THE ROYAL ENGINEERS JOURNAL

DECEMBER 1994 VOL 108 NO 3

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 well written and interesting.

Length. Normally approximately 4500 words (ten A4 pages **double line**) + illustrations. Good blockbusters can sometimes be serialized.

Clearance. The author must clear his/her article with his/her CO where applicable.

Copy. Ideally text should be double space typed and include the author's pen picture, photo and captions for artwork.

Computers. Articles saved as Wordperfect 5.2, Microsoft 5, or ASCII files, on a 3.5in DOS floppy disc, are welcomed.

Photographs should be black and white if possible. Coloured photographs rarely reproduce well unless they are of good quality with sharp definition.

Line Drawings should be drawn in proportion with the page size (145mm x 205mm).

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

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

Contributions should reach the Editor by:

17 February for the April 1995 issue
Early June for the August 1995 issue
Early October for the December 1995 issue

Submissions before the deadline will be particularly welcome.

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Contents

Editorial

"Editors are unaccountable in their judgements."

HAVING never ever submitted an article for publication in the *Journal*, I find myself in the position of editing "other men's flowers" with some apprehension and not a little awe. It is in fact rather easier than I had imagined. Quite apart from relying extensively on the knowledge and experience of our Assistant Editor, Juliet Scanlan, without whose efforts the *Journal* would never get published, there are some excellent articles being submitted and very little in the way of editing, as such, seems necessary. Even so, my constant companions are "The Collins English Dictionary" and "The Complete Plain Words" by Sir Ernest Gowers.

An enduring feature of the Corps, despite the great changes which have been experienced over the past year, is that the varied and busy life in field units goes on as usual. And with no let up! A flavour of this is reflected in the pages of the *Journal*. Understandably though, there has been an emphasis during this year on some fascinating articles on World War Two, more of which appear in this issue. For those looking further into the past, there is much to enjoy in reading Colonel Bill Adams' article on military engineers in India, Colonel Tom Foulkes' article, *A Walk with Heroes*, and Major John Hancock's article, *T W J Connolly – The Man*. And for those wanting to keep up-to-date on current engineer operations, the two articles on Bosnia give an interesting view from different levels and perspectives. There is much else besides to savour, but perhaps I can be permitted to single out *Cheh Inch Ageh* by Colonel Perceval-Price – not to be missed by those who draw some comfort from knowing that things can go desperately wrong for even the best of us.

You may have noticed some changes to the officers of the Council of the Institution. We bid farewell to our President, Major General Geoffrey Field, in mid-December, when he hands over to our new Engineer in Chief, Major General John Drewienkiewicz (whose profile appears opposite). In September, we said farewell to the previous Editor, Colonel Robbie Reive, who has moved on to pastures new in Pembrokeshire. We welcome two recently elected members of Council, Brigadier Geoff Hyde and Major Tim Grimshaw.

On membership matters, the take-up of associate membership by warrant officers has been encouraging and the number in this category seems likely to continue to grow. Honorary associate membership has been extended to the Chief Engineers of the armed forces of the nations in ARRC. The response has been very enthusiastic, which can only lead to even better understanding and cooperation between our Corps and the military engineers of our allies.

Looking back over the years, I wished that during my career I had read more extensively the articles which appeared in the *Journal*. At the time, I used to skim through them, choosing to read the occasional article which caught my eye. Should you have ever read this far, I would urge others like me to spend a little more time and perhaps make a little more effort to read further. You will be well rewarded.

Engineer in Chief

MAJOR GENERAL JOHN DREWIENKIEWICZ MA

MAJOR General John Drewienkiewicz (known as DZ) is to assume the appointment of Engineer in Chief (Army) on 15 December 1994. His name stems from his Polish father, who was a sergeant in the Polish Parachute Brigade during the Second World War, and who subsequently settled in England. Born in Stamford in 1946, DZ was educated at Stamford School. An army scholar, he entered Sandhurst in 1964. On his first appearance on Old College Square he was detailed to sweep up horse manure. Thirty years later, in the Ministry of Defence (MOD), only the location has changed.

After Young Officer training at Chattenden, his first tour with soldiers was in Osnabrück with 7 Field Squadron, then in 2nd Division Engineers, under the watchful eye of Lieut Colonel W G H Beach, MC. Returning to UK, he spent three carefree years at Sidney Sussex College Cambridge, reading Mechanical Sciences.

He returned to regimental duty as a troop commander in 38 Engineer Regiment and, in early 1971, was deployed to the Persian Gulf to support 1 Staffords. His troops were spread thinly with a small number at places such as Bahrain, Sharjah, Masirah and Salalah, keeping him busy on a series of construction tasks over a 900-πmile wide parish. Luckily he had an outstanding pair of senior NCOs, who set the standards which have guided him throughout his career. Returning to Ripon just in time for winter, he was again sent forth, this time to Royal Air Force Wildenrath to support the Harrier force.

In 1973 he moved to 36 Engineer Regiment in Maidstone, as Adjutant. A frustrating period followed, since the Regiment was mainly a mounting base for squadron deployments. However, there was the satisfaction of a month-long stint of public duties in London in 1974, then only the second time the Corps had mounted a Palace Guard; as that episode closed, Her Majesty's Prison, Maze, was burned down in a riot, and the regiment deployed to Northern Ireland to rebuild it.

In 1975 DZ moved to the MOD, Stanmore, to become the Staff Captain AG7. A fascinating tour followed, where he came into contact with a wide cross-section of the Corps, and gained many insights into officer manning and recruiting, leaving with great reluctance in late 1977 to go to Staff College .

Engineer in Chief p253
Maj Gen J Drewienkiewicz

On completion of the staff course he was posted to HQ 3rd Armoured Division in Soest in late 1978 as Deputy Assistant Adjutant and Quartermaster General (Operations). His office had no windows and in the winter he would go days without seeing daylight. However, this was the time of the *Spearpoint* Series of British Army of the Rhine (BAOR) exercises and he was heavily involved in setting up and running the logistic umpiring of *Spearpoint 80*. Having found his feet in Germany, it made sense to stay out there, so in 1981 he moved 30 miles down the road to take over 25 Field Squadron in Iserlohn. The squadron bounced from Canada to engineer concentration to divisional exercise and round the cycle again. It was busy but happy, and a very satisfying period.

All good things have to come to an end, and after a short tour in Chatham as the Engineer in Chief's Recruiting and Liaison Officer, he was promoted and returned to the Staff College on the Directing Staff. Having learned thoroughly what he should have learned in 1978, he was allowed to escape in 1985 to Perham Down, to take over command of 22 Engineer Regiment.

The regiment supported 1st Infantry Brigade, and had roles in Schleswig Holstein and Denmark, strongly resembling those of BAOR-based units, albeit with far more constraints on training areas and training time. The two years in Perham Down were split evenly into one year with the regiment broadly together, working up for a major North Atlantic Treaty Organization exercise in Schleswig Holstein, and the second year with the squadrons deployed to Belize, the Falklands, Germany and Norway. In this job he first came into contact with the RE TA.

In 1988 he moved back to the MOD, this time to the Centre as Secretary to the Chiefs of Staff. The main feature of this tour was running the Secretariat on the MOD Arms Control Committee, which moved at a considerably brisker pace, and seemed more relevant, than normal Whitehall business.

After two years in Main Building he was promoted brigadier and allowed to return to the Corps as Commander 11 Engineer Group Minley, responsible for all apprentice, junior and recruit training in the Corps. The job also included the Central Volunteer HQ RE, with over 1000 TA officers and soldiers. On taking over he was faced with a need to train many more soldiers than normal, but within six months all plans were on hold as *Options for Change* was developed in parallel with the Review of the Training Base. Sadly, this led to the demise of the Junior Leaders Regiment RE in Dover, but it was clear that the Corps' training establishment was larger than needed for the post-Options Army.

1992 was spent on the Royal College of Defence Studies Course, during which he researched and wrote a thesis on the training of the TA in 1939 and 1940, a subject which had been neglected before.

Director of Manning (Army) came next, in June 1993, after a spell on the Grove Study into officers' and soldiers' career patterns. As Director of Manning, he had to manage the third phase of redundancy, as well as taking part in the Defence Costs Study.

In 1970 he married Christine, who has managed to combine a career in and around the pharmaceutical industry with the extra demands of being an Army wife. They have two teenage sons. His principal leisure interest is in military history, and he is an avid war gamer.

After three years away he is delighted to be allowed to return to the Corps. His theme is as follows:

> "The Corps is as busy as it has ever been at any time in my service. The new factor is the extent to which the balance between battlefield engineering and construction engineering has shifted. A decade ago we had to take special measures to keep our construction skills honed; we must now ensure that we retain our expertise and place in the all-arms scene. Every commander from troop SSgt to squadron OC will have experienced combined arms tactics, and it is up to them to produce imaginative and challenging training to keep battlefield engineering skills alive. In all this the degree to which the regular and the TA elements of the Corps are interdependent will have to increase; I welcome this, for the mutual benefit to be gained."

Military Engineers in India and the Royal Society

COLONEL M B ADAMS MA FICE

Bill Adams was commissioned from the Royal Military Academy Woolwich in 1936. Thereafter followed Young Officer Courses at the School of Military Engineering, Chatham, Trinity Hall, Cambridge, and the Cambridge Expedition to Spitzbergen 1938.

From 1939 to 1946 he served mainly with King George V's Own Bengal Sappers and Miners in India and Burma. Latter service included tours in Cyprus, Egypt and Libya.

After retirement from the Corps in 1963, he worked with civil engineering contractors and consultants and developed a special interest in graduate and technician education.

WHILST researching for an article[1] for the Indian Army Association on the non-regimental employment of engineer officers in India, covering the period roughly 1750 to 1950, I became very conscious of the fact that an appreciable number of these officers had been elected Fellows of the Royal Society. As this is recognized as one of the highest honours a scientist can attain, I applied to the Institution for a list of names but, perhaps astonishingly, found none existed. The purpose of this article therefore is to attempt to remedy this situation, at least as far as India is concerned; to record the names of those fellows associated with India, and to detail some of their achievements.

Some of the names will probably be unknown to a majority of readers and yet they include some of the most illustrious of our predecessors. I have tried to make the list as complete as possible but apologize for any omissions. I have in no way included any names which are more rightly associated with other areas of the world.

First a few words about the Royal Society. A group of philosophers, who had been meeting on an informal basis since the 1640s to discuss the explanation of natural phenomena, decided, on the restoration of Charles II in 1660, to regularize their affairs. They received royal encouragement and approval and in July 1662 received a charter (subsequently amended in April 1663) with the object of "improving natural knowledge by experiment." The word "natural" was used advisedly to exclude all that was "supernatural". In the 17th century belief in witchcraft was still rife and Sir Walter Scott is reputed to have said, at a later date, that this belief decreased materially after the Royal Society began critical investigations.

The Society has naturally had its ups and downs. Its opening years were full of enthusiasm, but men of science were comparatively rare in the 17th century, money was hard to come by and royal support waned. It was necessary therefore to recruit fellows from statesmen and other educated and well-to-do classes who could support the aims of the Society. For a long time such non-scientific members constituted as much as two thirds of the Society and it was not till 1860 that scientific members were in a majority.

Perhaps, for a period, the original enthusiasm of the founder members was lost; the 18th century was possibly a period of self satisfaction but outstanding Presidents like Sir Isaac Newton (1703-1727), Sir Hans Sloane (1727-1740) and Sir Joseph Banks (1778-1820) ensured the Society maintained progress and that knowledge acquired was used to improve the conditions of human life.

[1] "The Builders" published in the *Indian Army Association Newsletter* April 1992.

Col M B Adams
Military Engineers in India and the Royal Society p255

As might be expected during the 19th century there was great progress and privileged election of non-scientific members gradually ceased. Since the beginning of the present century the Society's aims and policies have been directed wholly to the advance of scientific research.

Turning to India, the end of the 18th century was a period of political disintegration and lawlessness. Central government had lost control over much of the country and the collection of public revenue had dried up. As a result public works were neglected, no new works were constructed and maintenance and repairs ceased. Much of the country is subject to climatic extremes and there is a narrow margin between devastating floods and failure of crops due to drought, either of which leads to severe famine. As a result, as *de facto* government gradually passed into the hands of able Honorary East India Company (HEIC) administrators during the early 19th century, the need for engineers for public works, especially irrigation, roads and later railways, became paramount.

The reasons why these could only be provided by the army are complex and only lightly touched on here. Education of engineers in the UK was slow to develop, compared to on the Continent and in the USA. The great engineers of the Industrial Revolution period came from an apprentice and self-taught industrial science system. The first civil engineering school was not founded till 1840 at Glasgow University, and the Imperial College of Science and Technology (London University) did not open till 1879, although these were followed by other universities.

As far as India was concerned, the Royal Indian Engineering College at Coopers Hill, built to train civil engineers for the Public Works Department, (PWD), opened in 1869.

The three officer Corps' of Madras, Bengal and Bombay engineers were allowed to maintain their peacetime strength at a high level, so that officers, unless actually required for war, could be lent to other government departments and therefore few were employed regimentally in peacetime. Early recruitment was difficult, though where possible, some came from the Royal Military Academy at Woolwich.

Finally a college was opened at Addiscombe, Surrey, in 1809 to train engineer and artillery officers, and it soon expanded to cover the cavalry and infantry as well. The Royal Engineers establishment (now the Royal School of Military Engineering) at Chatham opened in 1812, and both Woolwich and Addiscombe cadets were to receive specialist training there. In practice there were still insufficient engineers, and the shortfall had to be made up from other arms (and especially of course from the artillery which had a common background and in early days were more interchangeable than they would be now).

After the middle of the 19th century the system began to go into reverse. In 1854 the PWD became a civilian department of state (though still staffed almost exclusively by military officers), the Mutiny of 1857 led to sweeping political changes, Addiscombe closed in 1861, and the three Corps' of Madras, Bengal and Bombay engineers amalgamated with the Royal Engineers in 1862. The Sappers and Miners had a major reorganization in 1885 following lessons learnt from the second Afghan war, which reduced the number of officers available for civil secondment and, by the end of the century, colleges and universities both in England and India were producing increasing numbers of civil engineers. Finally, the outbreak of the Great War in 1914 not only led to the cessation of almost all such secondments but produced a demand for civilian engineers to officer the Sappers and Miners. The system never recovered, to the same extent as before, during the final years of British involvement in India.

A quick glance at the Royal Society in 1830 is illuminating. Out of 662 fellows, there were 66 naval and military officers. Other fellows included 10 bishops, 74 clergymen and 63 peers. It is clear, by the number of communications made to the Society at that time, that many of these fellows would probably not be elected under 20th century conditions. Their support, however, both financial and moral was obviously extremely valuable to the Society at the time and it was not till the end of the century that non-scientific elections more or less ceased.

It can now be deduced that at the same time as the Royal Society's policies were leading towards increasing scientific research, military engineers were becoming increasingly regimental and the numbers suitably qualified for election were rapidly diminishing. It therefore seems obvious that, unless conditions change, future elections of military fellows will be rare events.

To conclude this article I have written short memoirs on five of the military engineers of special interest and short notes on another eight I

have been able to trace. No special grading is implied but the five I have chosen for more lengthy study are those with possibly the most varied careers.

Major James Rennell, was born in 1742. Entering the Navy as a midshipman in 1756, he served with some distinction and took an active interest in marine surveying. At the end of the Seven Years War he transferred to the Indian establishment on account of better promotion prospects. In 1764 he was selected by Clive to be Surveyor General in Bengal, with a commission in the Bengal Engineers, and can be seen as No 7 on the list of officers of the Bengal Engineers. He led an adventurous life and by 1777, when he retired to England, had completed a map of Bengal, Bihar and Orissa, as well as the Mogul Empire as far as Delhi and a chart of the Ganges.

He was elected a Fellow of the Royal Society in 1781 and his second great work, the first approximately correct map of India, was published in 1783. In 1791 he received the Copley Medal of the Royal Society. This medal, instituted in 1736, was funded by a bequest in 1709 from Sir Godfrey Copley (a former controller of army accounts). Over the years it has come to be the most important mark of scientific recognition which it is in the power of the Society to bestow and, upon its receipt, Rennell joined some of the most illustrious names in scientific history. From this time on he was constantly consulted on geographical matters and especially by the HEIC. On the return of Mungo Park, the great Scottish explorer, from Africa in 1797, all his materials were given to Rennell who worked out his explorations with meticulous care.

On his death in 1830 he was acknowledged "to be the leading geographer in England if not in Europe for a period of 50 years." He stands out as a unique figure – a calm disinterested man of science and it is no surprise that he is honoured by a memorial tablet and bust in Westminster Abbey, a perhaps unique achievement for a military engineer. I have made no attempt to list his many other achievements outside of India. Rennell is fittingly known as the "Father of Indian Geography."

Colonel Sir Proby Cautley, is next, not a Sapper but a member of the Bengal Artillery. Cautley was employed in the canal department at Saharanpur. The great famine of 1837-38 accelerated the requirement for a Ganges Canal and work started in 1843. Due to the First Sikh War and Cautley's absence on furlough, vigorous prosecution of the project did not commence until 1847 (the same year as the Thomason Civil Engineering College at Roorkee, now the University of Roorkee, was founded and which provided the junior engineers, foremen and overseers for the project). No Sapper who has served at Roorkee has failed to be awed by this fast flowing canal with its massive architectural embellishments, the famous aqueduct which took the canal over the River Solani, and its headworks in the foothills of the Himalayas at Hardwar. Completed in 1854 it was the longest canal in the world with some 568 miles of main canal and 3250 miles of distributing channels.

Two schools of irrigation engineers had developed, one headed by Cautley in the north of India and the other headed by Cotton (later Major General Sir Arthur Cotton) in the south as a result of different geological conditions and environments. Unfortunately, though Cautley's design was magnificent in concept, there were nevertheless errors in detail and in 1863 Cotton was asked to report on the design. He found the bed slopes were too great and masonry falls caused severe scour, and this caused much acrimonious discussion. It should be remembered that both Cautley and Cotton were working close to the frontiers of knowledge at the time as there was no background experience of such major irrigation work design to be obtained from the UK. Further, the original Government of India briefing was extremely confused. In the event the soundness of Cautley's judgement was little short of marvellous and it is no wonder that he is honoured by a memorial in the church at Roorkee, the headquarters of the Bengal Sappers and Miners.

But Cautley's election to the Royal Society may have been due to his fame as a palaeontologist. In the Siwalik Hills, bounded by the triangle Saharanpur, Dehra Dun and Roorkee, he carried out geological research with Dr Falconer, superintendent of the botanical gardens at Saharanpur and aided by two of his Bengal engineer assistants, Baker (later Lieut General Sir William Baker) and Durand (later Major General Sir Henry Durand, the hero of Ghazni and later Lieut Governor of the Punjab.) The Siwaliks are of Tertiary age and the four collected fossils and bones from many extinct animals which were eventually presented to the British Museum.

Lieut Colonel Thomas Montgomerie, is third, a Bengal Engineer, born in 1830, who passed out top of Addiscombe. After working on the Hindustan-Tibet Road with 5 Company of the

Lieut General Sir Richard Strachey.

Bengal Sappers and Miners, he joined the great trigonometrical survey of India in 1852. In 1855 he was selected to undertake the survey of Jammu and Kashmir. In spite of the outbreak of the Indian Mutiny in 1857 and the death a few months later of his patron and great supporter Maharajah Gulab Singh, work never stopped. By 1864 he had completed the survey of 7700 square miles, much of the work being carried out at high altitudes (and including 1400 square miles of glaciers). He discovered the mountain K2 and delineated the border with Chinese Turkistan and Tibet.

At the time it was more or less impossible for Europeans to cross either the Tibet or Turkistan frontiers and, as a result the geography of these areas was still vague. Montgomerie's greatest achievement was to train Indian surveyors in the carrying out of clandestine route traverses. He perfected a system using rosaries and prayer wheels to conceal their observations. The most successful of these surveyors was Pandit Nain Singh, whose journeys make enthralling reading; he reached Lhasa in 1866 and was able to fix its position with surprising accuracy and carried out two further journeys but the stress and high altitudes led to his retirement in 1875, when he then devoted himself to training further such surveyors. Montgomerie himself was forced to retire for the same reasons in 1876, and he died at the early age of 48 in 1878. His name is still remembered by an Institution of Royal Engineers prize. Nain Singh received many awards including a Companion of (the Order of) the Indian Empire, and he died in 1895. Colonel Sir Henry Yule described his work as "adding a larger amount of important knowledge to the map of Asia than that of any living man."

Lieut General Sir Richard Strachey, is the subject of my next short memoir. Commissioned into the Bengal Engineers in 1839, he had a most diverse and varied career. As a junior engineer he had been employed under Cautley on the headworks of the Ganges Canal at Hardwar (interrupted by service in the First Sikh war).

Among the senior appointments held later in General Strachey's career, were those of Inspector General of Irrigation, Consulting Engineer for Railways, Secretary to the Public Works department and, on retirement in 1871, Chairman of the East India Railways. As a soldier, engineer and financier, he left his mark on the improvement of administration in India in many ways, and at the same time was eminent as a botanist, geologist, meteorologist and geographer.

Cautley's example had inspired Strachey to study fossils in the Siwaliks. Obliged to go to Naini Tai in 1847 to recover from malaria, he continued his geological and botanical studies and, in 1848, journeyed into Tibet as far as Lake Manasarowar, making a large collection of geological and botanical specimens which, on returning to England in 1850, he arranged and classified and this brought him Fellowship of the Royal Society. He died in 1908.

Field Marshal Lord Napier of Magdala. And last but not least, Field Marshal Lord Napier of Magdala. Born in 1810 he was commissioned in the Bengal Engineers from Addiscombe in 1826. His distinguished military service in the Sikh wars, the Mutiny (and especially Lucknow), China and Abyssinia are well known. He was Commander in Chief in India from 1870 to 1876 and later Governor of Gibraltar.

It is not often realized that he also had a distinguished career in the PWD. He served for ten years from 1831 in the Canal Department on the Doab and East Jumna Canals where he was the pupil and friend of Proby Cautley. After the Sikh

Military Engineers in India and the Royal Society p258

wars he effectively became Chief Engineer of the Punjab where he transformed a war ravaged wilderness into an orderly province by the construction of cantonments, civil offices, roads including overseeing the extension of the Grand Truck Road from Lahore to Peshawer, some 278 miles, bridges and canals. There is no doubt that his construction of roads in the Punjab was a vital factor in bringing the relief armies speedily to Delhi in 1857. He was elected a Fellow of the Royal Society in 1869.

Short Notes on Further Military Engineers From India Who Became Fellows of the Royal Society (FRS)

- **Colonel Colin Mackenzie**, Madras Engineers 1783. Had distinguished military service. Surveyor General of Madras 1810 and of India 1816. Eminent antiquarian and historian of south India. Died 1821.
- **Lieut General J F Tennent**, Bengal Engineers. Siege of Delhi 1857. A keen astronomer. Master of the Mint at Calcutta 1876 and 1881 to 1884.
- **Colonel Lord Sydenham of Coombe**, Royal Engineers 1868. Instructor Coopers Hill 1871 to 1880. Governor of Victoria 1901 to 1903. Secretary of Committee of Imperial Defence. Governor of Bombay 1907 to 1913. Erected "Gate of India" at Bombay. Died 1933.

Three Surveyor Generals of India all very much involved with the Grand Trigonometrical Survey of India:

- **Colonel Sir George Everest**, Bengal Artillery. Surveyor General of India 1821 to 1843. Died 1866.
- **Major General Sir Andrew Waugh**, Bengal Engineers. Born 1810. Surveyor General of India 1843 to 1861. Died 1877.
- **General J T Walker**, Bombay Engineers. At siege of Delhi 1857. Surveyor General of India 1880 to 1883. Died 1896.

Two very eminent geodesists:

- **Colonel Sir Sidney Burrard**, Royal Engineers. FRS 1904. Surveyor General of India 1911 to 1919.
- **Colonel Sir Gerald Lenox Conyngham**, Royal Engineers. FRS 1918. Retired 1919 and became a Fellow of Trinity College and Reader in Geodesy at Cambridge University.

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Minefield Clearance in Central Bosnia

CAPTAIN P A BUTTERY BSc

The author read for a degree in maritime geography at the University of Wales Institute of Science and Technology.

After graduating he travelled the world for a year before entering the Royal Military Academy Sandhurst in January 1990, after which he was attached to 3 Field Squadron before starting Young Officer course number 102.

Posted to 26 Armoured Engineer Squadron, where he passed the Army Compressed Air Divers course and lead his troop in British Army Training Unit Suffield, Canada, Captain Buttery was finally posted to 49 Field Squadron (Explosive Ordnance Disposal) in May 1993, where he is currently serving as a section bomb disposal officer.

Background

During the war in central Bosnia the warring factions laid mines along confrontation lines as part of their defensive plan. This article concentrates on the clearance of mines around a particular line: the Vitez pocket. The location map shows the confrontation lines that existed during the war. Only the former BiH/HVO confrontation lines, which became dormant after the peace accord was signed by the BiH and HVO on 24 February 1994, will be considered.

The peace agreement did not mention mines and consequently these remained in place. As an element of distrust remained, standing minefields provided security and protection to both sides along the confrontation lines, with anti-personnel mines accounting for the majority of those laid.

These mined areas were not marked in any way and often it was apparent that little thought had been put into which types of mines should be laid to produce the desired effect. For example, antitank mines would be laid in tracks that were only wide enough for foot soldiers.

The protective minefields laid by both sides lacked depth and were positioned too close to friendly trenches, especially when rearward danger areas and effective weapon ranges were considered.

In some cases mines were booby trapped; an example was a PMA-2 connected to a MRUD with detonating cord.

The table below shows a summary of the types of mines found.

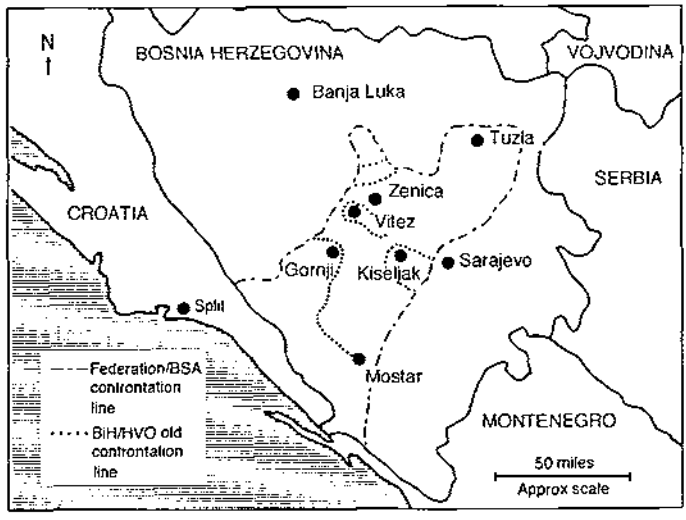
Antitank Mines	
Name	**Remarks**
TMM-1	Metallic/Blast
TMA-1 TMA-2 TMA-3 TMA-4 TMA-5	Non Metallic/Blast/Single Impulse
TMRP-6	Shaped Charge
Antipersonnel Mines	
PMA-1 PMA-2 PMA-3	Non Metallic/Blast
PMR-2A	Stake Mine
PROM-1	Bounding Fragmentation
MRUD	Directional Fragmentation
TV	Homemade Directional Fragmentation

[1] BiH – Bosnian Muslim Army
HVO – Bosnia Croat Army

Captain P A Buttery
Minefield clearance in Central Bosnia p260

The main differences between HVO and BiH minefields were the density of mines per square km and the number of minefields laid.

