a discrepancy and initiate an alarm. In some countries, additional leak localisation equipment is installed which can identify the point of the leakage to within a short distance. Within the depots, all tanks, including storage tanks, fuel tanks, contamination tanks, etc are all double walled, with leak detection equipment installed between the walls.

Within the NATO system, all high pressure pumps are diesel driven so as to avoid depend-

ence on local mains electricity supplies. Low pressure booster pumps are either diesel or electric, but in any case all essential electrical needs can be satisfied by standby power supplies in the depots. Because of the potential fire hazard represented by hot diesel engines driving the pumps, engine rooms and pump rooms are separated by firewalls. Driveshafts pass through these walls via vapour proof glands, and positive air pressure is maintained in the engine rooms while negative air pressure is maintained in pump rooms.

All buried facilities have to be protected against corrosion. Pipelines are supplied with factory applied coatings which become ever more sophisticated, but the lifespan of the best coatings is about ten years, and so from the outset pipelines are protected by impressed current cathodic protection. This has evolved into a science in itself, both for providing complete protection for the pipes, even in areas where stray earth currents, generated typically by electrified railway lines, create an acute corrosion hazard, and also for monitoring the effectiveness of the protection provided. Recently a 30 year old pipeline in a highly aggressive environment was found to be completely flawless. However another line of similar age, whose protection was inadequately installed and monitored, is now undergoing critically urgent replacement. With good protection, an effective life in excess of 30 years can be expected, although lives of almost 60 years have been recorded for buried pipelines.

Depot facilities are also cathodically protected, but in the case of storage tanks, most corrosion occurs on the inside. Fuel always contains some water, usually originating from condensation inside the storage tanks. Accelerated corrosion occurs in the tank bottoms where the water settles out, and a particularly aggressive environment develops at the boundary between the water and the fuel. Despite regular draining of the accumulated water, corrosion of the tank bottoms is a persistent problem. The only effective cure for this is shot blasting the tank interior and coating it with glass reinforced epoxy resin, or a similar coating impervious to fuel and corrosion.

While dirt, sludge, etc, accumulating in tanks can be cleaned regularly using detergent sprays and subsequent shot blasting, pipelines are cleaned using pigs. Not the ones with snouts but cylindrical objects fitted with driving rings, wire brushes and neoprene scraping rings. These are introduced into a section of pipeline at one depot, driven along by the fuel, scrubbing the inside of the pipe and pushing along the dislodged sludge with them, and are taken out at the next depot, together with all accumulated dirt.

In addition to ordinary pigs, the pipeline operator also has at his disposal intelligent pigs. These are very high priced, sophisticated equipments used for conducting in situ condition surveys of pipelines. They too are pushed through the lines by the fuel, and as they go they record surface defects; thinning, cracks, distortions or other defects in the pipe. They operate primarily on magnetic or ultrasonic principles and log information as they go along. The position of each significant feature may be identified by distance run from the start or by reference to distance markers installed along the line before the survey run. The form and detail of the information varies, but the best available specify the size and position of every significant defect, give a summary of the incidence of non significant defects, and even identify the welds between lengths of pipe! This happens to be a field in which Britain leads the way, with the best system developed by British Gas.

Conclusions

While critics may point to the bureaucracy of NATO, and some of the petty bickerings that go on in the international committees, NATO Infrastructure must be regarded as a success story. Of this story, the CEPS is amongst the most successful elements. One reason for this is that, come peace come war, the CEPS provides NATO with a useful asset. In peace it handles large quantities of commercial fuels movements, generating the majority of the funds needed for its operation and maintenance, while stimulating industry at the same time. In war it would satisfy the enormous thirst for fuel of modern forces, a thirst which could not be satisfied by any other means.

CEPS is, as already stated, the largest pipeline network in the world, and it provides employment for hundreds of operators, maintainers, specialist contractors, and managerial staff. Not

least significant, it provided me with a completely absorbing and fascinating job for three and a half years.

So the next time you replenish your troop vehicles in Germany from a fuel pool out in the field or from a stack of green jerrycans on the back of a four-tonner, ponder for a moment on how it got there, and where it might have come from - perhaps a tanker at Le Havre or a refinery in Antwerp.

Ubique

This silver centrepiece was commissioned by the Corps to commemorate all campaigns in which the Corps has taken part throughout the world from the end of World War Two to the present day. It was designed and executed by Stuart Devlin

Ubique

An Initiation to the Survey of India

MAJOR GENERAL R C A EDGE CB MBE

General Joe Edge retired from the Corps in 1960 following a distinguished career in Survey. After his retirement he wrote an account of his initiation into Survey using diaries he had kept at the time. The full account is held in the RE Corps Library. We now have pleasure in publishing the last section of the article as an appetite whetter.

In the earlier part of the article General Edge tells of his pleasure at being posted to the Royal Bombay Sappers and Miners in 1936 after his early training, having held fond memories of India since living there as a child. However his ambitions to serve on the North West Frontier had met with a rebuff and as a ploy to avoid the more sedentary life to which he had been assigned, he applied and was accepted for the Survey of India.

His training was to take place at Dehra Dun and after making preparations which included parting with his recently acquired horse, he and a brother officer, Richard Gardiner, who was similarly under instruction found themselves in the hands of the highly experienced Mr Wyatt, learning the art of triangulation and later in the foot of the Himalayas, plane tabling.

"We had been thus pleasantly engaged for about a week when Richard ... noticed that a fixing he had made close to our camp had a height of 2980ft. He had earlier made a study of our allowance regulations and realized that, if our camp could be raised another 20ft, we should qualify for the "hills" rate of field allowance which was 50 per cent better than the "plains" rate. In next-to-no-time we had shifted our camp half-a-dozen fields up the terraced hillside and made our financial position much securer for the next few weeks."

Life became more earnest early in 1937 when they started their two years of practical work with the Survey Party based at Mussoorie, No1 Party under Major Gordon Osmaston, an experienced mountaineer. Their first destination was in the area of Niti, a village on the Tibetan border at about 12,000ft, a journey which took about a month by metre-gauge railway, lorry, taxi and on foot. Their stops for various administrative purposes included Ranikhet where they received "the last civilized meal we were to have for three months" from Mrs Brown, wife of the Secretary of the Club who looked after most expeditions passing through. By the time they reached Niti they had each acquired a team of 11: three Garwhali Khalasis of the Survey of India, two Sherpas and six Garwhali coolies.

There they joined Fazal Ellahi, a very experienced Himalayan Surveyor, who was to demonstrate mountain surveying before they went off on their own. After many adventures learning how to cope with both climate and the daunting terrain as well as with the problems of survey they split up for their own areas of operation.

I started work at a HS called Sathdunga and, for the next few days, made little progress, experiencing for the first time the full effects of "surveyors' blues". Nothing seemed to be where it ought to be and the scale of the country was so vast that definable detail seemed to be almost totally absent. The trig points were few and far between and,

Major General R C A Edge CB MBE
An Initiation To The Survey Of India

a single set of components could meet all bridge needs?

The most important reasons are these:

a. The Bailey Bridge is a flexible structure relying on a large number of pin-joints. It is therefore subject to heavy deflection and sway under heavy loadings, necessitating severe speed limits for railway use.

b. On the longer spans it is very expensive in material as the following table (prepared by 21 Army Group) of span loads illustrates:

TABLE I
EQUIVALENT UNIFORM DISTRIBUTED LOAD

Span in ft	Road	Rail (In British Standard Unit Loadings)	
	Class 70 Tons	16BSU Tons	20BSU Tons
30	123	136	137
60	139	192	240
100	145	304	371
140	183	388	485
340	374	705	882

As will be seen there is little difference for short spans but, as the spans increase so greatly do the loadings and so also must the strengths of the equipments.

DESIGN AND DEVELOPMENT

IN 1940 it was clearly seen that if we were eventually to win the war the conflict would be very mobile and would develop into a series of pursuits over heavily damaged and demolished areas.

The bridging then available was considered to be unsuitable for the heavier loads envisaged and there was a need for greatly increased speed of erection. It was also considered too complicated to develop.

At that time work on Transportation (TN) railway equipment, which had started in 1938, had already made progress covering trestling and shorter spans. This work was carried out by Lieut Colonel W T Everall RE, later to be Chief Bridging Instructor at No 2 Railway Training Centre, Derby, and was developed urgently.

The Bailey concept was thought out and design started late in 1940 under the direction of Donald Bailey at the Experimental Bridging Establishment at Christchurch.

The subsequent Bailey story is well-known. As the TN Railway Range of Equipment was already so well developed it was decided to restrict the use of the Bailey Bridge to road bridging and manufacturing arrangements made no provision for railway work.

So separate systems came into being for road and rail with the intention of large volume production, the use of standard parts, as light and as few as possible, with complete interchangeability within each system.

Both systems were developed under extreme pressure until early 1942 when both had been taken to the stage where they had been proven and war production had been put in hand. Thus, in good time for the first landings in North Africa, Sicily and Italy and, of course later, for the main thrust through Normandy, the Sappers, both Field and TN, had a magnificent range of bridging equipment in adequate quantities.

It proved so satisfactory in action that it was gleefully used by our Allies in large volume.

By any standards this was a remarkable achievement by both Bailey and Everall and it was indeed merciful that they were given by events the time to finish the task.

The following Table illustrates the tonnages manufactured in UK and USA and the uses made.

TABLE II

Type	Tonnage Manufactured Tons	Total length of bridging erected lin ft	Tons/lin ft average
BB	490,000	1,267,200	.39
TN	90,950 excluding trestling & launching equip	179,800	.50
	150,450 including trestling & launching equip		

In these figures the BB overshadows TN in quantity and broadly over five times the tonnage of Bailey Bridge produced just under seven times the bridge lineal footage. However the tonnage/

Photo 1

lineal footage of bridging indicates that approximately 30 per cent increase in metal per lineal foot is able to deal with the greatly increased deck loadings in *Table I* and, of course, provides the necessary stiffness against excessive sway and deflection in railway structures.

At this stage, nevertheless, it is fair to say that Bailey Bridging was used successfully for three railway bridges in the very early stages of the Italian campaign on the East Coast line, but under very heavy speed restriction.

At that time there was very little TN bridging available and that consisted only of light trestling and no overall TN organization had arrived. 160 Railway Construction and Repair Company RE with the help of 561, 586 and 587 Field Companies RE evolved a double triple Bailey Bridge design and carried out the erection at the three sites.

The floor decks had to be strengthened, welded lateral bracing provided to control sway, and the sleepers had to be packed individually to take out the initial deflection.

This was the first, and believed to be the only, occasion when Bailey Bridges were used for railway traffic in Europe.

These three bridges carried heavy traffic for 18 months until replaced by permanent structures.

Altogether this was a most creditable effort by all concerned.

Photo 1 illustrates Bailey bridging supported on TN light trestling over the River Ofanto at Barletta.

The TN Range of Equipment

The range of standard bridging equipment available to TN units in 1942 consisted of:

Spans up to 35ft - RSJs and Sectional joist equipment
40ft Sectional plate girder
Spans up to 110ft - Unit Construction Railway Bridge (UCRB)
Spans up to 150ft - Sectional truss bridge
Piers - Standard and light standard unit steel trestling
Camel's feet

This was a fine range up to 150ft span but the maximum span available became a severe limitation.

It was fortunate that quantities of the German Rolf-Wagner were found in various places and good use of this was made for spans up to 70m. Details of these equipments are given later.

The USA undertook to manufacture some of the TN bridging and it was found that particularly with UCRB the US manufacturing tolerances were slacker than the British so that components were sometimes not compatible with the British counterparts and sometimes not even with each other. Bridges erected using the US units had a noticeably greater initial deflection. Care was necessary with identification, storage and stacking so that they were not confused with those of UK origin. It took some time to correct this lack of compatibility.

Scale of Manufacture

Table III illustrates the scale of manufacture of Railway bridging by type with the equivalent lengths for average bridges.

The scale of manufacture and use can be seen to have been formidable.

Generally when considering Railway bridge reconstruction it must be realized that severe constraints are usually experienced by the need for easy curves and flat gradients. This limits the possibility of diversion or lowering in level and usually has to be accepted. However, at major crossings such as those of the Po and Rhine rivers, where the clearance of wreckage would be too large and slow a task, limited diversions were made to allow work on a clear site; but line level was preserved.

TABLE III

Type	Tons Manufactured		Length of bridging ft	
	UK	USA	UK	USA
RSJ Span	13,400	1,500	67,000	7,500
Sectional Plate Girder	7,000	-	23,000	-
Unit Construction Railway Bridge (UCRB)	15,100	5,500	26,000	9,500
Standard Truss	7,500	950	7,800	1,000
Everall Standard Truss Bridge (ESTB)	40,000	-	38,000	-
Light Standard Unit Trestle (LSUT)	33,000	12,000	-	-
Standard Unit Trestle (SUT)	10,000	1,500	-	-
Erection Equipment	3,000	-	-	-
	129,000	21,450	161,800	18,000
	150,450 tons including trestling & launching equip		179,800 feet (102 miles)	

DESCRIPTION AND TYPICAL USES OF EACH TYPE

RSJ SPANS

THESE were supplied pre-drilled with standard and universal bracing and spacer units in spans of 20, 21, 27, 31 and 35ft, all suitable for 20BSU. Their use was widespread and presented no problems. Spans of 36 and 39ft started to be available after hostilities ceased and would have been useful in closing the gap with the 40ft Sectional Plate Girder.

Photo 2 illustrates a simple use of RSJ spans at Caen which was possible after a demolished steel and RC deck slab had been cleared away. Two other lines were subsequently repaired using a combination of partially dropped deck slabs, SUT and LUST trestles.

This work was carried out by No 2 Railway Construction & Maintenance Group RE (RC&M Group) and opened for traffic in August 1944.

40FT SECTIONAL PLATE GIRDER

THIS bridge was provided mainly to replace demolished spans of 12 metres which were widespread on European railways. It was easily handled and quickly put together. It was, however, a fixed length for 20BSU but was extended by 5ft using locally made extensions in Italy where the maximum loadings experienced there during hostilities were only 16BSU. The bridge served TN well and it was seldom or never that the launching equipment provided with it was needed.

Photo 3 overleaf illustrates a double line bridge at S'Hertogenbosch (Nederland) reconstructed by No 3 RC&M Group RE and completed in January 1945. The repair required ten forty foot sectional welded spans supported on existing piers which were repairable and on LSUT trestles founded on two badly damaged piers.

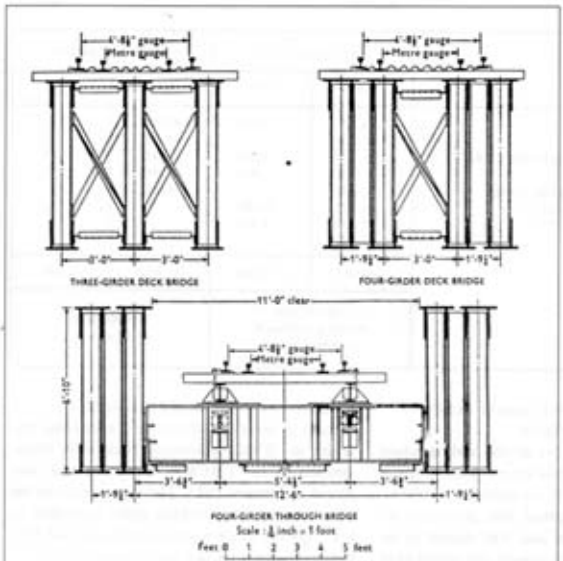
As can be seen the spans are neatly designed and are most appropriate for this type of repair.

UNIT CONSTRUCTION RAILWAY BRIDGING

THIS was the most useful, versatile and popular type in the TN range and gained the unstinted praise from all who used it, whether British,

Photo 2

Figure 1



TYPICAL CROSS-SECTIONS OF U.C.R.B. FOR 85-FOOT SPAN.

Commonwealth, US, or, when involved German POW.

The heaviest component weighed 2271lb and was 20ft long; bolted connections were used and *Figure 1* and *Tables IV* and *V* indicate the different arrangements which were possible and the permissible loading and spans.

Photo 3

The span range was 55 to 110ft in units o

Photo 4 illustrates a typical use at Caen was constructed by No 5 Railway Constr and Maintenance Group RE and complet August 1944.

Here the original plate girder spans were damaged and one dropped in the river ar other left insecure; but the piers and abut remained sound. After the damaged spans removed the UCRB spans (2 x 90ft) were lau at rail level as a single unit using the laun nose and the spans were lowered to working and separated. The photo illustrates the des UCRB and the type of portal frame of which was often used for lowering the spa

A very difficult repair was carried out river Dogna, just north of Dogna Station north of Udine (Italy) by 150 RC&M Con RE under No 1 RC&M Group RE using U

Standard Military Railway Bridging 1939-45 (3)

TABLE IV.—PERMISSIBLE LOADING AND SPANS FOR THROUGH TYPE U.C.R.B.

B.S. Unit Load.	Speed : miles per hour.	Permissible span : feet. (NP=Not Permitted.)										
		2-Girder type.					4-Girder type.					
20	40	55	70	NP	NP	NP	75	80	90	100	NP	NP
	25			NP	NP	NP					105	NP
	10			75	NP	NP						110
19	40	55	70	NP	NP	NP	75	80	90	100	NP	NP
	25			75	NP	NP					105	NP
	10				80	NP						110
18	40	55	70	75	NP	NP		80	90	100	NP	NP
	25				80	NP					105	NP
	10					85						110
17	40	55	70	75	80	NP		80	90	100	NP	NP
	25					NP					105	NP
	10					85						110
16	40	55	70	75	80	NP		80	90	100	NP	NP
	25					85					105	NP
	10											110

TABLE V.—PERMISSIBLE LOADING AND SPANS FOR DECK-TYPE U.C.R.B.

B.S. Unit Load.	Speed : miles per hour.	Permissible span : feet. (NP=Not Permitted).														
		2-girder type.					3-girder type						4-girder type.			
20	40	55	70	NP	NP	NP	75	80	90	NP	NP	NP	95	100	105	NP
	25			NP	NP	NP				95	NP	NP			105	NP
	10			75	NP	NP					100	NP				110
19	40	55	70	NP	NP	NP	75	80	90	95	NP	NP		100	NP	NP
	25			75	NP	NP					100	NP			105	NP
	10				80	NP						NP				110
18	40	55	70	75	NP	NP		80	90	95	NP	NP		100	NP	NP
	25				80	NP					100	NP			105	NP
	10					85						105				110
17	40	55	70	75	80	NP			90	95	NP	NP		100	NP	NP
	25					85					100	NP			105	NP
	10											105				110
16	40	55	70	75	80	NP			90	95	NP	NP		100	NP	NP
	25					85					100	NP			105	NP
	10											105				110

538 Field Company RE also carried out considerable preliminary work. The first emergency repair which was carried out, under pressure from 8th Army, is shown in progress at *Photo 5*.

At this point rail level is 145ft above water level. Curvature is 5 degrees 7 minutes with superelevation of five-and-a-half inches with a central span of 153ft. There is a rising gradient of 1.587 per cent rising from south to north.

In short, this was an extreme case of limitation on diversion and change of gradient. The photo clearly shows the method adopted where a new pier was constructed and the UCRB girders, which were put together on the river bank, were raised and put into position.

Superelevation was reduced to one-and-a-half inches over the whole viaduct and the line opened on 1 August 1945 under a speed restriction of 8km/hr.

Subsequently, for various reasons, this repair was replaced by a captured Rolf-Wagner span and normal running restored by October 1945. Thereafter the temporary pier was removed and the river bed cleared.

The story here is worth an article on its own and displays great ingenuity and determination.

Launching of UCRB could be by single spans or as a single unit of several spans which were thereafter separated to form a series of single spans. It could be launched at track level and then lowered down to bearing level or, at bearing level from a trench excavated behind the bank-seat.

Deck or through spans were used and special launching equipment provided and generally used.

At *Photo 6* is shown the nearly completed launch of the single track bridge over the River Orne carried out by No 5 RC&M Group RE in August 1944. This case illustrates the method of launching at track level and the LSUT portal frames used to carry the launching rollers and to lower the UCRB girders to bearing level. The launching nose is clearly seen at the far end and launching the two spans together saves time as the nose has only to be fitted and removed once.