On average the density of mines in BiH minefields was much lower than that of the HVO; the BiH laying between 10-20 mines per square km compared to the HVO's 20-50. The number of minefields laid by the BiH on the 82km of confrontation line around Vitez totalled only 41, whereas the HVO laid 133. Due to these differences and the lack of marking, every effort had to be made to gather accurate information prior to any clearance operation.



Map showing area covered by article.

Agreement to Clear Minefields

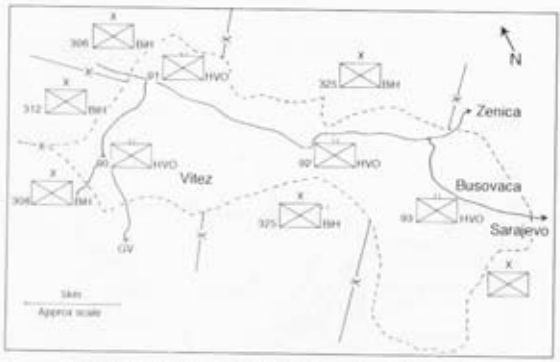
The Delic/Roso agreement of 24 February made no reference to mines but all sides, including UNPROFOR, recognized the long term hazard associated with them. The UN liaison officers and EOD personnel worked hard to gather information regarding minefield locations.

The process took some time as a trusting relationship had to be established between them and HVO/BiH personnel: this involved drinking gallons of coffee which would have been more at home in a soil analyst's laboratory. Despite these efforts information gained was often vague and inaccurate. Based on an agreement made by the Canadians for the Kiseljak pocket, OC 5 Field Squadron decided to have a similar accord drafted for the Vitez pocket. This was negotiated in detail with both sides and an agreement prepared. Prior to signing, it was taken a step further and presented at the Joint Policy Committee meeting held in Gornji Vakuf, where it was ratified for all of Sector South-West.

An agreement was thus signed, on 29 May 1994, at Corps level by the HVO and BiH to eventually clear all minefields that were laid along former HVO/BiH confrontation lines in central Bosnia. The agreement had three main elements. Firstly, that all minefield maps would be handed to UNPROFOR by 14 June 1994. Secondly, that UN personnel would produce a plan by which the minefields could be cleared, and finally that the clearance operation would be monitored by the UN and that it would start on 28 June 1994. Within the BRITFOR area of responsibility (AOR) the monitoring responsibility was undertaken by EOD detachments based in Vitez and Bugojno.

The map of the Vitez pocket shows the subunits from both factions, their AOR and the confrontation line. The pocket follows the Lasva Valley and encompasses the towns of Novi Travnik, Vitez and Busovaca. During the war the whole of the exterior of the pocket was in BiH hands whilst the interior was HVO territory. The only exception was a little Muslim enclave called Stari Vitez which was inside the HVO territory. During the war both sides laid mines along the confrontation line in such large numbers that gaps of 500m between minefields were rare. HVO regiments inside the pocket belonged to the HVO Operations Zone Central, and the BiH brigades on the outside belonged to 7 Corps.

Initially it was intended to hold meetings with both sides so that information about minefields could be passed. Meetings were arranged with Col Totic (CE HVO Ops Zone Central) and Brig Hadzic (CE BiH 7 Corps). Unfortunately, after several attempts, this was abandoned as neither representative turned up at the same time. The final solution was to visit each in turn and act more as a liaison officer until the information could be obtained. The HVO produced a map at 1:25,000 scale compared to the BiH maps that were produced on 1:100 000 scale. According to their records a total of 174 minefields had been laid along 82km of confrontation line.



Vitez pocket showing confrontation lines and mine laying units.

Once the minefield maps had been received the second stage of the agreement was implemented, which was to draw up a plan by which the minefields could be cleared. Yet again meetings proved inconclusive as the BiH insisted on sending their deputy CE, who was unacceptable to Col Totic. Eventually, frustrated by the delay, Comd Filipovic (Comd HVO Ops Zone Central) issued an order to Col Totic to start minefield clearance. The first minefield clearance was carried out around the Travnik "T" junction, by the HVO on 4 July 1994 only one week after the agreed date. After an additional meeting with Col Totic and Brig Hadzic, on 22 July 1994, the BiH started to clear their minefields. Both sides drew up their own minefield clearance plans.

In the first week of joint mine clearance a total of 147 mines were removed; of these 88 were lifted by the HVO and 59 by the BiH. All BiH mines were commercially produced and listed in the mines summary table. But the HVO had a large number of locally manufactured mines: during the first week 64 per cent of the mines lifted by them were of local manufacture. The HVO, being surrounded by the BiH during the war, had only a limited supply of commercially produced mines, but no shortage of explosives or expertise as within the Vitez pocket is the largest explosives factory in Bosnia. The factory produced two sorts of high explosive: Amonex, which is light brown in colour, granular and based on ammonium nitrate, and Vitezit, which is red brown in colour and is nitroglycerine based.

An HVO engineer prepares to disarm a TV bomb.

Programmes for the minefield clearance were given to the EOD teams who then monitored operations. Eventually both sides started their clearance plan but this took a great deal of effort over three months, because every proposal one side made had to be discussed in detail and agreed by the other.

These efforts proved worthwhile as over a period of time a degree of trust and respect developed between the three parties. On the occasions that representatives failed to attend an arranged meeting they were asked for an explanation. Eventually the BiH and HVO managed to attend all meetings or, if unable to attend actually informed the EOD teams before the event. The level of trust, respect and friendship continued to be built upon and reached a new height when two of the EOD team were invited to the wedding of the local CE's daughter.

Method of Clearing

The EOD monitoring teams would meet with the minefield clearance teams at a prearranged RV. The detailed records would then be produced by the senior man of the clearance team for scrutiny by EOD personnel. The quality of these detailed records varied greatly, from a simple sketch map, as shown in Figure 1, to very detailed and accurate records similar to our own.

Once the types and numbers of mines in an area had been assessed, the clearance operation would commence. The methods employed by each individual team varied. Some teams were extremely professional and carried out drills using mine tape and proddlers, with metal detectors for the deep buried mines. However despite these good drills no safety equipment was worn. On the other

Minefield clearance in Central Bosnia p262

hand, some teams would turn up dressed in safety equipment but would then lift mines in no particular order and with no coordination. Not once did any of the clearance teams wear any sort of eye protection and not once were safety distances employed between the different clearance parties.

To monitor the clearance operation the EOD teams followed detailed standard operational procedures (SOPs) which stipulated a minimum safety distance of 100m between teams, the wearing of protective clothing and many other safety factors.

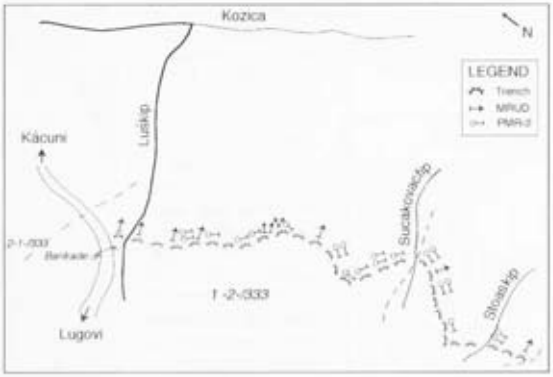


Figure 1. Example of BiH minefield record.

The faction that was being monitored would execute the operation in their individual way. On the whole they would neutralize the mines and then carry them to the edge of the minefield. Once the area had been cleared, a member of the EOD monitoring team would check the mines off against the minefield record. On other occasions the monitoring team would be taken to a demolition pit and shown the mines that were set up for demolition. The bulk of the mines removed were blown. Both the BiH and the HVO clearance teams preferred to neutralize the mines and then hand lift them to an area for demolition. This practice was potentially dangerous due to the large number of home-made mines containing Vitezit; the potential for degradation of the explosive was high and these mines could well have been unstable for a number of reasons.

Firstly, the home-made mines contained Vitezit which could be up to 60 per cent nitroglycerine in content. When exposed to temperature fluctuations this type of explosive tended to sweat and then resolidify. Upon resolidifying, crystallization of the nitroglycerine occurs which makes it both shock and friction sensitive. Secondly, the fuses used to initiate these devices were also sensitive to shock and friction because they were made from butchered TMA-3 fuses. In order to convert the TMA-3 fuse, the top was milled down, exposing the friction sensitive material integral to the fuse. The outer housing of the fuse was also milled to reduce its overall diameter. A new home-made cap was fitted which encased a striker. The striker was held back from the friction sensitive material by a safety pin, which was not rustproof and was often found on the point of breaking. Figure 2, over the page, shows the construction of these fuses. Finally, some of the locally made mines had been placed at the beginning of the war some two years ago, so had plenty of time to rust, sweat and generally deteriorate. Thus the practice of not blowing these mines *in situ* was regarded as foolhardy.

Thanks to some of the mine clearance drills used by the HVO and BiH it was soon realized that the Royal Engineer EOD teams had once again become involved in very dangerous work. The EOD teams had to be constantly vigilant as members of the BiH and HVO would often rush into the overgrown mined areas and come back bearing locally manufactured mines. The EOD monitoring teams had a difficult balance to strike between going forward to verify the detailed mine records and trying to maintain a safe distance behind the clearance team. On the occasions when mine prodders were used the need for safety distances

A smaller TV bomb.

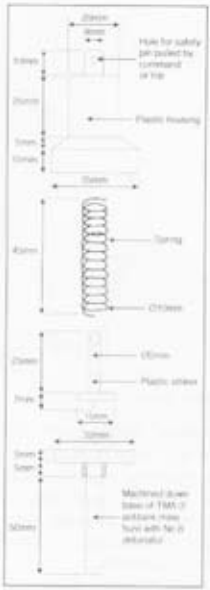


Figure 2. Example of locally made initiation system for fragmentation mines.

became apparent. On one occasion a member of a clearance team missed a PMA-2 with his prodder, but found it with his knee. Fortunately it did not initiate, but if it had there would have been three casualties instead of one.

In addition to the methods used to locate and neutralize mines the EOD teams were also placed in compromising situations as the clearance teams proved to be totally unpredictable. One such occasion involved an HVO mine clearer who stepped off a cleared route, initiating a PMR-2 stake mine; another involved a BiH guide who fell over the trip wire of a PMR-2, but as the wooden stake was rotten it broke before the safety pin had come free. At the end of each day's clearance the HVO regiment or BiH brigade submitted reports to their respective HQs. As well as the daily report the EOD supervisory teams made notes as to the numbers, types and locations of the mines that had been lifted. This information was then transferred to a master trace and fed into a computer database. The information, in tabular form, was then distributed to HQ Sector South-West and to G2 Engineers in HQ UNPROFOR, Zagreb.

A locally manufactured claymore mine.

A locally manufactured mine called a Fugasa. It contained 30kg of explosives.

Conclusion

The clearance programme will continue for quite some time and no accurate estimate could be made as to how many mines remain in the ground. On 31 July 1994 the HVO submitted a report to UNPROFOR stating that during the period 4-30 July 1994 a total of 2802 mines had been lifted from their minefields. These came from only 20 per cent of the confrontation line. On 1 August 1994 the BiH informed the UN that all their minefields were cleared. However it was known that some mines had not been lifted and actually they had only cleared 82 per cent of their recorded mines. As long as a single mine remains in the ground, so the threat of serious injury and death remains. It is a sad reflection that the injuries will continue to be sustained by civilians after the peace accord. The UN are sponsoring a programme to educate children in schools on mine awareness and our EOD teams have been active in this area, producing mines demonstrations and posters. Fortunately the vast majority of minefields follow the confrontation lines and accurate records have been made. Coupled with the fact that both sides are now working alongside each other to clear the mines the number of injuries should reduce. These encouraging facts suggest that although the problem is extensive it is not on the same scale as in Angola, Afghanistan or Cambodia where they lack mine clearing expertise, training, and equipment.

Minefield clearance in Central Bosnia p264

Royal Engineers Association Aden – Flashback – 1964/6

LIEUT COLONEL D F DENSHAM-BOOTH OBE

TURNING out a box of memorabilia recently, I came across a copy of *The Dow* Middle East Forces newspaper dated 18 November 1965. It included an article relating to the dedication, by the Reverend M M Wright, Chaplain to the Forces, of a Branch Standard, presented by my wife and myself, at a Church Service in Anzio Lines, Little Aden, on 7 November 1965.

Since British Forces left Aden unexpectedly in 1966 I wondered if this Standard might have been mislaid, but former members may be gratified to learn that the Controller Royal Engineers Association has confirmed that it now hangs in the RE Garrison Church at Chatham.

The formation of the Aden Branch in 1964 was perhaps unique. It involved a number of expatriate Sappers resident in the Colony, as well as serving personnel, of whom there was a sizeable force, included in field and park squadrons engaged on deployment camp projects, outstation road and airfield construction and defensive works in support of infantry units. A separate RE works services unit also existed, responsible for supervising construction of battalion camps for the brigade units stationed in Little Aden and for providing specialist engineering services at military bases in the Radfan area of South Arabia. The Ministry of Public Buildings and Works (MPBW) was responsible for construction and maintenance of permanent tri-service installations and married quarters within the region. British Petroleum (BP) had a major oil installation and refinery at Aden employing a considerable number of expatriate engineers, and among these were many ex-Sappers.

With their usual flare, Sapper units had already established a recreational club in a "spare" Twynham flat, and cordial relationships were developing with MPBW and BP employees. The club soon became the focal point for convivial meetings between serving Sappers and old comrades and this sociability was enhanced further when the newly created Military Engineering Service Aden, integrated with the civilian establishment of MPBW and a number of clerks of work, architectural draughtsmen and civil engineers appointments were filled by serving Sappers.

As a result of these closer ties, and encouraged by an assurance by the Defence Secretary that British forces were to remain long-term in Aden, it was decided to use the hut as the foundation on which to build a Branch of the REA. An inaugural meeting was held in October 1964, presided over by the Chief Engineer, Middle East Command, Colonel P F Drake-Wilkes, attended by a large gathering of servicemen and local civilians. A committee was duly elected and the pattern for future activities formulated.

Thereafter, the branch continued to flourish and membership soon exceeded one hundred; a programme of social events resulted in substantial contributions being made to RE Benevolent Funds. The Ministry of Defence decision to withdraw from Aden sadly brought about the closure of this thriving Branch; to quote Tennyson's Morte D'Arthur – "The old order changeth yielding place to new."

The REA continues to flourish, however, through its many branches in the UK (and overseas), strengthening the bonds of comradeship and support among Sappers wherever domiciled.

Middle East Command Aden Branch – 7 November 1965. From left to right: Ex WO1 J Craigie RE (BP Ltd), Captain J Rex RE (TA) MPBW, and ex-Captain K Dando RE MPBW (Regional Architect).

Lt Col D F Densham-Booth OBE
REA Aden - Flashback - 1964 - 6 p265

T W J Connolly – the Man

MAJOR J T HANCOCK

Commissioned from Sandhurst in 1949, the author served in the UK, Germany, Trieste, Malaya and Aden. When sentenced to two years in the Ministry of Defence in 1967, he discovered the delights of the Ministry of Defence Main Library and, as a result, spent most of his spare time reading and researching military history.

Retiring in 1978, he was appointed to the Retired Officer 3 dual post of Librarian to the Royal Engineers Library and Editor of The Sapper *magazine.*

Since his final retirement in 1992, he has continued with historical research, his particular interests being in the Peninsular War and the Royal Staff Corps.

Background

Prior to 1856 there were two engineer Corps, the officers of the Corps of Royal Engineers and the soldiers of the Corps of Royal Military Artificers, renamed the Royal Sappers and Miners. While the "History of the Corps of Royal Engineers" is well known, the two volumes of "History of the Corps of Royal Sappers and Miners", covering the period to 1856, are less well known. They were written by T W J Connolly, a soldier of that Corps, and are the only comprehensive source of information about the life and work of those soldiers.

Little is known about Connolly, since he was reticent about his own part in the history, rating himself as worth only a brief mention in one of the annexures to volume 2. However the Royal Engineers Library holds three of his manuscript diaries, covering the period from 10 January 1848 to 1 February 1864, and these tell us a great deal about him. He refers to an earlier volume but nothing is known of its whereabouts. There may have been a later volume, since the third one is filled, the last entry being dated 1 February 1864. The last few pages contain family photographs, and notes on his wife's death, his retirement and a move to London in 1865.

The diaries, with every page covered from top to bottom and edge to edge with Connolly's tiny writing, contain over a million words (equivalent to about eight present-day novels), giving very private details of his family life, his work, thoughts and feelings. The factual details in this article, giving a brief outline of his life, are taken from the diaries and, since it is unlikely that many people will spend the many hours necessary to read the diaries from end to end, I have added my own views of the character they portray.

I do not think that Connolly ever contemplated the diaries being read by anyone other than himself since at times he compares his wife unfavourably with other women, reveals his innermost thoughts, gives intimate details of a passionate affair between his bandmaster brother-in-law and the wife of a lieut colonel in the Royal Artillery, and makes extraordinarily slanderous comments about officers of the Royal Engineers. A number of pages have been neatly cut out and on others there are crossings out that are heavy enough to make whole paragraphs unreadable, so that he, or a descendant, must have censored some of the items he recorded, which is an indication of the honesty of the diaries.

Thomas William John Connolly, was born in the Champs Elysees on 6 October 1815. His father was a soldier in the 95th Foot, who had been wounded at Waterloo and who was, at that time, with the Army of Occupation in Paris. There is no further mention of his father other than to comment that, since his grandfather had been a

Major T Hancock
T W J Connolly - the Man p266

commissioned officer*, "we ought to have been in very different circumstances to those which the imprudence of my father reduced us", and that while his grandfather used the single "n" spelling of their surname his father "from some whim, introduced the second 'n'" (this explains the variations in the spelling of his surname since in army records there is only one "n" while TWJ used the double "n" version).

The first three years of Connolly's life were spent in France, before his parents returned to London where his mother was washerwoman to a family who were very kind to them. In 1824** he was accepted as a pupil in the Royal Military Asylum at Chelsea (nowadays known as the Duke of York's Royal Military School) and remained there until he enlisted in the Corps of Royal Military Artificers on 1 October 1829, just five days before his 14th birthday.

The Soldier

No mention is made of his first few years in the Corps, but he became a clerk in the Brigade Major's office at Woolwich in 1831 and remained there until he was commissioned as a quartermaster. There were four clerks in the office and he was made corresponding clerk in 1833, promoted to sergeant in 1841 and became chief clerk in 1843. In January 1848 the Corps awarded him a medal for meritorious service and a £10 annuity (about £480 at 1993 values). Promoted to quartermaster sergeant in 1850, he was retained in the office as a supernumerary.

At the age of 21 he married 18 year old Mary Collins, at East Wickham. Her father was a military bandmaster and her brother, William, became the very talented bandmaster of the Royal Artillery band and later of the Royal Engineers' band. Mary bore him 12 children, of whom two were stillborn and two were miscarried. They lived in a basement quarter in the Royal Engineers barracks, Woolwich, until his commissioning as a quartermaster, when he was posted to Chatham. There they lived in a cottage quarter in Brompton Barracks until 1865, when Mary died of cancer of the breast at the age of 48.

Quartermaster Connolly.

Three months after Mary's death, Connolly retired on half pay and was granted the honorary rank of captain. His two eldest sons had already left home, his eldest daughter, Louisa, was not yet 18, his third son Stephen, who later became a doctor, was just 16, and he had four children under the age of ten, so he promoted his maidservant, Mary, to housekeeper and moved to 51 Chester Road, Kilburn. He died in London on 21 May 1885 at the age of 69 years.

* John Conolly: 12th Light Dragoons. Adjutant 30 September 1795 to 14 November 1804, cornet 5 April 1796, lieutenant 21 November 1799, retired 17 December 1807.

** The only Connolly in the registers of the Duke of York's Royal Military School, is a John Connolly, the son of Private Edward Connolly of the Royal Regiment of Lancers who was born at Doudeville, France, on 18 June 1816 and was admitted to the Royal Military Asylum in July 1825. Although T W J Connolly is not recorded as a pupil, he organized the erection of a tablet at the school in memory of the Adjutant, John Fulham, so there is no doubt that he was a pupil there.

Writing the "History of the Corps of Royal Sappers and Miners"

As he records in the preface of the first edition of his history, Connolly first became interested in the history of his Corps in 1836, when he was asked to assist in listing the Royal Engineer officers who had commanded companies of the Royal Military Artificers. This list expanded to become a basic history of the formation and reduction of the companies and the various stations in which they served. The results are recorded in a register, dated 1840, which is now held in the Royal Engineers Library. Surprisingly, Connolly did not include this information in his history which lacks a clear and comprehensive outline of the companies.

However, his interest in historical research aroused, Connolly commented "after daily fulfilling the routine duty of the office, I spent all my leisure intervals in bringing to light old books and papers, which for some years had been buried in disused depositories and stores." It took him ten years to collect all the information needed for the history before starting to write in 1846, completing the work in March 1853.

Included in the volumes are 17 hand-coloured uniform plates, which appear to have been a late addition since he does not mention them until 1854. He made his own sketches of the uniforms and then negotiated with a Mr G B Campion, who was a drawing master at the Royal Military Academy, to complete the drawings with background detail and engrave them in wax on stone. It is interesting to note that two thirds of the books' production costs were expended on these illustrations. He did consider including a vignette of himself but decided that it would be too expensive.

Upon completion of this major historical work, Connolly was faced with the problem of its publication. Although senior officers had encouraged him to write the history, it was decided, after lengthy deliberations, that the Board of Ordnance could not assist with printing costs. Instead Lieut General Sir John Burgoyne, as Inspector General of Fortifications, recommended to Royal Engineer officers that they should give their support by subscribing £1 for a copy in the hope that 300 would be purchased, while the publisher undertook the sale of a further 200. The sale of 500 copies would give him a profit of £51 after paying his estimated research expenses of £50. At the end of May 1854 he sent out a printed circular to all Royal Engineer officers and by the middle of July had received 170 subscriptions. At that point there is a gap in his diary until April 1855, but it is known that the first edition was published in 1855 and when he recommenced his diary he refers to favourable reviews, including one from Charles Dickens. He was negotiating for the binding of 600 copies, so it appears that the publication was both a personal and financial success.

There is a long gap in the diary from June 1855 to January 1860 which is particularly unfortunate since during that time he was commissioned as a quartermaster, wrote the chapters on the Crimean War for his 2nd edition* and also wrote and published his "Romance of the Ranks"**. In 1858 he also started to gather information for a "History of the Officers of Engineers", but this project did not have the support of senior officers and Lieut General Sir Charles Pasley wrote to him to say that "it would be deemed invidious if a man from the ranks should criticise their public conduct." Pasley suggested that they should join together in producing the work so that he (Pasley) would "take upon himself the business of examining the errors of our Engineers and commenting on them." Connolly states that the proposal "angered me greatly."

The notes that he made for the Royal Engineers' history are held in the Royal Engineers Library and are in everyday use. They fill 17 foolscap notebooks, with his tiny writing covering every page, and are meticulously indexed. He called them the "Noticia Historica of the Corps of Royal Engineers." From the officers' names included in these notes, it would seem that he continued his researches until the mid-1860s. He never did write them up in history form, but they were used by Major General Whitworth Porter, when he wrote volume I of the official Corps' history and in the preface he acknowledges that they provided him with useful detail. The notes and indices are remarkably accurate and are invaluable to the Library as a source of information on the early officers of the Corps.

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* The 2nd enlarged edition sold for £1 10s 0d.

**Published by Longmans in two volumes in 1859. The subtitle of the book is "Anecdotes, Episodes of Social Incidents of Military Life". It is a collection of some 165 items which came to light during his researches. The edition of 650 copies sold out in three months, despite adverse reviews and comments. Personally I found the writing pretentious and dull. It is a pity that he did not keep to the much more appealing style of both his history and his diary. The only items of historical interest are those giving background information about the men employed on the surveys of London, Scotland and Ireland.

The Man

In an age when there were very few free civilian schools and the average recruit was illiterate, Connolly was fortunate when he was accepted by the Royal Military Asylum, but even then the education was very basic. With the Royal Engineers establishment at Chatham teaching far more than the three Rs, the standard of education in the Corps was much higher than that of the rest of the Army, so that most NCOs could write reasonable reports and letters. Even so, there can be no doubt that Connolly stands out as a very intelligent, self-educated and remarkable man, who took a lively interest in the theatre, music and literature, and who read several books a week covering a wide range of subjects.

Working in the Brigade Major's office, he was at the hub of the Corps since it dealt with postings of individuals and units, discipline, pay and general administration. A gossip at heart, Connolly took a keen interest in all engineer matters and kept his finger on the pulse of his Corps by an exchange of letters with his many friends in stations around the world. He records that in a two-week period: "I have received 29 private letters and answered and written 46." In a position of power over postings and pensions, he was scrupulously honest, at one time refusing a £10 bribe (at the time he earned just over £100 per year) to forward a particular claim to a pension: "It has been the one standing and unalterable principle of my life to allow no favour, bribe, or cupidity to be mixed up with my duty or conscience."

By nature an austere and methodical man, he kept strict account of his money. He also took on the running of the Royal Engineers Library at Woolwich, to increase his pay by £5 a year, yet his kindly nature lead him to give advice and help to those in misfortune: "lent Collins the shoemaker £6."

He firmly believed that drunkenness was the downfall of many in the Corps and frequently spoke out against it, but he was not a teetotaller and enjoyed a drink both at home and in the Mess: "had plenty of wine and everything to make us comfortable and merry." He was addicted to snuff and suffered badly when his nose was too sore to sniff it: "the darling pinch of snuff could not be enjoyed ... temper soured and badly out of sorts."

A good family man, he took his wife and family on picnics and outings to fairs. He enjoyed entertaining and parties, particularly dancing: "Last evening we had a party which we kept up joyously till 4 o'clock in the morning ... the dancing went on without flagging. In every dance I was up and worked away for very life." As often as he could afford it, he went with his wife and older children to the London music hall and theatre: "saw Henry VIII. C Kean* as Wolsey, Mrs Kean as Queen Katherine. The performance was perfection. The vision was entrancing." He supported amateur dramatics, helping with the production and advising on management. There were a few aspiring authors and poets in the Corps and he was always willing to read their efforts and to help get them published in magazines. A keen supporter of the talents of his bandmaster brother-in-law, he went to all his local concerts, discussed music with him and wrote for him the many letters necessary to obtain engagements for the band. He was also a frequent visitor to the NCOs' Mess where he discussed matters of the day, gossiped, enjoyed a drink and played dominoes.