The bridge at the River Melfa to the north of Cassino is shown at *Photo 7*.

Here the girders were launched just above bearing

Photo 4

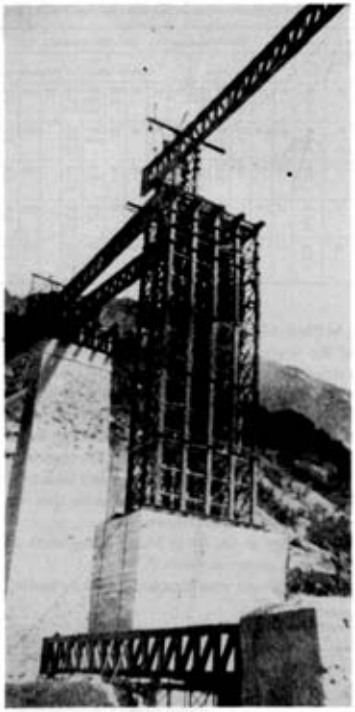


Photo 5

Photo 6

Photo 7

level from a trench which can be seen above the abutment. In this case further time was thus saved in the jacking down stage.

A completely new bridge over the Rhine was required for the British Sector and the site selected for various reasons was at Spyck.

Photo 8 shows the bridge under construction which consisted of UCRB on timber piled piers and is one of the largest single uses of this equipment.

The work was carried out by No 2 RC&M Group RE during April and May 1945 and was made up of six 35ft RSJ approach spans, twenty seven 75ft two girder deck type UCRB and one 105ft four girder through type UCRB which was later converted into a lifting span. Twenty seven of the piers were piled in water. The UCRB spans were launched at rail level in groups, lowered to bearing level on the piled piers and divided into separate spans.

It would be an interesting exercise to work out if savings in material, plant and time would have been possible using longer spans of cantilever construction material such as ESTB, Rolf-Wagner (or similar) on a greatly reduced number of piers. No doubt the design took into consideration such matters as supply or availability of material and plant, flood water levels, urgency, availability of troops trained in such material and so on.

Such decisions are never easy when there is a choice but they are very important particularly in major tasks such as this.

Standard Military Railway Bridging 1939-45 (5, 6 & 7)

Photo 8

Photo 9 shows an example of UCRB in use with 40ft and RSJ spans with LSUT trestles on Camel's feet. This is the bridge at Tilburg, repaired by No 2 RC&M Group RE in late 1944 and is a case where a limited diversion was necessary and possible. The robustness, neatness and compatibility of the different components show up well and it can be seen how well they can be used together.

The excellent bridging equipment has now been overtaken by ESTB below.

Standard Through Truss Railway Bridge

This proved to be a very good bridge having a span range of 90ft to 153ft 9in. Although more difficult and slower to handle and launch initially, performed well under traffic. 8,450 tons were manufactured giving the equivalent of 78 spans of 150ft.

The panel length was 10ft 3in so that it was only possible to use the bridge with square bearings or with a skew lead of about 10ft, unless it was possible to adjust the piers and/or the abutments.

Photo 10 was taken of the three-span bridge at Cancello Arnone over the River Volturno which was repaired by 150 RC&M Company RE under No 1 RC&M Group RE and is really a classic example of the use of this material. Both piers had to be reconstructed and widened from below water level and each abutment altered to suit the bearings of the replacement girders. The three 123ft spans were launched from the south bank. Span one was launched and jacked down to its bearings - the girders for span two were braced

Photo 9

close together and passed through span one and launched to span two, lowered and spread to their bearings. Span three was dealt with in the same way, the girders passing through spans one and two.

As this was the first truss bridge erected in Italy and as no TN unit then in the Theatre had experience of it the site took on the nature of a bridging school. This, however did not impair progress and many lessons were learnt which were of great value in future uses of this material.

The heaviest unit was 3T 6cwt with a length of 30ft 6in which made the use of a crane necessary. This equipment was also superseded by ESTB.

The Everall Standard Truss Bridge

This was designed for both the launching and cantilever methods of construction giving a range of spans from 80ft to 400ft.

Photo 10

Standard Military Railway Bridging 1939-45 (8, 9 & 10)

Photo 11

As the campaign and pursuit in Italy progressed the restricted maximum spans possible with the TN bridging became more and more evident. But, of course the Rolf-Wagner German bridging which had been captured was put to good use in spans up to 72m (236ft). Details of this equipment were reported to UK and it was decided to produce similar equipment for Railway use by the Allies. Colonel Everall took the project in hand and, following the broad concept of the RW but not necessarily the details of design, he designed, tested and verified a complete range of parts which became known as ESTB.

Manufacture was quickly undertaken and the bridge became available near the end of hostilities in Europe.

Although requested, none became available in Italy where it would have been very useful. It was, however, used extensively in NW Europe during late hostilities and thereafter.

Photo 11 shows the three 230ft spans over the water gap of the River Ijssel at Deventer. ESTB is a flexible design which can be used to meet almost any variation of span up to 400ft. However, its use calls for a thorough understanding of steel bridge design particularly as applied to railways, covering both erection and use. Units, when properly trained, can handle this equipment easily, as they did with the Rolf-Wagner in Italy.

Thus was created a range of British Railway Bridging Spans by the end of the European hostilities available to TN units and the units of the Allies ranging from 15ft span to 400ft span as shown in Table IV.

TABLE IV

Type	Range of Spans	Increments
RSJ Spans	15 - 35	1ft
Sectional Joist Spans	18 - 39	1ft
40' Sectional Welded Plate Girder	38 - 40	1ft
Development of above	41 - 56*	
UCRB	56 - 110	Zero to 5'
Standard Truss	90 - 153	10ft 3in
ESTB	80 - 400	0ft 6in

*Not available until after hostilities ceased

STEEL TRESTLING - HEAVY AND LIGHT

ACCOMPANYING the bridge deck equipment above, TN units were provided with Steel Unit Trestling.

There were two ranges viz:

a. Heavy Standard Unit Trestling (HSUT) which was used for very heavy loads and/or high piers; and
b. Light Standard Unit Trestling (LSUT) which, as the name implies was used for lighter loads and/or lower piers.

This equipment was a marvellous tool and the tonnage of LSUT used was about eight times that of HSUT, the combined tonnage manufactured being about 56,000 tons.

Both HSUT and LSUT were used for their original purpose of bridging but LSUT was found to be so adaptable and versatile that it was used to a great extent for other purposes such as tunnel repairs, stabilizing unsupported arches, erection portals, falsework etc.

The equipment was greatly admired by all Allied units and won the unsolicited envy of German POWs who, although very efficient with timber, could well have used it to advantage.

At *Photo 12* is shown a LSUT trestle founded on timber piles to carry a Bailey bridge at Mook over the River Maas. This road bridge was constructed over a demolished railway bridge by Canadian

Photo 12

Army Troop Engineers with the sub-structure by No 3 RC&M Group RE, and was completed by the end of February 1945.

Photo 13 shows LSUT in use as inclined strutting to stabilise an unsupported arch.

Much work of this type was done and the actual design of the strutting varied to suit the needs of each case. This case was at the Rio Piastola viaduct between Prato and Bologna.

Camel's Foot Foundation

These 3ft diameter foundation bearing pods were intended for use with LSUT and proved very effective in both rail and road over wet gaps. *Figure 2* gives some details.

The principal uses were:

a. The founding of trestle piers in water, each column being supported independently by a Camel's foot where the safe bearing pressure on an unprepared bed was one and a half to 2 tons/sq ft. On harder surfaces the Camel's foot could support up to 40T and could adjust to 15 degrees from the horizontal. Each was remotely adjustable vertically by about 2ft.

b. Taking up and spreading the load where LSUT was used as a strut as in tunnel work or when supporting damaged or unsupported arches.

The placing of a LSUT trestle pier founded on Camel's feet is clearly seen in *Photo 14* using a floating gantry. This reconstruction was at Le Manoir over the River Seine, and is quite typical.

General Comments

The TN range of spans throughout hostilities met requirements very well except for spans over 153ft. However it consisted of several different types of bridging and did not compare in simplicity with the BB which met every requirement with a single set of components.

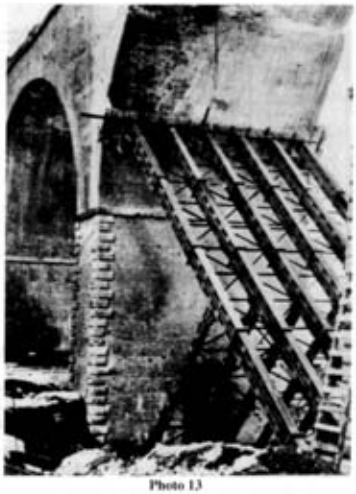
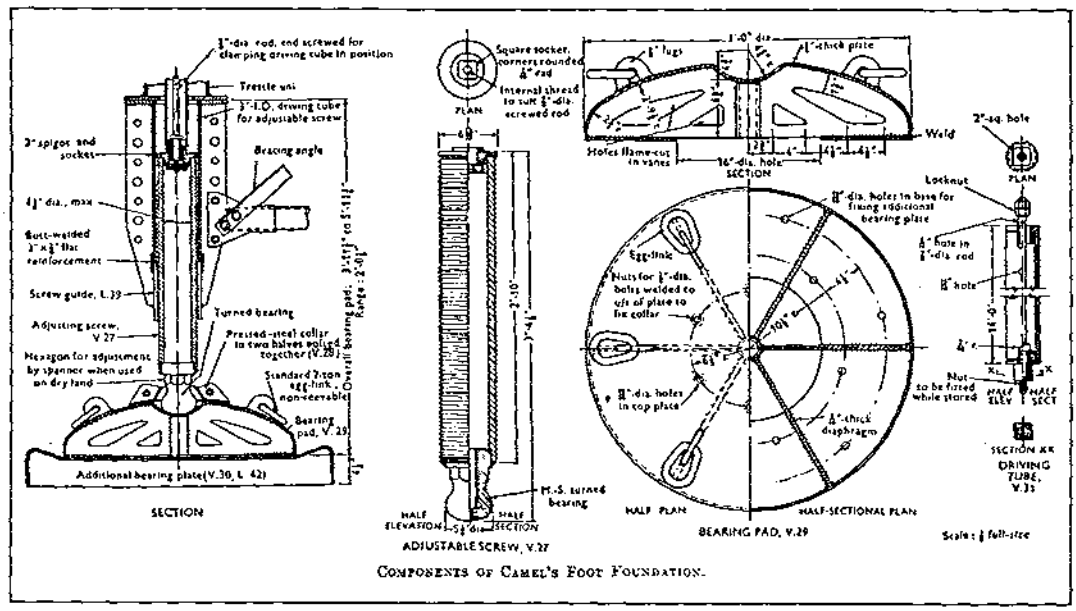


Photo 13

With the arrival of ESTB towards the end of hostilities it would have become possible to simplify the provision, storage and ordering of stores by using a set of components which would give a range of spans, from say 20ft to 60ft and using ESTB from 60ft to 400ft, thus using only two sets

Photo 14

Standard Military Railway Bridging 1939-45 (12,13,14)



COMPONENTS OF CAMEL'S FOOT FOUNDATION.

Figure 2

of components. At the end of World War Two efforts were made to design a set of parts which would provide the "universal" bridge covering road and rail as did BB for roads and these attempts are clearly set out by the then Major Johnson in RE *Journal* Vol 96 No1. The effort however, seems to have fizzled out.

Long spans were splendidly useful but they are heavier and sometimes slower to erect and more sensitive to air attack. Very careful consideration should be given to their use in the face of determined and capable air attack and the German experience in Italy merits attention.

The Allied Air Forces constantly attacked targets on the Railways particularly on the Brenner Line. Here they tied up about 15,000 German Railway troops, experienced in railways, repairing damage inflicted daily and who were forced to employ first aid methods in order to get at least some of their traffic through on a day-to-day basis using river-bed diversions and removable spans for darkness-only operation. Throughout the campaign they never used any of the long-span RW material of which they had plenty.

CONCLUSION

IN any future major conflict if railways are needed, and are to be kept operational, the response will most probably have to be immediate and the units concerned must know what they are about. The lull which allowed build-up in World War Two is not likely to happen again, and the idea that the so-called Host Nations would deal with railway repairs in areas where a modern conflict has passed, is not realistic in the face of experience in World War Two. This of course means immediate adequate provision of bridging material and trained Railway Construction Units. However, at the moment signs of the existence of either are not apparent.

The TN Bridging effort and success in World War Two were immense by any standard involving the manufacture of 150,000 tons of bridging for use by all the Allies including TN units from the UK and various parts of the Empire, together with many units from America using the same bridging materials.

In this general and descriptive article the author hopes he has been able to illustrate how the range of TN Railway Bridging was planned and produced and the extent to which it was used. Although bridging took a great effort, a very large mileage of track repairs and reconstruction was accomplished as were many difficult tunnel repairs. Tunnel repairs of very efficient demolitions, especially in mountainous Italy, were usually

on the critical path of any project and often presented immense difficulties - but that is another story.

ACKNOWLEDGEMENTS

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RE *Journal* - Major I H Johnson Vol 96 No 1
The Bailey Story - Colonel J H Joiner
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Bridging - Normandy to Berlin - General Inglis CE 21 Army Group
Institution of Civil Engineers - *The Civil Engineer in War 1945*
Institution of Royal Engineers - Library
Railway Reconstruction in Italy - CMF - September 1943 to January 1946
MEXE
Imperial War Museum

Operation Salam - Mine Clearance Training In Pakistan

LIEUT COLONEL R A HYDE-BALES

Rob Hyde-Bales was educated at Wellington College and Mons Officer Cadet School. He was commissioned into the Corps in 1967 and his first troop commander appointment in 39 Engineer Regiment brought tours in Libya, Canada and Masirah.

In 1970-71 he was attached to the United Nations in the Congo (now Zaire) and worked with the United Nations Development Programme (UNDP) on a bridging project. This was followed by a tour as ADC to GOC Strategic Command and later Northern Ireland.

Various regimental and staff appointments followed by the Army Staff College culminated in two very happy years with 38 (Berlin) Field Squadron RE.

From Berlin he moved to the British Embassy in Poland 1984-86 for a fascinating assignment.

This was followed by a most enjoyable command tour at 1 Training Regiment. From Gibraltar Barracks he moved to Pakistan again with the United Nations. He is currently undertaking Russian language training prior to a posting with BRIXMIS.

Background

After nearly ten years of both political and miltary stalemate in Afghanistan, the Soviet Union under the initiative of President Mikhail Gorbachev agreed to withdraw its combat troops from Afghanistan by February 1989. The withdrawal was both "front-loaded" and rapid and was completed on schedule by February 1989 when General Boris Gromov led the remaining Soviet troops across the Friendship Bridge back to the USSR. Though Soviet aid to the Peoples Democratic Party of Afganistan (PDPA) government in Kabul continues to be provided on a massive scale and Soviet advisers still remain in Afghanistan, it seems certain that Mr Gorbachev would dearly like to reduce economic support to Afghanistan as soon as possible bearing in mind the parlous state of his own economy. The withdrawal of Soviet troops did not, however, bring about peace in Afghanistan and civil war now continues between the Soviet backed PDPA government under President Najibullah on the one side and the USA and Pakistan backed Mujahideen on the other. If anything, prospects for peace look more remote now than they did in February 1989.

Operation Salam

During 1988 it was decided by the United Nations that a major obstacle to any kind of economic rehabilitation to a shattered Afghanistan would be the massive quantity of land mines and unexploded ordnance (UXO) that litter the Afghan countryside. Various nations including the UK were requested to investigate the problem and suggest a plan of action. As a result of this multinational study a twin track approach to the problem was recommended. On the one hand there would be a wide scale mine awareness education programme for all the Afghan refugees living in Pakistan - currently some 3.5 million - and on the other a programme of mine clearance training would be given to suitable Afghan male refugees.

A new United Nations office was formed - the Office of the Coordinator for United Nations Humanitarian and Economic Assistance

Lieut Colonel RA Hyde Bales
Operation Salam Mine Clearance Training In Pakistan

UK contingent outside British High Commission, Islamabad, with the High Commissioner

Programmes relating to Afghanistan (UNOCA). In 1989 UNOCA launched Operation Salam, the overall rehabilitation programme for Afghanistan and the mine awareness and mine clearance training programmes form part of Operation Salam. As the result of United Nation requests to various nations, mine clearance training began in Peshawar - capital city of the North West Frontier Province of Pakistan - in February 1989. Military Teams from Australia, Canada, France, New Zealand, Norway and the United States are currently based in Peshawar. Italy has in the past had a training team in Peshawar.

The other training location is at Quetta - capital city of the Baluchistan Province of Pakistan - and training began there in April 1989 with teams from France, Turkey and the United States.

British Participation

UK participation in Operation Salam in answer to a United Nations request from Geneva began in June 1989 when the author undertook a reconnaissance in Pakistan to confirm the scope of the task and suggest a *modus operandi* for RE participation. The recce which covered the capital city Islamabad, Peshawar and Quetta was completed on 4 July 1989 and confirmed the requirement for a lieutenant colonel to be the United Nations Chief of Staff in Quetta and two four-man training teams. Each training team was to be led by a captain and to include a warrant officer or senior NCO and two junior NCOs. The next stage was a week's preparation in the Field Engineer Wing at RSME. This covered a briefing on the relevant mines and fuzes, UXO, some practical mine warfare and demolitions revision, a briefing on Operation Salam and the requisite personnel administrative preparation.

Move to Pakistan

The UK contingent flew from London Gatwick to Quetta via Manchester and Islamabad on 20/21 July 1989. The flight with British Airways was excellent and provided a very good start to the tour. We were met at Islamabad by UNOCA representatives and the Defence Section of the British High Commission and then flew PIA from Islamabad to Quetta.

On arrival in Quetta we were met by the Turkish and US training teams. The Turkish team left Quetta shortly after this on completion of its tour and we settled down alongside our new neighbours - training teams from the US Special Forces. There were then four US training teams and two UK training teams based in Quetta. The UK Chief of Staff (COS) was located in a small multi-national headquarters staffed by Pakistani, UK and US personnel. This headquarters coordinated training in Quetta and reported to the overall United Nations headquarters in Islamabad.

The Mine Clearance Training Programme

The Afghan refugees undergo a 14-day training programme covering the following subjects:-

- Identification and recognition of the 30 types of land mines currently in use in Afghanistan. The majority of mines are Soviet and include some of their most modern land mines - the air-delivered PGMDM anti-tank mines and POM 2S anti-personnel mines are two examples. In addition to Soviet mines, British (Mk7), Chinese, Czech, Italian, Yugoslavian, and Pakistani mines are also in use in Afghanistan.
- Recognition of likely mined areas - marking of mined areas.
- Detection of mines both by probing and metal detector.
- Detection of trip wires.
- Breaching and pulling drills.
- Neutralizing and disarming drills.
- Explosive disposal of mines - students trained on Pakistani-made commercial explosives.
- Recognition and disposal of UXO.
- Recognition and disposal of booby traps.

Operation Salam Mine Clearance Training In Pakistan (1)

Cpl D Bullock instructing on a Soviet-made POMZ2 AP mine

- First Aid - this is undertaken by the Pakistani
- Red Crescent Society.

At the end of the course the students are given a day long practical test covering all aspects of the course. Successful students are presented with a mine clearance certificate, an individual mine clearance kit, a first aid kit and a set of mine warning silk screens depicting various aspects of the land mine and UXO problem in Afghanistan.

Mine Awareness Training

This is undertaken in the refugee camps themselves by a US philanthropic organization, the International Rescue Committee which has a good deal of refugee experience worldwide. US and Canadian training teams support the IRC. The training programme consists of a two-day course covering recognition of the most common land mines and UXO and how to avoid them.

The Students

Our students were, to a man, former Mujahideen now living in the Afghan refugee camps around Quetta. They were, in the main, aged between 20 and 35 years old, physically tough, extremely resilient, dextrous, competitive by nature and the majority of them also had a strong, if at times, somewhat perverse sense of humour. They made very good students who were quick to learn and keen. A strong bond formed between student and instructor as the course progressed.

During the course the students were accommodated and fed at Baleli Camp - the United Nations training camp at Quetta. Many of the students had combat experience in Afghanistan and were able to confirm reports of the fate of those Soviet troops unfortunate enough to be taken alive by the Mujahideen. The actions of Soviet combat troops in Afghanistan and their effect on the population and countryside made this kind of treatment inevitable in this part of the world where the "eye for an eye" philosophy reigns supreme.

The Instructors

Initially our instructors at Quetta were either American or British. The American instructors were all drawn from US special forces and not Army engineers and it thus says much for their dedication that they were able to instruct so competently on land mines and UXO. The two

Afghan instructor receives his diploma from Chief of Staff UN Quetta

Operation Salam Mine Clearance Training In Pakistan (2)

Unexploded ordnance near Peshawar

British team leaders were Captains Colin King and Dick Winfield respectively. One British team was drawn from UK units and the other from BAOR units. All team members quickly and confidently settled down to the task in hand. The requirements of the instructors were firstly a good knowledge of mine warfare and demolition training and secondly the ability to instruct under relatively testing circumstances. As for the requisite personal qualities, these included maturity, self reliance, self sufficiency, the ability to be able to react to and cope with the unexpected (or more likely the unobtainable) and a robust constitution - Pakistan is not a place for those with a delicate stomach. In due course we trained Afghan instructors to work alongside their British and American counterparts. These instructors undertook a total of eight weeks training which culminated in a Methods of Instruction Course. By the end of our tour we had trained 23 Afghan instructors who will surely be the key to the success of Operation Salam in the long term.

Baleli Camp

The United Nations training camp at Quetta was situated 12kms outside the city itself. It was a tented camp which could accommodate up to 200 students at any one time. The camp was well equipped as desert camps go with running water and electricity. On good days one could also reach it by telephone. The students were accommodated in tents and fed for the duration of the course by the United Nations. The camp was run by the Pakistani Army Engineers in a most professional and efficient manner. It was very

The complex Soviet-built VP12/13 mine initiating system

interesting for us to work with the Pakistani Army Engineers whose traditions and operating procedures are based so closely on our own. They also provided the interpreters for training. Our students spoke either Farsi or Pushto which meant that the UK or US instructor spoke English and this was then translated to Pushto by the Pakistani interpreter. An Afghan interpreter then translated from Pushto to Farsi. This was a laborious process which tested the humour, enthusiasm and staying power of all concerned. It says much for the instructors who did so well under these conditions.

Quetta

Quetta city has very strong historical ties with Great Britain and in particular with the British Army. Prior to World War Two it was one of the largest British garrison towns in the world. To this day the city remains an important garrison town with the best part of an army corps stationed there - the military cantonment occupies about one third of the city. It is a bustling and vibrant city situated astride one of the main trade routes from Afghanistan. Unfortunately this is also one of the main heroin supply routes which causes the

Operation Salam Mine Clearance Training In Pakistan (3)

there was a well turned out parade of World War Two vehicles accompanied by the Bands and their good music.

The streets were crowded. I rode in a 1943 jeep with Frans whom most of the Tilburg population seemed to know, not surprisingly perhaps, as he has been in medical practice there for forty years. In the evening there was an excellent concert of nostalgic music and songs in the fine Schouberg theatre. The day ended with a noisy Liberation Ball. On Sunday, although we are Church of England, we attended High Mass with our hosts in St Josephkerk op de Heuvel. You might remember it is the church with the very tall twin spires that dominate the centre of the city. We had brunch on a wet and windy day on the main square. Dutch brandy tasted very well!

In the afternoon we joined a coach party for a pilgrimage to the tiny war cemetery at Goirle. There are just 23 graves there - it must be one of the smallest of the 23 war cemeteries in The Netherlands - where in 1984 a cenotaph was unveiled by Field Marshal Lord Bramhall, who as a platoon commander of B Company 2 KRRC was himself a liberator of Goirle, along with me and 20 trusty Sappers!

As one of our young sappers - Cridland - a boy of 19 lies there - Cridland had both his feet blown off by a mine and died from shock and loss of blood, it was most fitting that Burgomaster van den Wildenburg's moving speech centred on Cridland. I was most honoured to reply and then in company with a former tank driver of the Royal Scots Greys to lay the wreath. The Greysman could only have been yards away from me at the same place in 1944!

It seemed that most of the town turned out in homage, including the Guildsmen and Ladies in their sombre black attire with their flag bearers ahead. This particular guild dated from 1562, the flag bearers proceeded to give us a physically exhausting display, symbolic of a prayer to God, to the Queen of The Netherlands and to the Burgomaster and his citizens.

We were then entertained to a very cordial reception in the Stadhuis, with enough vino for all. More speeches of thanks, and the lone piper raising even more steam!

It is hard to describe the warmth of the friendship the Dutch people have for us, "lasting gratitude" were the oft-spoken words, perhaps best illustrated by a stranger Dutchman sitting in our pew at High Mass who at the end of the service turned to me, shook my hand, and said before disappearing into the crowd "I was only eleven at the time but thank you for our liberation".

Before leaving Tilburg we were invited to see a television film of the *Herdenking van Bevrijding*. I had been interviewed with the Greys man at Goirle, but I still have to see the three hour video being sent to me as a present.

En route to Flushing, Dorothy and I called on the Burgomaster of Gilze-Rijen, a small town where I can truly say I was with the very first liberators. Apparently Rijen commemorates VE Day (5 May), but that did not prevent the Burgomaster presenting us with a bottle of Chateau Bordeaux and a trouser belt bearing the town's emblem of St Peter.

This memorial was unveiled by the Burgomaster of Tilburg, Mijnheer E Ph Broks.
The Sculptor was Frans Broers of Goirle – his model was Pipe Major Willy MacVean – Royal Scots Dragoon Guards

Operation Salam Mine Clearance Training In Pakistan (5)

city authorities all kinds of problems. The majority of the world's supply of heroin now comes from Afghanistan and Pakistan. One did not have to look far to see the devastating consequences of heroin addiction in Pakistan. The Government of Mrs Bhutto is currently running a nationwide anti-narcotics campaign in an attempt to reduce the problem.

Quetta is also situated on a geological fault line and in 1935 the majority of the city was devastated by a massive earthquake. Among the thousands of fatalities were many British service personnel and their families. Their names are inscribed on a memorial near the city centre.

In the main Christian Cemetery in Quetta are also numerous graves of former British service personnel and their families who died during tours in and around Quetta prior to 1947. Looking at the headstones made one realize just how large the risk of disease was in those days, particularly to women and children - typhoid, cholera, malaria and dysentery all took a heavy toll amongst Europeans in the days prior to inoculations. Sadly today they still take a heavy toll amongst the local population. The combination of flies, open sewers and extremely high summer temperatures means that health is potentially a continual problem in Pakistan unless one is very careful. The Quetta climate is blisteringly hot in the summer - up to 45 degrees centigrade and extremely cold in the winter - down to -10 degrees centigrade. Not far from Quetta is a town called Sibi which because of its physical location is one of the hottest places on earth. When we visited, the temperature was 50 degrees centigrade. The locals have a saying, "Lord, why did you make Hell when you already had Sibi?". The saying is apposite - the open sewers running through some parts of the town totalled the same width as the main road itself.

Reflections

The tour with the United Nations on Operation Salam was interesting, exciting, enjoyable and it produced excellent training benefits. Our training team personnel are now better trained on Warsaw Pact mines than anyone else in the Army and this must be a major benefit for the Corps. It gave us the chance to serve in a part of the world which has strong historical ties with the UK and our Corps. Working for the United Nations on a humanitarian project alongside the US Special Forces, with the Pakistani Army Engineers and also the very tough and likeable former Mujahideen was a unique experience as was a four month sojourn in an Islamic Republic.

The training programme allowed an R and R vacation which was very necessary and team personnel got as far afield as the Maldive Islands, the Himalayas and the Khyber Pass and then returned to Quetta suitably refreshed and impecunious. Naturally, as we were off the mainstream of British overseas tours nowadays and away from many of the normally accepted military support facilities this did at times cause some problems. This, however, was to be expected and there is a great deal of satisfaction to be gained from solving problems unilaterally. The good times certainly far outweighed the not so good times and those of us fortunate enough to have been involved in the very worthwhile Operation Salam will never forget it. In these days of recruiting difficulties and, more significantly, retention problems we need as many tours of this nature as possible. It is the kind of life that most young people still join the Army to experience. As training problems in BAOR multiply and the political map of Europe looks set to be redrawn in the coming decade, so the need for interesting and exciting overseas tours such as Operation Salam will increase.

Straightening the Record at Le Havre

MAJOR GENERAL J C WOOLLETT, CBE MC MA CEng FICE

In addition to the 50th Anniversary of the outbreak of war, there has also been recent media coverage of some of the battles which took place in Normandy in 1944. These have included newspaper articles and a BBC television programme about Le Havre, all of which gave the general impression that the capture of the city was unnecessary, that the civilian population should have been evacuated and that the attack when it came was a walk-over. Most of the coverage has concentrated on the bombing of the town, the damage and civilian casualties caused, and on the actions of William Douglas-Home who, as a captain in an armoured unit, decided that the attack should not take place: he refused to take part and was subsequently cashiered.

Some 500 veterans, 200 of whom were accompanied by their wives, visited Le Havre for the 45th Anniversary of the Liberation of Le Havre at the invitation of the French Association of Reserve Officers. The activities included a tour of the battlefields to the north of the city and receptions in the villages in the area, a dinner attended by veterans and hosts, presentation of memorial plaques at the Ste Marie Cemetery and a parade at the War Memorial in Place General de Gaulle, followed by a Church service. Most of all, there was the opportunity to meet and talk with old comrades, as well as those from other arms and services, and our French friends.

In view of the situation in September 1944, it is difficult to understand how anyone could consider the capture of the port of Le Havre to have been unnecessary. All supplies and ammunition for the forces in Belgium had to be brought up from the Mulberry harbour at Arromanches over such roads as had been opened - a distance of some 400 miles, with winter approaching. Although Antwerp had been captured, the Scheldt had not been opened and was not in fact cleared until November. Moreover, coast defence guns on the cliffs and enemy raiding vessels based on Le Havre had already been interfering with shipping on the Normandy coast. The proposal to evacuate the civilians from a town of 60,000 inhabitants would have presented appalling logistic problems, and considerable delay. Anyone who has seen the remains of the defences, well north of the high ground above the city, with concrete bunkers and steel cupolas, must realize how strong they were when the anti-tank ditches and minefields existed as well.

It would have been quite impracticable to attack such defences without the assistance of specialized armour, whose arrival was held up because many tank transporters were being used to ferry petrol and ammunition to Belgium. In the circumstances it was sensible to invite the 11,000 strong German garrison to surrender and to keep the pressure up by selective bombing. The bombing of the city centre on the day of the attack, whilst no doubt contributing to enemy demoralization, did not do much to directly help the attack, and some 3000 civilian casualties was far too high a price to pay. From the Assault Engineer viewpoint, we were relieved that the target was not the defences, which would have added bomb craters to the existing obstacles.

The breaching of strong fixed defences is a traditional Sapper role, and the attack was led by the Assault engineers and the mineclearing flails, using the techniques developed in 79 Armoured Division by 1st Assault Brigade RE. The fact that they worked so well gave us great confidence for the rest of the campaign, and a diorama showing the methods and techniques used on the 51 (Highland) Division front is in the RE Museum.

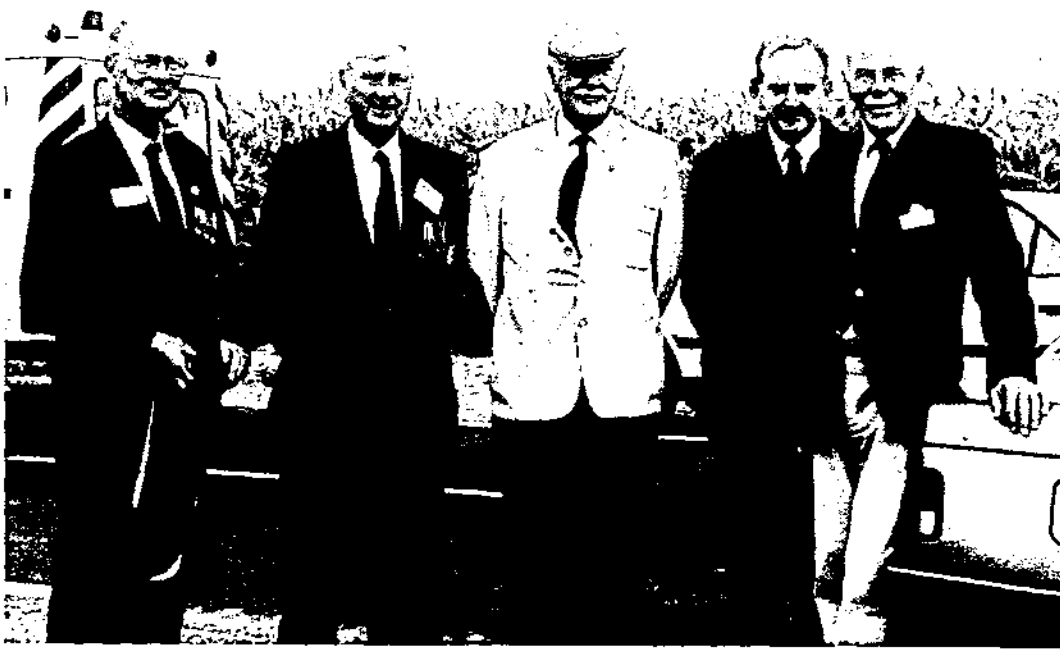
Although the city was captured in two days, it was in no sense a walk-over, as 400 British casualties testify. Towards the end of the operation, the Fort of St Adresse was still holding out and the Brigade Commander of the leading Brigade sent for me and said: "Bring your AVREs up here and do something about this". Whilst I was considering how on earth to breach 18th century fortifications using 20th century equipment, the fort conveniently surrendered!

There is a tendency these days to look back and to expect everything to have gone right, and, if not, to apportion blame. It is accepted that the

bombing of the centre of Le Havre was a tragic error, but it must be seen in the context of the campaign as a whole, when the higher command was concentrating on exploiting success, and about to try to get a bridgehead over the Rhine at Arnhem before winter set in.

A balanced view of the Le Havre operation, which I have endeavoured to present, shows how little went wrong and to expect perfection is to misunderstand the nature of war, when decisions have to be taken quickly, based on incomplete knowledge. As Brigadier Sir Mark Henniker wrote in a most amusing article in Blackwoods Magazine about the hazards of a bridge demolition: "All this promotes the thought that war is a stupendous muddle, and the side that adapts best to this usually wins".

Capt E J Armitage, late of 16 Assault Squadron RE, who designed the plaque made by 21 Engineer Workshop of 40 Engineer Group RE at Willich



Left to Right: Captain Norman Weston, Sergeant George Campbell, Major (now Major General) John Woollett, Capt Tuggy Street, Captain (Major on retirement) Peter Leslie MC, all of the former 16 Assault Squadron RE during the battlefield visit on the occasion of the 45th Anniversary of the Liberation of Le Havre.

Return to Tilburg

D R VERNON ESQ FCIT

In October 1989 Derrick Vernon took part in the celebrations of the 45th Anniversary of the liberation of Tilburg, an operation in which he had participated in 1944 as a platoon commander in 24 Field Company. The full story was told in the article Sapper Platoon *in the September 1986* Journal.

Major Dennis Moores was a former OC 24 Field Company but in the Tilburg battle was commanding 55 Field Company. This article is the text of the letter to Major Moores written after the Vernons' recent visit.

Letter to Major D N Moores
Former OC 24 Field Company RE
Wath-upon-Dearne

9 November 1989

Dear Dennis and Beth

We have just returned from the 45th Anniversary celebrations of the Liberation of Tilburg - the seventh largest city in The Netherlands - where for several days we were the guests of 24's former interpreter Frans Franken and his wife Elfy. They did us proudly. Frans asked me to write and tell you something about the programme of events, so here is a short account. But firstly they send you their greetings, and with us hope you are well and still enjoying life especially after this wonderful summer. Your health was toasted with rather more than one *gezondheid* and the weather was kinder than that of October 1944!

Dorothy and I sailed from Sheerness on the new 35,500 ton Olau *Hollandia*, the largest ferry on the Channel - built at Bremerhaven - to Flushing. On the way to Tilburg we visited the grave of Lieut Walter Coldham RE who was only two months with 24 Company before he was killed, aged 21, near Breda. He lies at Bergen-op-Zoom with 2500 British, Poles and Canadians. We were alone with our thoughts, especially myself, as I reflected it might well have been me instead, as his death was the possible consequence of the toss of a coin.

The following day I with three other liberators of those parts (a Pole from the 1st Polish Armoured Division, a Dutchman who served with 6 KOSB in 15th Scottish Division and an RAF Lancaster bomber pilot) lectured 50 or so student teachers at Tilburg Training College on our varied memories of the Liberation. We were asked some interesting but thoughtful questions, especially by a marxist student who was shot down in flames by the Lancaster man!

The next day we attended a most dignified wreath-laying ceremony at the Tilburg War Graves cemetery where rest some 70 allied servicemen including several of the Corps. The Burgomaster of Tilburg spoke of their lasting gratitude for the Liberation, young Dutch children laid flowers on the graves, a lone piper played a lament, the Last Post was sounded, the homage dominated by the Cross of Sacrifice silhouetted against the western sunset.

On Saturday 28 October the Liberation was commemorated by wreath-laying at the Princess Irene Brigade monument followed by the unveiling of a bronze statue depicting a Scots piper in memorial to the 15th Scottish Division, the principal liberators of the city. There was some good humoured banter about this as 50 per cent or so of 15th Scottish were Englishmen - quite apart from other English units involved, eg 24 Field Company RE! It was a very impressive ceremony, supported by an excellent choir.

The pipes and drums of the Royal Scots were there from Dortmund, a Dutch Army band together with a civilian band of pipes and drums were also present.

The Dutch pipes and drums tutored by Pipe Major Willie MacVean (ex Royal Scots Dragoon Guards) are very much part of Tilburg life.

The Burgomaster, Mijnheer E Ph Brokx, made an excellent speech of thanks which was followed by a most generous reception in the Stadhuis with more speeches and a convivial exchange of presents. I met Major General John Woollett - a former Colonel Commandant RE - who at the time of the Liberation was OC 16 Assault Squadron, which came in with AVREs in support of 15th Scottish from the east. In the afternoon

there was a well turned out parade of World War Two vehicles accompanied by the Bands and their good music.

The streets were crowded. I rode in a 1943 jeep with Frans whom most of the Tilburg population seemed to know, not surprisingly perhaps, as he has been in medical practice there for forty years. In the evening there was an excellent concert of nostalgic music and songs in the fine Schouberg theatre. The day ended with a noisy Liberation Ball. On Sunday, although we are Church of England, we attended High Mass with our hosts in St Josephkerk op de Heuvel. You might remember it is the church with the very tall twin spires that dominate the centre of the city. We had brunch on a wet and windy day on the main square. Dutch brandy tasted very well!

In the afternoon we joined a coach party for a pilgrimage to the tiny war cemetery at Goirle. There are just 23 graves there - it must be one of the smallest of the 23 war cemeteries in The Netherlands - where in 1984 a cenotaph was unveiled by Field Marshal Lord Bramhall, who as a platoon commander of B Company 2 KRRC was himself a liberator of Goirle, along with me and 20 trusty Sappers!

As one of our young sappers - Cridland - a boy of 19 lies there - Cridland had both his feet blown off by a mine and died from shock and loss of blood, it was most fitting that Burgomaster van den Wildenburg's moving speech centred on Cridland. I was most honoured to reply and then in company with a former tank driver of the Royal Scots Greys to lay the wreath. The Greysman could only have been yards away from me at the same place in 1944!

It seemed that most of the town turned out in homage, including the Guildsmen and Ladies in their sombre black attire with their flag bearers ahead. This particular guild dated from 1562, the flag bearers proceeded to give us a physically exhausting display, symbolic of a prayer to God, to the Queen of The Netherlands and to the Burgomaster and his citizens.