Connolly was very much a man for the ladies, seeking out the company of good looking females at parties and making entries in his diary when he caught a glimpse of a leg: "in their hurry to get into the chaise and to keep the ends of their garments dry, they made a display of their legs that was very creditable to their beautiful countenances."

He writes affectionately of his wife and approvingly of the way she managed his household and helped other wives at times of illness or

PUBLISHING COSTS

For 500 copies of the first edition of the "History of the Corps of Royal Sappers and Miners"

	£	s	d
Setting and printing the text	85	0	0
Lithography and printing the uniform plates	97	10	0
Hand colouring the uniform plates	106	5	0
Binding	16	10	0
Printing costs	305	5	0
Publisher's profit	73	10	0
Connolly's travelling and postage expenses	50	0	0
20 Presentation copies	20	0	0
Total costs	448	15	0
Connolly's profit	51	5	0
Sale of 500 copies @ £1	500	0	0

* The actor manager son of the famous Edmond Kean, he was married to Ellen Tree.

distress, but on occasions he is a little disparaging: "Miss Linley must have been a beautiful woman, but not more so than mine was when I first made affectionate advances to her. Beauty now with her, is a thing of the past, but considering her trials, her sufferings and her large family she is a Princess yet."

As one would expect from a man who prized education so highly, he sent his boys to school, his sons Beaumont and Stephen going to Rochester Grammar. Surprisingly for the times, he also sent his daughters to small local schools, in particular his favourite, Lizzie, went to Brompton House. She was a talented pianist and he was very proud of her: "My Lizzie's 'Carnival' was the piece of the evening. She played it without a fault, all her chromatic runs were singularly true."

So far we have a picture of a happy family man who revelled in his work and took a full part in 19th century military life. Unfortunately there were two aspects that spoilt his happiness. For many years he suffered from an acute anxiety state which, surprisingly, centred on his research work: "Head has been very bad lately – seriously so. I seem as tho' I must lose my reason or die in a fit. My head feels surcharged with something and beats like the pulse. A whizzing, like hot iron in water, is constantly in my ears. I can bear no excitement or scarcely see strangers, or speak to officers without holding on to anything near to save me from falling." – "Head dreadfully giddy. I really ought not to write and yet I am forced to it against my strongest resolves. It is killing me by inches. My mind reels with the exercise of the brain, however trifling its employment. Anything I have to do works me up to maddening excitement and when I commence it I am necessarily unfit to keep my seat or to make progress with my subject. This is an awfully distressing state of things, and yet, unable to relinquish it, my mind wanting other things to charm it, is chained to the constant contemplation of the particular subject, which nearly deprives me of my reason. My history is the chief incubus, and, try as I will, I cannot withdraw my thoughts from it. Involuntarily I am hastening on my own ruin, like the silly moth circling the rays of the candle and then flying into its flames."

He could only find relief from his misery when walking and most days he walked for miles in all weathers. It seems very sad that his history, which should have been the joy and triumph of his life, should have caused him so much distress.

Usually he walked alone, but when his brother-in-law had an affair (with the young wife of a retired artillery officer), he started to meet him in the evenings so that they could walk and talk together. The lady wrote to William almost daily and, while walking, he would read the letters and hear how the romance progressed. He then returned home to record passages from the letters in his diary: "my nights instead of being cold and wretched would be – Oh! Collins, I dare not say what my thoughts are on that subject."

Perhaps it was natural that an intelligent man, who had worked so hard to educate himself, should feel that his abilities were not fully recognized. There is an underlying theme in his diaries that he feels himself as good, if not better, than many of the Royal Engineer officers, and that only fate had put him in a subordinate position. When he is commissioned as quartermaster, it is a moment of triumph for him which soon turns sour when he finds that he is not accepted by other officers as he feels he deserves: "The Queen gives us Commissions, and so makes us gentlemen, but the officers differ with her in this respect, and regard us as snobs – Oh! He is a man from the Ranks, and must be treated as tho' he were there still – Much as I have tried by my writings to prove capacity above the Ranks and to show my right to treatment as a gentleman, I have not found, even from my friends, any disposition to look on me in any other light than as a soldier." This, and similar themes, begin to dominate his diary as he became more and more bitter. He had previously made comments about the people around him, usually sympathetically, but by this time his adverse comments about officers and their families became more and more frequent, bitter and slanderous: "How he managed to get in the Engineers is a riddle. He is scarcely two removes in colour from Creole, his little mind scarcely entertains any profounder matters than beer, Bordeau and his pipe." "... marched in the rear of the column as tipsy as a tinker, but the poor man is seemingly half witted." "She was rough in face and figure and rough and unsympathetic in character, without one humane feeling in her heart for anyone whom she considered beneath her."

He also became pompous and difficult. When an officer organized an impromptu ball in the Officers Mess: "to show off, no doubt, his little wife to whom he was recently married", he was not invited and complained to the Adjutant about this slight to quartermasters and insisted on a

written apology. He records his dealings with a new commander: "so far mild and amiable, but still so impressed with the dignity of his position to be distant with his Quartermaster. The Colonel is an intellectual man, and may be disposed to respect it, if ever so humble, in one beneath him."

In 1862 the rules for commissioning from the Royal Military College at Sandhurst were changed so that a limited number of commissions would be granted, without purchase, to those at the top of the final examination list, and at the same time the course was reduced from two years to one year. For Connolly this was a wonderful opportunity for his son, Beaumont, to become an officer, since he could never have afforded the £450 purchase price of a commission but he could stretch his finances to pay the cost of the one year course. At considerable expense he sent his son, aged 19, to a crammer to study for the entrance exam to Sandhurst, which he passed at the end of that year. For parents who were serving officers, the College fees were considerably reduced, but even so they were a strain on Connolly's pocket: "His expenses are a great drag on us. For a long time I have wanted underthings, but my shirts must still cover me, full tho' they be of fringes, slits and rents." Beaumont studied hard, came top in the final examination and received a free commission in the 72nd Foot. Naturally Connolly was very proud of his son, but at this point his detailed diary ends so his innermost thoughts are not known. It can be assumed that it really was a wonderful moment for Connolly when his son achieved the status to which Connolly had aspired for so many years, and it can be appreciated what a crushing blow it must have been when his son resigned that commission after only three years.

Less than two years before that happened Connolly had suffered an even greater blow when his wife died in May 1865. Five months later, after he had retired and moved to London, he pasted a photograph of her at the end of his diary with details of her death. She had consulted a Dr Briant about swellings in her left breast and as a result had an operation to remove them. She died seven months later: "Oh! What a loss to me was her demise. Mine has been one long unmitigated day of anguish since. I write this from a heart still swelling with grief."

If the first volume of his diaries should ever be found it will give a fascinating account of life in the ranks as a young soldier. If there is a fifth volume I hope that, for his sake, it is not that of an increasingly bitter old man.

CHRONOLOGY

Date	Event	Age
6 Oct 1815	Born in Paris	
1824 to 1829	Pupil at the Royal Military Asylum, Chelsea	8 to 13
1 Oct 1829	Enlisted in the Royal Sappers and Miners	13
1831	Posted as a clerk in the Brigade Major's office at Woolwich	16
1833	Made corresponding clerk.	18
?	Promoted to corporal	?
3 Aug 1836	Married Mary Collins at East Wickham	21
2 Sep 1838	1st son born, Thomas William Collins	23
1841	Promoted to sergeant	26
1843	Became chief clerk	28
15 May 1843	2nd son born, Beaumont Rowley	28
2 May 1845	1st daughter born, Mary, died 18 Sep 1845	30
20 Aug 1847	2nd daughter born, Louisa Elizabeth	32
Jan 1848	Awarded a medal for meritorious service and a £10 annuity	32
18 Jun 1849	3rd son born, Stephen Fullom	33
1850	Promoted to quartermaster sergeant	34
25 Jun 1851	3rd daughter born, Kate	35
28 Jun 1854	4th son born, Paul Bennett	38
1854	First edition published	39
26 Jun 1855	Commissioned as a quartermaster and moved to Chatham	39
3 Jan 1857	4th daughter born, Hebe Millicent	41
1857	Second edition published	41
18 Jul 1859	5th daughter born, Nelly Caroline	43
4 Mar 1861	4th daughter, Hebe, died	45
22 Mar 1862	6th daughter born, Ella Teresa	46
30 Apr 1865	Wife died of cancer	49
22 Aug 1865	Retired on half pay with the honorary rank of Captain and moved to Kilburn, London	49
21 May 1885	Died in London	69

Sir Joshua Jebb (1793-1863) and the Model Prison – Pentonville 1840-1842

COLONEL K W DALE OBE TD CEng HonFCIBSE

K W Dale is senior partner in Dale and Goldfinger Consulting Engineers (Building Services), which has practices in Cirencester and London, and has been in private practice since 1954. Concerned with building services engineering throughout his career, he has designed the building services for many important buildings both at home and abroad.

He was appointed Aide-de-Camp to Her Majesty the Queen from 1977 to 1979.

Serving initially in the Royal Air Force, from 1942 to 1946, he then joined 101 Field Engineers, was Commander Engineer Specialist Pool 1974 to 1977 and Colonel Engineer and Transport Staff Corps from 1977 (now supernumerary).

Appointed President of REHVA (Federation of European Heating and Air Conditioning Associations) in 1993, he has represented the Chartered Institution of Building Services Engineers on REHVA for many years, and has held many other public appointments.

He has written and published several technical papers.

Introduction

The first half of the 19th century covered a period of considerable social reform, industrial innovation and development throughout the western world and particularly so in Great Britain. It was a remarkable era which produced men and women noted for their integrity, initiative and industry. One such man was Sir Joshua Jebb (1793-1863).

Between 1840 and 1842 Jebb, then a Sapper major, was responsible for the design and building of a model prison at Pentonville. The prison, now 150 years old, is still in use and as a result of recent modifications is likely to remain in use for many decades to come, basically as Jebb conceived it.

In common with Royal Engineers of the day, Jebb left behind comprehensive records of his work amongst which is an account of the design, construction and cost of Pentonville Prison. (1)

Jebb (2)(3)(4)(5)

Jebb was born at Chesterfield on 8 May 1793. He was the son of Joshua Jebb, a Derbyshire Magistrate, his mother was the daughter of General Henry Gladwin (Gladwyn) who fought in the American War of Independence. His family was and still is well-known in England. His great grandson is Lord Gladwyn (the diplomat Gladwyn Jebb).

Joshua Jebb attended the Royal Academy Woolwich and was commissioned as second lieutenant Royal Engineers in 1812. In 1813 as first lieutenant he embarked for Canada and, in 1814 in the Army of Sir George Prevost, he took part in the Battle of Platsburg. His services in that battle are mentioned in General Orders.

On return to England in 1820, he was stationed at Woolwich and later in Hull until 1827, then posted to the West Indies. In 1829 he was invalided home.

In 1830 he married Mary Leigh Thomas; the following year was appointed Adjutant of the Royal Sappers & Miners, and, in 1837 was promoted first captain.

Jebb first became involved in prison work in 1837, as Surveyor-General of Prisons. He is mentioned in the Third Report of Prison Inspectors (1838) for having assisted them with prison construction.

During this period he was appointed to hold inquiries on Grants of Charters, and Incorporation to Bolton and Sheffield, as well as being appointed to be a member of the Commission on the Municipal Boundary of Birmingham.

Seconded from the Army in 1839 as Technical Adviser to the Secretary of State on prison building, he became Commissioner for the Government of Pentonville Prison in 1842, Inspector General of Military Prisons in 1844, when he was also a

Col K W Dale OBE
Sir Joshua Jebb 1793 - 1863 p272

member of the Royal Commission to report on the punishment of military crime by imprisonment, and his work in prison building and management continued until 1850 when he became Chairman of the Directors of Convict Prisons. That year his wife died and he retired from the Army. In 1854 he remarried, and the same year was granted the honorary rank of colonel.

Promoted to KCB in 1859 for his civil services, he was granted the honorary rank of major general in 1860.

In 1861 and 1862 Jebb served on commissions which considered the construction of the Thames Embankment, and communications between Blackfriars and Mansion House and Westminster Bridge and Millbank.

A riot at Chatham Prison and riots by ticket of leave men in the winter of 1862/3, resulted in the directors of convict prisons being criticized to such an extent that a Royal Commission was appointed. Jebb was vindicated but the strain of the controversy so damaged his health that he collapsed and died in the Strand on 26 June 1863.

Sir Joshua Jebb (1793-1863)

Prison Reform/The Separate System

The need for prison reform was brought to the attention of the Government in the mid-1700s by John Howard, who publicly exposed the deplorable condition of our goals of that time. Howard was supported by others such as Elizabeth Fry, the Duke of Richmond, Lord Auckland and Quakers in America. Their pleas for reform coincided with the loss of America as a colony to which prisoners could be transported and so several new systems of discipline were reviewed along with the need to provide more prisons in England.

Following experience at Horsham, Petworth and Gloucester prisons, and with the knowledge of work in America, a system known as the "separate system" was chosen as the best which could be devised.(6) This involved the separation of prisoner from prisoner whilst providing labour, religious and moral instruction as the means of deterring others from crime and reforming those who had committed it.

Pentonville Model Prison

Jebb's brief was to provide prison accommodation in which the separate system could be enforced. His report on how he implemented the brief, the building of the prison and its first two years of operation forms the basis for these notes.(1) It was translated into French and German and was widely read by prison reformers in America.

Captain Jebb selected the site in 1840, produced designs for the prison, including its building services, supervised the construction and commissioning, and all the work was complete by September 1842. Occupation took place on 21 December1842.

The prison (to house 540 prisoners) became known as the "model prison" and the model was used at home and abroad. Jebb himself oversaw the building of similar prisons at Portland, Portsmouth, Chatham, Brixton and Woking, as well as several military prisons. The Mountjoy Jail in Belfast and new prisons in Paris and Prussia, were built on the same lines.

The isometric drawing of the prison is shown in *Figure 1* on the next page. The site covered about six acres, there was a garden at the rear. Four cell blocks, three storeys high, radiated from a central hall behind the Chapel. Each cell was 13ft x 7ft x 9ft high. A fourth storey was added to the cell blocks in 1872-96 increasing the capacity to about 708 individual cells. Besides the Chapel there were houses for the Governor, chaplains, 19 prison officers, a schoolmaster, a clerk of works and an engineer.

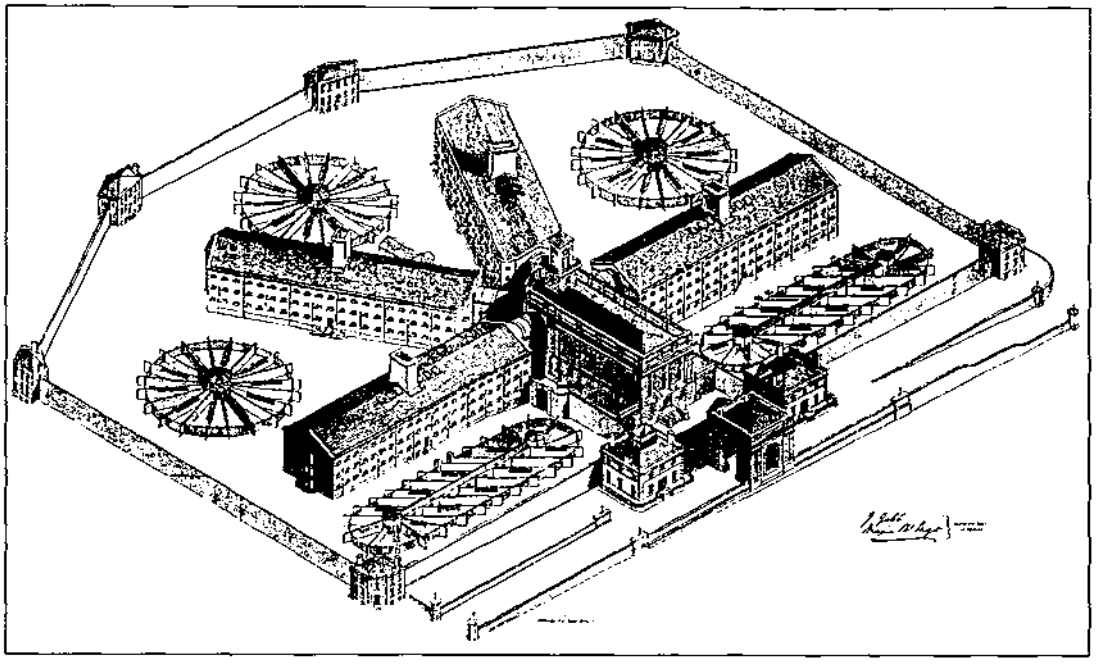

Figure 1. Isometric view of prison.

Eight bathrooms, a kitchen, medical facilities, offices, library, store rooms and heating-plant rooms were also provided.

The design of the Portcullis gateway was that of Sir Charles Barry.

The whole complex cost around £90,000 (£3,500,000 1992 prices) ie about £167 per cell (£6,490 per cell 1992 prices). PSA projects paper "Prison Design and Construction" puts the cost of a prison place in Pentonville (1842) at £158 and likens it to the cost of a reasonable family cottage at the time.(8) Today they suggest the cost per inmate of a Category "B" prison is about £71,000, the average cost of a semi-detached house in central and southwest England.

The Building Services costs per cell were:

	£	s	d
Warming apparatus	4	10	0
Water closets	6	13	5
Gas lighting	1	8	1¼
Stoves, clocks and bells		15	4
Builders work, flues etc	4	0	3½
Well machinery	2	17	0
	20	4	2¼

Thus the building services element of the cost of the works was about 12 per cent, between £10,500 and £11,000 (£408,000-£427,500 at 1992 prices.)

Nowadays engineering services account for 20-25 per cent of the capital cost of a new establishment.(7) (£1 (1841) approximately equal to £38.86 (1992) Central Statistical Office.)

Heating and Ventilation

One of the major concerns of services engineers nowadays is that of indoor air quality. Jebb was very concerned about this, he was firmly convinced that the quality of ventilation of a cell had a direct influence on the health of a prisoner, and was therefore one of the most important objects connected with the construction of prisons. He also felt that the warming of cells was necessary and inseparably connected with ventilation. His peers at the time were not so convinced.

One, a Captain Williams, in a letter to Jebb, criticized him "for applying the luxury of heat to prisoners' sleeping quarters, the more especially as the greater portion of the honest population in the country neither experience the want nor enjoy the possession of such advantage."(8) Jebb however felt that it was neither difficult nor expensive to provide warming and ventilation and recommended it for all new prisons.

The main objects of his design were:

- To withdraw a stated quantity of foul air from each cell – 30cfm (14.2 litres/second).
- The supply of an equal quantity of fresh air without causing a draught.
- Means of warming the air when necessary without "injuring the quality or affecting its hygrometrical condition (52-60°F (11-15.5°C) to be maintained in the coldest weather."
- The air channels and flues should not be a means of communication between prisoners.

Jebb consulted Hadens of Trowbridge, and with them an apparatus for warming the air and a system of flues was developed, *Figure* 2, by means of which outside air, warmed or not as necessary, was introduced into each cell at high level. An extract grille was placed at low level in each cell and ducted to the foul air extract in the roof.

To induce flow in the summer, a small fire was maintained at the bottom of the vertical shaft. Jebb remarks that the fire was needed because wind forces alone could not be relied upon to produce the necessary circulation.

Haden's apparatus was a boiler with extended heating surface, cast iron plates in "zigzag lines", in a brickwork setting. It was designed to produce 60°F at 32°F outside temperature with water at 100-120°F. This water temperature was chosen to avoid high entering air temperatures.

Other requirements were that temperatures should be adjustable and the whole apparatus should be simple in its construction so that there would be no difficulty in its management. Jebb tells us that once the flue ways had dried out and experiments had been made, it was possible to determine the amount of fuel needed for a particular outside air condition; this amount was issued and thus any under heating or over heating that would have arisen if a subordinate officer had been required to exercise his discretion was avoided. He sensibly cautioned his peers not to rely on any results until the structure was properly dried out.

Commissioning and Testing of the Cell Heating and Ventilation

Whether or not the system worked was not left to chance. Dr Owen Rees the principal medical officer was charged with conducting trials and produced a report which showed:

- 30-45cfm of fresh air was supplied to each cell with regularity. (How this was measured is not clear, Captain Williams in 1842 made some observations of the ventilation with a lighted candle.)

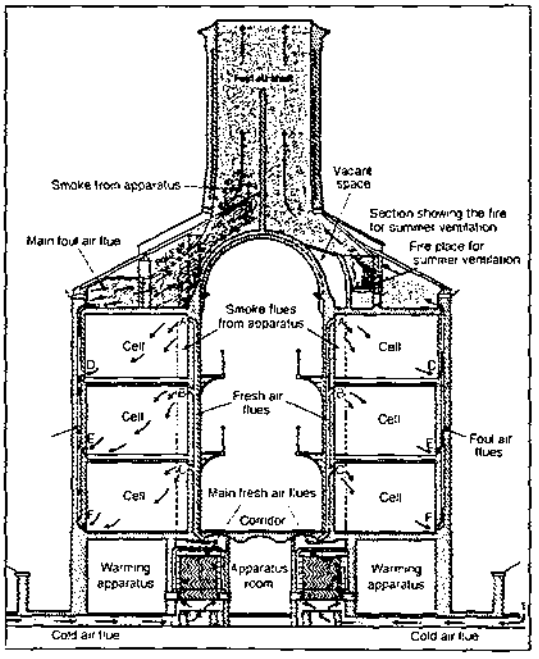

Figure 2. Cross-section of prison.
(Reproduced with the kind permission of the editor, Building Services Journal)

- That this volume could be supplied, maintaining 52-60°F in the cells during the coldest weather at a cost of less than a farthing a cell for 24 hours. (Jebb, in a footnote, remarked that initially this was not so, because the building and flues had not dried out and cautioned against trusting temperature or fuel consumption results until all the flues and building materials had dried out.)
- That the same degree of ventilation was maintained in summer at half the expense.

A table of temperature results was provided showing that with 22-23°F outside, the cells were at 57°F, and at 41-46°F outside they were at 57-58°F. The temperature gradient in the cells was not more than 1°F.

The Surveyor General of Prisons' costs for the year 1854-5 gives the cost of fuel and light as £700 for 561 prisoners. This is about three farthings/day/prisoner for heat and light for cells and ancillaries.

Baths, Washing and Sanitary Facilities

George IV, (1820-1830) required that warm and cold baths be introduced into all prisons. Jebb provided eight baths by means of which, he stated, there was no difficulty in bathing 32 prisoners in an hour. Each prisoner bathed once a fortnight.

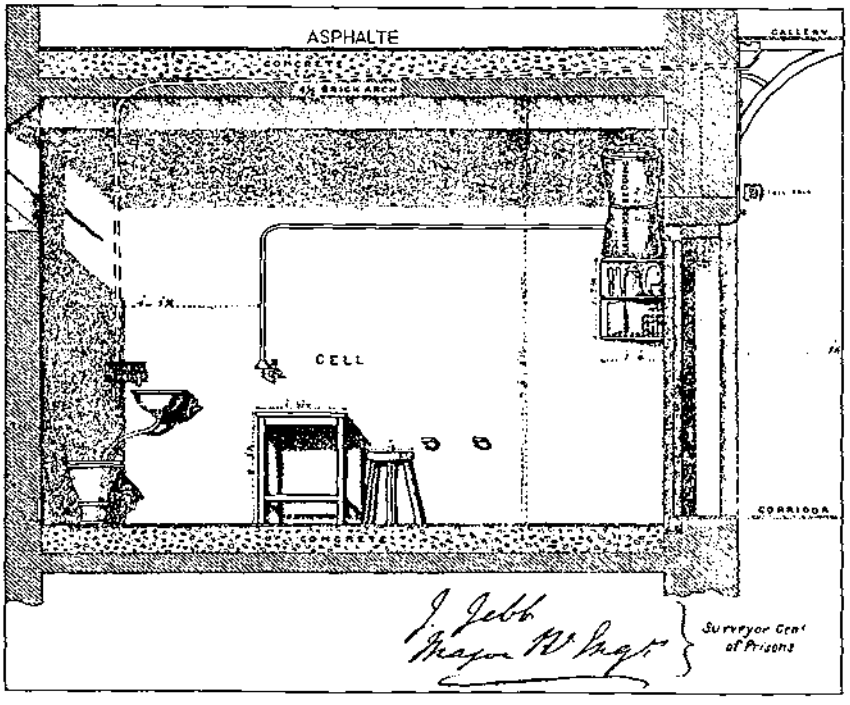

Figure 3. Prison cell.
(Reproduced with the kind permission of the editor, Building Services Journal)

Perhaps the most remarkable facilities provided were those of a wash hand basin and a strong glazed earthenware pan (WC) in each cell. As *Figure 3* shows, water (six gallons per cell per day) for washing and flushing was provided from a cast iron sectionalized channel running beneath the galleries. It will be noted that water from the basin went via the soil pan so that it was not wasted.

When describing these provisions, Jebb cautions on the need to avoid freezing and suggests that this can be accomplished if cisterns and pipes are placed in or near to the foul air flues and kept away from the influence of outside air.

At what point in the prison's history these facilities were removed from cells and "slopping-out" became the norm is not clear but it is interesting to note that it is only recently that such facilities have been reinstated as a part of the programme of upgrading of the prison.

45, Parliament Street,
17th February, 1843.

Messrs. G. and J. Haden,

Gentlemen,

I have now had sufficient experience of the new hot water Apparatus you have designed and applied in warming three wings of Pentonville Prison, to be enabled to state to you that it fulfils all the conditions to which I directed your attention. An equable temperature of from 52° to 58° has been maintained in all the Cells under circumstances of great variation in external temperature. The consumption of fuel has not exceeded from 2 to 2¼ cwt of coal for sixty-six Cells, and the Ventilation or quantity of fresh air introduced into each Cell has been from 30 to 45 cubic feet per minute. The cost of maintaining this temperature and ventilation has been about ½d. per cell for 24 hours.

You have now completed your contract with the Commissioners of Her Majesty's Woods and Forests, for works at Pentonville; and I only do you justice in stating that everything you have undertaken has been executed in a manner which has proved your practical skill and ability and that all your engagements have been fulfilled with straight-forward integrity.

I am, Gentlemen,
Your Obedt. Servt.
(Signed) J.JEBB.

Figure 4. Copy of a letter from Major Jebb, Royal Engineers.

Gas Lighting

Jebb employed Mr Faraday to provide gas producing apparatus and light fittings to each cell and throughout the prison buildings.

Prison Call System

Though prisoners were not allowed to communicate with one another, it was considered essential that they should be able to gain the attention of the prison officer at any time. For this purpose, each cell had a handle attached to a spindle on the gallery end of which was a metal label. The label was normally horizontal but when it was turned vertically it indicated the prisoner's need for attention.

Commentary

Nowadays, design teams and contractors who manage to design and build a building in three to four years, talk of the project as fast track.

Even though planners were probably not around to delay matters for Jebb, that he managed with his contractors and suppliers to build, fit out and commission a prison for 560 prisoners in 18 months was no mean achievement.

It makes one wonder why we, with the technology and machinery of today, take so long to produce buildings.

Had Pentonville been built today its architect(s) (Barry and Peirce, to whom Jebb paid a guinea a drawing) would no doubt have reaped the credit for it and no doubt his (their) report on its building would have put less emphasis on its building services.

There is no doubt that those who read these notes will discern that Jebb was well ahead of his time in being concerned about indoor air quality, fuel consumption/energy conservation, public health engineering and the commissioning of the services he designed.

It is also striking that Jebb and his contemporaries put considerable emphasis on recording what they had done and how they did it so that a record and guidance were available for others to follow and for us to contemplate 150 years on.

Reading Jebb's papers and correspondence with his suppliers and colleagues has been a pleasant experience, the courtesy with which they addressed one another is refreshing.(3) Witness the testimonial *(Figure 4)* Jebb provided for Hadens of Trowbridge in 1843.(9)

How often are such generous testimonials sent to those who have provided a service these days?

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The names of some of the firms/gentlemen involved in the building of Pentonville Model Prison 1840-1842

Engineer	Major Joshua Jebb RE
Architects	Sir James Barry, Mr Charles James Peirce
Surveyors	Williams & George Cordoroy, 98 High Street, Marylebone, London
Warming Apparatus etc	Messrs Hadens Engineers, Trowbridge, Wilts
Steam Cooking Apparatus	Hadens
Pump and Machinery	Hadens
Gas Fittings	Mr Faraday, 14 Wardour Street, London.
Locks	Mr Thomas, Lockmaker, Birmingham
Cocks in cells for water distribution	Messrs Pontifex & Mallory, 15 Upper St Martin's Lane, London
Earthenware Closets	Messrs Oldfield, Brampton Moor, Chesterfield

Some Ideas for Improving Engineer Communications

MAJOR J F PELTON BSc(ENG) CENG EURING MICE

Major John Pelton was commissioned into the Corps in 1982 having graduated with a civil engineering degree from Imperial College. Tours followed as a troop commander in 48 Field Squadron (Construction) and the Junior Leaders' Regiment, before he attended the Professional Engineer Training Course. On qualifying as a chartered engineer he was sent to 4 Field Squadron and took part in Operation Granby. *After a brief visit to the United Kingdom with the Military Works Force, which included taking part in Operation* Grapple 1, *he returned to Germany in 1994 to command 12 (Nova Scotia) Field Squadron. He has since returned to Bosnia as a staff officer in Headquarters Sector South West, prior to taking command of 23 Amphibious Engineer Squadron.*

CONSIDER, for a moment, a time many years into the future. A sapper squadron commander is giving orders to one of his troop commanders for a reconnaissance in order to prepare a bridge for demolition. The troop commander receives his orders in clear through his combat helmet sound system and a written transcript is simultaneously produced by his vehicle equipment. If required, or available, graphic information on the target, or the operation, will also be sent and displayed on his helmet visor head-up display. This will then be saved on his computer system for future reference. On arriving at the target he commences scanning the bridge with his helmet-mounted sensor systems. Without leaving his vehicle he quickly sizes the bridge, its main members and any details of the gap. Once scanning is complete he selects the demolition method from the computer-generated options presented to him on his helmet display. The computer then automatically designs the charges and produces the stores list and any other planning information. The bridge and demolition data are then automatically transmitted to both his squadron commander and the support squadron. If the squadron commander wants more information he can establish a real-time video link with the troop commander's helmet sensors allowing him to "see" through the troop commander's eyes. The same link allows the troop to get a view of the bridge on the video screen in their harbour area during the reconnaissance. Stores are delivered to site and work starts. Progress reports are sent either by voice link, burst transmission or by further use of the video link. If a problem occurs the support squadron can be shown exactly which stores are required to solve it. The demolition is completed successfully and the troop returns to its harbour area for further tasking.

Such communication systems are, at the moment, pure science fiction. However, to be effective they would still have to rely on the same three elements as current communication systems, that is: rugged, reliable and easy to use equipment utilizing the latest technology; well trained personnel; and simple standard formats for passing information. The communication systems in service today could not match the capability of the systems described above. Nevertheless improvements in communication must always remain an aspiration so that information can be passed as quickly as possible on the battlefield.

The aim of this article is to propose a system of engineer radio message formats, suitable for use with insecure radios on squadron nets. This aim has been chosen because the format of information is the only element of the communications system which can easily be changed and also, as will be

Major J F Pelton
Some ideas for improving Engineer communications
p278

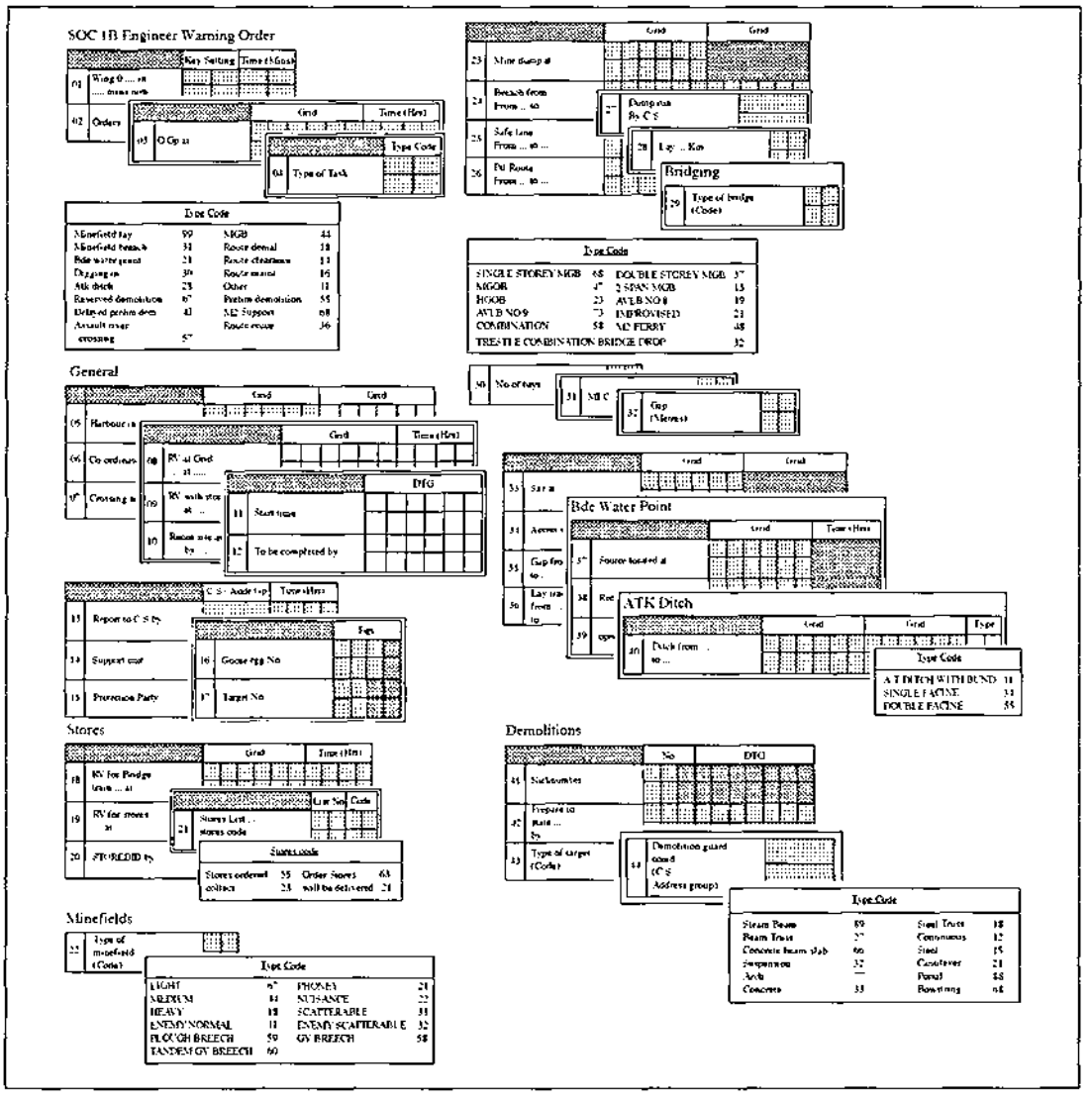


Figure 1. SOC 10.

seen later, because it is currently in some disarray. There is little that can be done to influence the available equipment. The Clansman series of radios is unlikely to be modified in the near future and Project *Bowman*, the successor to Clansman, is still many years from being introduced into service. Furthermore, Clansman enhancements, such as Kipling, are only being issued in sufficient numbers for use on regimental nets. Regarding the training of signallers, the Corps is aware of the steps required to improve standards but is invariably constrained by a lack of resources, such as finance or exercise time. There is, however, scope for improving the message formats used by engineer units so as to achieve an improvement in communications by simplifying procedures.

Military messages can be divided broadly into three categories: orders, demands and reports. These categories have been defined more closely in order to develop the radio message formats. Firstly, "orders" was taken to include the traditional mix of orders including warning orders, fragmentary orders and full orders. Secondly, "demands" was taken to include stores bids, combat supply demands and all other logistic

demands. Finally, "reports" was taken to include any messages which provide updated information on a task, such as contact reports, situation reports (SITREPs), or progress reports.

It has long been accepted that standardization of the various formats required to send such messages simplifies and speeds up the actions necessary to compile and, subsequently interpret the information. Standard formats also allow reduced transmission time and are easier to encode and decode for use on insecure systems. The Army has, over the last 15 years, introduced a variety of such standard formats and procedures. During the early 1980s the BATCO (Battle Code) code came into use with its associated vocabulary cards. In 1989 the latest Engineer Operating Procedures (EOPs) were produced by 1 (British) Corps which included standard stores lists and an attempt at a progress report matrix. Other procedures and publications include: Secure Orders Cards (SOCs), Army Unit Standard Operating Procedures (AUSOPs), the Tactical Aide Memoire (TAM) and Army Formation Standard Operating Procedures (AFSOPs). Whilst the introduction of these publications may have simplified all arms communications the (inevitably young and inexperienced) signaller, in the back of an engineer troop command vehicle is still presented with up to six manuals or pamphlets, seven if his own unit has its own standard operating procedures. From these he must extract or interpret the message formats necessary for sending or receiving engineer information by radio.

When considering ways of simplifying the current procedures the first step is to look at the information formats themselves. The first of these, using the categories described previously, is the orders format. There is, currently, no standard format for giving engineer orders on an insecure radio net. It is possible to improvise using the BATCO vocabulary sheets although even the simplest warning order can require several sheet changes. The resulting message is not easy to encode and decode and, particularly if a reasonably full set of orders are sent, can take a long time to transmit. It is possible to alleviate some of these problems by the adroit use of Card 12, although such a method would be unique to the unit or formation which devised it causing problems when, for example, regrouping occurs. Some units have made use of the all arms SOCs. For example SOC 04, obstacle crossing, can be used to send information on the ground, enemy or coordinating instructions. However, there are no serials to allow an engineer commander to give missions to the engineers and there are other details critical to engineer planning, such as information on stores, which are not included in SOCs.

Alternatives have been tried. During the early 1980s a system similar to SOCs was devised by 53 Field Squadron (Construction) to give airfield damage repair post attack orders. However, no standardized format has appeared for general use. More recently an attempt has been made to use the concept of SOCs for engineer warning orders and the Signals Wing at the RSME has been giving out draft copies for comment. This draft SOC (*Figure 1* on the previous page), numbered SOC 10 to avoid confusion with the existing all arms SOCs, was used by 12 (Nova Scotia) Field Squadron during reconnaissance training and field training exercises which took place during the first six months of 1994. During and after this training the original draft SOC was adapted and modified until it could be used to send effective radio orders.

The result is shown at Figures 2A and 2B. Firstly each type of engineer task was given a separate SOC. Demolitions, for example, became SOC 10, bridging SOC 11 and so on (to date only these two have been written). Secondly the SOCs were expanded so that they contained serials to cover all the main orders headings and could, therefore, be used for warning orders, fragmentary orders and detailed orders. The SOCs did have their disadvantages. It is not easy to give a detailed situation paragraph or to include the purpose for the tasks, that is mission direction, without the SOC becoming cumbersome and unusable. However, the advantages were felt to outweigh the disadvantages. Most of those who used them quickly picked up the format and began to identify the critical serials which needed to be decoded first and became adept at reacting to orders quickly. When used as a warning order followed by a series of extra pieces of information they allowed sub-units to be kept up to date at all times. As they are in the same format as SOCs the signallers also picked them up easily and in general the orders process was speeded up.

The SOC 10 format is still no substitute for a full set of oral orders. It is difficult to clarify points of uncertainty on the radio net and although it is all informed the many other benefits of bringing together the key personalities are lost.

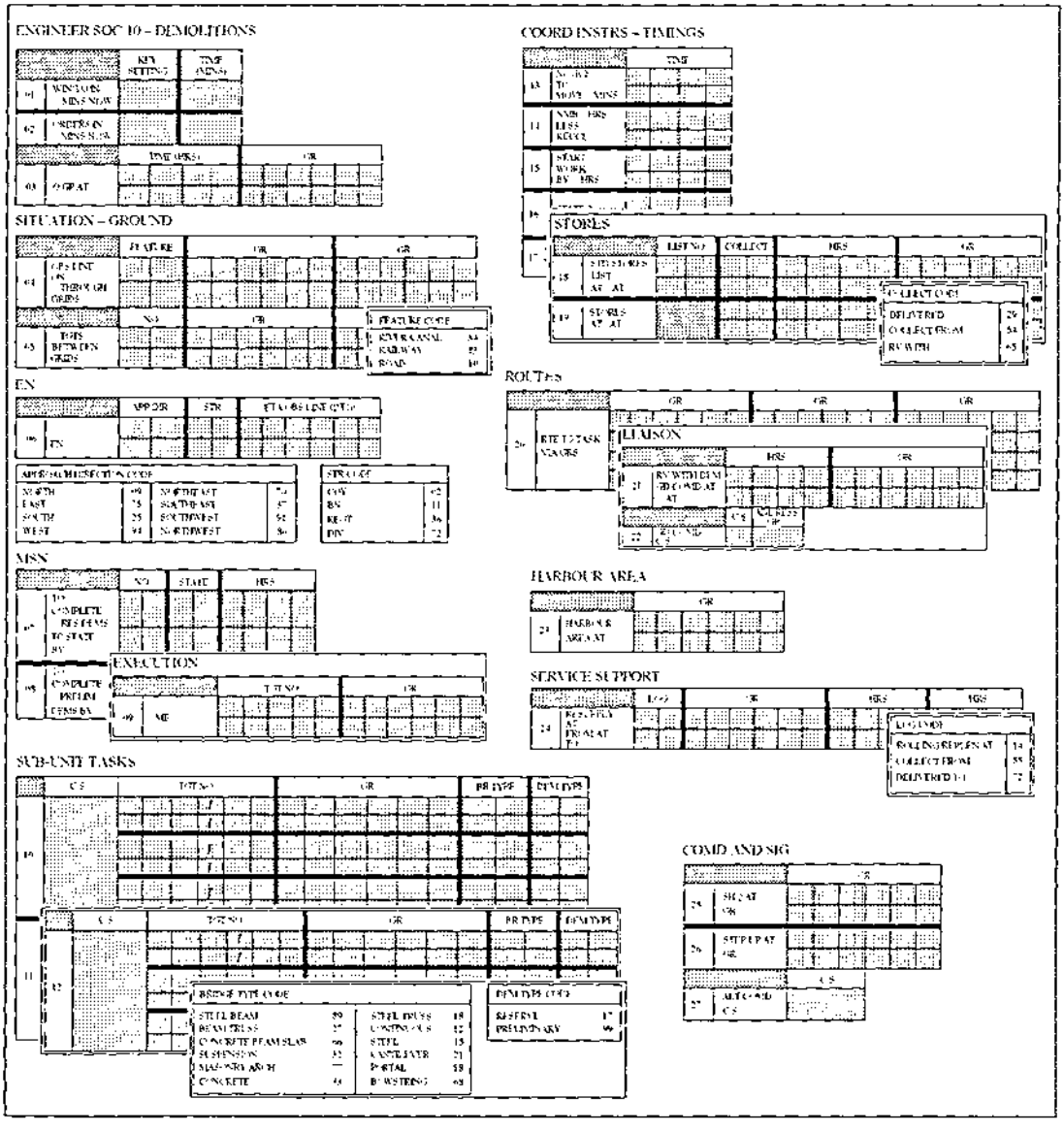


Figure 2A. Modified SOC 10.

However, it is an excellent way of speeding up battle procedures. Furthermore, it is a reasonable substitute for oral orders if time and/or distance prevent them from being possible.

Considering the battle procedure sequentially, the next set of messages likely to be sent will be stores demands following the reconnaissance. The transmission of long lists of stores, whether in clear or in code, has always created a security risk as they can identify the net as an engineer net. They also block up the net at what may well be a critical stage in the battle. A good solution to the problem already exists in the form of the standard stores lists contained in EOP 33 (*Figure 3* on the next page). This system is not perfect as, for example, a task requiring a number of non-standard stores items will still require a stores list to be sent in full, although the process can be simplified by using one of the detailed stores lists contained in EOP 33. The EOP 33 lists have been in operation without amendment since 1989 and there is now a case

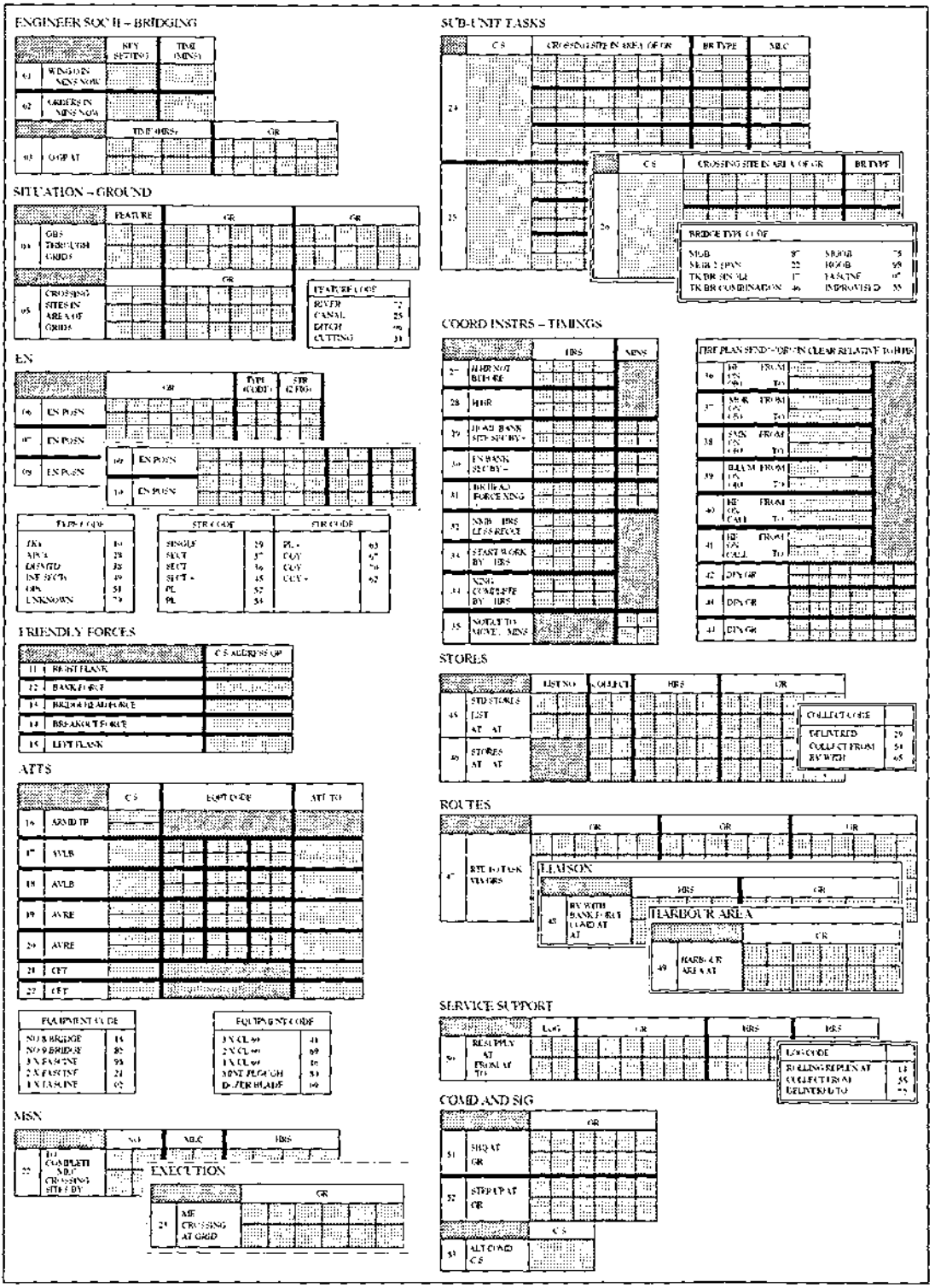


Figure 2B. SOC11.

for updating them. Several lists contain out of date items and there are items of new equipment which have come into service since 1989 which should be included.

Once the stores lists have been processed and stores delivered then work on a task can begin. At every stage the pressure for information on progress grows. The all arms reports contained in AFSOPs and AUSOPs are ideal for non-engineer reports. However, for task progress reporting there is little help available to a section or troop trying to send accurate progress information by radio. The BATCO vocabulary cards can, again, be used. However, they are not well suited as several serials must often be combined to give a reasonable update of the situation. EOPs provide a reporting matrix at Annex B to EOP 37, although, it is really aimed at squadron and higher command posts. It does not, usually, provide enough detail for a section or troop commander to send an adequate progress report.

Nevertheless the matrix concept can be extended to provide a simple and effective method of sending progress reports. An example of a draft matrix, again for demolitions, is shown at Figure 4 (over the page). Each cell contains a short sentence describing a stage of a demolition. The matrix can be used for both reserved and preliminary demolitions and can be adapted for a particular operation if required by using the spare cells to the right. It is envisaged that it would be used by referring to the report from a BATCO card in the same way as SOCs. Once on the appropriate report matrix, the two-figure coordinates of the cell, supplemented by any caveats contained in the cell, would be encoded directly into BATCO. It should be noted that the matrix is intended to complement and not replace the BATCO vocabulary cards as it may prove quicker to send a single BATCO vocabulary card serial than to use the matrix. However, there are many circumstances when such a message would be insufficient and the matrix is then available to pass more detail.

Having established a set of formats, a system must now be devised which allows them to be referred to easily, encoded and decoded. This can be achieved with some adaptation of BATCO vocabulary card 006, the engineer card (*Figure 5* over the page). The SOC can be accessed using serial 65 in the card header section. The stores lists in EOPs can be accessed using serial 47 which

ANNEX B TO EOP 33

MAJOR BR DML

STD STORES LIST ....01..... DATE/TIME RECEIVED.....

FROM/TO CALLSIGN.....BATCO/VOCAB SERIAL.....

SER	ITEMS	QTY	U OF I	REMARKS
	1	2	3	4
21	DETONATOR FLASH L1A1	2	EA	
63	DETONATOR ELEC L2A1	2	EA	
44	SAFETY FUZE L1A1	15	M	
19	FIRING DEVICE DML GRIP	1	SET	1 SWITCH + 4 FLASH INIAT
08	DETONATING CORD	1200	M	8 REELS
22	CD L3A1 (5.4 KG)	16	BOX	4 TO A BOX
55	CD NECKLACE L1A1	30	SETS	5 X CD 14 PER SET
90	PDS(C) 2 X BRICKS	8	PALLET	
73	FIXING ASSY KIT	1	SET	
71	ALL OF ABOVE 9 SERIALS		EA	QTY AS REQ
53	MEASELS IF SITED 125 LB (CHEESE DML)	4	EA	PER SHAFT
88	CRATER IF NO MEASELS RCX	1	SET	PER CRATER
50	(CD NO 1 OR CD NO 11)	1	EA	PER CRATER
	PE 4 CART	70	LB	PER CRATER
	DETONATING CORD L1A1	150	M	1 REEL
	DETONATORS L1A1	2	EA	PER TGT
30	MINES ATK	10	EA	PER GP OF CRATERS
12	MINES APERS	36	EA	PER GP OF CRATERS

Figure 3.

requires adapting to: 47 STORES LIST (2 FIG). The engineer task progress report can be treated in the same way by adapting serial 41 to: 41 ENGR PROG REP (2 FIG). This would then allow all the formats described in the article to be used with the minimum length of code preamble which is seven encryptions (three for the BATCO card number and two each for the serial and SOC/list/report number).

The final step to completing the system is to reduce the number of publications required for routine radio communication. The simplest approach would be to combine all the three message formats described above, engineer SOCs, stores lists and task progress reports, into an updated version of EOPs. However, they could, more usefully, be included in an engineer insert to AUSOPs which would, then, allow all standard routine radio message formats, including the all arms formats, to be combined in a single publication. It may prove more practical to keep the engineer SOCs separate in the same way as for the all arms SOCs. They can then easily be inserted into a plastic wallet for easy use and

ENGINEER TASK PROGRESS REPORT 01 – DEMOLITIONS							
	1	2	3	4	5	6	7
1	CONDUCTING RECCE	LEFT GIRDER CHARGES IN PLACE	NEAR ABUTMENT CHARGES IN PLACE	STAGE 1 FIRED AND COMPLETED	ABANDONED PART DEST GAP SIZE ...M (2 FIG)	LIAISING WITH GUARD COMD	
2	PREPARING FOR TASK	RIGHT GIRDER CHARGES IN PLACE	FIRING CIRCUIT COMPLETE	PREPARING STAGE 2	COMPLETE IN ...MINS (3 FIGS)	FIRING POINT(S) ESTABLISHED	
3	MOVING TO SITE	DECK CHARGES IN PLACE	RING MAIN COMPLETE	STAGE 2 FIRED AND COMPLETED GAP SIZE ...M (2 FIGS)	FAR BANK CRATERS COMPLETE	HANDING DEMOLITION OVER	
4	TROOPS DEPLOYED	TOP BRACING CHARGES IN PLACE	NOW AT STATE 1	FIRED AND COMPLETED GAP SIZE .. M (2 FIGS)	NEAR BANK CRATERS COMPLETE	HANDOVER COMPLETE	
5	STORES ON SITE	CHARGES IN PLACE PIER ... (2 FIGS)	NOW AT STATE 2	MISFIRE RECHECKING CHARGES	FAR BANK NUISANCE MINES LAID	ESTIMATED COMPLETION TIME	
6	GOTO BATCO CARD ... (3 FIGS)	FAR ABUTMENT CHARGES IN PLACE	TIME FROM STATE 1 – 2 IN MINS ...(2 FIGS)	ABANDONED INTACT	NEAR BANK NUISANCE MINES LAID	GOTO STORES LIST NO ... (2 FIGS)	

NOTE: 1 THE 2 FIGURE COORDINATES OF EACH CELL ARE TO BE ENCODED IN BATCO.