We were then entertained to a very cordial reception in the Stadhuis, with enough vino for all. More speeches of thanks, and the lone piper raising even more steam!

It is hard to describe the warmth of the friendship the Dutch people have for us, "lasting gratitude" were the oft-spoken words, perhaps best illustrated by a stranger Dutchman sitting in our pew at High Mass who at the end of the service turned to me, shook my hand, and said before disappearing into the crowd "I was only eleven at the time but thank you for our liberation".

Before leaving Tilburg we were invited to see a television film of the *Herdenking van Bevrijding*. I had been interviewed with the Greys man at Goirle, but I still have to see the three hour video being sent to me as a present.

En route to Flushing, Dorothy and I called on the Burgomaster of Gilze-Rijen, a small town where I can truly say I was with the very first liberators. Apparently Rijen commemorates VE Day (5 May), but that did not prevent the Burgomaster presenting us with a bottle of Chateau Bordeaux and a trouser belt bearing the town's emblem of St Peter.

This memorial was unveiled by the Burgomaster of Tilburg, Mijnheer E Ph Brokx.
The Sculptor was Frans Broers of Goirle – his model was Pipe Major Willy MacVean – Royal Scots Dragoon Guards

And so back home over a placid North Sea and the first-class Olau ferry.

Frans and Elfy really went to town with the hospitality and *gezelligheid* of their home, we talked over many glasses of *eau-de-vie* into the small hours, I suppose about everyone we both once knew, and joked, and muttered a few ribald verses of the songs that raised our morale in former days. My letter is not so short after all, but I thought you would like to savour the atmosphere, and to know you were not forgotten.

Frans has retired now and leads a pleasant life just over the Belgian border, this for personal reasons. There was a thought to visit another RE Anglophile - one Albert Binnendijk in Nijmegen, but there was not time, and on the one "free day" we made a pleasant visit to Bruges.

Although clouded with sad memories, it was all most enjoyable and somewhat euphoric.

There was talk of another commemoration for the 50th anniversary in 1994, but as the 45th cost 250,000 guilders, we shall have to wait and see.

And now back to terra firma and at last 24 hours rain which hopefully will eliminate the prospect of standpipes in the streets for Christmas!

Best wishes to you both from Dorothy and a big *gezondheid* from me.

Yours ever Derrick

Fifty Years Ago

MAJOR GENERAL J C WOOLLETT CBE MC MA CEng FICE

On 10 May 1940, 23 Field Company were billeted in the French village of Elmez, some ten miles SE of Lille, where we had been building defences along the Belgian frontier since October 1939. At first light we were awakened by the distant sound of bombing and anti-aircraft fire, and the news that the invasion of Holland and Belgium by the German Army had begun.

23 Field Company was part of the Divisional Engineers of 1st Division and was an all regular unit, composed about half-and-half of serving regular soldiers and regular reservists called up on mobilization. We had been in France since September 1939, for the most part engaged in building defences along the Belgian frontier. A field company of that period was an independent self-administering unit, commanded by a major with a captain as 2IC and one HQ subaltern. It was organized in three sections (troops) of 60, each commanded by a subaltern, and an HQ Section, making a total strength of some 220 all ranks. Full mechanization had only existed since 1938, and the section transport consisted of four 3-ton lorries, each carrying a sub-section commanded by a corporal, a 15cwt compressor truck, a 15cwt tool truck, an 8cwt truck for the Section Commander, and motor cycles for the Section Sergeant and two despatch riders. Dating from the horse transport days, there were two classes of soldiers, sappers and drivers, the former being tradesmen and the latter somewhat looked down on and suspected of still smelling of the stables. 23 Field Company normally supported 1st Guards Brigade, but the company which should have moved off with the advance guard was away at the bridging camp near Amiens, so we had to take their place.

The company was on the move by mid-day, driving down the main road in convoy towards Brussels with vehicles keeping 200 yards apart, just like an exercise, and I wondered whether it would turn out the same way. It was a fine sunny day and the convoy was greeted by cheering crowds as we drove through Brussels and out on the road towards Louvain. We turned south off

Lieut J C Woollett. Photo taken just before embarking for France in September 1939

the main road towards the Valley of the River Dyle, and here we encountered reality for the first time.

A Belgian horse-drawn artillery battery was withdrawing - thoroughly demoralized: *O, le bombardement, c'est effroyable*, and in the villages people were packing up and moving out. The plan was to hold the River Dyle, and we were concerned to make it as strong as possible. First, the bridges were prepared for demolition and then we intended to construct dug-outs for HQs - there was still a lot of World War One thinking.

Imagine the surprise when the CRE, Lieut Colonel Dan Perrott, gave strict orders that each company was to keep one section at a time in

Major General J C Woollett CBE MC
Fifty Years Ago

reserve resting. How right he was!

The two or three days whilst we awaited contact with the German forces were not without incident. A car which appeared to contain two Belgian officers drove into our village shouting "Gas, Gas" ... The air was full of the scent of newly blooming flowers in the gardens, and gas masks were hurriedly donned, only to be taken off ashamedly a few minutes later, when the true source of the smell was identified.

Louvain is a centre for training priests and the novices were being evacuated, walking along the roads in procession, wearing their habits. Information was received that the Germans were dropping parachutists disguised as priests, and that we should look out for this. I returned from a recce to my billet to find a group being searched for arms by the sappers. They were telling their beads and clearly expecting the worst, but the Sappers were amused by the whole business, which no doubt added to the novices' apprehension before they were sent on their way.

As the leading German units approached the River Dyle, our troops in contact fell back and the bridges were blown, whilst the locations of the Germans were closely observed as they moved into woods and harbour areas on the far side. They launched an attack soon after dark and the gunners brought down heavy defensive fire whilst those attempting to cross the river were engaged by our infantry. One of our detachments was working to improve the obstacle by cratering a road which crossed the flood plain in front of the forward defences.

When the attack started, the sappers ran back, jumped into the trenches of the North Staffords and joined in the fire fight and we sustained our first casualties. Counter preparation fire was then brought down on the places where enemy vehicles had been seen harbouring, and many fires were soon blazing. Having effectively seen off the attack, we were surprised next morning to be ordered to begin a withdrawal, but our French liaison officer, Lucien Haegelin, had heard the news of the German advance through the Ardennes, and was full of gloom.

There ensued several days of intense activity - moving by night to avoid air attack, and working by day on bridge demolitions and craters. We fell back across the Senne, the Canal de Charleroi and the Dendre, to the line of the Escaut. Demolition supplies were brought up in standard lorry loads containing all that was needed and the supply was adequate.

At one stage we were running short of petrol and I was sent back to find a supply. I encountered the AA & QMG (DCOS) standing by the roadside and asked him. He indicated a dump on a nearby airfield and told us to help ourselves, but not to take more than we needed to fill up, as the administrative machine was creaking badly!

In Tournai there was a security problem, because a fifth columnist had opened up the lunatic asylum and there were numbers of suspicious looking characters wandering about without papers, and unable to give an account of themselves. This overloaded the military police and the intelligence staffs. Some of the demolitions on the Escaut had been prepared by Corps troops and we moved to the high ground north of Tournai, hoping for a chance to rest. Hardly had I got my head down than I was wakened and told that another bridge had been found which was not prepared and to get on with it without delay. I thought to myself "this is too much! I can't go on much longer". I woke Sergeant Stevens, who got smartly to his feet, saluted, and said "I'll get the men fell in at once, sir". I felt ashamed of my weak thoughts, but what a good example this was of how discipline strengthens upwards as well as downwards.

Later that evening all the Divisional Engineers were deployed as infantry along the River Escaut as the arrival of 3 Infantry Brigade had been delayed because a fifth columnist had diverted the transport sent to bring them back. A number of enemy patrols was engaged during the night, but no serious attack developed and in the morning the Brigade relieved us and we moved to the north of Lille.

There were no radio communications below Brigade HQ at this period, and our OC, Major Colin Browning, went off to find Divisional HQ for orders. He came back and summoned 'O' Group and started by saying "We are to withdraw and prepare the bridges over the Yser for demolition" - at which point he fell fast asleep. We could not wake him, so we looked

at his map and divided the tasks amongst ourselves. He then woke up and continued.

I was now acting 2IC and was to lead the convoy, and on asking where the Germans were, was told they were attacking both sides of the corridor between Ypres and Cassel. I set off in the dark with only a 1:250,000 map towards Poperinghe, taking compass bearings at road junctions to ensure I led them on the right road. It was whilst doing this that a French medical unit appeared moving the opposite way. They were to evacuate the wounded from Lille, but I told them that the city was probably in enemy hands by now. In contrast to some allied units, they were very determined and replied that their orders were to go to Lille and off they went.

We deployed on the Yser and prepared the bridges, but had no orders about blowing them, and heard that the Belgian Army on our left had surrendered. The roads were now choked with traffic and as I have mentioned, we had no radio, so the OC sent me off to find Divisional HQ. I set off on the back of a despatch rider's motor cycle to get through the traffic, and the two of us were also able to hump the machine over obstacles.

I failed to find Divisional HQ but got to BEF HQ at La Panne as it was getting dark. I went into the G Office and was told that orders had been sent to blow the bridges and withdraw and that the Divisional Engineers were moving towards Bray Dunes. I decided that the Sapper DR and I would doss down until daylight and then set off to return. From various snatches of conversation overheard, I gathered that the embarkation was not going well. Next day we rejoined the company on the road to Bray Dunes. All non-essential vehicles had been dumped, including my truck with all my kit!

It was a fine sunny day, and as we moved down to the beach we could see the ships spread out to seaward along the coast. At that moment an attack by Stuka dive bombers developed. Flak was going up and Hurricanes were attacking the Stukas. A Sapper watching it all turned to me and said, "Cor, Sir, better than a f...ing football match".

Soldiers were being shipped out in ships' boats from the beach, and the problem was that when loaded they tended to ground on the sand-bars on the way back. Clearly some form of pier was needed and we decided to build two, by driving lorries into the sea at low water and decking over the canopy frames. For stability it was necessary to load them with sandbags and puncture the tyres. There were a number of stragglers on the beach from various units, who were attracted by our cooking facilities. We fed them and then fell them in as a working party to fill sandbags and load them into the lorries.

They disappeared as darkness fell, but we ensnared another lot next day. The FBE decking bridged the space between the lorries, and floor boards taken from houses completed the piers. The folding boats were pressed into service to take soldiers out to the ships and the evacuation proceeded much more rapidly. As the number of troops embarked increased, the chaos became more under control, but some of our sappers began to wonder when their turn would come, especially as they had embarked several other RE Units. Our Divisional Commander, General Alexander, who visited us regularly, inspired confidence and reassurance.

We suffered occasional air attacks, but when La Panne was captured, our beach came under observed shellfire, and could no longer be used. We were ordered to march that night to a rendezvous where vehicles would take us to Dunkirk to embark.

The OC gave orders that 23 Company would move off clean, shaved and properly dressed and instructed me to make a rum issue, but to be careful about it! Amongst the reservists who had joined us on mobilization in 1939 was Sapper Stacey. He was very much older than the rest of us, having been a "false enlistment". In other words, having completed one period of service he had re-enlisted giving a false age. Such cases were not uncommon in the depression of the early 1930s. Stacey was known as "Daddy" and was very popular. I personally issued a tot of rum to everyone and destroyed the rest with some sadness. The company fell in to march off, looking a credit to the Corps, but when we moved off, Stacey was found to be incapable of marching and rather spoilt the image by bringing up the rear in a French wheelbarrow. The OC turned to me and said "How did Stacey get so much rum?" but

to this day I do not know. I was not the only one to incur the OC's displeasure, for shortly afterwards he fell into a bomb crater. John Blomfield, who had reconnoitred the route, tried to explain that it was not there when he had done so. It was not, I am afraid, the OC's night, which was a shame as he had done so well throughout the withdrawal. We met the transport and were taken to Dunkirk where, after a wait on the mole, we embarked in the destroyer *Winchelsea* and flaked out until our arrival next day at Dover. 23 Field Company was one of the last units to leave France.

Looking back, my chief recollection of this short three week campaign is of exhaustion and lack of sleep, inevitable when one is withdrawing and therefore having to react to the enemy all the time. We were fortunate in being part of a well-trained regular division, and in our GOC, General Alexander, and his staff. In spite of the pressure, plans were made rapidly and clearly and orders issued in good time, so that there were few muddles. In the company, there was a tremendous team spirit which had grown in the months we had been together, and a great pride in being Sappers. Finally, we landed at Dover with our arms, but having lost all our vehicles and equipment, and with a strong sense of failure. But there were people on the dockside cheering and welcoming us, and as we moved to the trains there were WVS ladies with cups of tea and postcards to send home announcing our return. It was a tremendous uplift and made one feel very proud of our country and determined for the future.

As a tailpiece, the company had been issued with someBelgian money for our imprest account on 10 May. Towards the end, when acting as 2IC I had used some of this to buy supplies locally and on return to UK I handed the balance in. The response was a request for vouchers to support the purchases and an exchange of correspondence followed. Some things do not change!

Royal Engineer Geologists and the Geology of Gibraltar
Part III - Recent Research on the Limestone and Shale Bedrock

COLONEL E P F ROSE TD MA DPHIL MIWEM FGS AND
CAPTAIN M S ROSENBAUM RE(V) BSC PHD ARSM DIC EURING CENG MIMM FGS

Parts I and II in this series reviewed unpublished research conducted on Gibraltar by Sapper geologists A L Greig and G B Alexander in 1941-43 and 1945-48 respectively. Part III brings the history of pre-Quaternary geological research up-to-date. It describes recently mapped features of Gibraltar's Mesozoic bedrock geology, of potential engineering significance, and relates the geological structure of the Rock to recent dynamic interpretations of the geological evolution of the western Mediterranean region.

INTRODUCTION

AFTER the 1939-45 war, geologists soon ceased to serve as such in the British Regular Army. They were, however, established as a Pool of Geologists in the Army Emergency Reserve. In 1967 this Geologists' Pool merged with the Engineer Works Pool of officers to form the Engineer Specialist Pool of the Territorial Army (TA), a unit retitled the Royal Engineers Specialist Advisory Team (V) in 1988.

TA geologists continued Sapper geological work in Gibraltar by a series of sporadic "Annual Camp" visits from 1967 onwards, on attachment to 1st Fortress Squadron (later Specialist Team) Royal Engineers (as noted by Rose, 1978). Their reports dealt with such practical problems as evaluating potential groundwater resources, road alignments, slope stability, tunnel stability, and airfield subgrade. Assistance was given to all three Services on Gibraltar: the Army, Navy and Royal Air Force; also to the Property Services Agency (Department of the Environment) and the Gibraltar Government Public Works Department. From 1975-1980 TA geologists collaborated with geologists of the Institute of Geological Sciences (later renamed the British Geological Survey) deployed on behalf of the UK Overseas Development Administration (ODA) to maximize development of the groundwater resources of Gibraltar.

By 1980 it was clear that such specific projects and many site investigations on Gibraltar were being seriously hindered by lack of a definitive large scale geological map with supporting descriptive memoir. No large scale geological map had ever been published and the three unpublished maps in local circulation differed significantly from one another (as described by Rose & Rosenbaum 1989a,b). The most recent map (Alexander, 1947) lacked a descriptive text in explanation, and the major published description of the geology of Gibraltar (Ramsay & Geikie, 1878) had largely been rendered obsolete by 100 years of subsequent study.

But TA geologists lacked the time, and Geological Survey geologists the funding, necessary to remedy the deficiency. Moreover, they were not authorized to make studies on similar areas of Spain or Morocco for comparative purposes. Accordingly, a joint initiative with the British Geological Survey sought funds from the UK Natural Environment Research Council for a research student to do the work. The application was successful, and Graham Cunningham (a graduate of Imperial College with distant but distinguished Service relations) registered in 1981 under supervision of E P F Rose at Bedford College, University of London, with joint supervision from Dr Edmund Wright (then Hydrogeological Adviser to ODA) on behalf of the British Geological Survey. Sappers at all levels provided much encouragement and practical support. That Cunningham and the then OC 1st Fortress STRE were both old boys of Gordonstoun School was pure coincidence!

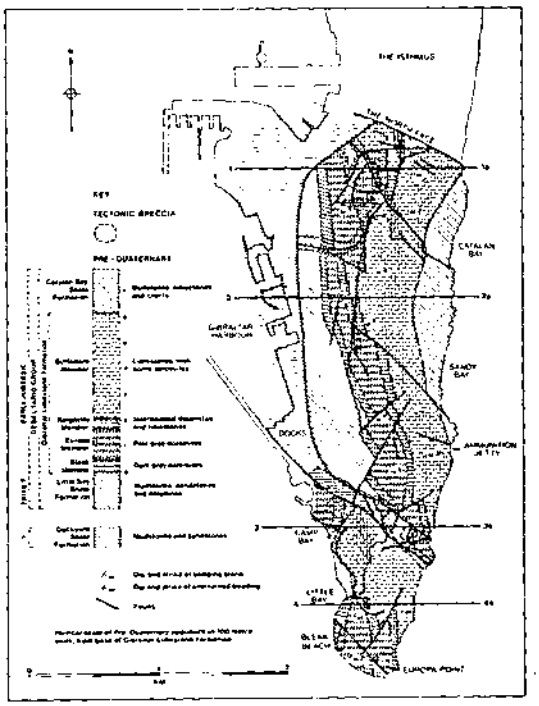


Figure 1. Solid Geological Map of Gibraltar, simplified from computer-drawn map at 1:5,000 scale compiled by M S Rosenbaum; based on manuscript geological maps by Ramsay & Geikie (1876), Greig (1943, Alexander (1947) and fieldwork during the years 1980 to 1989 by G Cunningham, E P F Rose and M S Rosenbaum.

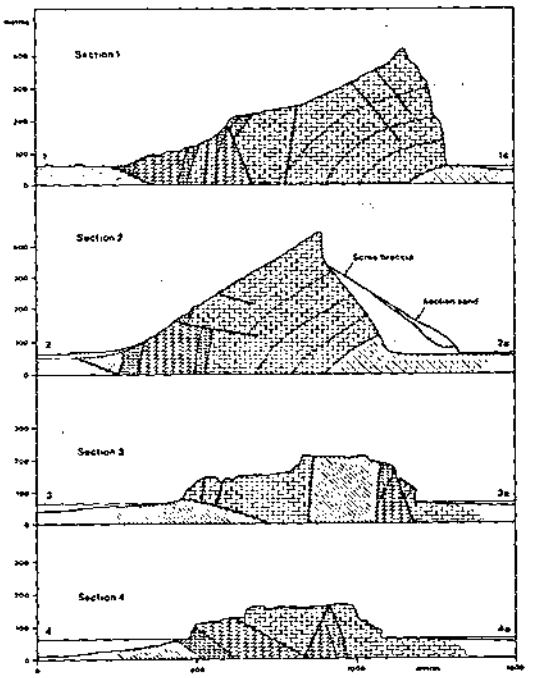


Figure 2. Geological cross-sections west-east across Gibraltar following the lines of section shown on *Figure 1*; ornament as for *Figure 1*; vertical scale in metres, using datum comparable with *Figure 2* of Rose & Rosenbaum (1989b) for convenient comparison; dotted lines within Buffadero Member indicate bedding planes inferred by Alexander (1947).

The interpretation of Gibraltar geology which follows owes much to extensive field mapping and laboratory observations made by Graham Cunningham, primarily in the three years 1981-84. Sadly, much-advertised loss in Gibraltar of a critically important field note book, and subsequent loss of his research base at Bedford College as it merged with Royal Holloway College some 40km distant, prevented Cunningham from completing his map and thesis within the scheduled time frame. The present authors therefore combined their Sapper skills and University research facilities to complete a new map and account of the geology of Gibraltar in 1989, based both on earlier information and their own fieldwork.