Figure 4.

reuse. If this were achieved then the section commander or the troop command post would require only a BATCO wallet, AUSOPs and TAMs, possibly augmented by a SOC folder.

No system is ever perfect, nor can it satisfy everyone who has to use it. The proposals contained in this article provide some measure of improvement over the current rather ad hoc group of publications and procedures. If nothing else they confirm that there is a need to overhaul the current procedures largely based on EOPs which were issued six years ago and which are becoming increasingly outdated. There is certainly a need to simplify engineer communication procedures and if this results in increased standardization and a reduced number of publications then that is all to the good.

(The engineer SOCs and engineer task progress report referred to in this article have been produced using WordPerfect for Windows Version 6.0. Anyone who would like copies is requested to send a 3.5in disc to the author who would also be interested in any proposals for further amendments or improvements.)

BATCO VOCABULARY CARD		
	UNIT	CARD 006 ENGRS
03 CHANGE TO CARD (3 FIG) 01 GR (4 FIG) 02 REPORT NO (3 FIG)	32 CHANGE TO CARD 001 33 CHANGE TO CARD 002 34 SPELLING STARTS	65 SOC (2 FIG) 66 GR (6 FIG) 67 FIGURES
ORDERS 00 BG 04 BLOW/BLOWN 05 BREACH(ING) 06 CONSTR 07 DEFEND/DEFENCE 08 ENGR RV 09 ETC 10 IN LOAD 11 IN SP 12 OUTLOAD 13 REC/REPAIR 14 START TIME 15 TASK(ING) 16 UNDER COMD	35 MGB (1 FIG) 1 = 30M 2 = PIER 3 = LINK 4 = SPAN JUNC 36 M2 RIG 37 MINE PLOUGH 38 TRACKWAY (1 FIG) 1.CLASS 30 2.CLASS 60 **REPORTS/RETURNS** 39 ARMD ENGR STATE 40 ENGR LOG REPORT 41 ENGR PROGRESS REPORT 42 EOP 43 ENGR STATE REPORT 44 INTENTION TO LAY 45 SOP 46 STORE BID/REL 47 STORES LIST 48 TGT NO 49 UNIT MATRIX 50 VEH STATE **BRIDGING/CROSSING** 51 BANK (1 FIG) 1 = FAR 2 = HOME 52 BAY(S) 53 BR(ING) 54 X(ING) 55 EXIT 56 HARD CORE 57 58 SITE 59 SPAN (2 FIG) M 60 TK/TRACKED ROUTE 61 WAITING AREA 62 WHEELED ROUTE **DML/ROUTE DENIAL** 63 CRATER AT GR (6 FIG) 64 DITCH FM GR (6 FIG) TO GR (6 FIG)	68 DML 69 DML FIRING PARTY 70 DML GUARD 71 MEASLE SHAFT 72 PRELIM 73 PRELIM (DELAYED) 74 RESERVED 75 STATE (1 FIG) **MINELAYING/BREACHING** 76 BARMINE 77 CLEAR FROM GR (6 FIG) TO GR (6 FIG) TO ... 78 FENCE(D)(ING) 79 MINEFD 80 MINE DUMP 81 PERIMETER 82 PHONEY 83 ROW 84 SAFE LANE 85 SCATTERABLE MINE CLEARANCE **MISCELLANEOUS** 86 ANCHORAGE 87 CLOSE 88 CULVERT 89 DIVING/DIVERS 90 FD DEFS 91 HARRIER PAD 92 OBS 93 OPEN 94 PALLET 95 PARTY/TEAM 96 ROUTE 97 SETTING OUT 98 WATER PT 99 WDR

Figure 5.

A Walk With Heroes

"Albertopolis"

SOUTH Kensington has a special place in Sapper history. The area around the Albert Hall owes much to the Corps, and the story of its genesis reveals something of the impact of Royal Engineers on 19th century civil affairs.

When time allows, I enjoy the walk from Whitehall to Kensington Gardens through the lush green sweep of St James's Park, Green Park and Hyde Park. Arriving at Coalbrookdale Gate, I look for the site of Joseph Paxton's 17-acre "Crystal Place" where the hugely successful "Great Exhibition" of 1851 was staged by Prince Albert. For some strange reason (probably financial, I guess) Albert allowed himself the absurdly short time of just 15 months for the complete organization, design and construction of the Exhibition. Consequently, the whole venture became a race against time and he decided, on the recommendation of Lord Taunton – President of the Board of Trade, to appoint a number of Royal Engineer officers under the command of Lieut Colonel W Reid to "project manage" the complete undertaking and to chair the plethora of executive subcommittees involved. In addition, two companies of Sappers (the 5th and the 22nd) and an ad hoc group of artisan tradesmen were drafted in to assist with construction.

Fortunately, this arrangement worked so well that the Exhibition not only opened on time, but also proved irresistible to six million people including Queen Victoria, who visited no fewer than 40 times. I like to think that Sapper skill and ingenuity were largely responsible for the Exhibition's colossal success. Albert certainly thought so, and when he wrote to thank the Master General of the Ordnance he commended the Corps in the most glowing terms.

The Exhibition, however, was just the beginning. Shortly afterwards, Albert suggested that its finest exhibits should be placed on permanent display in an ambitious new cultural centre for the promotion of art, science and industry on 86 acres of South Kensington, funded from the Exhibition's £186,000 profits. The idea captured the romantic spirit of the time and was quickly nicknamed "Albertopolis". Remembering their sterling work before the Exhibition, Albert wasted no time in securing the services of another company of Sappers to start preparing the site. He also included several prominent Royal Engineers in his design team under Captain Francis Fowke RE whom he appointed "Engineer and Director of Museum Construction." Such generous public recognition and royal patronage came as a welcome boost to the Corps' dwindling prestige at a time when the Army was in steady decline after nearly 40 years of peace.

Prince Albert's passion for culture and his fascination with science must, I believe, have struck a particularly resonant chord with our 19th century Sapper predecessors. Like so many of his generation born in the age of optimism, Albert dreamed of a time when everything would be known and everything possible. During the course of the Exhibition he began to understand that Royal Engineers could help him realize his aspirations in art and science through the media of engineering and architecture. One of the key figures in this process was the highly original Captain Francis Fowke, who first came to the Prince's attention through the pavilion he designed for the Royal

Horticultural Society at the 1851 Exhibition and later through the library (judiciously named the "Prince Consort") which he built at Aldershot in 1859. Fowke also designed highly acclaimed structures for the International Exhibition of 1862 and later won the architectural competition for the Natural History Museum. In 1864 he completed his last and most famous work – the general design of the Albert Hall – but sadly died in 1865 before he could see it built. Fowke's successor as "Architect to the Science and Art Department" was another Royal Engineer officer, Major General H D Y Scott, who eventually completed the Albert Hall project in 1871, ten years after the death of Albert.

The spirit of "Albertopolis" was a milestone in Victorian social and cultural development, but it was by no means Prince Albert's only achievement. Besides bringing much needed *gravitas* (authority, dignity) and erudition to the monarchy, he also introduced the Christmas tree from his native Germany and probably did more to foster musical, artistic and scientific progress in Britain than any other man of his time. We have much to thank him for and it seems appropriate that his lofty gothic memorial should soar high above the plane trees opposite the Albert Hall overlooking the magnificent institutions he helped establish.

For me, the Albert Memorial is one of London's most striking and evocative landmarks. Designed by Sir George Gilbert Scott in 1862, a year after Prince Albert's untimely death from typhoid, it is the epitome of Victorian decorative style. I was not surprised to learn that it was commissioned by Cubitt, Lord Mayor of London, and paid for partly by public subscription (£70K) and partly by the Treasury (£50K). Queen Victoria herself selected Scott's highly sentimental design which was inspired by medieval reliquaries. The monument itself was conceived on a vast scale: its full 200ft can best be appreciated from beside G F Watts' statue of Physical Energy (1904) in the middle of Kensington Gardens. It takes the form of an elaborate shrine with a soaring spire and a statue of the Prince enclosed beneath its vaulted ciborium. This preposterously romantic structure stands on a low pyramid of Cornish granite steps surrounded by contemporary sculpture and anchored at each corner by massive marble groups representing the four continents of the world.

Although its proportions may be somewhat questionable, it certainly conveys the dazzling self-confidence of Great Britain in the mid-19th century at the height of her imperial power. Only Victorians could have decorated every conceivable surface of such a structure – even those totally invisible from ground level! Its extravagant use of materials such as bronze, copper, iron, granite, marble, limestone, agate, onyx, jasper, cornelian and crystal may be considered by some as overwhelmingly vulgar, but I like its kaleidoscopic colours and intricate craftsmanship. And I admire John H Foley's massive 15ft high, 10-ton figure of the Prince in wistfully contemplative mood which sits beneath the gabled canopy. Robed in the Order of the Garter, I notice he holds a weighty tome in his right hand. Is it the Bible? No; it is the catalogue of the 1851 Exhibition!

Unfortunately, however, no amount of glorious Victorian self-confidence could overcome the corroding forces of nature. And sure enough, beneath its glittering exterior the memorial's iron skeleton has been steadily deteriorating for the past 120 years. Thermal cycling, poor drainage and insufficient maintenance have all exacerbated the problem. In 1989 it eventually became so serious that the Property Service Agency decided to commission a detailed survey by specialist conservation consultants, the Morton Partnership Ltd. Their report highlighted several areas of concern including corrosion of structural ironwork and water damage to mosaics and other decoration. As a result, a comprehensive and technically fascinating repair programme was launched without delay.

A key feature of Morton's investigation was how best to tackle the rusting and delamination of the monument's wrought-iron box section structure. Several high-tech options were considered, but in the end Morton opted for a traditional flexible coating of red lead, micaceous iron oxide and wax covered by the original, highly decorated lead cladding. Work started in 1990 with scaffolding erection which was a major project in itself lasting a year and costing about £0.3M. Repairs were then divided into two phases with the first being completed in early 1993. But Phase 2, which involved the most important repairs and conservation, was delayed due to unexpected funding difficulties at the Department of National Heritage. Fortunately, however, the project received a green light in the 1993 budget and, all being well, should now be forging ahead once again.

Passing beside the memorial and crossing Kensington Gore to the Albert Hall itself, I enter the foyer to find an old photograph which is a particular favourite of mine. It shows the memorial

£¼M of free-standing scaffolding encloses the Albert Memorial during essential repairs. Marble group representing "America" in the foreground.

Field Marshal Lord Napier (1811-90). Engineer, artist and Fellow of the Royal Society.

under construction in 1864 with the original scaffolding in place and the spire's wrought-iron box sections being assembled by what would be described today as "fast track" construction. The scene is a vivid reminder of the enormous energy and resourcefulness of those 19th century engineers who never tired of experimenting with new materials, construction methods and technology.

Outside the Hall, on its western perimeter, the work of another Royal Engineer, Lieutenant H H Cole, can be seen in the ornately decorated Royal College of Organists (1875). Sadly neglected and empty today, it still glows with all the radiance of a Venetian palace. I am heartened to hear of plans for its use as the new Museum of Music and Sound. Both Albert and Cole would approve, I think.

A hundred yards further west, "Albertopolis's" Sapper roots emerge once again at the top of Queen's Gate. Here stands the imposing equestrian statue of Robert Cornelis, better known as Field Marshal Lord Napier of Magdala (1811-90), a true "universal man" in the Renaissance style. Commissioned into the Bengal Engineers in 1826, he was responsible for public works all over India before making his name as a commander during the Indian Mutiny (1857), the Chinese War of 1860 and the Abyssinian Expedition of 1868. But how on earth did he find time to become a distinguished artist, botanist, geologist and palaeontologist as well? In 1869 he was even elected a Fellow of the Royal Society.

Napier's blend of artistic, scientific and military flair perfectly embodied the cultural philosophy of "Albertopolis" and explains the siting of his statue here. What is more, Napier's achievements helped secure the profound admiration with which the Corps of Royal Engineers was regarded throughout Queen Victoria's reign. Appropriately, his statue by Boehm shows him in tropical uniform seated on a fine charger and holding a pair of binoculars in his right hand. He looks vigorous and alert, every inch the self-assured Victorian hero and intrepid Empire-builder.

Indeed, it was the committed vigour and ingenuity of Napier and his contemporaries, such as Fowke and Scott, that established the intellectual foundation from which the Corps' reputation has developed ever since. And it was Prince Albert who promoted these virtues, and the wider cause of scientific progress, through his employment of

TA walk with heroes Albertpolis p287

Royal Engineers on the Great Exhibition and the "Albertopolis" projects. So successful were they that these ventures demonstrated beyond all doubt the value of maintaining the Corps of Royal Engineers in peacetime for civil works. We therefore owe it to posterity to see the Albert Memorial properly conserved. At the same time, we might ask ourselves what lessons it offers for the future.

"Albertopolis" may be a rather long walk from Whitehall but for anyone inclined to wonder where our professional heart should lie it is, I believe, well worth the visit.

This is the sixth in the series written and photographed by Col T H E Foulkes, featuring 19th century personalities.

Thoughts in Whitehall

They stood six-deep in ordered ranks,
To raise their hearts in grateful thanks
For those who made the sacrifice.
On land, on sea and in the skies.

Silent they prayed and thought of years
Now long since gone, and there were tears
As mem'ries came of those who fell
In jungle, desert, field and dell.

Firm was their gaze as they marched by,
Medals gleaming, heads held high.
Tobruk, Cassino and Imphal
Were one with Ypres and Passchendaele.

Take up our quarrel with the foe,
The poet bade us long ago,
But who is it that we must fight
To set this sorry world aright?

'Tis not the Jap, nor yet the Hun
O'er whom the vict'ry must be won,
But Envy, Hate, Bad Faith and Greed;
These are the foes that we should heed.

So Lord, forgive our wayward past,
Receive us when we come at last
To join with those who went before,
And rest in peace for evermore.

Captain F A Anthony, RE (Retd)
November 1979

Reminiscences of a Corps SOREII in the British Liberation Army – 1944

BRIGADIER H G W HAMILTON CBE DL

Following his article in last December's *Journal*, the author writes some further reminiscences of the period he spent in France, Belgium and Holland from D+1 to September 1944.

HQ 30 Corps, which I joined in Sicily in late 1943, returned to the UK just before Christmas to start planning for the invasion of France. Our Chief Engineer (CE), Basil Davey, was still acting as CE 8th Army, but rejoined us once we were set up at the planning HQ near Victoria station. By April we had virtually completed the Corps engineer plan, loading tables, stores build up and roads plan, particularly for bridging. We spent the remainder of April and May finalizing the plans and studying the almost daily batches of air photos to see where and whether the build-up of German defences would cause us to make any changes. Corps HQ was due to land on D+1 on Gold beach, behind 50 Infantry Division (50 Inf Div).

The Landing and Advance to Brussels

Our landing on D+1 was without incident, and in the early days whilst we were trying to capture Caen and break out of the beachhead, there was not much to do except monitor and organize route maintenance.

After the break-out we moved forward through the absolute chaos and carnage of the Falaise pocket, to the Seine, where all the bridges north of Paris had either been destroyed by the Royal Air Force or else blown. The Corps crossing point was to be at Vernon, and here the assault was carried out by 43 Infantry Division (43 Inf Div) which initially put over a folding boat equipment (FBE) bridge (code named David). This was followed by a Bailey pontoon bridge (BPB) (Goliath) constructed by 7th Army Troops Engineers, and later a further BPB (Saul) by 15 GHQ Troops Engineers (15 GHQ Tps Engrs). We then received reports that the river level was falling and that the inshore pontoons were liable to ground. I managed to get hold of a light aircraft to fly me down to the next lock and its sluices which were still in enemy hands; we suspected that these had been destroyed. Flying at just above the water between the trees we found that the level had stabilized so all was well.

Next came the rapid advance across the battlefields of the Great War, with the Guards Armoured Division (Gds Armd Div) leading. On the morning of 1 September, Corps HQ was just south of Arras and, as there was little doing for the CE's branch, I decided to visit the village of Izel les Equirchins where I had spent nearly nine months of the phoney war in 1939/40 as stores officer of a Corps field park company. The village was just off the Arras/Douai road and near the Vitry airfield I found a boy who told me that the Germans had left a few hours before but that no Allied troops had arrived, and that there were no mines on the road, so in we went with him sitting on the front mudguard. My old friend Monsieur Dupont, the *estaminet* keeper who had been so good to our company, greeted me affectionately since I was the last British officer there in 1940 and the first to "liberate" them in 1944. Floorboards were pulled up, the champagne produced and after some time I proceeded to Douai to visit the owner of a large store where I used to purchase electrical stores, and whose daughter, Anne-Marie, I sometimes took out dancing. He and his wife greeted me warmly and served me a really good omelette; sadly Anne-Marie had been killed by a Stuka on the road west in 1940.

The next day the CE, who was not well, decided to follow up the leading division and insisted that we kept passing and overtaking until we found ourselves with the leading tanks. By then we were out of wireless range of our HQ so I insisted on waiting up a side street in the village, which was just as well as the next column to pass was German!

Eventually we arrived in Tournai. A German horse-drawn artillery unit had been caught and bombed in one street and the inhabitants were already out hacking off the horses' flesh. With Corps HQ now in range, we repaired to a Belgian "cafe" where the locals were celebrating their liberation in fine style. After singing the Belgian national anthem, "God Save The Queen" and the "Marseillaise", two of us were asked by a delightful

Goliath and David bridges over River Seine at Vernon.
© *Survey School SME.*

Belgian family to come to their home whilst we waited for Corps HQ to catch up. The father was so euphoric and drunk that he offered his daughter to both of us but we declined!

On 4 September we moved into Brussels; an amazing experience with girls climbing onto and riding in all our vehicles, and the crowds in the street offering us what little they had to celebrate our arrival and their liberation. Eventually Corps HQ parked in the grounds of the Royal Palace of Louvain where we received a visit from the Belgian Queen Mother.

Our Corps Field Park Company had managed to harbour in what had been the German "NAAFI" (Navy, Army and Air Force Institution) main warehouse, where thousands of cases of champagne had been stored, together with cigars, cigarettes et cetera, and champagne was issued with the rations! All water jerricans were filled with the stuff and I found myself cleaning my teeth in champagne for want of water!

We soon moved out to Diest where we started the detailed engineer planning for Operation *Market Garden*, the most complicated planning we had had to undertake. At this stage Basil Davey, with whom I had been since 1941, was sadly evacuated home sick and replaced by Brigadier L O Clark.

Operation Market Marden

The 21 Army Group plan was to outflank the German Siegfried Line defences by attacking north-east and establishing a bridgehead over the Lower Rhine in the Arnhem area, and securing a bridgehead over the river IJssel. This involved crossing at least three canals (two of 100ft and one of 200ft) and the three wide rivers (the Meuse at Graves 600ft, the Rhine at Nijmegen – 1200ft with a 3½ knot current, and the Lower Rhine at Arnhem 600ft). To secure the crossings three airborne divisions were to be used: 1st Airborne at Arnhem, 82 US Airborne to secure the Graves-Nijmegen area including the bridge over the Rhine/Meuse canal, and 101 US Airborne the area north of Eindhoven and the bridges over the Zuid Willemsvaart and the Wilhelmina canals. 30 Corps was to advance up the corridor held by the airborne forces, establish itself north of Arnhem and secure bridgeheads over the river IJssel. The advance would be on a single road with Gds Armd Div leading, followed by 43 Inf Div and then 50 Inf Div. There were few if any diversions possible, the road for the most part was slightly elevated and crossed numerous culverts and the land on either side was soft. We had already secured a bridgehead over the Meuse/Escout canal (Joe's bridge) on the Belgian/Dutch border and this would be the start line. We had no guarantee that the bridges would be taken intact, or even taken by the airborne forces and, even if secured, we had to allow for duplicate bridges or rafts in case of damage due to enemy counteraction. If any of the main bridges were destroyed the plan was for the armour to fan out along the river line, and for 43 Inf Div, in conjunction with the airborne forces, to carry out the assault and the bridging operation. We therefore had to plan for almost any and every eventuality.

We were obviously going to require an immense amount of bridging and also a large reserve of hard-core or stone for road cratering repair. 2nd Army Sappers were planning to dump a huge supply of bridging stores and road metal at Bourg Leopold just behind the start line. They were also arranging to make available four Commander Army Group RE (CAGRE) HQs, four regiments of army troops engineers, two regiments of GHQ troops engineers in addition to our own Corps and divisional engineers. We were also to be given three bridge companies, two general transport companies, and one tipper company. A total of some 10,000 Sappers with 1700 vehicles, and 3000 Royal Army Service Corps troops with 1600 vehicles. It was however for the CE 30 Corps and his staff to work out and put into effect the bridging plans.

Reminiscences of a Corps SOREII p290

The Engineer Plan

Our engineer plan was as follows: to each of the CAGRE we allotted a major obstacle and a portion of the road. They and the two regiments allotted to them were to plan their tasks in detail together with the Sappers of 43 Div. Each CAGRE was also allotted the HQ of a bridge company and a wireless network provided by an Army Group Royal Artillery (AGRA) which was in reserve. The general principle was that the Gds Armd Div Engrs, with extra equipment and Sappers, should undertake all the bridging of the early canals and unexpected obstacles up to but excluding the Meuse. 43 Div would assault the main rivers and work the assault boats and FBE bridges and rafts, whilst the AGRE units placed in support would construct and operate the storm boats, Cl 40 rafts and Cl 40 bridges.

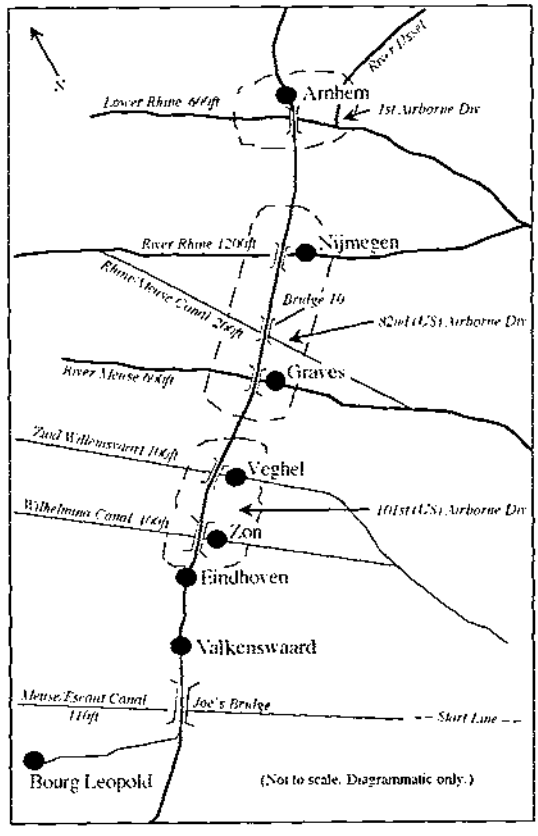
The next problem was how to organize the bridging and allotted engineer units into an order of march, bearing in mind that everything had to go up a single road. Until the word "go" was given and the first reports had come in we would not know which bridges had been demolished, or which were held by the enemy or by our own troops; and even then that could well change as operations developed. Owing to the inevitable congestion on the single road, only the exact amount of equipment and engineer troops for a specific task could be sent up. As different CAGRE and Sapper formations had planned successive obstacles, we would have to link up specific personnel in the correct order with the appropriate portion of bridging equipment. To get over this we based our plan on various assumptions and prepared details of a number of columns for each river, canal or task accordingly.

The assumptions that we made were as follows:-

Case 1. All bridges demolished but in the hands of airborne forces.
Case 2. Individual bridges demolished but in the hands of airborne forces.
Case 3. All bridges demolished and held by enemy.
Case 4. Bridges intact and in own hands.
Case 5. Individual bridges demolished, some in enemy hands, some in own.

As examples:

Case 1. Columns contained limited numbers of rafts and bridges so that bridging equipment could be ferried forward and thus bridging operations could go on over each obstacle at the same time.



Map of area covered in the article, 17 September 1944.

Case 3. Columns to provide assault equipment and initial bridging and rafts for each individual obstacle.
Case 4. Columns to provide duplicate bridging for each obstacle.

In all, 15 different columns were planned and each was given a boy's name. We located one of the CAGRE at Bourg Leopold to assist in marshalling and moving whatever we at CE Corps called forward, in conjunction with the Corps movement control organization. Thus we were prepared for all eventualities and could call forward any bridging required by just signalling the appropriate boy's name and obtaining the requisite priority from "G" Operations.

The Event

On the day before the operation the Corps Comd (Lieut General Horrocks), decided that as Joe's bridge was within range of enemy guns, and he could not afford to have any hold up on the start line, a duplicate bridge should be built, so Corps Troops built a 130ft Double Double with the

necessary approaches alongside that night. Sunday 17th was fine and at midday we heard and saw the air armada moving towards the dropping zones. At 1430hrs Horrocks gave the word "go" and by nightfall Gds Armd was harbouring at Valkenswaard, and we heard that all airborne divisions had made successful drops and were consolidating their positions, but had no reports on the state of the bridges.

The next day the advance was resumed and the morning was spent by Gds Armd and 101 US Div in fighting for Eindhoven, which was captured that afternoon. We now knew that the bridge at Zon had been demolished, and here occurred one of those odd things that happen in mobile warfare. An American engineer officer of 101 Airborne Div, after measuring the gap, managed to raise the Post Office at Valkenswaard on the phone with the enemy still in possession of Eindhoven. By an extraordinary coincidence it so happened that John Thomas, the Commander RE of Gds Armd Div was sitting in his jeep outside and was able to give him instructions regarding the preparation of the bank seats etc. Thus when the divisional Sappers came up to the canal they had the exact amount of equipment with them and in the correct order and were able to start immediately with the site ready and prepared. They put over a 100ft Triple Single Bailey starting at 2000hrs and the first vehicles were moving over at 0600hrs the following morning. Further back at Valkenswaard the Armd Div had had to make a temporary diversion as they had come across a gap made by a series of road craters. We rushed Corps engineers up, together with the necessary equipment to put over a 190ft continuous Cl 40 Bailey, which was done in 12hrs under very difficult conditions. The bridge at Veghel was intact and the US Airborne Sappers had duplicated it with an improvised RSJ (rolled-steel joist) and timber bridge over the lock.