The New Geological Map

Figures 1 and *2* illustrate, in simplified form, the Pre-Quaternary bedrock component of a new geological map of Gibraltar prepared originally at 1:5,000 scale by M S Rosenbaum. Data from fieldwork by both authors, together with information from a draft geological map prepared by Graham Cunningham and the unpublished maps of Ramsay & Geikie (1876), Greig (1943) and Alexander (1947) were digitized by Rosenbaum at Imperial College and included within a database management system from which he derived the new map using the Drawing Office Graphics System (DOGS) mounted on the Imperial College VAX 8600 computer. The map was then field checked for accuracy by both authors.

The map follows Alexander (1947) in distinguishing more than one "shale" unit in the bedrock of Gibraltar. Shales north and east of the Main Ridge are here given the new name Catalan Bay Shale Formation, for consistency with modern British stratigraphic practice. Shales west of the Main Ridge are deemed to belong to two different rock units as recognized by Alexander, but there

Photo 1. Finely laminated sandstones within the Little Bay Shale Formation, near base of cliff southeast of Little Bay promenade; the only place where ancient sandstone still crops out on Gibraltar. (Illustrated rock is about 0.15 metre in total height.)

is no proof that they are of similar age. We therefore do not group them together as Rosia Shales, but map and describe them separately here under the names Little Bay Shale Formation and Dockyard Shale Formation. The boundaries of all Shale formations shown on the map take account not only of earlier maps but also unpublished borehole and site investigation reports made available to us on Gibraltar.

For mapping purposes, the Gibraltar Limestone is here subdivided into four units (members), but these do not correspond exactly in character, thickness or position with the four major units mapped by Alexander (1947). Alexander lacked the supporting facilities provided by modern geological research laboratories, such as were available to Graham Cunningham and ourselves, and the map takes account of recent laboratory study of numerous rock samples. In consequence, we believe that the map shows a more meaningful subdivision of the Gibraltar Limestone. Boundaries left uncertain on Alexander's map are here interpreted more positively.

The map illustrates a large number of geological faults. The major fault pattern is consistent with that gradually recognized by successive earlier authors, but we have reinterpreted some faults in the light of the subdivision of the Gibraltar Limestone adopted here. We also suspect that the thrust plane inferred by Bailey (1952) and Alexander (1947) to lie beneath Gibraltar might be located near the line of the western city walls, between the Little Bay Shale Formation and the Dockyard Shale Formation.

Greig (1943) recognized the engineering significance of the many regions on Gibraltar where rock had been fractured and thus weakened in the vicinity of major faults. Such regions of "tectonic breccia" are also indicated on our map. For the civil engineer, the map is thus a guide to areas of potentially weak rock (the Little Bay, Catalan Bay, and Dockyard Shale Formations, and zones of faulted or tectonized Gibraltar Limestone); major fault zones which may facilitate groundwater flow; Limestone/Shale boundaries which might form springs of groundwater; and dolomite horizons within the Gibraltar Limestone which are especially prone to development of caves and fissures because of their greater porosity and solubility than pure limestone.

Thick superficial deposits of sand and scree breccia commonly obscure the bedrock on the flanks of Gibraltar, and much of the ground adjacent to the waterfront in the city and dockyard area is artificially made ground whose characteristics indicate nothing of the underlying geology. These deposits, which often have high engineering significance, are not shown on *Figure 1* but will be described separately in the fourth (final) part of this series of articles.

New information can readily be incorporated in the database to facilitate map revision. Moreover, the DOGS facility allows copies of the map to be drawn in whole or part at varying scales. Its different components (solid geology, tectonized areas, superficial deposits, and fill) may be printed separately or combined as required. It should prove a useful tool to assist future civil engineering projects on Gibraltar.

Little Bay Shale Formation

The oldest rocks now visible on Gibraltar may be seen in Little Bay, at the base of the cliff just southwest of the northern entrance to the Keightley

Royal Engineer Geologists and the Geology of Gibraltar Part III (1)

Way Tunnel, adjacent to the steps which lead down to the southern end of the promenade, much frequented by bathers. The rocks are red and green coloured fissile mudstones (shales) with thin beds of fine sandstone (*Photo 1*) and pebbly conglomerate, together with thicker beds of dark grey dolomite. (The rock dolomite superficially resembles limestone but is composed predominantly of the mineral dolomite, calcium magnesium carbonate; limestone in contrast is predominantly calcite, which is just calcium carbonate).

No fossils are known from these rocks to indicate their age. Even rock samples submitted to our academic colleagues Drs A R Lord, J Riding, and A C Scott for micropalaeontological study proved barren. However the Shales dip steeply inland (eastwards) beneath the Gibraltar Limestone. Since the Gibraltar Limestone in southern Gibraltar can be shown to be in its original depositional sequence ("right way up"), these underlying rocks of the Little Bay Shale Formation must be older than the Limestone. Similar rocks in Spain and Morocco have been dated as Triassic in age, (ie at least some 213 million years old).

Other outcrops of red and green Shales, more badly sheared by faulting, may be seen in the base of the cliffs to the north, towards Camp Bay, from the Devil's Bowling Green onwards. More occur inland, at the base of Engineer Road, but many of the Shale outcrops reported by Ramsay & Geikie (1878) and other early authors have now been quarried away or obscured by building works.

Some of the most spectacular exposures of Shales still remaining are currently passed daily by a high proportion of Gibraltar's military population. They occur within the Lathbury Barracks area, notably opposite Devil's Bellows where the road to the Barracks branches south towards the buildings currently occupied by 1st Fortress STRE. Here red and green Shales appear with a vertical orientation in a rock face cut to accommodate the north side of the road. The beds have been deflected from their original horizontal orientation by the Great Main Fault, as recognized by Ramsay & Geikie (1878), which crosses northwest-southeast across Gibraltar from the Dockyard South Gate through the Lathbury Barracks area to Hole-in-the-Wall and beyond, separating the westward dipping Limestone of the Main Ridge from the eastward dipping Limestone of the Southern Plateaux.

Borehole records indicate that towards Gibraltar Harbour similar multicoloured Shales lie beneath much of the lower slope now occupied by the city of Gibraltar, and influence foundation works for new construction projects there. Shales have adversely affected several tunnelling projects: the Poor Relations tunnel soon collapsed, and several attempts to commence tunnelling in other areas had to be abandoned.

Gibraltar Limestone Formation

The Gibraltar Limestone forms the most obvious mass of the Rock. It is a pale to dark grey finely crystalline rock, forming beds which vary from less than one metre to several metres in thickness. In general appearance it resembles the much older Carboniferous Limestone widespread in the British Isles, particularly in northern England.

Its Jurassic age has been accepted for over a century, but although shown as Middle-Upper Jurassic (Dogger-Malm) on Spanish maps (eg that described by IGME, 1986) published evidence favours an Early Jurassic date (Bailey, 1952). The fossil brachiopods identified for Bailey are still in the collections of the British Museum (Natural History), and Drs L R M Cocks, Ellis Owen and Colin Prosser have kindly confirmed for us that although they are rather nondescript, they are certainly not Late but Early (at latest early Middle) Jurassic in age, giving an origin within the range 213-180 million years before present.

Fossils are normally rare within the Limestone, and difficult to extract because of its hardness, but they can be common at some localities, particularly along the crest of the Main Ridge. They include shells of bivalve and gastropod molluscs, rhynchonellid and terebratulid brachiopods (identifications cited by Bailey, 1952), occasional corals, and fragments of sea-urchins (echinoids) and sea-lilies (crinoids). These indicate that it formed originally as sediment in a marine environment. Algal laminations are common (*Photo 2*), and since these typically occur in recent seas in peritidal to shallow waters (seldom below 30 metres water depth) and most commonly in warm (tropical-subtropical) environments, they indicate that the marine environment

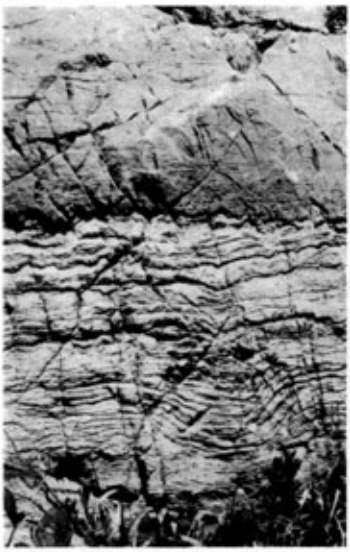


Photo 2. Stromatolitic algae within Keightley Member of Gibraltar Limestone, at base of cliff north of Europa New Road, west of entrance to Keightley Way tunnel; typical of algal laminations widespread on Gibraltar, notably above St Michael's Cave, beside St Michael's Road (The irregular bedding plane in centre of photograph is a feature of pressure-solution; illustrated rock is approximately one metre high.)

was both shallow and warm-water. The "ripped-up" character of some of the algal laminations confirms shallow-water deposition, for such features are typical of waters shallow enough for wave generated turbulence to scour the bottom sediments. Other features indicative of shallow water sedimentation include: oncoids (concentrically layered algal balls up to 0.1m in diameter) (*Photo 3*); ooids (spherically layered particles typically 0.2mm to 1.0mm in diameter); peloids (pellets of muddy sediment, commonly formed as faecal pellets of marine invertebrates); possible fluid escape structures (small voids with digitate upper surface probably indicating differential compaction of sediments and upwards escape of water soon after deposition) and sheet cracks, now infilled with crystals of sparry calcite (the cracks due initially to dessication of intertidal algae or sediments). There are many similarities with sediments forming today in the Arabian Gulf or Caribbean Sea regions, particularly sediments from the Bahama Banks, typical of tropical "carbonate platform" environments.

Shallow-water marine sediments accumulated through most of the 600-630 metre thick Gibraltar Limestone succession. Subsidence of the sea floor to approximately this extent must therefore have taken place during deposition, with sediment accumulation keeping pace with rate of subsidence to maintain the shallow-water conditions.

In Gibraltar south of the Great Main Fault zone, the Limestone beds do not lie in their original horizontal position but dip to the east, the result of major post-Jurassic earth movements. However, the beds are still in their original depositional sequence ("right way up"), with the oldest beds at the base. This sequence is confirmed by numerous features hitherto undescribed on Gibraltar: orientation of fluid escape structures (calcite infilled voids formed with a digitate top and planar base); algal truncation (only the top of algal laminations being truncated by current scour or browsing marine animals); rip-up clasts (some distinctive horizons of fragmented sedimentary layers, notably algal laminae, whose upper layers have been partially ripped-up by storm or strong currents soon after formation); shell orientation (disarticulated mollusc shells are hydrodynamically most stable in a current-swept environment with their convex surfaces upwards); and geopetal infills (voids such as partly empty fossil shells in which fine mud settled at the base under gravitational influence. The remainder of the void was then filled by sparry calcite crystallizing from the sedimentary pore waters, thus preserving the originally horizontal mud-water interface as a fossil "spirit-level").

Such features also serve to indicate that the Limestone in the Main Ridge north of the Great Main Fault zone must have been completely overturned by the earth movements, causing it to dip to the west.

The map indicates four subdivisions within the Gibraltar Limestone Formation, distinguished partly on the basis of field characteristics and

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Photo 3. Pisolithic algae and oncoids within Gibraltar Limestone, beside Europa New Road; typical of concentric algal structures widespread both in the Southern Plateaux and Main Ridge areas of Gibraltar. (Illustrated rock approximately 0.12 metre high.)

partly on laboratory studies. These subdivisions ("members" in formal stratigraphic terms) are best seen when walking from west to east across the Europa region of southern Gibraltar. They are here named after "type" localities in conformity with modern stratigraphic practice:-

Bleak Member: dark grey-black bituminous well-bedded dolomites which can be seen clearly at the extreme northern end of Bleak Beach on the western coast of the Europa region; also north of Hole-in-the-Wall Road. They form a unit some 55 metres thick.

Europa Member: a uniform series of pale grey-white dolomites with very poorly defined bedding which succeeds the Bleak Member eastwards across Europa and south eastwards along the cliffs backing Bleak Beach. The boundaries are gradational; the member is some 120 metres thick.

Keightley Member: a very distinctively well-bedded unit, about 35 metres thick, which is visible from about 100 metres west of the southern entrance to Keightley Way Tunnel. The bedding is emphasized by variations in rock type: pale-grey algal "boundstones" (in which the original sedimentary components were bound together by algae during deposition), dark bituminous beds of limestone or dolomite, coarsely crystalline and also microcrystalline beds of both limestone and dolomite. Some horizons are fossiliferous, with bands of

Photo 4. Fossil marine gastropods (snails), within Buffadero Member of Gibraltar Limestone; found widely on Gibraltar but best seen along the crest of the Main Ridge. (Largest fossil shell approximately 15mm long.)

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Photo 5. Catalan Bay quarry, viewed from the east, showing massive Gibraltar Limestone underlain (to right) by more thinly bedded limestones and shales of the Catalan Bay Shale Formation. These are downfaulted to the north along an almost vertical fault (near photo centre) bringing them down against thinly bedded cherts which are lower down in the Catalan Bay Shale Formation to the south.

disarticulated shells (bivalve mollusc or brachiopod) and isolated marine gastropod (snail) shells. The beds form a transition series between the underlying dolomites of the Europa Member and the overlying limestones of the Buffadero Member.

Buffadero Member: a relatively homogeneous sequence of mainly light or medium grey, fine-grained limestones ("chinastones"), often partially dolomitized towards the base, which overlies the Keightley Member eastwards below Buffadero Battery. It is sparsely fossiliferous, with gastropods (*Photo 4*), brachiopods, and occasional poorly preserved belemnites, crinoids, echinoid spines, coralline algae, corals and benthic foraminifera. Rock types vary. Algal boundstones predominate near the bottom of the unit. They may include ooids large enough (>2mm) to be termed pisoids; also oncoids and the distinctive pores known as "bird's eye structures". Peloidal and skeletal grainstones (limestones in which there is little fine muddy sediment and the coarser grains are in contact) characterize the upper part of the sequence. Total preserved thickness is approximately 400-420 metres on Gibraltar as a whole.

Though most easily seen in the Europa region, the rock types characteristic of these four members can be recognized throughout Gibraltar, except in the vicinity of some large faults where deformation has obliterated the features of the original rock.

The Gibraltar Limestone is a strong rock in engineering terms. Tunnels and cliff or quarry faces formed within it are generally stable. However, stress relief has allowed the rock to crack open forming "joints", and these joints may have orientations relative to engineering features which allow lines of weakness to develop in the rock leading to failures in the modes defined by Hoek & Bray (1981) unless appropriate remedial works are undertaken.

Catalan Bay Shale Formation

The youngest bedrock unit now exposed on

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Gibraltar is the Catalan Bay Shale Formation. This may best be seen in the Public Works Department quarry at Catalan Bay; on the beach at the southern end of Sandy Bay; at Ammunition Jetty; and at the base of the slope bordering the Public Works Department incinerator beneath the North Face of the Rock.

The largest exposure is at Catalan Bay quarry. This is now disused, but is too hazardous to enter since a combination of geological features (faults and weak rock) has resulted in cliffs which are extremely unstable and suffer from frequent rock falls. All the features of significance can, however, be viewed safely from outside the quarry: 0.2 to 0.3 metre thick beds of grey limestone (containing darker patches of silica "chert" nodules) alternate with thinner beds of reddish fissile mudstones and apparently dip beneath massive Gibraltar Limestone above the Williams Way Tunnel entrance; south of the tunnel area, the main quarry face reveals a thick sequence of thinly bedded cherts, partly obscured by scree breccia; and an obvious fault separates the two zones, with downthrow to the north (*Photo 5*).

Shales have been traced from the Catalan Bay quarry and into the Rock through the Lower Waterworks Tunnel, although this is extremely hazardous since the tunnel is unlined and the weak alternating limestones and mudstones are prone to frequent roof collapses.

The Shales can be viewed less spectacularly, but more safely, at the southern end of Sandy Bay. A small exposure, partly obscured by ancient scree breccia and (intermittently) by modern beach sand, reveals pale grey limestone beds 0.3 to 0.4 metres thick alternating with thinner reddish mudstone beds and dipping steeply to the southwest. Further south, authorized Service personnel can view shales just below road level by the tunnel entrance at Ammunition Jetty, reached via Dudley Ward and Dog Leg tunnels. Contact with the Gibraltar Limestone has here been faulted. Moreover, the once continuous beds of cherty limestone have been broken and deformed. Just to the north of the Jetty, the slabs of grey-green limestone appear to have been folded and torn apart (*Photo 6*). This spectacular exposure may be interpreted in two quite different ways. The Shales may have been deformed, soon after their deposition as laterally continuous beds of sediment, as their partly hardened beds slumped downslope having accumulated on a slope too steep to be stable, or perhaps been disturbed by an earthquake shock. Alternatively, the Shales may have been deformed very much later in time, as the Gibraltar Limestone was thrust over them.

Highly deformed Shales may also be seen at the North Face but here the style of deformation is quite different to that at Ammunition Jetty. A patch of highly folded black cherts, some 10 x 12 metres in size, is visible near the base of the slope behind the incinerator and can be seen from the road. These siliceous rocks, in beds 0.03 to 0.15 metres thick, alternating with thinner beds of grey-black shale, weather to a rusty brown on the surface as iron within them oxidizes. The chert beds are fractured into slabs, and tend to curve westwards, consistent with a thrust westwards of the whole mass of the Rock of Gibraltar. Some blocks of thin limestone and red siltstone also occur here, similar to the oldest parts of the Shale

Photo 6. Ammunition Jetty, showing highly deformed cherty limestones within shales of the Catalan Bay Shale Formation close to a faulted junction with the Gibraltar Limestone (above top of photo). The deformation of the limestones and shales is not continuously developed at this location and may be the result of slumping of weak sediment soon after deposition, before consolidation had made it rigid.

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Photo 7. Gibraltar Dockyard. Steeply dipping Dockyard Shale Formation exposed during dockyard excavation between 1900 and 1902. (Photograph dated 3December 1900 from PSA collection.)

outcrop at Catalan and Sandy Bays.

Fossil ammonites were found by A L Greig both at the North Face and in Catalan Bay quarry. These are of similar types and were identified by Dr L F Spath at the British Museum (Natural History) and dated as of Early Jurassic (Domerian = Middle Lias) age (Bailey, 1952). This would make them about 195 million years old. One of us (EPFR) has found a fragmentary ammonite in Catalan Bay quarry, confirming their occurrence there. Although none of Greig's ammonites can now be traced in British Museum or Geological Survey collections, Dr M K Howarth of the British Museum (Natural History) has kindly confirmed that in his identifications and discussion of the ammonites collected by A L Greig, Spath (in Bailey, 1952, p166) was almost certainly correct in assigning an Upper Pliensbachian (= Domerian) age to the northern and eastern Shale outcrops.

Dockyard Shale Formation

Photographs taken between 1900 and 1902 show that the Gibraltar docks were then being excavated, at least partly, through alternating light and dark, often contorted "shaly" beds which dipped very steeply to the east *(Photo 7)*, in the opposite direction to the westerly dipping Gibraltar Limestone of the Main Ridge. Alexander designated these as "Dockyard Shales" on his 1:2,500 geological map, whose key indicated they should be "uniform grey black calcareous shales" some 100 metres in minimum thickness. Although known only from the actual dock excavations, Alexander clearly believed them to form the lowest part of his Rosia Shales sequence to which he elsewhere ascribed a Rhaetic (Triassic) age.

The docks are now lined with masonry so it is no longer possible to view the Shales here. No fossils have been reported from them, so their age is unproven. Two conflicting comparisons are possible:-

a. Alternating dark (red) and pale (greenish grey) shales of near vertical orientation may be seen

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in the major quarry complex at Los Pastores west of Algeciras in Spain. Alexander's figures also ascribe these to the Rhaetic (Trias). The most recent description is given by Didon (1969), who confirms a sequence ranging from red and green mudrocks of Middle Triassic age, through massive dolomites and brecciated limestones of Early Jurassic date, to red nodular limestone with Middle Jurassic ammonites.

b. Alternating highly inclined dark grey mudstones and pale creamy-yellow sandstones crop out extensively along the shore south of Algeciras, opposite Gibraltar (*Photo 8*). These are typical flysch (turbidite) deposits, and of well-established Tertiary age, therefore significantly younger than the Trias. Their mineralogy has been briefly described by Pendon & Polo (1975).

By correlation with one or other of these sequences the Dockyard Shales may ultimately prove to be either the very oldest (Triassic) or very youngest (Tertiary) bedrock on Gibraltar! Their age is one of the remaining uncertainties regarding Gibraltarian geology. Its determination requires suitable rock samples, to be obtained from future boreholes or sampling opportunities during dock reconstruction.

Geological Structure

The Southern Plateaux, it is now clear, comprise uninverted Gibraltar Limestone which dips steeply to the east. The Limestone is underlain by the Little Bay Shale, as seen along the western coast. Earlier published accounts of Gibraltar geology which consistently state (Ramsay & Geikie, 1878) or imply (Bailey, 1952) that the Limestone here is inverted are in error. Many features can now be recognized (as cited above) which clearly indicate that the rocks are "right way up".

Several faults intersect the Limestone of the Southern Plateaux, most obviously where the fault plane is exposed in the cliffs fringing Europa Flats and at the south end of Windmill Hill Flats. A thrust brings the youngest Limestone member westwards over older rocks in the Little Bay area. At the north and especially at the northwest margin of the Plateaux region the Limestone is extensively brecciated as it approaches the Great Main Fault zone.

The "Great Main Fault", as recognized by Ramsay & Geikie (1878), is a zone of highly tectonized strata which extends northwest to southeast from the Dockyard South Gate via the Lathbury Barracks area to the coast southeast of Hole-in-the-Wall, separating eastward dipping strata of the Southern Plateaux from westward dipping Limestone of the Main Ridge. Blocks of Limestone within the fault zone have been extensively brecciated, probably because these competent, relatively brittle rocks have fractured whereas less competent, more ductile Shales beneath them have been deformed by the post-Jurassic earth movements which overturned the Limestone of the Main Ridge. The red and green Shales so clearly visible in the Lathbury Barracks area have been squeezed into a vertical orientation between the two massive Limestone units which form the Southern Plateaux and the Main Ridge.

The Main Ridge is composed of massive, inverted Gibraltar Limestone. This is underlain by younger Catalan Bay Shales along much of its eastern coastal margin, and seemingly overlain by older (Little Bay?) Shales in the town area which forms its western margin. Although Ramsay & Geikie (1878) assumed these rocks to be "right way up", our sedimentary observations are consistent with

Photo 8. Tertiary Flysch cropping out along shore south of Algeciras, Spain: steeply dipping medium bedded sandstones alternate with thin dark mudstone bands.

Bailey's (1952) contrary stratigraphic interpretation: that the succession has been inverted, and the Rock here is "upside down".

The Isthmus extending northwards from the North Face exposes only unconsolidated superficial deposits of relatively recent (Quaternary) age. Bedrock lies at variable depths beneath the superficial sands and clays, seemingly some 20 metres below the surface in the west and over 60 metres below the surface towards the east of the Isthmus. Fragments of both Limestone and Shale have been recorded from the few boreholes to penetrate the bedrock, but none of the holes has been continued to significant depth. The structure of the bedrock and its relationship to the Main Ridge therefore remain speculative. However, it seems unlikely that the sheer North Face of the Rock (*Photo 9*) can be explained in terms of a normal fault downthrowing Limestone to the north as claimed by Ramsay & Geikie (1878). Marine erosion of weak Shales at the base of the overlying massive Gibraltar Limestone during a time of higher sea level probably formed the sheer cliffs of the North Face just as it formed the sheer cliffs immediately south of the water catchment areas of the eastern coast, although such erosion of the North Face could equally well have followed a zone of rock weakened by lateral fault displacement. Such a fault would be consistent with others seen within the Main Ridge. Regional geological studies (Didon, 1973) indicate that a major transcurrent fault might lie somewhere beneath the Isthmus, but if so, whether on the British or Spanish side of the frontier is uncertain.

Regional Geology

Topographically, Gibraltar lies at the edge of the Betic Cordillera, a mountain chain in southern Spain extending in a broad arc from near Cartegena on the east coast west and south to meet the Atlantic coast south of Cadiz. On the opposite side of the Straits of Gibraltar, the Rif mountains of Morocco curve west and north to meet the coast between Ceuta and Tangier. The Betic and Rif mountain chains thus appear to be aligned with each other across the Straits, thereby forming the Arc of Gibraltar which has long been regarded as the southwestern extremity of the Mediterranean Alpine mountain belt.

The Arc has proved a problem to interpret (Fallot, 1945). Conflicting views expressed by numerous geologists over many decades are summarized by Durand-Delga (1972) as three alternatives:-

a. the Arc does not actually exist (in reality the Betic and Rif Mountain chains extend independently towards the Atlantic);
b. it is only superficial (a consequence of the gradual westerly disappearance of the mountain chains);
c. it is a feature of fundamental geological significance (in which the Betic and Rif chains join).

Durand-Delga strongly favours this third interpretation.

His view is based on the work of the many German, French, Spanish and Moroccan geologists which has gradually established over the last century that the Betic and Rif mountains consist of a series of separate structural and stratigraphical units, and that similar units exist on both sides of the Straits. The twin pillars of Hercules, Gibraltar and Gebel Musa, are two obvious parts of one such unit. In relatively recent years, work by French geologists such as Durand-Delga and Villiaumey (1963), Didon (1969, 1973), Didon & Kornprobst (1972), Didon, Durand-Delga & Kornprobst (1973) and Choubert & Faure-Muret (1974) together with that by Dutch geologists such as Rondeel & Simon (1973) has clarified the geological composition and relationships of structural units in the Straits area. A brief synthesis of this recent work (in Spanish) is provided for the Southern Spain/Gibraltar region by the descriptive booklet published to accompany the Algeciras sheet of the 1:200,000 scale geological map of Spain (IGME, 1986).

It is now clear that the different units represent a series of rock masses, mostly ranging from Triassic to Oligocene in age, which (in Spain at least) have been thrust broadly westward or northward some considerable distance. Displacements between 70 and several hundred kilometres have been estimated. In general, relatively old rocks are separated by a thrust plane from much younger rocks beneath, either because

Photo 9. The sheer North Face of the Rock, viewed from the northwest.

old rocks have been thrust over the younger sequence, or because a slice of young rocks has been thrust beneath the older rocks.

In detail the pattern is extremely complex and precise geological relationships are still a matter for controversy and further study, but the overall pattern is now clear: a series of overthrust rock structures apparently radiates outwards from a focus within what is now the Alboran Sea, to the east of Gibraltar (Faure-Muret & Choubert, 1975).

When did this thrusting take place? There is evidence for more than one phase of movement, but the final major phase of thrusting must have taken place after deposition of the youngest sediments to be found within the thrust slices, and prior to deposition of the relatively undeformed sediments which lie upon them. Formation of the Betic-Rif mountain chains can, in this way, be dated with reasonable confidence to the Miocene, to about 25-20 million years ago, (although there is evidence that in parts of the region minor tectonic activity continued up to much more recent times) (Benkhelil & Guiraud, 1976).

Why the thrusting took place is more controversial. What caused the uplift in the Alboran Sea region that allowed the rock slices ("nappes") to thrust outwards, and why did this region of uplift subsequently collapse to form the present day Alboran Sea basin? Recent debate has centred around three dynamic models of interpretation: radiogenic heating of the continental crust; plate tectonics; and active mantle diapirism. Only the latter two have received much support:-

a. In the early 1970s, plate tectonic interpretations were favoured (eg by Hsü, 1971; Andrieux & others, 1971; Andrieux & Mattauer, 1973; Auzende & others, 1973; Araña & Vegas, 1974; Kampschuur & Rondeel, 1975). The evolution of the Betic Cordillera was argued to be in some way related to the relative motion of the European, African and American tectonic plates. The Tethyan Ocean (the remnant of which is the present Mediterranean) which once lay between the continents of Europe and Africa had been narrowing since Permian times, ie during the last 260 million years, as Africa moved northwards towards Europe. The European and African tectonic plates seemingly came together in the Miocene, causing continent-continent collision in the Straits of Gibraltar region. One view (Andrieux & others, 1971) is that the Arc of Gibraltar can be explained in terms of a small sub-plate, the Alboran plate (named after the Alboran Sea) being squeezed westwards by the closing European and African plates, thus deforming the associated rock sequence in an arc around its western margins. Other views take the opening of the Atlantic Ocean into account: movement apart of the American and African plates to form the Atlantic involved lateral movement of the African plate relative to Europe along the East Azores Fracture Zone (Rosenbaum, 1974), with consequent rock deformation in the Straits region. Movement is still active along the Fracture Zone, and it has been calculated (Krause & Watkins, 1970; Rosenbaum, 1974) that the relative movement is 2mm/year, with the north side moving east relative to the south side.

b. By the late 1980s, mantle diapirism was receiving some support (Van Bemmelen, 1972; Weijermars, 1987). Two colliding continents, it is argued, would have been expected to produce a thickening of the Earth's crust between them, but the opposite appears to be the case in

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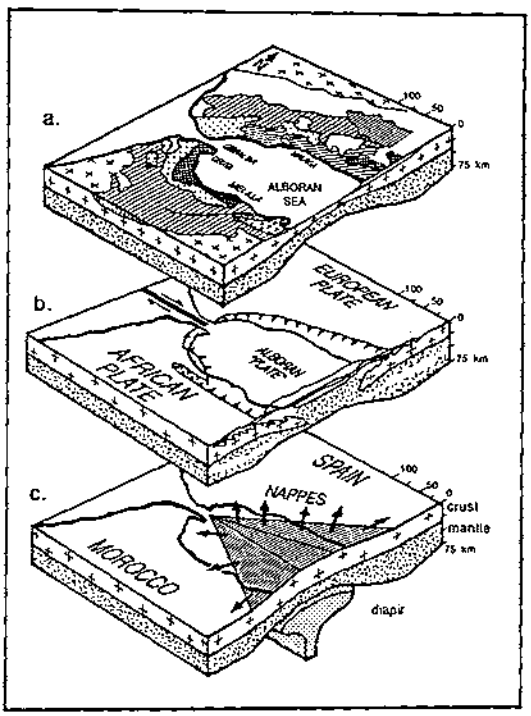

Figure 3. Geology of the Straits of Gibraltar.
a. Pattern of structural/stratigraphic units concentric about the Alboran Sea (see Didon & others (1973) for description of the units distinguished by different ornament on this figure).
b. Plate tectonic interpretation of Straits geology (cross-section after Andrieux & others, 1971); plate boundaries diagrammatic. The Alboran "plate" is interpreted by some authors as a true sub-plate, by others merely as a region of broad tectonic disturbance.
c. Pattern of thrust rock units (nappes) radiating from Alboran Sea area interpreted to be a consequence of gravitational sliding following crustal uplift due to the emplacement of a diapir within the Earth's mantle (after Weijermars, 1987).

this region. Seismic reflection profiles and gravity anomalies beneath the Alboran Sea basin suggest the presence of a diapir in the mantle beneath the crust (*Figure 3*). The emplacement of this Alboran diapir 25-20 million years ago could have caused the upward lithospheric bulge in the crust which led to outwards shedding of nappes at this time. The upward doming of the crust would have thinned it, leading in turn to cooling, and consequently collapse of the cooled crust to form the depression now occupied by the Alboran Sea.

Even more recently geologists such as Professor John Dewey of Oxford have explained the arc in terms of "collapse tectonics": continent-continent collision producing a central dome-like uplift followed by collapse (as the thickened orogenic root falls away) and accompanied by an outward-moving orogenic (ie mountain building) wave due to gravitational spreading, the crust then returning to normal thickness by stretching.

Whatever the detailed explanation, it seems clear that Gibraltar has been moved westward from the position in which its Limestone was originally deposited, perhaps by as much as 100km, and that it was thrust and partially overturned during a phase of mountain-building about 20 million years ago.

Earth movements have continued since these severe deformations. Some have led to dramatic changes in the Mediterranean region as a whole. Deposits of evaporite minerals up to several kilometres thick (with a total volume estimated to exceed one million cubic kilometres) have been inferred from borehole and seismic investigations to occur widely in the Mediterranean area in sediments dated as Messinian (latest Miocene) in age. These evaporites imply that earth movements gradually closed the Mediterranean basin at its western as well as its eastern end, and consequent evaporation of the Mediterranean Sea formed a series of salt lakes about 5.5 million years ago, killing most of the marine species then living in the Mediterranean region. Normal deep marine sediments (dated by their contained microfossils as early Pliocene in age) lie above the evaporites, the fossils being comparable with those known from the Atlantic area at this time. To geologists such as Ken Hsü the implications are obvious: the Atlantic Ocean broke through the land barrier crossing the Straits of Gibraltar at the start of the Pliocene to once again fill the dessicated Mediterranean basin, "with water cascading in from the Atlantic via the straits of Gibraltar on a scale that makes the Niagara Falls seem like a mere trickle" (Hsü, in Drooger, 1973). To say that this idea has proved somewhat controversial would be an English understatement! Different models to account for the Messinian "salinity crisis" have been passionately argued (Drooger, 1973; Hsü & others, 1977), and intensively studied by participants in the International Geological

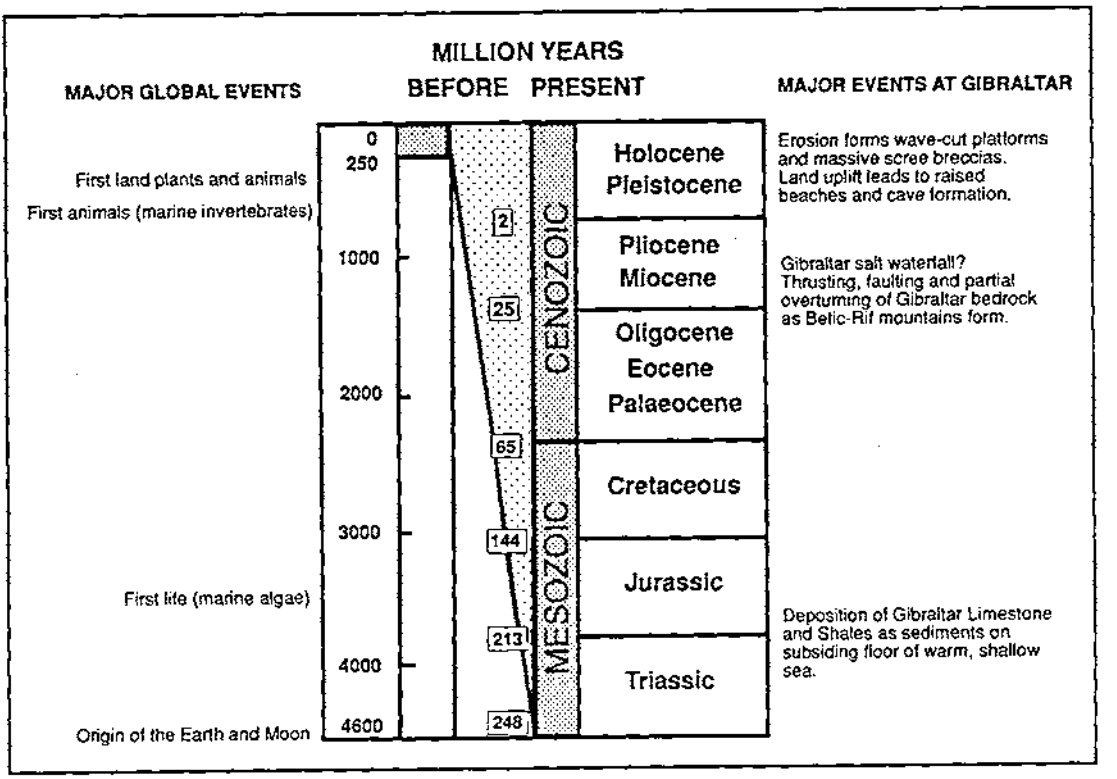

Figure 4. The geological history of Gibraltar related to major events in the history of the Earth: dates and global events after Harland & others (1982). (Time scale is non-linear.)

Correlation Programme Project No 96. By no means all geologists now accept that a "Gibraltar salt waterfall" is necessary to account for the end of the "salinity crisis". However, there is no doubt that the marine life of the Mediterranean sea underwent a major change between 6.5 and 5.1 million years ago, and that Gibraltar must have experienced the warmth of climate then prevailing in the Mediterranean region.

By two million years before the present the world's climate was very different, and even Gibraltar experienced the direct and indirect effects of the Pleistocene Ice Age. But that story is to be told in the fourth and final part of this series, to complete this history which shows how the present Rock owes its origin to deposition as sediment on a subsiding carbonate marine platform some 200 million years ago; emplacement by thrusting during formation of the Betic-Rif mountains some 20 million years ago; and final shaping by erosion as the Rock rose from the sea within the last two million years (*Figure 4*).

ACKNOWLEDGEMENTS

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Memoirs

COLONEL S K GILBERT

Born 3 July 1902, died 21 September 1988 aged 86 years.

THE death of Colonel Stuart Gilbert brought many tributes particularly from those who had worked with him on Mulberry harbour with which his name had been particularly associated in the Corps. There he had commanded the Port Construction Force under Brigadier Walter, who recalled the value of his past engineering experience, his unorthodox and lively approach to problems and his ability to see the funny side of things, a most useful trait in those very difficult days.

Stuart Kendrick Gilbert was educated at the King's School, Macclesfield and Manchester University where he read Civil Engineering. Before the war he worked on engineering projects around the North of England and joined the TA in the 1920s.

Then came the war taking him (and his family) to Gareloch in 1940.

Of his wartime service RJPC writes: "I met Stuart Gilbert in France (BEF) in December 1939 and served with him in North Africa (1st Army), Italy and Normandy.

In North Africa (1942-3) he was responsible for the clearance and repair of the forts east of Algiers damaged by the retreating German army - Bougie, Phillipville, Bone, La Calle, Labarca, and finally La Goulette at the entrance to the Lac de Tunis.

He had under command the first specialist Port Repair Company and the Port Repair Ship *Progress*, a sea-going vessel fitted out with equipment for harbour repairs, diving bell, echo sounding gear, oxyacetylene cutting equipment etc. (See RE *Journal* August 1989 p184).

After the Salerno landing in Italy in September 1943 he undertook the clearance and repair of the small harbours in the Bay of Naples and Ischia Island, also raising sunken vessels in Naples harbour - for the 5th American Army. During the winter 1943-44 the Port Repair Company built and repaired bridges over oddly named rivers in the Italian mountains for US 5th Army and British 8th Army.

In February 1944 the *Progress* sailed round to Bari in the Adriatic and was involved there in harbour repairs.

His last operation during the Italian Campaign was at Anzio before leaving to join the Mulberry team under Brigadier A E M Walter (when he was promoted Colonel) for *Operation Overlord*.

His part in the construction of Mulberry has been recorded in Brigadier Walter's article *"A Harbour Goes to France"* (see RE *Journal* March 1986, p14).

We found Stuart Gilbert to be a keen, imaginative energetic, rather eccentric soldier, a great believer in soldier first, engineer second.

A great chap to serve with - never dull, usually very exciting. All officers under his command had to dive, he did so himself, and crawl about under water in silt and centuries old sewage working by feel. He expected maximum effort from us at all times.

He was one of four gallant and remarkable men who, by sheer force of personality, inspired a half-trained company of men to build Mulberry and to hold it together during the storm of 19-23 June 1944.

Mulberry Harbour was probably one of the most interesting and outstanding feats of military

Colonel S K Gilbert

engineering of all time - and Stuart Gilbert played a major part in its success".

After the war he stayed on in India for a year, working with Bruce White and Partners, the Construction Engineers. He drove back from India, on his own!

He was then employed by the Ministry of Housing and Local Government, which subsequently became the Department of the Environment. He was a Government Engineering Inspector and enjoyed travelling the length and breadth of the UK. He ended this interesting work by being involved with the initial planning and management of the Thames Barrier.

MK writes: "When, in early 1968, the Ministry invited the former Greater London Council to undertake an urgent examination of the means of flood prevention and to come up with an answer, Stuart was appointed to the Policy Committee set up under the Chairmanship of Lord Kennet, to direct the organization of the GLC investigation.