The evening of 19 September found the Gds Armd Div up to the bridge at Nijmegen which was intact (due to the courage of Dutch partisans who had cut the demolition leads) but still in enemy hands. An attempt to rush the bridge by tanks had been thwarted. The canal bridge (bridge 10) was damaged but a difficult diversion over an adjacent lock was in use. The Graves bridge was in our hands but had been damaged; the bridge at Arnhem was intact but still in enemy hands. We rushed welding sets and other equipment up to Graves and soon had that bridge back to Cl 70 two-way. Bridge 10 was repaired to Cl 70 two days later.

The morning of the 20th saw the start of what became known as "Axis Trouble". Eindhoven was bombed just as we with Corps HQ were about to pass through and later that morning the enemy put in a strong attack on the Zon bridge which caused delay but, after a brief fight the advance was resumed. Going over the Zon bridge was like passing through the eye of a needle with tanks of 8 Armoured Brigade (8 Armd Bde) facing outwards on either side, hayricks and houses blazing and through we rushed in our lorry command vehicles – not an exploit often experienced by a Corps HQ, but we had a very thrusting BGS (Brigadier General Staff). That evening we harboured in the Nijmegen area.

During the day the American airborne forces, with great courage, took to the river Rhine, paddling in our assault boats, which they had not used before, across a 1200ft wide river flowing at over 3½ knots, in full view of the enemy, particularly as adverse wind conditions broke up the essential smoke screen, and with limited artillery support. They suffered heavy casualties but managed to capture the north end of the road and rail bridges which was the signal for the Guards tanks to rush in, followed by Sappers who removed the charges quickly and captured some 80 German Sappers hiding in the demolition chambers. Rafting was then ordered together with the equipment for a planned barge Bailey, and bridging for the Lower Rhine. 1st Airborne Div was in difficulties and it looked as if 43 Div might have to make an assault crossing to relieve them.

The next few days were spent consolidating. The bridge at Zon had been reinforced to Cl 70 and the whole line of communication (LOC) was being improved to that classification. A subsidiary Cl 40 pontoon bridge had been built at Graves, a 250ft high-level BPB had been built over the Rhine/Meuse Canal, the railway bridge at Nijmegen had been converted into a Cl 40 road bridge, and the barge Bailey was also nearing completion.

At Nijmegen the bridges were being bombed and further back attacks were being made on the LOC. Corps HQ was located in woods to the east of Nijmegen and came under long-range shell fire resulting in our intelligence officer, in the adjoining slit trench to me, being hit and having

to be evacuated that evening. We then withdrew to the south of the town and dug in again.

By the 28th it was clear that the Airborne Div at Arnhem could not be sufficiently reinforced or supplied and it was decided to evacuate. Thirty five assault boats were sent up for 43 Div Engrs to operate and 19 storm boats to be operated by Canadian engineers. In all 2163 men of 1st Airborne, 190 of the Polish Parachute Brigade and 75 of the Dorsets, who had gallantly crossed the river to cover the withdrawal, were evacuated. A month later a further 138 officers and men, who had been sheltered by the Dutch underground, were evacuated by 210 Field Company assisted by elements of the 101 (US) Airborne Div.

Troubles With the Nijmegen Bridges

One of our main headaches on the Rhine was the boom question with the river flowing so fast. We tried normal oil drums or jerricans linked with SWR (steel wire rope) and supporting a net of Sommerfeld track (used successfully on the Meuse and the Orne at Caen) but this just would not work on the Rhine. Our available tugs were weak, the anchors would not hold and the SWR snapped. A temporary but only partial solution was to anchor a series of half pontoons across the river supporting a dannert wire boom which did not go deep enough as will be seen later. Naval boom defence experts were called over from England, but I do not know how they solved the problem.

The two bridges at Nijmegen were under observed enemy artillery fire and were bombed as well. The centre span of the railway bridge received a direct hit on the roadway estimated as a four-day repair job. The road bridge was repeatedly hit and required constant repairs, with welding sets and quick setting cement, by 15 GHQ Tps Engrs and Dutch civilians. One problem was that shells exploded on hitting the bridge girders and superstructure, raining shrapnel onto vehicles passing underneath. All we could do at that stage was to erect a screen to prevent German gunners from seeing passing vehicles.

Early in the morning of 28 September terrific explosions were heard. The centre pier of the railway bridge had been demolished, with one end of the main span fallen in the river, and 70ft of the roadway of the road bridge was missing. The plans for ferries were immediately put into operation as a Cl 40 raft and close support ferries were already constructed and standing by. In addition we ran DUKW (a name given to a piece of amphibious equipment) ferries for stores and storm boat ferries for passengers, and put in hand all the necessary preparations for a Cl 40 BPB, but luckily the barge Bailey was ready later that evening. The next day we put two 80ft Bailey bridges over the gap in the road bridge. The railway bridge was past repair as a Cl 40, but was used as a footbridge using timber steps and footwalks down to the broken span.

Conflicting opinions as to how the demolitions had been carried out abounded. Some thought delayed action charges had not been removed, some thought parachute mines, some floating mines and some saboteurs. However a metal float chamber was found under the road bridge and at midday eight German frogmen in rubber suits were taken prisoner lower down the river. It had been a fine performance of courage and endurance on their part. Twelve swimmers had started seven miles upstream guiding German naval mines each of 1200lb and fitted each end with float chambers. They wore breathing apparatus and had managed to get the mines under our makeshift booms to position the charges in a necklace round the piers and then release the float chambers. On sinking, the mines trued up to vertical and started a delay mechanism. Fortunately one of the mines at the roadbridge failed to go off, and the mines in the shallow water on the other side expended all their force upwards thereby disrupting the roadway. The frogmen had hoped to carry on down to German occupied Holland, but had been forced to land earlier due to cold and exhaustion which had already accounted for two of them. Floodlit river patrols were instigated in DUKWs upstream of the booms. The enemy then tried strong land attacks against the bridge, one from the Reichwald Forest south of the Rhine and one from the Arnhem direction, but both were repulsed after heavy fighting.

The blowing up of the Nijmegen bridge nearly cost me my job. After our intelligence officer had been wounded, I had dug my bed in and had the telephone extension beside me at night. The conflicting reports about the destruction of the two bridges started coming in at about 0500hrs, and from then on I was on the telephone constantly trying to get information regarding the extent of the damage, passing it on to my CE, and putting into effect the plans for the rafts, ferries etc so that when at last I managed to get out for a wash and shave beside my slit trench, I had not had time to

The Nijmegen road bridge showing the two 80ft Double Single Bailey bridges over the gap caused by the enemy frogman. *Crown copyright*

take the phone back into the command vehicle. When it next rang the caller did not announce himself, but the voice sounded exactly like that of Martin Jackson, the GSOII Royal Artillery, a Gunner who used to delight in the traditional Royal Artillery/RE banter, and I was rather expecting him to call. The voice said "That you Hamilton, why the bloody hell did you take so long to answer the phone?" "Because its still in my slit trench and I had to climb down into it." "Why on earth is it in your slit trench?" came the answer and still thinking that it was Martin, I replied "I'll have my phone where I something well like, and its no bloody business of yours." There was silence for the moment and the voice then said "I don't think that you know who is speaking, this is the Corps Commander here. Now I know you have had a difficult morning, but that is no excuse for your being rude on the phone, and you will remember when I first arrived at Corps HQ, I stressed that I would not tolerate rudeness by my staff. You will come and explain yourself to me in 15 minutes time. Now, what is the situation on the bridges?"

Having told him, I quickly finished dressing, and went in search of the General Officer Commanding's Aide-de-Camp (ADC) still not sure that it hadn't been Martin. The ADC told me that the General had left Corps HQ. The word got round and I was then subjected to all and sundry ringing and saying that they were someone else! Some time after I heard that the General had asked a senior member of his staff "Who is going to the Staff College next year?" and on hearing that it was me said: "Ah yes Hamilton, spirited but efficient young officer that, the only officer who has told me exactly where I got off, and got away with it!"

Maastricht Floods

It was shortly after all these happenings, that I decided to go into hospital in Brussels to have the full treatment to end recurrent malaria attacks. On discharge I found that Corps HQ had moved south and were located at Beek a few miles north of Maastricht and in between the Meuse and the Rhine. Recent weather had been very bad, and the Meuse was in full flood. All the bridges had been demolished and a series of Bailey pontoon bridges were in operation to maintain the essential link to 30 Corps on the lines of communication. The river was flowing so fast that we were having great difficulty in maintaining the pontoons against the high bow waves and the scouring at the end of landing bays. I found that CE Army had instituted a flood

The 11000 barge Bailey bridge over the River Rhine at Nijmegen.

A Bailey pontoon bridge over the River Meuse in flood near Maastricht and showing the bow wave problem. *Crown copyright.*

control intelligence system whereby each bridge and some intermediate points had to submit periodic river level details through Corps to Army. We had to monitor the depth at the centre of the river and the depth at the approaches.

One particular bridge on the main supply route was giving me some concern as the end of the landing bay was under water and the hardcore approaches were being eroded, so I had gone out to have a look myself. When I got back to HQ I found one of my staff, the young stores officer, was sitting there shaking like a jelly in what appeared to be an advanced state of shock. He told me that the CE Army, Major General Pat Campbell, well known for his fiery temper, had just been in and had torn him off a very large strip; apparently the reported levels appeared to the CE to be wrong. Disliking having one of my staff treated in such a manner I immediately rang through to Army to speak to the CE personally, and after some heated discussion I managed to convince him that he was in the wrong!

Shortly after that I was on my way home to go to the School of Military Engineering at Ripon prior to going to the Staff College in the New Year. I handed over to Major John Cave-Browne and left him with the problems of the German offensive through the Ardennes.

Outcome of the Engineer Plan

I WOULD like to think that our Sapper planning was successful and that it really worked and took care of all demands. The column system worked well, four "boys named" columns were called forward exactly as planned. One column of 450 vehicles was up in the Nijmegen area 50 miles from its start point in 3½hrs from the time we sent the order. Others, modified to meet special circumstances, came up almost as quickly. The total amount of bridging used was as follows:

Lower Rhine – 19 storm boat ferries, 35 assault boat ferries.
Rhine/Meuse Canal – 250ft Cl 30 High level BPB.
Rhine – 1200ft Barge Bailey, 2 x Cl 40 Rafts, 2 x 80ft Cl 40 DS Bailey, 1200ft BPB (in reserve on ground), assault and storm boats, Bailey pontoons for booms.
Zuid Willemsvaart, Canal (Veghel), Wilhelmina Canal (Zon) – RSJ and timber bridge over lock, 110ft Cl 40 Triple Single Bailey.
Meuse – 600ft Cl 40 BPB.
Meuse/Escaut Canal (Joe's bridge) – 130ft Cl 40 Double Double Bailey.
Valkenswaard – 190ft Cl 40 continuous Bailey.

The following RE units were involved:

10, 11, 13, CAGRE.
Guards Armoured Division Engineers.
43 Infantry Division Engineers.
50 Infantry Division Engineers.
30 Corps Troops Engineers.
6 and 7 Army Troops Engineers.
1 and 2 Canadian Army Troops Engineers.
8 and 15 GHQ Troops Engineers.

Reminiscences of a Corps SOREII p295

Cheh Inch Ageh

(Urdu for "6 Inches Forward" – Phonetic Spelling)

COLONEL M C PERCEVAL-PRICE BA(H)

Colonel "Mike" Perceval-Price passed top into the Royal Military Academy Woolwich in June 1925 as Perceval (without Price).

Having acquired that valuable asset of being able to guess what answers examiners wanted, he continued to pass out top with the King's and Pollock medals and the Sword of Honour.

Commissioned into the Corps in 1927, he gained a 1st class honours degree at Cambridge in 1929, and joined the Bengal Sappers and Miners in March 1930.

After a few weeks in Roorkee, he went to Peshawar to help bring 4 Field Company up to war strength in order to take part in the Khajuri operations.

In 1939 he left to join the first War course at Quetta, returning to the staff college later for 18 months as instructor, after which he joined the Planning Staff in General Headquarters New Delhi.

His description of the crossing of the Indus by the Risalpar Cavalry Brigade in February 1936, which he organized while commanding 31 Field Troop of the Bengal Sappers and Miners, has already appeared in the RE Journal *of December 1936.*

In 1931, the Bengal Sappers had just been issued with some 30cwt lorries, and Indian drivers were being trained to drive and look after them. We had several lorries, including a breakdown lorry, but at that particular time, only one trained Indian driver in Roorkee. Orders were very strict that on no account were British officers or NCOs allowed to drive the lorries – the Indian drivers would never get any practice if they had been allowed to do so.

It so happened that the General Officer, CinC Eastern Command, was shortly due to inspect units at Roorkee. This involved a visit of two or three days and it was decided that there should be a demonstration of improvised rafting over the Ganges Canal, using one of our new 30cwt lorries as cargo. To make the demonstration more dramatic it was also decided that the raft should cross the canal as a flying bridge and the breakdown lorry should be used to winch itself up a long steep bank at the far side. I was to be in charge.

Folding boat equipment had just been introduced and I carefully read the reports on its use and studied the photographs. The raft that we made was roughly an improvisation of the folding boat equipment raft. One of the points on the diagram I noted was that, in order to speed up the turnround of the raft, no complicated anchorage was provided for the raft on arrival at the far bank – only a picket at each side with a couple of turns of rope round each, the ends being held by Sappers. This, of course, was pictured on the Avon with nice flat banks only just above the level of the river. I determined to do the same; at the time of year of the inspection, the Ganges Canal was in full use for irrigation with a current of four or five knots.

All went well and the day of rehearsal arrived. The breakdown lorry, driven by our one trained driver, mounted the raft. It swung across the canal in fine style two Sappers held it into the shore with a couple of turns round a picket, the front ramps were lowered and the lorry put its front wheels on the shore. All perfect.

The cable from the lorry's winch was now unreeled and the end taken up the steep bank to a tree – it just didn't reach. "Give us a few more inches" came the shout from the top of the bank "*cheh inch ageh*" was the order given to the driver. But the lorry made no move and the driver naturally accelerated. Too late we noticed that the Sappers holding the raft into the shore were having an unequal tug of war with the lorry, whose front wheels being on the steep slope was therefore rapidly pushing the raft out into the canal with it's back wheels. Having got rid of the raft in the

Col M C Perceval-Price
Cheh Inch Ageh p296

Second lorry after three days' immersion. (Note upstream "salvage raft" with its two winches just beyond steps.)

Every officer in Roorkee had his own plan for salvaging the lorry. Grapnels, netting, a form of suspension bridge from which we could fish for the lorry were all suggested. Even Soniput, the last elephant then on charge with the Indian Army, remembered (of course) pulling a field gun out of a bog. But the simplest plan of all was to ask the canal department to turn off the tap and stop the flow, or at any rate reduce it to such an extent that the lorry could be got at in safety.

Consequently a telegram was sent to them ending with the words "wire reply". Back came the reply quoting a vast sum as the cost of stopping the canal and asking what sort of lorry was worth all this money. The telegram had arrived in a slightly mutilated form ending with the words "will pay". Naturally stopping the canal was out of the question.

I don't know who thought of the scheme that we finally adopted, but like all good schemes it was simple but effective. Two pontoons with winches on them were anchored up stream of the lorry. A wire rope between these winches was lowered onto the bottom of the canal. The pontoons were then allowed to drift slowly down stream until the wire rope caught against the back wheels of the lorry. The pontoons were then halted and by means of the winches the back of the lorry was lifted a little off the bottom. The process was then repeated with the wire rope passing outside and underneath the first two pontoons until it caught against the front wheels of the lorry. The four pontoons were then tied together to form a sort of raft with the lorry suspended below it and as soon as the front wheels were lifted off the bottom of the canal the current brought this raft in shore exactly like a flying bridge.

We were still working on this scheme when the General came down to the canal to see, according to his programme, a demonstration of improvised rafting. All he saw were four pontoons with winches being manipulated in the middle of the canal. He was told that there was a lorry underneath the surface, indicated by a buoy but no part of it could be seen.

He couldn't have been nicer. He told me how lucky I was to be in charge of the sort of job that might arise in war but would not normally be allowed to occur in peacetime. Fortunately we landed the lorry the evening before he left the station and we were able to send a message into the Colonel's final dinner party to this effect. Incidentally the silt and the current had removed nearly all the paint from the lorry.

As I have already said we learn by our mistakes but it is against human nature to write articles about them and it has taken me more than 50 years to do so. However I do claim to be the only officer who has sunk a lorry in the Ganges Canal in successive days – a record surely.

Cheh Inch Ageh p298

Raft having been turned by hand, lorry about to disembark, and go driving instead.

manner of a dog digging, the lorry subsided slowly backwards and disappeared completely from view. The driver, still accelerating and with a puzzled look on his face, went down with his ship in the best naval tradition. Another officer and I stood watching for him to bob up and the other officer was just unbuckling his belt when up he popped – very breathless. The steering wheel had prevented him from getting out on the off side and with great presence of mind he had left his way across to the other side.

There was no difficulty in salvaging this lorry. A large winch was brought from the field work stores and a diver sent down to attach the end of the wire rope to the lorry. Many Indian troops are expert divers and could go down with perfect safety as the lorry was sitting in an eddy at the side of the canal. It was safely landed that evening. The lorry already had about a foot of silt in it and any delay in its extraction would have left us with a very much heavier load to pull out.

Surprisingly I was entrusted with another lorry and, even more surprising, our one and only trained driver volunteered to drive it, provided that he was allowed to take his shoes and socks off and have the front part of the lorry hood folded back. Just in case the lorry went back into the canal, we attached buoys to it fore and aft. This time I had arranged holdfasts for the raft on the far bank of tremendous strength – we learn by our mistakes. All started off perfectly, the lorry mounted the raft quietly and the driver sat there somewhat nervously. The *hawildar* in charge thought that it wasn't quite central so he said to the driver "*cheh inch ageh*". The driver's bare foot slipped, the clutch came in with a bang and the lorry plunged bonnet foremost into the middle of the canal, disappearing completely. The driver reached the surface almost immediately followed by one of the buoys, the other must have got entangled in some way. Probing with a boat hook revealed the lorry was facing downstream in the middle of the canal with the back part of the hood still intact. With the strong current and the risk of the diver being swept under the hood and trapped it was decided that no diver should attempt to attach any rope to the lorry. I was not entrusted with another lorry, although we still had the raft which was only slightly damaged by the lorry's plunge.

Improvised raft with breakdown lorry as "cargo"
Crossing canal as "Flying bridge."

Cheh Inch Ageh p297

Anzio or "Hell in a Hatbox"

COLONEL F H FOSTER DSO OBE TD DL RIBA

The following is the fourth, much edited extract from the book "Recollections of an Amateur Sapper" which recounts the author's experiences throughout his peace and wartime service, and which is lodged in the Corps Library. This extract is published with the author's kind permission, and covers the period he spent in Italy when he took part in the Anzio bridgehead campaign between December 1943-June 1944.

BY the end of 1943, the situation in Italy was not particularly promising. The Germans had halted the Fifth Army, establishing themselves firmly along the Gustav Line. The strength of the enemy position convinced Allied high command that a frontal assault would prove long and costly. An outflanking movement, coupled with a frontal assault, stood a better chance of success. The only solution to the problem lay in a seaborne attack on the left flank.

The operation was to be carried out by a combined American and British Force, 3 US Division (3 US Div) and 1 British Division (1 Div), to be known as VI Corps under US Major General Lucas.

The British 1 Div landed in Italy early in December 1943 from Tunisia, became part of 8 Army and concentrated just south of Cerignola, with Division HQ (Div HQ) in the city itself.

The secret of the division's switch from 8 Army to 5 Army was closely guarded. The small "planning" convoy which left Div HQ in Cerignola on 28 December was routed, as far as everyone knew, to Vasto where Main HQ 8 Army was located. At Foggia, however, an unexpected left turn was taken and they arrived at 5 Army HQ based in the one time King of Naples' Palace at Caserta.

The planning section had been set up in the palace for Operation *Shingle*, a landing at Anzio and Nettuno, no more than 30 miles south of Rome. With Kesselring holding the Gustav Line, a rapid advance towards Rome would cut Route 7 in the vicinity of the Alban Hills, and Kesselring's army would be outflanked.

The plan was decided in general outline by 5 Army. VI Corps should seize and secure a beachhead in the vicinity of Anzio and then advance on a feature known as Colle Laziale. The initial landing to be at three points simultaneously: 3 US Div on X-ray beach, three miles east of Anzio, 2nd Brigade Group of 1 Div on Peter beach, north of Anzio and a ranger force of three US battalions with one parachute battalion, to land on Yellow beach, immediately adjacent to Anzio Harbour.

HQ 1 Div staff immediately settled down to work out details in conjunction with the US Army staff and the Royal Navy. 1 Div was to be lifted by a separate naval task force under Rear Admiral Tommy Troubridge. "D" day had been provisionally fixed for 22 January and all shipping bids were required without delay.

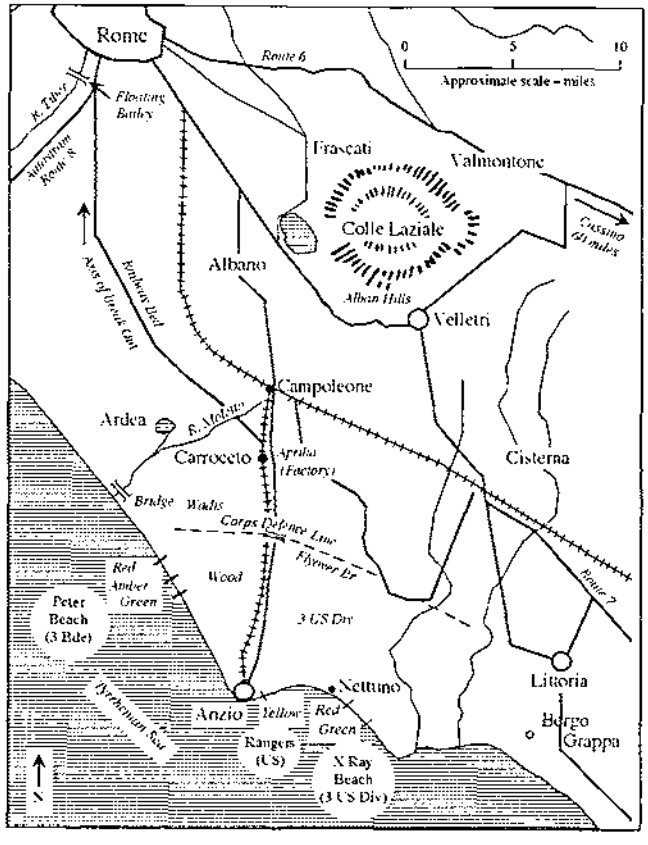
I spent a lot of time and thought with my staff on our plans. With the aid of maps and air photographs, we tried to foresee the quantities of engineer and defence stores required. I asked for a limited amount of bridging, but my main bid was for barbed wire, sandbags and mines (just as well seeing how things turned out.) It was a long and complicated list. My opposite number from 3 US Div asked if he could have a look at it. His only comment was "What a comprehensive list ... and it looks just fine, but I think I shall double it!"

I submitted my list but was horrified when a copy was returned marked, (as I thought) "Cancelled". On closer examination, I saw that the indents were marked, in large letters, CANCELLO, the title of the Engineer Stores Base Depot.

There is a wonderful opera house within the palace, and the Americans engaged an opera company from Naples to come and stage grand opera. Although HQ 1 Div staff were working all out on planning, they found time to attend some of the acts. In my case, I saw "The Barber of Seville" Act III, II and I in that order. What is more, I was comfortably seated in the Royal Box!

HQ 1 Div was set up at Nocera and on the eve of the operation, all plans were complete and stores loaded. Our Divisional Commander, Major General Ronnie Penney, decided he would like to look at Mount Vesuvius and asked his G1 and me to go with him in his jeep. Near the summit there had been a fall of rock, so we didn't get to the top, but we had a good look at Pompeii which made up for our disappointment.

Next day we steamed out of Naples Harbour and headed south. We saw the beautiful Isle of Capri; then made our way out to sea by a long



Map of the Anzio Bridgehead.

and circuitous course to avoid German minefields and to deceive the enemy. Darkness fell and the convoy turned sharply north and east towards Anzio, dropping anchor just after midnight. The assault crafts were lowered and made for Peter beach. Rocket ship salvos were launched with a deafening roar and at 0225hrs, 2 North Staffords reported they were ashore, followed in nine minutes by 6 Gordons. They encountered a few mines of Italian box type but no enemy opposition.

The remainder of 2nd Brigade (2nd Bde) were ashore by dawn, and guns of 67 Field Regiment were in action by 0830hrs. As soon as it became light, I was up on deck of the HQ ship and the first thing I saw was General Alexander standing as a lone figure on the deck of a small launch. I think the very sight of this man gave all of us who saw him a great deal of confidence.

2nd Bde continued to advance. Scattered enemy posts had been encountered by the advancing troops and a handful of prisoners taken, but the only report of enemy in any considerable number, came from a patrol which covered the blowing of a bridge over the Moletta, on the coast road, by 238 Field Company (238 Fd Coy). An armoured car had become bogged in soft ground on the far side of the bridge and a second car, trying to tow it out had got bogged in as well. As the bridge had to be blown, both cars were abandoned, but an attempt was made to recover them the following day. 238 Fd Coy brought up a DUKW (name given to a piece of amphibious engineer equipment) fitted with a folding boat equipment structure to bridge the gap. This conspicuous vehicle came under fire from the enemy and quickly withdrew. Other DUKWs may have turned round at higher speed in the width of a minor road, but such instances must be rare!

A glance at the map will give a general picture of the beachhead. Anzio harbour and the town are protected by a small headland jutting out into the sea. From Anzio, the road to Rome runs as far as Campoleone. The road then continues onwards via the Albano area just southwest of the feature Colle Laziale (our main objective).

The first six miles of road out of Anzio, is thickly wooded on both sides until it passes under a flyover bridge carrying an east-west lateral road (to be known later as "The Corps' Defence Line"). Onwards the road is in very open country with numerous wadis until Carroceto is reached and the new settlement known as Aprilia (afterwards known as "The Factory") comes into view. From Carroceto a new railway bed runs towards Rome.

By 29/31 January, 3rd Brigade (3rd Bde) had secured a narrow salient as far as Campoleone Station. Most of the advance so far had been made by the element of surprise created on the enemy by the landings.

The arrival of two battalions of 168 Brigade (168 Bde) which had disembarked by 2 February was extremely welcome, as it provided a potential divisional reserve. These battalions were the advance guard of 56 Division (56 Div) which was to be moved from the southern front to reinforce the troops in the beachhead.

By 2/4 February the enemy had brought forward 3 Panzer Grenadier Division and had attacked

3rd Bde from the north, west and east. By 7/10 February our brigades had fallen on the general line of Carroceto/the railway bed where they were reinforced by the two battalions of 168 Bde. 238 Fd Coy were placed under command of 6 Gordons. Detachments of 248 Field Company (248 Fd Coy) erected belts of protective wire.