In addition to being a prominent member of the Steering Committee formed by the GLC to undertake detailed control of the scientific and technical studies needed for the decision-making process, Stuart served as the Ministry's representative on each of the seven working parties set up for the studies. In this role, he calmed the ruffled waters of many a potentially rough passage, ranging across subject areas as diverse as navigation, pollution, siltation, groundwater, oceanography, meteorology, amenity, cost of delay to shipping - not to mention civil engineering.

Stuart's grasp of the multi-disciplinary facets of the problems associated with Thames flooding and his directness and clarity of expression saved many tedious hours of unnecessary and unrewarding conjecture. This was a vital contribution when not only the day-to-day functioning of our capital city, but also the very survival of numbers of its working and residential population, would have been threatened by failure to accept quite literally and to respond positively to the warning implicit in the familiar axiom: 'time and tide wait for no man'".

He was co-author of a book *The Thames Barrier*, with the project manager, Ray Horner. Stuart continued to be employed by the Department of the Environment long after the normal retirement age as a part-time consultant.

Following his wife's death in 1970, he moved to Sherborne. He developed a keen interest in and knowledge of Eastern Europe, visiting friends in Russia, East Germany and Poland annually. He also travelled extensively in many other parts of the world increasing his considerable knowledge of the arts and sciences in many areas.

When Stuart's eyesight failed he moved to Chelsea He remained extremely busy in his last years, maintaining an active social life and creating a lovely roof garden. Despite being unable to read, he kept up-to-date with scientific Journals and also wrote the memoirs of the first half of his interesting and eventful life. He is survived by his two daughters and six grandchildren.

MK AEMW RJPC

COLONEL T WRIGHT CBE, BA

Born 10 November 1906, died 7 January 1989 aged 82

COLONEL WRIGHT was educated at Dover College, the RMA Woolwich and St John's College, Cambridge.

He was commissioned into the Royal Engineers in February, 1926. After serving four years at home in the 56th Field Company RE and the Training Battalion RE he went to India and joined the 3rd Field Company of King George V's Own Bengal Sappers and Miners. He served with this unit on the North West Frontier, in Roorkee and Malaya until 1941. In 1942 he was appointed CRE 15 Corps Troops, seeing service in Arakan, Bengal and Assam until 1944, when he became CRE 7th Indian Division. In 1945 he returned to India to command No 6 Mechanical Equipment Training Depot. Of his time in Burma SEMG writes: "Seen through the eyes of an irreverent platoon commander Tom Wright, the CRE of 7th Indian Division, was the epitome of the reserved, courteous Englishman. However his shy, self effacing manner concealed a strength of purpose that brought firm loyalty from those who served him. In return he gave back loyalty

and complete support to the officers of his Divisional Engineers." And IHLG writes: "He was a fine leader who set high standards and I had the deepest respect for him. He was a thorough professional and perhaps the highlight of his military career was organising and directing the engineer side of the successful assault crossing of the Irrawaddy at Nyaungu in February 1945, the vital prelude to General Slim's masterstroke at Meiktila."

From 1946 until 1948 he served first as ADFW in the War Office and then as a CRE Works. He then went to Kenya where he served some two years as a CRE at Nanyuki and MacKinnon Road. He moved to the Canal Zone in 1950 to be DDES at GHQ MELF until 1952 when he returned home to command, in turn, 26 Construction Group RE (TA) and 1 Engineer Stores Depot. He was appointed OIC RE Records in 1956.

JCW who served with him in India, where they both took part in the Mohmand operations, and later in Kenya recalls: "In his prime Tom was tall, handsome, very athletic and cut a fine figure. In character he had many of the old knightly qualities - absolute integrity, a high sense of duty, great energy and the will to have things done well. He was a good organizer and had evident confidence in his own men and what they could achieve. He expected high standards in everything.

"Tom was my model of what a good field company commander should be. He was always honest and fair. He made his men work hard continuously. He knew all the details of company administration and somehow always had the right men in the right jobs. He understood the Indian sapper's character and capabilities and they in turn admired and worked willingly for him.

"I shall always treasure the memory of my service and friendship with Tom. He was such a good man - upright, unselfish, thorough in all he did, rather reserved in manner, generous and utterly reliable. He was an example of the best type of pre-war regimental officer. He had a good brain and might have had a career with wider experience, but he preferred to serve always with troops."

RRLH writes, "As CRE 7th Indian Division in Burma, 'old Tom' (then about 38!) was a fine, firm and fair leader who through his own high personal standards inspired his subordinates to give of their best."

JCW SEMG IHLG RRLH

BRIGADIER R A G BINNY CBE BA FICE

Born 26 November 1908, died 8 June 1989, aged 80

ROBERT ANGUS GRAHAM BINNY, the son of Graham Binny, a well-known Scottish water-colour artist, "Nap" as he was generally known, was brought up in Edinburgh and educated at Cheltenham and Trinity Hall, Cambridge, where as well as being a first class rugby player, he represented the University at ice-hockey. He was commissioned into the Corps on 18 September 1929, completing his engineering training at the School of Military Engineering, Chatham.

His first appointment was with the 1st Field Squadron RE at Aldershot. Whilst there, by a long way the youngest bachelor officer in the RE Mess, he got married; but it did his career no harm.

During this time while the Squadron was being converted from an untimely horsed unit into a mechanized one, he took full advantage of the local facilities for fox-hunting, an interest he maintained throughout his Army life including a spell as Master of the Quetta Hounds, which he

Brigadier R A G Binny CBE BA FICE

hunted for three seasons, and running the Fayid Garrison Saddle Club in 1955. He was also a keen polo player.

After a year as a Garrison Engineer in Scotland, he went to India in 1935 and joined the Royal Bombay Sappers and Miners with whom he served more or less continuously until 1945, finishing up as CRE 20 Indian Division in 14th Army, including a short spell with the second Chindit expedition. In 1945 he went from Burma to Indo-China after the Japanese surrender where the 20 Indian Division was engaged in restoring French authority against vigorous opposition by the local Annamite nationalists. Here his fluency in speaking French was a great asset. The situation was, however, very unstable and restoration of the facilities in Saigon was finally achieved by the employment of surrendered Japanese sappers. He was awarded the CBE in 1945.

On returning to England in 1946, Brigadier Binny spent a year as CO 11 SME Regiment, and then went on a Long Civil Engineering Course. He then spent two years as CRE Shoeburyness, followed by another two as Chief Instructor of the Electrical and Mechanical School at the SME.

From there Brigadier Binny went on a special engineering course and after commanding the Engineer Base Group in the Canal Zone for a short period was appointed Chief Engineer, Home Counties District. His last appointment was Chief Engineer, Eastern Command until his retirement in 1961.

After retirement he took up an appointment with Christiani and Nielson, the Danish civil engineers with world-wide interests.

He and his wife finally retired to the charming village of Skilgate on the edge of Exmoor.

Nap Binny was known as a meticulous and able officer of great charm. He had a spirited and adventurous approach to life, a marked sense of humour and an artistic sense to add to his professional engineering competence and interest in athletics and sport.

He is survived by his wife, a son and three daughters.

WGF ECNM TR LJH

COLONEL G C L ALEXANDER OBE TD
FIMechE FBIM TN

Born 12 May 1912, died 21 July 1989, aged 77

Colonel G C L Alexander OBE TD

GRAHAM ALEXANDER was educated at Cheltenham College and joined the Great Western Railway in 1929 as a trainee civil engineer. A member of the OTC at school, he joined the TA (Royal Signals) in 1934 and a year later was commissioned in RE Searchlights. He was called up for active service in July 1939. At this time, searchlight units were gradually being transferred to RA and Graham was rebadged as a gunner.

In 1941, whilst commanding a searchlight unit in Egypt, he was required to transfer to RE Transportation, first as Deputy Assistant Director of Transportation, Palestine and Transjordan and then in a similar position in Syria. This brought him active involvement in a number of major railway construction projects, including the Haifa-Beirut-Tripoli railway and large scale depot construction in Syria and the Lebanon. It was typical of Graham's sense of loyalty that, whilst enthusiastically transferring to railway work, he insisted on wearing his gunner badges for the rest of the war.

By 1942 he was in India where he formed and trained a railway construction unit and took

it to Assam. The Bengal & Assam Railway provided the key element in the line of communication supporting the 14th Army, the Ledo Road and the airlift into China from airfields in north-east Assam. The railway had to be maintained under difficult conditions and its capacity greatly increased. In 1944, at the age of 32, he was promoted to lieutenant colonel and took command of 9 Railway Construction & Maintenance Group which comprised a railway survey company, two railway bridging companies, seven railway construction companies together with over 10,000 native labourers, pioneers and contractors. Despite the trying conditions, life in Assam had its lighter moments. Graham's headquarters were alongside a railway station and one day the camp woke to an awful commotion in the station yard. Three wagons full of goats, consigned to Major Alexander Sahib, had been detached from the local freight train. Investigation revealed that the animals were 'baksheesh' from one of the earthwork contractors. Needless to say such a gift was neither acceptable nor desirable and both contractor and goats were quickly despatched out of the area. Nevertheless, the story of Alexander's goats lived on in the theatre for some time.

Returning home in 1945, he was given a regular commission in the Corps and attended the long Transportation course at Longmoor. In July 1949 he took over command of 10 Railway Squadron in Egypt and during the next three years re-established it as one of the Corps' regular railway units. At the same time he greatly expanded its role, bringing out of mothballs a number of ex-LMS Class 8 locomotives to work military trains within the Canal Zone. The high standards he set greatly impressed the Egyptian State Railway people; something that proved very useful when, after abrogation, he was promoted to command the Middle East Transportation Regiment and took over the operation of the whole of the railway system in the Zone, keeping trains running in the face of frequent sabotage and attack. For this work he was appointed an OBE.

Back in the UK in 1952, he commanded 11 Regiment at Chatham before going to Longmoor, first as CO 16 Railway Training Regiment and then as Chief Instructor. From 1955 to 1959 he was head of Transportation Services in BAOR and Transportation Advisor to Northern Army Group; this latter brought him membership of various working parties on land transport at NATO Headquarters as well as close contact with the Deutsche Bundesbahn.

Returning for the last time to the UK, he was promoted to command 1 Railway Group, responsible for military railway work in depots and ports throughout the UK - at that time still a major undertaking with over a thousand civilian employees. From there he went to the War Office as Colonel E4 (TN) and Head of Transportation Services under the EinC, where one of his tasks was to see through the first stages towards the creation of the Royal Corps of Transport. On retirement, he continued his railway work with contractors engaged in construction and maintenance work on the Southern Region of BR as well as finding time to give active support to his local railway society in Ruislip.

Graham Alexander was one of the outstanding military railwaymen of his generation. A man of determination and strong moral courage, he had the ability to drive and to get results and at the same time to inspire respect and indeed affection from those who served with him. He is survived by his wife, Jan, his son Robin (a regular officer in the Corps) and his daughter Jennifer. To all the family we extend our deepest sympathy.

FJJP MW CFR

BRIGADIER J C B WAKEFORD

In the memoir for Brigadier J C B Wakeford CMG, printed in the August 1989 issue of the Journal, the date of death was incorrectly printed as 13 October 1988, it should have read 31 March 1989.

We apologize most sincerely for this error.

BRIGADIER J F GODWIN CBE BA

Born 20 March 1906, died 16 February 1989, aged 82

JAMES FREEMAN GODWIN was educated at Lancing and The Shop and commissioned into the Corps in 1927. After commissioning, he went up to Cambridge where he was at Jesus College and is affectionately remembered as an even tempered extrovert, full of jokes and good fun.

The early years of his service were all spent in India. He served with the Madras Sappers and Miners in Bangalore and Sialkot before the war and commanded 15 Field Company in Singapore from 1939 to 1941 before returning to the Staff College at Quetta. 15 Field Company was one of the first selected for "Indianization" and all four subalterns were Indians. They included such distinguished names as Partap Narain, R K Kochhar, M G Bewoor and A N Kashyap. After a year with Air Support Control in Poona and Baghdad he was appointed GSO1 (Ops and Plans) HQ 10 Army in Baghdad, he returned to India in 1943 as GSO1 Plans Indian Expeditionary Force at Poona from where he went to Algiers, attached to HQ 7th(US) Army. By 1944 he was back in Asia as Colonel GS (Ops, Plans and Air) for the final stages of the war and returned to England in 1946 to take up a Colonel's appointment in MI1. He was not to return to India. After a year on the Directing Staff at Latimer a number of senior staff appointments followed in the Ministry of Defence, SHAPE and in the Cabinet Office War Plans Secretariat. His final appointment before retirement in 1959 was as BGS Intelligence HQ BAOR. He was appointed OBE in 1945 and CBE in 1959.

Godwin was a highly active man with a love of sport. He played polo and golf to a high standard and had a natural aptitude for flying which he put into good practice obtaining a civilian pilot's A Licence and using his skills to good effect for engineer reconnaissance during the war years. He took up sailing after the war to fit his interests better to his family life owning a 10 ton Gauntlet sloop. Among his other talents were a gift for good writing and talent for playing the piano.

He maintained his active life after retirement from the Army. He was Personal Assistant to the Managing Director of Slough Estates and Administrator of Slough Industrial Health Service from 1959 to 1971. During that time he also undertook many voluntary commitments in the local community including the chairmanship of the Buckinghamshire Playing Fields Association and Council for voluntary Services.

His wife, Peggy whom he married in 1934 died in 1987 and he leaves two sons.

BSA REJ

Brigadier J F Goodwin CBE BA

COLONEL J L NICHOLSON OBE BA

Born 1 October 1913, died 22 August 1989, aged 75

JOHN LOTHIAN NICHOLSON was educated at Wellington and The Shop. His first overseas posting was to Singapore and the invasion by the Japanese found him organizing supplies of explosive to the III Indian Corps, a frustrating task performed with great energy. At the capitulation, he escaped to Sumatra where he was appointed to organize the escape route, then in considerable chaos, seriously delaying his own departure. For these services he received the OBE, one of the very few awards made for this campaign. Finally he sailed for India in an ancient junk with no navigational aids except the Pole Star and had made good progress until intercepted by a Japanese Supply Tanker.

As a POW he was sent with most other RE officers to Taiwan where he became desperately ill with malaria, beri-beri, dysentery and sprue. With no drugs and his weight down to four stone, his recovery can only be ascribed to sheer determination.

Life in a POW camp had the effect of magnifying the traits, good and bad, in everyone's character and few carried as much respect and affection as "Nick" - always cheerful, realistically optimistic, ready to help others and, incidentally, boosting morale by operating a clandestine radio.

After the war he continued in the Service, attended the Staff College and successfully held various appointments until his retirement as Colonel. His subsequent business career was equally successful.

John Nicholson was a man of wide interests: military history, genealogy, sailing, philately, bridge and golf to name but a few. He was a keen and useful cricketer, keeping wicket for the Corps on many occasions.

He died after a long and trying illness, a legacy from his wartime experience, patiently borne, and will always be remembered with great affection by his many friends. He leaves a widow, a son, a daughter and grandchildren.

JMM

Colonel J L Nicholson OBE BA

MAJOR-GENERAL J C WALKEY CB CBE

Born 18 October 1903, died 6 October 1989 aged 85

WHEN Major-General John Christopher (Chris) Walkey was Engineer in Chief at the War Office, 1954-1957, his Rear-Admiral brother Howarth Seymour (Bob) Walkey was also concluding a distinguished career, in London. Their slightly adventurous choice of calling was perhaps only to be expected for, as boys, they were the first two of an entire generation to be thrilled by *Yo! Ho! For the Spanish Main!* and a whole series of books in the same vein by their father, Samuel Walkey. As a bank manager at Penzance, and later Newton Abbott, he devoted his spare time to writing boys' adventure stories.

Chris was born in 1903, his school being Newton College, Devon, whence he passed into the Royal Military Academy, The Shop, in September 1921. After commissioning he was posted to India, joining the Bengal Sappers and Miners. He spent six years with them, as a field company officer, serving at a variety of stations throughout northern and north-western India; taking part in the frontier campaign of the Kajuri Plain 1930; and finally scandalizing his commandant by opting to transfer to Military Engineering Services. That reputedly lesser occupation engaged him as a Garrison Engineer for a further four years of Indian service, mainly in the trans-frontier areas of Baluchistan.

Those ten years among Indian troops and frontier tribesmen gave Chris ample work and responsibility, but somehow they also fostered his always considerable capacity for enjoyment. "Rather less earnest than the average Sapper", was how he was once described at that time. In an even, well-balanced way he was certainly one of the most cheerful of men; humorous, not witty; philosophical, kindly and reassuring. "It will all pan out", was a lifelong expression of his, followed - one could be sure - by the measures in his power to ensure that it would pan out.

In India, Chris adapted his hockey prowess to polo, his marksmanship to shikar, and generally made the most of life in a part of the world that - in its way - offered rather more than the Spanish Main. Even monetarily it was rewarding enough, for a bachelor, and if Chris did sometimes have to curtail his home leave he readily admitted it was only because he couldn't keep away from a certain very expensive restaurant in Piccadilly, London.

India was followed by an instructorship at The Shop - a highly prized appointment. He was still there when World War Two broke out, but soon found himself across the Channel on the engineer staff at GHQ, BEF. Returning to the United Kingdom in the Dunkirk evacuation he next commanded 7 Field Company. That was from June 1940 until September 1941, when, after a brief spell at the SME in Ripon, he joined the Engineer in Chief's staff.

It was the time of the blitz and the black-out: not at all the London he knew. Still a bachelor he lived at his club, bomb damaged but inhabitable, in Piccadilly: that restaurant knew him often: he endured.

Then, in 1942, to 46 Division as CRE: the Tunisian campaign, the Salerno landings and the first months of the Italian campaign, still with the Division but establishing himself as the obvious choice for Chief Engineer, 13 Corps, when that

Major General J C Walkey CB CBE

appointment fell vacant in December 1943. He held it the length of Italy, and on to Trieste, outstaying three Corps Commanders (Generals Dempsey, Kirkman and John Harding). His CBE came after the Battle of Cassino; he was appointed an Officer of The Legion of Merit (USA) in 1945.

In 1947, after a few months as CRE (Works) in south-west England, he was posted to Washington as Engineer Liaison Officer (Colonel) on the British Joint Services Mission. Returning in 1949 he resumed his wartime rank of brigadier as Deputy Commandant of the Royal Military Academy, Sandhurst. By this time his plentiful fair hair was turning white, adding to the distinction of his square, immaculate figure: his poise and geniality reigned as ever: and, with his long experience of The Shop, he was the very man for this important appointment in the formative stage of the post-war Academy; cadets of his time will remember him to their advantage.

His promotion to Major-General came in 1951, when he was appointed Chief Engineer, Middle East Land Forces. It was already an uneasy situation, and almost as soon as Chris arrived in Fayid the Egyptian Government abrogated the 1936 treaty, withdrawing all labour. Accordingly for the whole of his three years in the Middle East the burden of maintenance of all public utilities in the Canal Zone fell upon the Royal Engineers. In addition intensive planning was going on for the construction of accommodation in Cyprus, Libya and Jordan to receive the forces as they moved out of the Zone. Chris more than earned the CB awarded to him at this time.

In 1954 he was appointed Engineer in Chief. Sailing for England in the ill-fated trooper *Empire Windrush*, which was burnt out and sunk in the Mediterranean, he arrived in London with one suit of clothes, made straight for Savile Row; and promptly established himself as the best groomed member of the War Office. From now on it was always "Your Excellency!" at that Piccadilly restaurant! It would be nice to record that he once more frequented the place; but, alas, not so; inflation had sent the prices beyond the means of a major-general except on rare occasions which Chris perhaps relished all the more for their rarity.

As Engineer in Chief he travelled with zest; a welcome, cheerful, healthful visitor, the mere sight of whom did units good. His brief speeches, simple and direct, had a signal quality of manliness. In closer conclave there was always his good-humoured, authoritative manner of calming troubled waters, or of restoring the perspective, with just a few words, straight to the point: that well-balanced, detached outlook had stayed with him: he was perhaps never taken by surprise, except - he once admitted - by his own elevation: he was essentially modest, delightful as a companion.

On his retirement in April 1957 he set off for his new home at Chagford, Devon, characteristically determined to enjoy a quiet, country life as fully as he had enjoyed his thirty-three years' service.

He married, in 1947, Beatrice Record Brown, who survives him; sadly, their one child, a daughter, died in infancy.

REJ MBA

BRIGADIER J N D DREW CBE

Born 8 June 1912, died 2 January 1990, aged 77

BRIGADIER JAMES NORRIS DREW, was a character whose style and achievements will long be remembered both in the Army and in the Post Office. Educated at Queen Mary's School, Walsall, he entered the service of the Post Office in 1933 as an Assistant Traffic Superintendent (Telephones). Five years later he moved to the postal business as an Assistant Surveyor and very soon afterwards, as an Officer of the Army Supplementary Reserve, he became very much involved in the provision of postal services for the Army at home and abroad.

Known as John or Norris, he was powerfully built and in many respects he was particularly suited to an Army career and he flourished in a military atmosphere. In 1939 he served with the BEF as OC 2 Division Postal Unit, but undoubtedly his outstanding achievement was the planning and implementation of the postal arrangements for *OVERLORD*, in all of which as ADAPS 21st Army Group he played a major part. Field Marshal Montgomery's requirement that postal services between the UK and Allied Forces in Europe should begin to function on *D Day* was a most exacting one, but Brigadier Drew was determined that it should be met in full.

It was this very forcefulness which Norris Drew brought to his work that served him and the Forces postal services so well. Once it was demonstrated that something needed to be done, or that an objective needed to be secured, Norris Drew would go all out to secure it letting nothing stand in his way. After the war he remained in the Army and was later granted a Regular Commission. He was Director of Army Postal Services from 1960 to 1970.

It was during that period Norris Drew took over responsibility for the provision of postal services for the RN and RAF as well as for the Army. This was a long overdue reform. He also took over responsibility for the Forces Courier Service. The Service became part of the regular order of battle for the first time under his stewardship.

He was Mentioned in Despatches 1945, made an OBE in 1945 and appointed CBE in 1964.

In his youth he was a keen rugby footballer and represented both Walsall and Staffordshire; a useful bat, he went on to captain Army cricket XIs. He was a very knowledgeable student of the Turf.

He is survived by his wife, Pamela, a son and a daughter.

BL

Brigadier J N D Drew CBE

THE RAJA OF FARIDKOT

Born 29 January 1915, died 16 October 1989, aged 74

COLONEL SIR HARINDER SINGH BRAR, BANS BAHADUR, KCSI was the last in a long line of Rulers of Faridkot State going back to the days of the Mogul Emperors. They were remarkable for their interest in the Army and their consistent loyalty to the British Crown. His great-grandfather was given the title of Raja in 1846 on the conclusion of the 1st Sikh War and that of Bans Bahadur in 1858 after the Indian Mutiny, when troops from Faridkot kept open the vital bridge of boats over the river Sutlej, thus enabling reinforcements and heavy artillery to be brought down from Northern India to the Siege of Delhi. His grandfather was appointed Farzand-i-Saadat in 1879 after the 2nd Afghan War, and his father was granted the personal title of Maharaja in 1918 in recognition of the services of the Faridkot Sappers and Miners in East Africa.

Harinder Singh succeeded to the *gaddi* on 23 December 1918 when a small boy and he was brought up by English governesses and tutors which resulted in his impeccable English. He even enjoyed the Times crossword puzzle.

After attending the Princes' College of Lahore he was gazetted Hon Lieut and attached to the Royal Deccan Horse in 1936, where he learnt to play polo, and then Hon Lieut in the Sikh Regiment after his services in the Waziristan Operations of 1937. Two field companies of the Faridkot Sappers and Miners took part in the campaigns in Burma in World War Two and were remarkable in that they were able to retain their peacetime minimum height of 5ft 8ins. After World War Two he was honoured with the KCSI.

Faridkot House in New Delhi, an elegant Palace standing in eight acres of grounds, was lent to Lord Mountbatten on his first appointment as C in C of SEAC, but after Independence in 1947 was taken over as government offices. The Raja also lost his title but was quite undaunted and converted the 105 servants' quarters to his own use, with air-conditioning and nice furniture. Here he enjoyed entertaining VIPs from many countries. He had another house in the Simla hills and from there used to drive a powerful motorbike up mountain paths with his Rani on the pillion.

He kept up his close interest in the Army and, after playing a key role in the re-raising of the Sikh Light Infantry during World War Two, built up their morale over the next five decades. He was Hon Col of the Bengal Sappers and Miners and the Sikh Light Infantry for more than 30 years, attending a parade at Roorkee in November 1988, just before the onset of his last illness.

He was cremated at Faridkot with full military honours. He was predeceased by his wife and his only son but his mother the dowager Rani of Faridkot is still alive, and he leaves two daughters, the elder of whom is the Maharani of Burdhwan.

He will be remembered with affection by those sapper officers who served with his field companies in Burma.

WGAL

The Raja Of Faridkot

LIEUT COLONEL A J HARBY DSO OBE TD

Born 29 August 1906, died 27 October 1989, aged 83

ARTHUR JAMES HARBY, known to his many friends as George, was born in Dover on 29 August 1906. He was devoted to his parents, Travers and Maud Harby who lived at Cranbourne, Castle Avenue, Dover, Kent, which is still the family home. He was educated at Sherborne School, and at Jesus College, Cambridge, where he took his degree in engineering. He had a life-long affection for his college, and attended college reunions right up to his penultimate year.

It was here that his talent for rowing was discovered and developed. He was privileged to be coached by the legendary Steve Fairbairn, and represented his college at university and national level, winning the Grand Challenge Cup at Henley Regatta in 1930 and 1931, under the colours of London Rowing Club.

The climax of his sporting career was in 1930 when he rowed for Britain in the Empire Games at Hamilton, Ontario. He either participated in or attended as a spectator, every Henley Regatta from 1925 to his death.

He held several posts as a consultant civil engineer before the outbreak of the Second World War in 1939. The outbreak of war in 1939 marked for George the start of a new and distinguished career. He was lucky to be evacuated from Dunkirk and, later, saw active service in Egypt and, most importantly, in the construction and rebuilding of the bridges and roads that enabled the Eighth Army to move through Italy. At the end of the war he had attained the rank of lieutenant colonel and was awarded the DSO and OBE. One of his fellow officers once remarked that he had never met a man who was so determined to win the war; and yet he approached the serious business of soldiering with a wry sense of humour, typical of the generation to whom we must be eternally grateful for preserving our present liberties.

After demobilization, he moved to South Wales where he eventually became Traffic Manager of the Steel Company of Wales, enduring with fortitude and patience, frequent changes in political policy in the steel industry. He was always a wise and sympathetic manager of men and gave of his time unstintingly, frequently in the middle of the night, to resolve dangerous strikes and disputes. He was loved by all those who worked with him; the many representatives of the companies and businesses with whom he dealt. This was amply demonstrated by the gifts that he received and valedictory parties given in his honour when he retired to his father's home in Dover in 1968. The arm chair, which he used for the last remaining 21 years of his life, was given by his friends in British Rail, who described him as "almost a railwayman".

He was now free to engage in his two favourite hobbies, gardening and photography. In the early years of his retirement, he was able to combine this with a series of extensive tours, including South Africa, Australia and the Far East, visiting friends, relatives, wartime sites and comrades. The last of such trips was in 1982. He shared with his wife, Mary, a passion for adventure and travel, and a love of beauty and goodness. He was a devoted father and grandfather, and an exem-

Lieut Colonel A J Harby DSO OBE TD

plary husband. He retained to the end an almost schoolboy zest for life. He loved to stay with his daughter and her family in Ireland, and enjoyed the sporting facilities available there. He was no mean shot either, and carried a gun up to his last year of life.

He is survived by his wife, Mary, a son and a daughter. *GNH*

LIEUT GENERAL SIR WILLIAM STRATTON KCB CVO CBE DSO

Born 15 October 1903, died 25 November 1989, aged 86

LIEUT GENERAL SIR WILLIAM STRATTON KCB, CVO, CBE, DSO, who died on 25 November at the age of 86, was one of the select band of Royal Engineer officers, trained at the Royal Military Academy, Woolwich, who did so much to help the development of our colonial territories between the Wars, and then went on to excel as commanders and staff officers during the Second World War and its aftermath.

William Henry Stratton was the son of Lieut Colonel H W Stratton, OBE, and was born on 15 October 1903. He was educated at Dulwich and The 'Shop', and was commissioned into the Sappers in 1924. Throughout his life he was respected as an able, straightforward soldier, whose honesty of purpose and constructive approach impressed all who met him.

He was sent to the Gold Coast in 1927 where he was initially responsible for the survey of the major road development programme in progress at that time; he later served with the Colony's Public Works Department, supervising the construction of many hundreds of miles of new roads upon which the economy of Ghana still depends.

He was selected for the Staff College, Camberley in 1938, and had the good fortune to be one of the students sent on attachment to the German Army in August 1939! After visiting the German Infantry and Panzer Schools near Berlin, he was sent to the 24th Infantry Division, and was present during what turned out to be its last exercise before war was declared. He had indeed taken part, quite unknowingly, in the final rehearsal for the invasion of Poland! On his last night in Germany he dined *en famille* with General Olbrecht, the 24th Division's commander. Olbrecht was later implicated in the plot to assassinate Hitler in July 1944 and was executed.

During the War, Stratton rose rapidly from major to Brigadier General Staff (Training) at GHQ Home Forces, responsible for planning the major exercises for troops destined for the Allied landings in French North Africa and the invasion of Normandy. He himself saw service in neither theatre, but was sent instead to the Mediterranean in September 1944 to take command of 169th Infantry Brigade of 56th Division in Charles Keightley's 5th Corps in Italy just before Alexander moved 8th Army secretly across the Apennines to attack the

Lieut General Sir William Stratton
KCB CVO CBE DSO

Gothic Line on the Adriatic side.

Stratton's brigade led 56th Division's successful breaching of its sector of the Gothic Line, and went on to play a prominent part in the battles of Monte Gemmanano, Ceriano, and Savignano, which brought 8th Army into the sodden water-logged plain of the Romagna. He then fought his brigade over its many river lines until winter brought the fighting to a halt on the River Senio. For Alexander's final offensive in April 1945, Stratton's brigade was specially equipped with the amphibious Landing Vehicles Tracked (LVTs), in which they carried out the vital turning movement across Lake Comacchio to out-flank the German defence of the Argenta Gap. His success led to the British break-through and destruction of German Army Group 'C' on the banks of the River Po. His brigade then led 5th Corps' crossing of that great river at the start of the final advance to Trieste. He was awarded the DSO for his services in Italy.

Immediately after the War, he spent a short time as a Major General in Australia, and a year at the Imperial Defence College before becoming Chief of Staff, BAOR in 1947. He was one of the first commandants of the Joint Services Staff College, and then went to Washington as Head of the British Joint Services Mission in 1952 at the time when NATO was being formed.

After commanding North-West District and 42nd Lancastrian Division, his career came round full circle when he was appointed Commander British Forces in the Colony of Hong Kong in 1955. Two years later he joined the Army Council as Vice-Chief of the Imperial General Staff just as Duncan Sandys was carrying out his 'Big Bang' Defence Review, which made nuclear weapons the basis of British Defence policy, and thereby enabled the Macmillan Government to end National Service. He was Field Marshal Hull's right hand man in arguing the operational case for a regular army of adequate size in the nuclear era. History suggests that they arrived at a very sensible shape and size for the Army, which has stood the test of time.

Stratton retired from the Army in 1960. He spent two years as Inspector General of Civil Defence before joining Babcock-Wilcox as Chairman of three of their subsidiary companies. He retired finally in 1971.

He married Noreen Mabel Brabazon, daughter of the late Doctor F H B Noble of Sittingbourne, Kent. They had no children. Noreen survives him. *WGFJ*

Memoir in Brief

A Brief Memoir is published below on a distinguished man whose death has been notified recently in the national press and who served in the Royal Engineers during World War One.

T C Nicholas OBE MC died on 13 November 1989, aged 101. He was a geologist and senior Fellow of Trinity College, Cambridge where he served as Senior Bursar for 27 years.

In 1914 he had been a Research Fellow at Cambridge but in 1915 was sent from the War Office to join the staff of the Dardanelles expedition as Map Officer. In Cairo he met T E Lawrence who, while disapproving of the operation, agreed to take charge of all the map printing required in Egypt. Returning to England on leave in 1916 he was transferred to the Royal Engineers and joined 5 Field Survey Battalion on 1 July for the Somme Battle during which, on a few occasions, he was sent to take panoramic photographs from the front line. He was awarded the MC. In 1917 the unit was moved to Flanders for the Passchendaele Battle and in January 1918 to the then quiet St Quentin Front.

In 1918 he was made an OBE and promoted Lieut Colonel before being demobilized and returning to Cambridge.

Correspondence

Helicopter Minelaying

From Major General F W E Fursdon CB MBE

Sir, - I was delighted to read Major Bailey's article in *THE ROYAL ENGINEERS JOURNAL* of December 1989 about minelaying by helicopter - a subject which Captain J J Miller of his Squadron had previously written about in *THE SAPPER* of June 1989 under the heading 'A New Concept'.

My particular pleasure lay in the fact that Major Bailey's 51 Field Squadron had resurrected and further developed a concept first tried out in the UK by the RE Team at the School of Infantry, Warminster, in February 1959 - over thirty years ago! Using a RAF Wessex helicopter, and flying just a couple of feet up, we laid our specially camouflaged mines directly onto the ground surface by free drop. We used another Wessex to ferry mines forward to us in bulk, using an underslung net.

Having excitedly briefed the SME (as it then was) at Chatham of our unofficial trials, the Field Engineer School - under Lieutenant Colonel Roddie Harradine - very willingly embraced the concept and developed a mine chute which worked well. Photographs and details of the School of Infantry trial and the SME mine chute, together with discussion of the future tactical implications of minelaying by helicopter, were subsequently published in an article in the United States's *THE MILITARY ENGINEER* of September 1959: and later republished in the Journals of both the Canadian and Norwegian Army Engineers. Sadly, despite all the SME and School of Infantry effort that had been put into these stimulating trials, Army interest in the concept just faded away to nothing. It is therefore marvellous to see helicopter minelaying re-born with 51 Field Squadron, and I only hope that they will be more successful in their endeavours than we were.

The concluding paragraph of *THE MILITARY ENGINEER* article ran as follows:

'From this assessment, the enormous advantage of the technique is apparent. Many of the drawbacks are capable of solution, given the time, money and development work needed. As they are solved, they will enhance the already preponderous advantages. It must, therefore, be recommended that - within the obvious tactical limitations - helicopter minelaying be accepted as a proper mine warfare technique available to the Army. It is also recommended that future mine designs be suitable for the helicopter technique of laying. This affects fuse design, arming systems, physical shape, weight and camouflage. If these two principles are accepted, the ideal mobile minefield will one day become a reality.'

Will it? One just wonders ... and hopes ... - Yours, Edward Fursdon, *Elm Tree Cottage, Ridlands Lane, Oxted, Surrey, RH8 0TU.*

Reviews

PROJECT MANAGEMENT IN CONSTRUCTION
Second Edition
ANTHONY WALKER

Published by BSP Professional Books, Osney Mead, Oxford, OX2 OEL - Price £21.95
ISBN 0-632-02517-4

A Book for Students and potential project managers in construction.

The book is designed to promt those involved to re-examine, analyse and correct the organizational structures used. The foundation of the book uses the systems approach to management from which central ideas pertaining to the construction industry can be applied. The text concentrates upon the way in which the people involved in projects are constituted, their interaction and coordination, and the resulting decision-making process, which forms the basis of effective project management. The new edition has a new chapter on project leadership where case studies are analysed against the theoretical model.

The chapter on clients has also been revised taking into account recent work in the area.

SPS

THE TECHNOLOGY TRAP - SCIENCE AND THE MILITARY
TIMOTHY GARDEN

Price £16.95 UK, $24.00 overseas
ISBN 0-08-036710-0

This book, written by a serving officer in the RAF, has much to recommend it. It is a slim book, but it still manages to contain within 137 pages a comprehensive and wide-ranging look at how modern technology has been and can be applied to present and future warfare. The book provides a brief history of land, sea and air warfare, an examination of current technology areas such as chemistry, materials and nuclear physics, and a useful summary of how these technologies might be used in future sea-air, land-air and space battles.

Faced with the requirement to contain the whole of modern technology within 137 pages, the author has been forced to cut corners with his arguments, and leave many questions unexplored. He has a natural bias towards the weapons of his own Service, which occasionally leads to contentious treatment of other areas - I would for instance have liked to have seen a closer examination of the role of the anti-tank helicopter in the Land-Air Battle.

That said, this book is good background reading for those needing an outline introduction to military technology. The technology trap is with us - indeed we have been caught by it ever since warfare began. This book may help officers, and especially those not inclined towards technical matters, to understand that tactics and technology are inextricably linked, and that the understanding of the military craft requires a study of both.

PMB

BOOK NEWS FROM INSTITUTION OF CIVIL ENGINEERS

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December 1989 Journal Awards

The Publications Committee announces the following awards for articles of special merit published in the December1989 *Journal:*

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by Major W A Bailey - **£60**
THE KORUP BRIDGE
by Captain J E B Lockyer - **£50**
ARMOURED ENGINEER VEHICLES - HAVE THE GERMAN ENGINEERS GOT IT RIGHT
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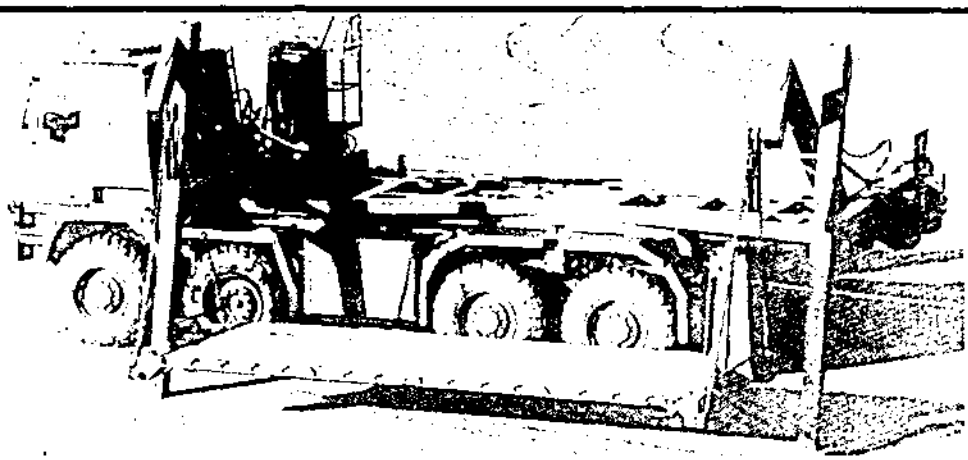

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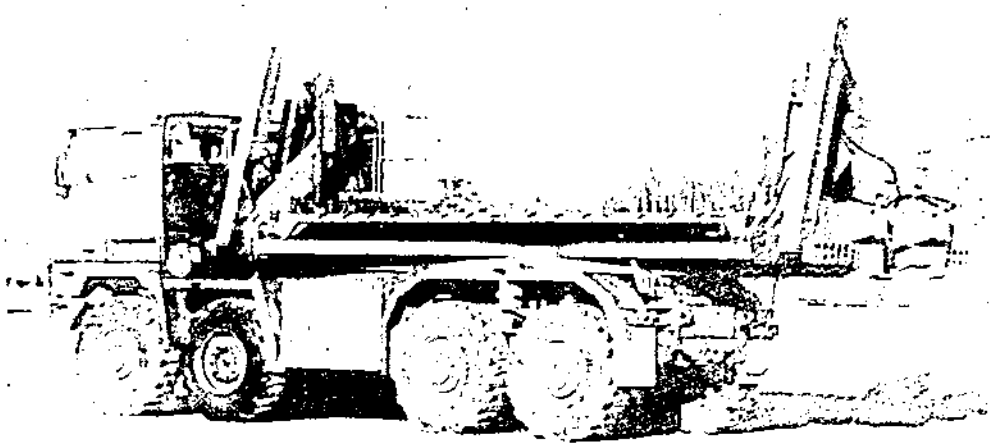

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