On 10 February the battle around Carroceto became critical and 23 Field Company (23 Fd Coy) was placed under command of the Scots Guards, at the time holding the railway station, but by the end of the morning this force was overrun by the enemy. Only one section of 23 Fd Coy escaped to join the defenders along the railway bed. Major Jack Hornby, the OC, was reported missing – in fact nothing was ever heard of him again. I can't say how very much I regret the loss of this gallant officer and so many other ranks of my 23 Fd Coy. I know the situation was desperate, the gap had to be plugged somehow, but to lose 100 splendid Sappers when they were under command of the infantry – words fail me.

Just as the drive of 3rd Bde had been brought up short, in the same way 3 US Div achieved no more success in their attack towards Cisterna and fell back after reaching the railway embankment.

Major General Gerald Templar and his HQ arrived and as soon as his second brigade landed, took over the Corps' left front.

VI Corps launched a counterattack with troops of 3 US Div and US 1 Armoured Division (US 1 Armd Div) with the object of recapturing "The Factory" area but could make little headway. Heavy fighting continued and eventually all British and US troops fell back to the Corps' defence line after resisting fierce attacks from 26 and 29 Panzer Divisions but not before the Royals and North Staffords had taken 200 prisoners.

From March right through to May, 1 Div's frontage of the Corps' defence line of over 500yds, was held with five battalions up and two in reserve.

Now to give some details of the work of my Sappers. The beaches were only lightly mined, with mainly Italian wooden box mines which could only be detected by prodding. Nevertheless, the beaches had to be cleared and this took some considerable time.

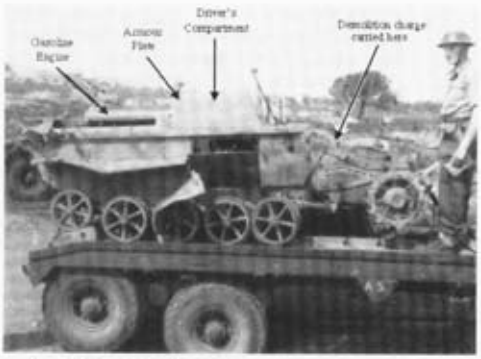
The improvement of roads and tracks was a continuous job throughout the whole time the division was in the beachhead. Nearly all the tracks were in heavily wooded country and the soil was very soft and boggy. There was quite a good supply of brushwood in bundles stacked in the woods and in the early stages they were used as fascines, but supplies soon became exhausted. Some Sommerfeld was used but supplies were very limited. Obviously rubble was the answer. Permission was given for the demolition of houses deemed beyond repair, giving an almost unlimited supply of rubble – records state that some 10,000 tons were lifted. Perhaps we could claim that the road to Rome was paved with the buildings of Anzio!

We tried laying pierced steel planking at night where the ground was under observation by day, but this was not a success as vehicles created too much noise on it and brought down enemy fire almost at once.

A major task was the laying of minefields, which became essential as soon as the division withdrew behind the Corps' defence line, and this had to be done at night. A belt of mines with wires was completed all along the defence line. The belt was about 100yds north of our Forward Defence Lines and was gapped at intervals for patrols. When all troops were behind the Corps' defence line, the gap in the minefield astride the main road was closed. Holes were dug in the road north of the Flyover and in the verges and, on receipt of the codewords "Kitchener Blocks On" (received soon after nightfall on 17 February) all mines were laid.

We also made preparations to block the road and railway under the Flyover bridge. Half a dozen unserviceable 3-ton lorries were filled with concrete and driven up under the lee of the embankment, ready to be driven into position and immobilized. This measure was never called for although the lorries were kept ready for three months.

Work on digging tunnels in the Flyover embankment was carried out in shifts 24 hours a day. Entrances were cut in our side of the embankment on each side of the bridge. About half way through the embankment, the gallery turned at right angles and culminated in dug-outs large enough for a medium machine gun team or an observation post party. Camouflaged observation slits were cut in front of the embankment, enabling our gunners to enjoy the advantage of excellent observation over the whole of the front. It is on record that one Sapper, engaged on tunnelling, added to the division's haul of prisoners: early one morning he observed a German, who had lost his bearings, walking in the thick mist carrying a can. He was rounded up by our Sapper (armed only with the implements of his trade) who



Engr VI Corps 21 April 1944 – German B4 radio-controlled tank.

found the can contained a very unappetizing breakfast intended for a forward German platoon.

In front of the Corps' defence line were numerous wadis rejoicing in the names "North Lobster Claw", "South Lobster Claw", and "The Boot", named from their contour appearance on the map. Extensive digging of communication trenches in these wadis was carried out under RE supervision. Our Sappers tunnelled right under the lateral road to provide a concealed approach to this sector.

During a minefield inspection, Lieut George Baker (238 Fd Coy) discovered a German B4 Goliath radio-controlled tank (see right) which was designed to deposit a large explosive charge and withdraw before detonation. Our Sappers tested for booby traps and removed the explosives. As the tank's tracks were blown off it was winched behind our lines by Royal Electrical and Mechanical Engineers with a long steel cable.

It seemed clear that having once established the Corps' defence line, our division must hold it at all costs as it was vital to the Allied cause. If the enemy was once able to cross the lateral road and gain cover of the thick woodland belt, our chances of survival were flimsy in the extreme and we could hope for little better than a second Dunkirk!

So close now were even the base troops at Anzio to the enemy's front line, that the whole of the divisional area was under fire from the smallest of enemy field guns. Once inside the beachhead one was in the front line. Only the intensity of the shelling marked the difference between forward and reserve. All in the dock area were greeted with salvos and soon a permanent smoke screen was maintained there. In addition air raids took place at regular intervals. Everyone in the beachhead was ordered to wear a steel helmet (and was glad to do so). The Germans used guns from 88mm, to a giant 280mm railway gun (known as "Anzio Annie").

The division took full advantage of "going to ground." Vehicles were dug in to bonnet level. The bombed houses in Anzio providing an unlimited source of materials for the construction of dug-outs. Even troops in the forward position, although they could not be comfortable, contrived to make themselves reasonably safe.

General Penney continued to utilize his office caravan with only the front part dug into a steep bank in spite of our wish to dig it in completely. Unfortunately he was slightly wounded and had to be evacuated. Next day the control was taken over by Major General Gerald Templer, who thus became responsible for the whole British front. As he had commanded 1 Div in North Africa he knew all personnel well and most of the brigades too.

I must pay tribute to the wonderful work of the Royal Army Medical Corps and ladies of Queen Alexandra's Imperial Military Nursing Service. The Casualty Clearing Station was situated on the main road to Rome a short distance out of Anzio. The usual hospital tents were erected but the only protection from shelling was a sandbag wall about 5ft high around each tent.

One of the jobs our Sappers did was to provide a dug-out cinema to hold about 16 men. It was known as the "Anzio Ritz" and films were provided by the Army Kinematograph Service.

Apart from water supply to the division there were countless other Sapper jobs to be done, but when we had men to spare we lost no opportunity to experiment and practice Bailey bridging. Major Bob Elliot was a wizard at this. He produced some ingenious design ideas which we put into practice, especially various schemes for "two way Bailey" and for launching Bailey bridges on restricted sites. The Chief Engineer (CE) of VI American Corps and his aide would visit occasionally when we had something of interest to show him, but he would never offer any engineer advice. This made me realize that I never saw a Sapper officer senior to myself during the whole time we were in the beachhead! Perhaps, as we were under an American Corps, British CEs or equivalent felt they should not intrude!

Recollection of an amateur Sapper p302

Now, after four months in the beachhead came the great moment for the breakout. "H" hour was 2000hrs on 22 May but during the two days prior to this, rations, water, ammunition and defence stores were brought up through the communication trenches to "Boot" and "Starfish" wadis. Gaps were cut in the wire on the start line and the wire left to be kicked aside, and gaps were made in the minefields. Dawn on 23 May showed that the enemy had withdrawn from Pantoni and Green Bush Hill. 133 Brigade occupied positions to the south of Dead End road.

Major General Hawksworth, who had recently had temporary command of the division, was posted to a new appointment and command devolved on Brigadier (later Major General) Charles Loewen (who was Commander Corps Royal Artillery XIII Corps) on 24 May.

On 25 May, the men of Anzio, isolated from the rest of the war in Italy for four months, met up with the main body of Fifth Army, at Borgo Grappa, six miles southeast of Littoria.

On 26 May, 2 Bde began to probe forward toward "The Factory". The following day saw substantial advances along the Corp's defence line, 2nd Bde cleared Dead End Road while 238 Fd Coy rapidly cleared mines from the tracks in the brigade area.

On 27/28 May enemy machine-gunners were still in position before "The Factory" but soon after daybreak it was entered without opposition. 2 North Staffords were established across the railway bed, half a mile west of Carroceto. By midday 18 Brigade (18 Bde) on the right had gained control of all roads leading into "The Factory" and Carroceto from the east. Behind them, 248 Fd Coy constructed one Class 30 and two Class 40 bridges and 23 Fd Coy lifted innumerable Teller mines.

1 Div now headed northwest along the railway bed with 45 US Division on its right and 5 Division on its left. Its role was to maintain close contact with the enemy as it withdrew, and not to attempt a breakthrough to Rome.

On the afternoon of 28 May, a composite force of 1 Reconnaissance Regiment (1 Recce Regt), the Assault Squadron and some Sappers, reconnoitred along the railway bed, encountering plenty of enemy but little opposition, and by nightfall, had established itself on the Ardrea lateral road, taking 105 prisoners. Next morning, 2nd Bde took over positions held by the Recce Regt. The railway bed was in a shocking condition. It was devoid of metalling and had deteriorated from use by heavy German transport. The surface was inches thick in dust. The track was narrow, verges were suspect until cleared of mines and there were many traffic jams. This difficult situation was later much improved by the construction of a long diversionary track to the north of the railway bed, by all three field companies.

Early next morning, the infantry advance continued against strong opposition. The village of Ardrea was entered by a troop of the Recce Regt. Fighting continued with heavy fire from enemy artillery mortars and small arms. 1 June was spent in consolidation and regrouping. On 3 June, 3rd Bde attacked the Acquabuna Ridge supported by a very heavy artillery programme. Two troops of 46 Royal Tanks and a section of 248 Fd Coy also accompanied each assaulting battalion in order to clear mines and booby traps.

During the night, patrols reported enemy withdrawing and a force commanded by Lieut Colonel Brett, comprising 1 Recce Regt, 14 Foresters, two squadrons Royal Tanks and a detachment of 238 Fd Coy, moved forward. Most of the bridges were blown but RE parties advancing with the leading troops soon prepared diversions and crossing places, so the advance was only slightly delayed. Early on 4 June a general advance began, 2nd Bde on the right and 18 Bde on the left. Progress was rapid, little organized enemy opposition was met and, by 1400hrs, C Squadron Recce Regt had reached the Tiber; by evening the reconnaissance elements of all three divisions held the line of the Tiber from Rome to the sea.

Early on 5 June a reduced *Brett Force* crossed the Tiber by a bridge the Germans had only partially destroyed. Progress was not at first rapid but by evening 6 June, the force had reached the junction of the coast road with Route 1. Meanwhile the construction, by 248 Fd Coy assisted by 102 Field Company, of a Class 40 pontoon Bailey bridge, midway between the sea and the outskirts of Rome, was completed. The division prepared to move across and a Military Police pointsman stood proudly on duty to direct traffic.

So ended our four months sojourn in the beachhead – the press called it, amongst other things, "Hell in a Hatbox." It certainly was a most unpleasant experience – never to be able to get away from it all. I was certainly given wonderful backing by my officers, WOs, NCOs and sappers during this period when I felt the job was a great responsibility.

United Nations Headquarters
Bosnia-Hercegovena Command Engineers

LIEUT COLONEL M D REYNOLDS BSc(ENG) CENG FIPLANTE MICE

The author was commissioned from Sandhurst in 1966. His pastimes include squash, running and antique furniture restoration. Other activities have included troop commander tours in Berlin and with the Gurkha Engineers in Borneo. Squadron Second in Command was with 4 Field Squadron prior to an assistant instructor's appointment at the Royal School of Military Engineering, followed by the Professionally Qualified Engineer course. Squadron command was with Queen's Gurkha Engineers in Hong Kong followed by another tour in Chatham, and then Staff Officer 2 in Headquarters Engineer in Chief. A gap between postings allowed for five months as expedition leader on Operation Raleigh *in Patagonian Chile. A tour at Supreme Headquarters Allied Powers, Europe was followed by Chief Instructor Civil Engineering Wing. The author is currently serving at Headquarters Allied Forces Central Europe in the Netherlands.*

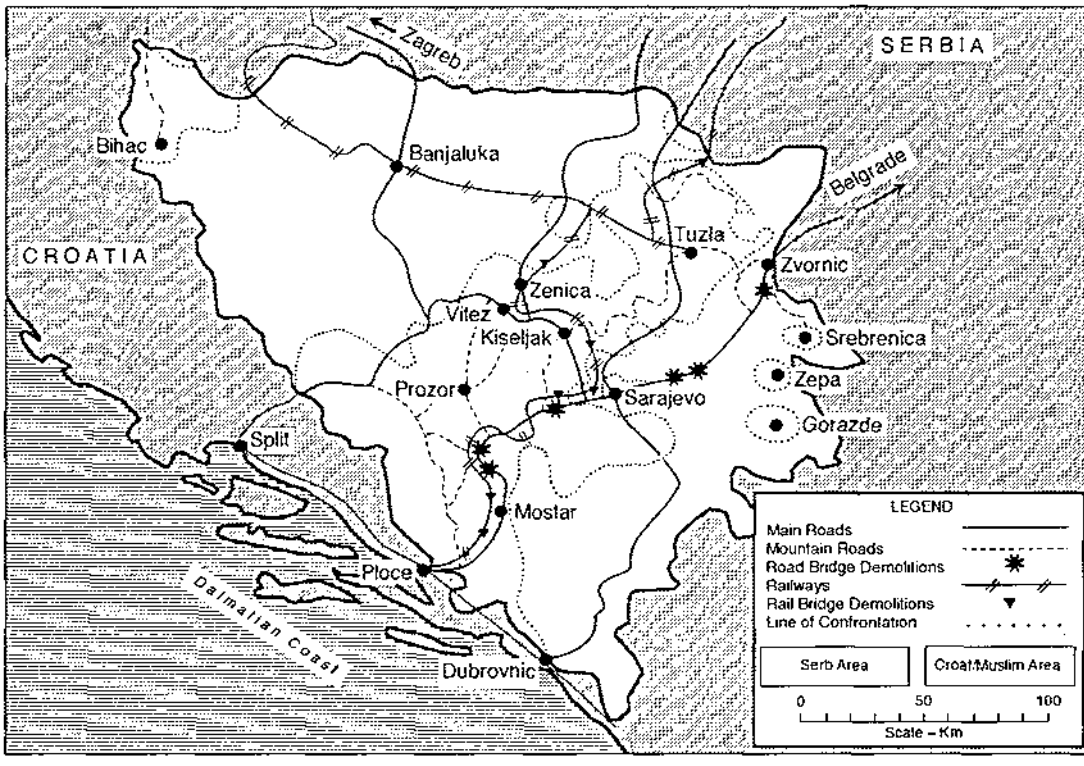
IN the summer of 1992 the UN asked the nations and the North Atlantic Treaty Organization (NATO) to provide a HQ for the proposed United Nations Protection Force (UNPROFOR) that was to be deployed in Bosnia-Hercegovena (BH). It made sense to use people from one that was up and running and so HQ Northern Army Group was tasked to provide core personnel. Thus HQ Bosnia-Hercegovena Command (BHC) was established in the town of Kiseljak, 20km northwest of Sarajevo, in October 1993. By March 1994 the UK personnel had served their six-month tour and the Ministry if Defence (MOD) directed that their replacements be found from other NATO HQs. Thus it was that the author found himself detached from HQ Allied Forces Central Europe (AFCENT) to fill the Engineer Operations and Plans desk in the G3 Engineer Branch of HQ BHC from March to September 1993.

HQ BHC was established on the edge of the town of Kiseljak in an hotel built at the time of the Sarajevo winter Olympic games in 1984. It had remained unoccupied for seven years and at the beginning of the civil war had been used to house refugees. HQ BHC squeezed into the building with difficulty. For example it was normal for three lieut colonels to share a bedroom and this gave each less space than that recommended for refugees by the United Nations High Commission for Refugees (UNHCR)!

This article has been adapted from part of a briefing given to the staff of HQ AFCENT by UK staff officers on return from Bosnia.

Of the 9000 UNPROFOR troops deployed in BHC just over 1000 were engineers. Each battalion deployed with an engineer squadron or troop under its own command, which was not directly available to HQ BHC. The capability and strength of each battalion's integral engineer sub-unit varied enormously. At the top end of the range the British battalion deployed with an enhanced engineer squadron of 300 and hired 60 local artisans. It had its own multidiscipline Specialist Team RE (STRE) and engineer park containing 3500 tons of stores, including spare construction plant, generators, accommodation units and bridging. At the lower end of the range another battalion arrived in the command with an engineer platoon of 25 men with no plant or equipment and just a few hand tools. To give you an example of their capability of supporting their battalion, they requested 30 porcelain wash hand basins. On a subsequent visit it was discovered that they had placed each wash hand basin on a wooden crate, and screwed an

Lt Col M D Reynolds
Bosnia-Hercegovena Command Engineers p304



Map of area discussed, showing lines of confrontation.

empty 15-litre open top container, with a tap, to the wall above. The method of use was to pour water from the container into the basin, wash, and then lift up the basin and pour the water back into the container ready for use by the next person!

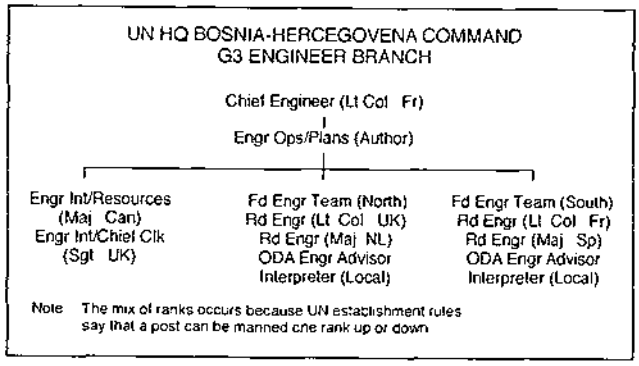
The only engineer asset that was under command of HQ BHC was a French engineer battalion. It was a battalion in name only and was in effect only one company, and a small one at that. It also suffered from being a composite battalion having been formed from volunteer personnel from 27 different units. Nevertheless, it carried out a wide range of engineer tasks. Last but not least it also kept the Engineer Branch supplied with very drinkable claret from its rations.

In September 1993 a Belgian engineer company deployed to BH, for a six-month tour, and was placed under command of HQ BHC. It was used exclusively on improving the gravel parts of the mountain road route from Central Bosnia to Tuzla. There was a Slovakian engineer battalion in Croatia, under command of the Force Engineer at HQ UNPROFOR in Zagreb. Assets from this battalion could be bid for, and very useful they were too. It was a regular battalion and well equipped with a full range of former Warsaw Pact equipment. The battalion personnel were very experienced and the average age much older than one would normally expect. For example the warrant officer, in charge of a T55 mine clearing section, who came to assist on the convoy routes, had in Warsaw Pact days been a lieut colonel tank battalion commander.

The mission of HQ BHC engineers was twofold. Firstly, to keep open the humanitarian aid convoy routes on behalf of UNHCR and secondly to supply BHC UNPROFOR units with engineer materiel.

The aid coming into BH came from three directions: from the northwest in Croatia, to Banja Luka for distribution in the Serb area and some onwards to Zenica for distribution in central Bosnia; from the northeast in Serbia, through Zvornic, and on to Sarajevo; but mostly from the Dalmatian coast up through into central Bosnia and beyond. The total aid delivered per week from all three directions was about 12,000 tons.

Throughout BH there is a well developed and modern road and rail network, perfectly capable of taking all the humanitarian aid convoys and all the administrative traffic of BHC UNPROFOR



units. So what was the problem? Well firstly, during the early stage of the civil war before the full deployment of UNPROFOR units, there were six major road bridge demolitions, shown on the map. The most important of them are the southern three on the motorway between Ploce and Sarajevo. These three bridges were rebuilt by UNPROFOR using a mixture of military bridging equipment and locally available materiel, such as timber and scaffolding. This main route was then reopened for traffic. However, in May 1993 the southern-most repaired bridge was again demolished. A by-pass was established but remained open for only a few weeks before it was closed by the warring factions with mines and roadblocks. Also, at an early stage of the civil war, seven rail bridge demolitions were carried out. This permanently closed the rail route from Ploce into central Bosnia because there was neither the skill nor equipment available to carry out the very large and complicated repairs that were necessary. The demolition north of Tuzla denied rail access from Serbia into northeast Bosnia.

The lines of confrontation shown on the map complicated movement dramatically because they cut the main road network many times. Broadly speaking, UNPROFOR was denied access into the Bosnian Serb-held areas and UNPROFOR operated almost exclusively within the lines of confrontation; that is the predominantly Croat and Muslim held areas. Offers were made to carry out work on the convoy routes in the Serb areas, but were turned down by the Serbs. What they wanted was for the UN to give them diesel fuel and money for them to do it themselves. This was unacceptable to the UN, because the diesel and money would more than likely have been used on the war effort and not on the roads. Thus, in order to maintain a network of convoy routes a network of roads had either to be newly constructed or existing tracks had to be upgraded into all-weather roads. The whole network of convoy routes is not shown on the map otherwise it would look far too complicated; only the outline network is shown. The total network amounted to 2500km, of which more than half was of gravel construction requiring constant maintenance.

All the engineer units, other than the French battalion and Belgium company, were used by their parent infantry battalions to look after their own domestic requirements, such as the construction, repair and maintenance of their accommodation, water and electricity supply, camp fortification and mine clearance. When spare engineer effort was available to HQ BHC it was deployed particularly on bridge construction and repair. The battalions required their own supply route to the coast and when the Ploce, Mostar, Sarajevo road was closed the only alternative was a newly constructed mountain road from Split to Vitez. This was constructed by the British squadron as their battalion main supply route (MSR) and it also became one of the main humanitarian aid convoy routes. The construction of this road has already been described in a previous *Journal* article. Other than this, road construction and repair was carried out by civilian contracts of which there were about six to ten running at a time. These were funded by a budget given to the HQ BHC engineer branch by UNHCR, amounting to $500,000 every five weeks. The banking system in Bosnia had collapsed and all transactions were carried out in cash, the preferred currency being Deutschmarks (DM). Every five weeks DM800,000 in cash would be collected from a bank in Croatia. The cash was held by the branch chief clerk, an RE sergeant. UNHCR required no formal accounting for the cash, only a brief statement of expenditure before collecting the next DM800,000. Payment to the contractors was made by the two engineer branch field teams which planned, let and supervised contracts. Contract work varied in reliability depending on the location of fighting and the value of the route to the warring factions. For example the route from central Bosnia to Tuzla was also used as a Muslim MSR and hence the contractors worked very hard and indeed Muslim military engineers also worked on improving the route. At night and at weekends the contractors probably put on uniforms and continued work as Muslim military engineers.

On some particularly steep mountain roads, in bad weather, armoured personnel carriers were deployed to carry out traffic control and recovery, and at times only vehicles with snow chains were allowed passage, even when there was no snow on the ground. Snow chains work well in mud.

Some basic materiel could be obtained in Bosnia but the majority had to be imported from Croatia and other countries. However, the biggest problem in obtaining materiel was the UNPROFOR civilian bureaucracy. The military had no delegated financial authority; not one penny. This was in complete contrast to UNHCR. All requests for materiel had to be passed to the procurement section of HQ UNPROFOR in Zagreb and obtaining financial authorization could take weeks even for small and simple items. For larger items the procurement section would go through a tendering process which would cause even longer delays. This was especially frustrating and quite unacceptable if for example there was an urgent operational requirement for fortification stores when the fighting moved close to an UNPROFOR camp. When HQ UNPROFOR was established the UN civilian personnel brought with them their procedures from New York or Geneva which were not suited to an operational situation. They were also under the same contractual terms, so for example they finished work at 3.30pm on Friday and started again Monday morning. If only the warring factions had adopted the same hours!

While utility repairs were not in the UN mandate, UNPROFOR engineers became involved since it was a part of the overall humanitarian relief effort. This was especially the case in Sarajevo. Also the Commander BHC realized the importance of utilities and took a special interest in them. General Morillon, the commander at the time, is a mechanical engineering graduate.

The Sarajevo water supply was pumped from deep wells beneath the city by electrically powered pumps. The electricity supply came from either hydro power stations on the Naretva river north of Mostar or from a coal-fired station in the Tuzla area. Transmission lines passed through Muslim, Croat and Serb-held areas to get to Sarajevo and had been extensively damaged by the fighting. Gas came to Sarajevo from Russia and the pipes passed through Hungary, Serbia and the Serb-held area in northeast Bosnia. The supply could thus be interfered with easily.

HQ BHC Kiseljak.

All utilities were frequently interrupted and even when working, strict rationing was in operation. The sewerage system was not functioning because it was blocked so that it could be used for military storage and for military movement.

As a result untreated human waste is dumped on open ground and it is only a matter of time before it percolates down to the level of the water pumps.

Repairs to all utilities were carried out by the Bosnians themselves, but were planned, coordinated, and supervised by UNPROFOR engineers. In Sarajevo this was done by French army engineers, escorted by either the French, Egyptian or Ukranian battalions.

In conclusion, the six months was very hard work and particularly frustrating when trying to achieve timely results, not only because of the vagaries of the warring factions but also because of the need to battle against the UN bureaucracy.

There is no doubt that if in the future the UN and military have to engage in similar humanitarian missions in the middle of a vicious, bloody and dirty civil war then there must be far more coordination, trust and understanding between the two. This can only be achieved by having a high profile military presence at UN New York and Geneva and by giving individuals and units deployed on UN missions, particularly those going to UN HQ, pre-deployment training in UN bureaucratic methods and procedures. The UN should also adapt its methods and procedures to the demands of the military operating in an operational environment.

The Boat Store, Sheerness Docks

MAJOR F J GREEN CEng EurIng MICE

Major Frank Green was commissioned into the Corps in 1985. Following troop commander appointments in Germany and 3 Training Regiment, a spell as Projects Officer Minley, rekindled his interest in professional engineering. This led to an extended period as Second in Command 39 Field Squadron before attending the Professional Engineer Training (Civils) Course, commencing October 1991.

He is currently commanding the 522 Specialist Team Royal Engineers (Works) Operation Grapple 5 *team.*

Introduction

Sheerness Docks was founded in 1665 as part of the great naval expansion connected with the Dutch wars of that period. By the early 19th century the government had entrusted the supervision of the Admiralty Works Department to the Corps of Royal Engineers.

A retired Bengal Sapper, Colonel G T Greene, became the director of the Admiralty Works Department in 1850. Greene's Boat Store (1858-1860) at Sheerness has been recognized as a monument in structural history for being possibly the world's first multistory iron-framed building stabilized entirely by portal action. It is therefore of great historical interest both to the Corps and to the engineering profession.

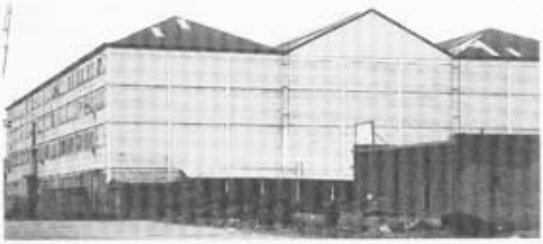
A striking building, which dominates the north-eastern end of Sheerness Docks, its exterior appearance is similar to many multistory building façades of the 1950s. Architecturally the horizontal and vertical proportions are balanced and pleasing to the eye. Currently used to store miscellaneous small cargoes, the exterior of the building is untidy and although on first examination the structure appears sound, there are hidden dangers in the cast and wrought iron structural members. To add to its problems, differential settlement of the building appears to indicate that the piled foundations have lost some of their original load capacity.

A structural study of the Boat Store by the author, revealed a fascinating history in terms of the design, the designer's background and his use of materials. This paper aims to impart a flavour of the history to readers of this *Journal*. Also highlighted is the need to carry out detailed material and component analyses when assessing the condition of old or damaged structures, a topic which is gathering pace in war-torn Bosnia.

Greene's Background and Royal Engineer Links

Born in 1807, Greene was the son of an East India Company army officer. Trained at the East India Company's seminary at Addiscombe, Surrey (1821-1823) and at the Royal Engineer Establishment (1823-1824), he was commissioned into the Bengal Engineers in 1823. His early career saw him involved with canal work, and included his playing a part in the siege of Bhurtpore (1825) in Lord Combermere's force. He was later employed as a barrack master, executive officer, civil engineer, garrison engineer, secretary to the military board, superintendent of embankments and, during the period 1848-1849, officiating mint master in Calcutta. A busy portfolio thus far but the highlight of his career as a professional engineer was clearly his work for the royal dockyards.

Major F J Green
The Boat Store, Sheerness Docks p308



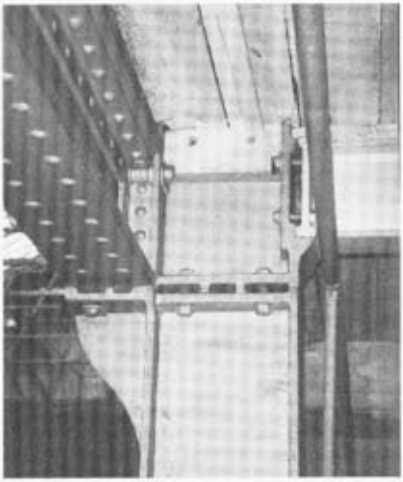
View of the Boat Store.

While serving in India it is likely that Greene kept abreast of developments in Britain by reading the Royal Engineers' professional papers. These included important articles such as Turnbull's 1843 *Practical Essay on the Strength of Cast Iron Beams, Girders and Columns* which included detail on deflections, "...strengths within the limits of elasticity..." and bending. Although Greene does not appear to have made notable use of structural iron in India, he had matured as an engineer officer in an environment which demanded that initiative was used and responsibility taken at every opportunity. In fact, shortly after taking up his post with the Admiralty, Greene became the first officer to take responsibility for the design of long span iron roofs in the dockyards, such as the No 7 shed at Chatham. His original design drawings for the Boat Store are archived at the Public Records Office, Kew, and bear his signature. By the 1850s cast iron work had become quite sophisticated with H-section columns and other cast iron elements being used in composite construction with wrought iron. Both metals are however subject to irregularities which affect their structural performance and now affect the structural integrity of the building under discussion here.

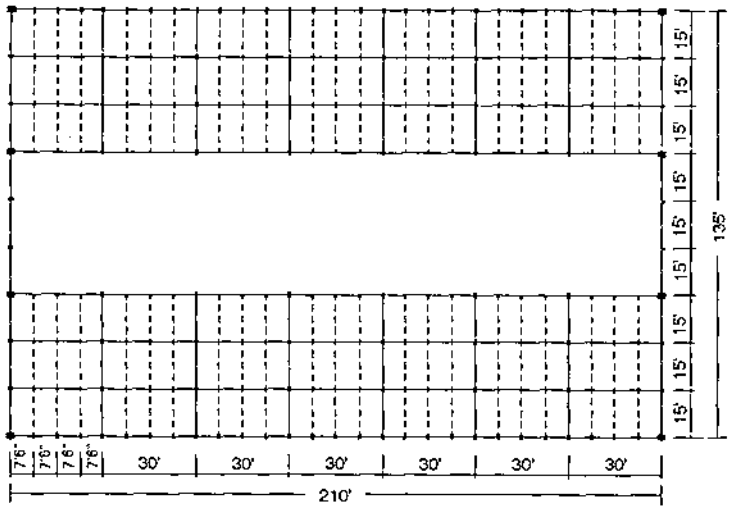
Description of Boat Store

The overall dimensions of the Boat Store are 210ft by 135ft by 40ft high. The columns are H-sections of cast iron with wrought iron plate girders spanning longitudinally between columns which are stabilized transversely by cast iron I-beams. The building is divided internally into three longitudinal bays, the central bay being a nave 53ft high capped by a full length skylight. The two side bays are three-storey frames, each floor with space for 28 ships' boats either side of the atrium. A fixed gantry crane spans the nave section at roof level. It was used to hoist the boats, on their trolleys, to gantry platforms at each floor level. The platforms travelled on wrought iron girders running the length of the atrium, enabling the boats to be pushed into their parking slots either side of the central bay, an ingenious space-saving system of which National Car Parks would have been proud.

Notwithstanding this creative flair, the genius of the building lies in its detailed design. The structural arrangement of the Boat Store was an innovation when it was built, making use of a frame of cast and wrought iron members to dispense with the need for diagonal cross-bracing. The building is stabilized by the stiffness of its joints, at odds with the majority of large structures built up to the end of the 19th century which relied for their stability on masonry, cross-bracing or a combination of the two. The transverse bracing beams and longitudinal girders are fitted with end plates which are connected to the columns by four ¾in bolts. There are cantilever brackets which transmit the vertical reactions to the columns but it is the rigidity of the bolted endplate/end-column connections which, in 1860, made the structure unique. Ironically it is these connections which



Beam/column connection.



Plan view of structural arrangement.

have become the Boat Store's Achilles heel, which will be discussed later.

Greene broke with the tradition of specifying sections of greater dimensions below the neutral axis in designing the main and exterior girders. The fixed-end connections reduce the centre span moment and create two tension zones in the top flange. Whether he was aware of this as a result of theory, or experimentation, is unclear. His decision to halve the external column spacing significantly reduces the vertical load taken by the exterior wall beams. In common with the transverse bracing beams the wall beams are cast iron and although they are loaded along their top flange, they also act as compression members by countering longitudinal wind forces on the building.

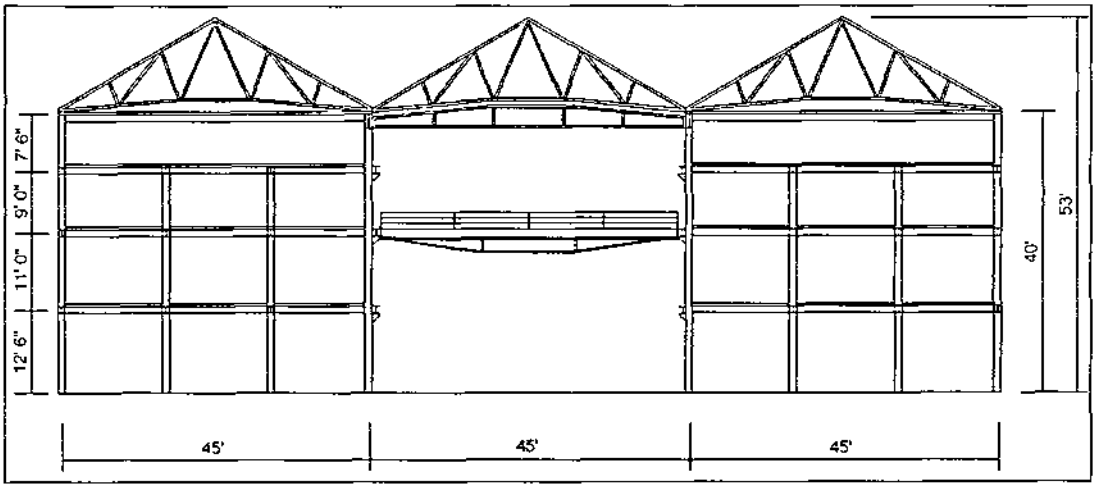
The cast iron corner columns which are square hollow sections have the same moment of inertia values in the longitudinal and transverse directions of the structure. This creates equal resistance to wind loading on all corners in both directions. The transverse cast iron beams take their share of floor loading but this again is small in relation to the spread of load onto the longitudinal wrought iron girders. The main function of these beams, as with the external longitudinal beams, is to act in compression and counter wind loading.

The wrought iron longitudinal girders are the "backbone" of each floor, taking the bulk of the dead and imposed floor loading. The timber flooring at each level is oak planking and this was likely to have been originally destined for ship construction but diverted to the Boat Store as a result of the introduction of iron hulls in the mid-1800s. The wooden joists and floor timbers do not contribute to the rigidity of the structure but the seatings for the joists act as stiffeners at fourth points. At the atrium the girders act as crane beam supports for the travelling platforms, and the 30ft girder span between columns is acknowledged as being noteworthy in building construction for that period. The 30ft girder span was noteworthy in building because Greene was apparently one of the first designers to use girders over this span. Although longer spans had been achieved in, for example, railway bridge design, there is little evidence of their prior use in building construction.

Changes to the Building

STRUCTURALLY the building is unaltered since it was constructed between 1858-1860. The changes that have been introduced have been cosmetic: the roof is now of corrugated asbestos sheeting rather than slate; the windows have been replaced, as has the original corrugated iron exterior cladding; the ground floor cladding has been replaced by brick and the sliding doors have been exchanged. The exterior appearance of the building is becoming dilapidated, and there are a number of specific areas which require attention. There is evidence of roof truss buckling, particularly above the atrium. A number of ground floor columns have been damaged and at upper levels there is some graphitization of structural members. Poor roof drainage has resulted in damage to the timber flooring and there is a danger of wet rot spreading. The hollow corner columns act as drainage downpipes and may be corroded from within.

The building is drained by channelling the roof runoff along the valleys and exterior of the roof to the square hollow columns located at the corners and roof valley junction. The water then passes down through the columns to a point below their bases, where it is diverted via a bend and fed out into the collecting pipework adjacent to the building. There is unlikely to be a downpipe within the column, or a skin to the cast iron; the



Schematic section showing one of three gantry platforms.

material was known for its corrosion resistant properties and it was common practice in the mid-1800s to employ hollow cast iron columns in this manner without protective skins. I think that if the interior of these columns was inspected, some degree of corrosion is likely to be found, which may have weakened them. This was the case in a similar drainage system within the arch ribs of Paddington Station, dating from 1837. Closed circuit television could be used to establish the condition and to assess the feasibility of refurbishing them by using a polyester felt and resin liner.

Metallurgy and Properties of Cast and Wrought Iron

Cast iron is a crystalline material whose main constituents are iron and carbon. Structurally it behaves well in compression, but has low tensile strength and is characteristically brittle, but also a durable material; most rainwater downpipes used in the 18th, 19th and early 20th centuries were made of cast iron. It usually contains between 2 per cent and 4 per cent carbon, and varying quantities of silicon, sulphur, phosphorous and manganese. A sample of one of the transverse cast iron beams in the Boat Store was analysed by Sheerness Steel, and the chemical make-up of the metal, other than its iron content, is shown in the table opposite.

The metal was assessed as having a Brinell Hardness of 163.

These results indicate that the sample is a grey cast iron, containing about 25 per cent pearlite and 75 per cent ferrite.

The presence of carbon in the iron lowers the melting point of the metal and also increases the amount of graphite available. The graphite flakes in the sample were plentiful and coarse. During solidification the carbon in iron separates, or graphitizes, to form these separate graphitic flakes which are of low strength, brittle and cause stress concentrations in the metal. The ferrite and pearlite constituents would normally fail under load through sliding of the internal structure of their individual grains. This process would create a plastic failure of the material but the graphite flakes prevent this gradual failure mode, resulting in brittle failure without any appreciable deformation. This has serious implications for the integrity of the structure. A number of the atrium columns have suffered from impact damage and have been strengthened by the addition of protective flange plates bolted across the web. Cast iron is brittle under impact loading and it is likely that sections of the flanges were "snapped off" after brittle failure, necessitating these repairs. There is also evidence of graphitic corrosion taking hold

Serial (a)	Constituent (b)	Percentage (c)
1	Total carbon	3.48
2	Silicon	1.55
3	Manganese	1.10
4	Sulphur	0.04
5	Phosphorous	1.06
6	Chromium	0.02
7	Nickel	0.016

in specific areas near the roof of the structure, on the longitudinal external beams and the transverse bracing girders.

Graphitization of cast iron is a form of corrosion which acts by removing the iron's ferrous matrix. The different constituents of the iron, including graphite, iron and silicon, act in a similar way to electrodes in a corrosion cell and the matrix becomes substantially dissolved. The change in dimension and surface texture which accompanies this is minimal but the mechanical strength of the graphitized layer is negligible. The graphitized area shows up as a black surface which is blistered and it can be scraped away from the member easily. Although the layers of paint act as a protective shield to counter external corrosion, graphitic corrosion thrives in the anaerobic conditions existing beneath paint layers. The paint thus conceals the extent of the corrosion and should be stripped back to determine the corrosion damage to the members in question.

Wrought iron is the purest form of iron and usually contains about 0.02 per cent carbon. This is almost completely dissolved interstitially in the iron lattice, which compares with the large amount of free carbon in the form of weakening graphite flakes in cast iron. Wrought iron is characteristically tough and ductile: it is a laminar, anisotropic material which contains glass-like, iron-silicate slag impurities of between 1 per cent and 4 per cent. These give the metal its veined/layered appearance and, together with the purity of the iron base-metal, make it highly corrosion resistant. Unlike cast iron, wrought iron is more efficient acting in tension than compression. The reason for this is that although the slag contributes to its corrosion resistant properties, it also creates a weak plane in the material enabling it to delaminate in compression. Cast iron members which are repeatedly stressed beyond their elastic limit will fracture (the "snapping off" of the column flanges referred to earlier is an example); wrought iron, on the other hand, will deform when stressed within its elastic limits. However, brittle fracture of wrought iron can develop from either a defect in the metal, or at points of stress concentration.

A spectrograph analysis of the cast iron sample enabled the compressive and tensile strengths to be estimated with reasonable accuracy. The tensile strength of the sample was judged to be approximately 10tsi (tons per square inch), (155N/mm^2). It should be remembered that Greene had employed the main cast iron load bearers in compression; the sample displayed a compressive strength in excess of 30tsi, (465N/mm^2). It was assumed that the sample results are representative of the cast iron throughout the structure.

Unfortunately no test results were available for the wrought iron due to difficulties in "sparking" the sample. It is probable that the Boat Store's wrought iron has similar ultimate tensile strength values as the main arch ribs of Brunel's Paddington Station roof, which was discovered to be 266N/mm^2. The latter was identified as Staffordshire wrought iron of low quality, found to yield at 220N/mm^2. "Iron Henry" Grizzel, the iron work contractor for the Boat Store, commonly achieved girder working strengths of 10tsi (205N/mm^2) and bearing in mind the close professional relationship which had developed between Greene and Grizzel, it is not unreasonable to assume that Greene was aware of this figure and took it into account in his calculations.

Structural Assessment

A detailed structural assessment was undertaken in 1984 by Posford Pavry and Partners in order to determine the building's suitability for use as a cold store. The required loading of 10kN/m^2 was found to be too high for the structure and it was determined that the foundations were overloaded by a factor of five. The load capacity against collapse, due to both vertical and wind loading was assessed and the sway buckling of the structure was examined. It was assumed that a plastic hinge does not occur in cast iron due to its brittleness and that failure is by fracture at the maximum tensile stress. Their analysis confirmed that under wind loading the critical elements in the structure are the bolted joints.

A computer analysis of a transverse bay of the structure was undertaken by the author for this paper using "Master Series" software. Greene's assumed maximum working loads were applied with the October 1987 storm wind loading of 87 knots (44 m/s). The analysis assumed that the feet were fixed and that there was no eccentric loading (ie, that the floors were fully loaded).

As the structure is a multistory frame which derives its rigidity by portal action in two directions it is very difficult to determine suitable effective lengths for the columns. Using the permissible compressive stress values recommended by CIRIA (Construction Industry Research and Information Association) for cast iron columns

(related to slenderness) and assuming the column effective length equals one (a lower bound example intentionally selected to take account of the material uncertainties) the external columns were found to be 50 per cent overstressed. Similarly, under the 1987 storm winds the bolts are overstressed. Had the structure been fully laden its members would have remained intact but the bolts would have failed.

Both investigations confirmed that the key stability elements are the bolts. Despite the approximations made regarding their strength, no results are held which provide a definitive yield stress. This may render the calculations inaccurate, no matter how sophisticated they are.

Deterioration of bolts in similar structures, as a result of pitting corrosion, is well recorded and is potentially dangerous. No accurate assessment of their condition can be made unless they are removed and individually inspected. It would be sensible to consider replacing the original bolts with modern steel bolts which have predictable performance.

Although there appears little danger of the structure failing if it continues to be used as a "light" cargo warehouse, the threat of bolt corrosion should not be underestimated. If the building is to serve a useful purpose it will require strengthening, to include replacement of the bolts and perhaps the addition of diagonal cross bracing and stronger flooring if any purpose other than lightweight storage or administrative use was anticipated.

LEVEL	CAST IRON COLUMNS			WROUGHT IRON LONGITUDINAL GIRDERS
	ANTRIUM	INTER-MEDIATE	EXTERIOR	ATRIUM & INTERMEDIATE
G	15 x 9	15 x 6	15 x 9	18 x 12
1	14 x 9	15 x 6	14 x 9	18 x 12
2	13 x 9	13 x 6	13 x 9	18 x 12
3	12 x 9	13 x 6	12 x 9	18 x 12
ROOF	–	–	–	24 x 12
EXTERIOR CAST IRON BEAMS:				12 x 9
TRANSVERSE CAST IRON BRACING BEAMS: TOP FLANGE				7 x 1
WEBB				10 x 1
BOTTOM FLANGE				9 x 1

Structural member sizes (inches).

Greene designed the structure so that the loadings would be carried down the stanchions and transmitted onto piled foundations, which included concrete, as illustrated in the foundation sketch on the next page. The use of concrete was well established by the 1850s; initially lime-mortar was developed and improved by the addition of clay (by Smeaton) for the Eddystone lighthouse about 100 years earlier. This led to a deeper understanding of pozzolanic action which brought subsequent improvements and in the 1820-40s, culminated in the roasted clay limestone clinker that is recognized as cement today. This was produced around 1846 and was probably specified by Greene.

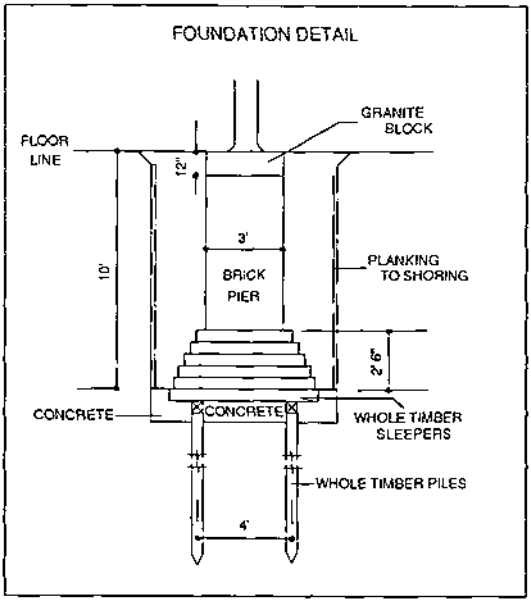
The poor ground conditions in the dockyard had been well documented by Rennie. Greene probably also considered the close vicinity of the structure to the adjacent No 9 Frigate Dry Dock and may have used some of the basic piling/bearing calculations of that period. The high water table (approximately 2.5m below ground level but subject to tidal variations) and the likely choice of greenheart for the piles, has probably prevented

Foundations

Soils investigations have shown the building to be underlain by fill, recent alluvium/fill, very soft alluvial clay and medium-dense, becoming successively dense with depth, alluvial sand. The difficulties of sampling in this sensitive material of high moisture content prevented realistic triaxial results being obtained but the soil parameters shown in the table on the right are typical for that area of the docks.

The original drawings indicate that the piles are likely to be bedded in the dense alluvial sand, at about 18m depth.

Serial (a)	Material (b)	Bulk Density (kN/m^3) (c)	Cu (kN/m) (d)	Qu (Deg) (e)
1	Clay alluvium	18	20	0
2	Medium dense (sand) alluvium	20	0	32
3	Dense (sand) alluvium	20	0	36



any significant deterioration in their condition. Greenheart is renowned for its high density and resistance to rotting; furthermore it is the alternate wet/dry cycle which is the primary cause of rot in timber piles, despite several other factors which could cause durability problems – including a vicious termite known as the teredo marine borer!

Greene presumably located the pile caps at a depth of 3.66m to keep them within the water table. It is not clear which method was employed to install the piles but numerous systems were in existence, for example Perronet's pile engine. The piles themselves were tipped with cast iron shoes and probably driven to an acceptable set. Rennie clarifies this by stating that piles were generally: "driven ... until a weight or ram weighing 15cwt and falling 25 to 30ft did not move more than from half to three quarters of an inch at each blow." There is no record of what Greene specified this acceptable set to be.

A line-and-level survey of the stanchions by the Survey Department RSME indicated that settlement of the piles has occurred. This may have been caused by varying degrees of negative skin friction, as a result of consolidation of the alluvial clay, acting on the piles. Clearly the capacity of the foundations would be a vital factor in any planned change of use. An analysis of individual pile group capacity was undertaken using Meyerhof's method, assuming that both end bearing and shaft friction were developed but not taking into account pile group action. This revealed that individual foundations have safety factors of two in the fully laden condition, each pile having a capacity of approximately 375kN. It can be concluded that there is little spare capacity in the foundations, a factor which would restrict future plans for the use of the structure. There is also a possibility of lateral pile movement occurring. If the ground floor of the building was subjected to prolonged overloading, soft soil flow could occur. Lateral movement of the alluvium would cause horizontal pressures to develop between the piles and the soil with the consequent development of bending moments and perhaps even deflection of the piles. This would in turn induce additional loading on the adjacent dry dock wall, ironically one of the factors Greene avoided by including piles in his original design.

Conclusion

The original design of the Boat Store has been proved by the lifespan of the building. It was clearly an innovation at the time, although its location in the former naval dockyard meant it had little wider impact. It remains a tribute to its designer, Colonel G T Greene, 134 years after it was constructed and by association, to the Corps of Royal Engineers.

This study of the Boat Store demonstrated two issues important to contemporary engineering. First, it is by the innovation of engineers like Greene that new methods are introduced, which often lead to the development of new materials. Secondly, of current relevance to the Corps, we should be cautious when assessing structures for a change in use, or when considering the repair of damaged buildings. Building surveys with either goal in mind must include an analysis of the materials which contribute to structural integrity.

Footnote: this article has been considerably shortened for publication in the *Journal*, but a full version, together with all references, is available in the Corps' Library.

Assess the Importance of Surprise in the Success of the German Invasion of France in 1940

LIEUTENANT E W JUDGE BEng

Prior to the author's last short article, The Road to Pak Nai *published in the December 1993 issue of the* Journal, *he wrote the following winning entry, for the Director General's Army Training Junior Officer Essay Competition.*

On 27 September 1939, Hitler summoned his senior generals to Berlin and instructed them to prepare for an offensive in the west at the earliest opportunity. At that stage Britain and France were desperately trying to close the wide gap in military capability between themselves and Germany, which their pacifist policies and economic difficulties between the wars had allowed to form. The Germans, by contrast, were enthused by their quick, successful attack on Poland, and Hitler was keen to strike while he retained advantage in capability and morale. Planning for the operation, known as *Fall Gelb* (Case Yellow), was complete by 19 October, and involved an attack through Holland and Belgium. The Allies were unable to form a strong alliance with the Low Countries to oppose Germany. Consequently the Allied commander, General Gamelin, adopted a plan involving the swift move of Allied forces into Belgium when invasion was imminent, after which they would adopt positions tied in with the Belgian army on what was known as the Dyle Line. This was known as "Plan D". The Allies had a secure source of intelligence and so were confident their plan was viable.

On 10 January 1940 a German aircraft made an emergency landing at Mechelen in Belgium. One of the passengers was carrying the orders for *Fall Gelb*, parts of which were captured. The Allies were heartened by this and their confidence in "Plan D" was raised. Hitler was furious and demanded that the plan be changed. The revised *Fell Gelb* was issued on 24 February and involved a slow advance into Belgium and Holland to lure the Allies forward, followed by a swift attack through the Ardennes and on to the Channel coast to cut off the Allies completely.

The attack began on 10 May when the Germans invaded Holland and the Allies began their move to the Dyle Line. On 15 May the German *panzers*, under Guderian, crossed the river Meuse around Sedan and began to drive northeast through the Allied rear areas. They reached the Channel at Abbeville on 20 May and despite some Allied counterattacks succeeded in destroying most of the Allied 1st Army Group on 4 June.

Clausewitz, in "On War", considers surprise and claims that "secrecy and rapidity are the two factors", the former to catch the enemy unaware and the latter to ensure that maximum benefit accrues from it. These two factors can be expanded to the six elements of surprise (as taught in British tactical doctrine); originality, audacity, secrecy, concealment (physical and of intent), deception and speed.

Brigadier Mackenzie points out that surprise can occur in different forms at different levels and breaks it down into strategic surprise, which involves the political aims of governments and the relationships between them; operational surprise, which involves the military methods used by commanders to achieve political aims; and tactical surprise, which involves commanders of units in individual battles. He notes two particular forms of operational surprise: technical surprise, in which the forces of one belligerent are unable to counter a new technology developed by their opponents; and doctrinal surprise, in which both belligerents have reached the same level of technical development, but one has a far more effective method of using the technology.

In this analysis I intend to consider firstly the importance of each element of surprise in relation to the campaign at all levels. I shall then consider the other factors which were of great importance in deciding the outcome, and finally I shall assess the relative importance of surprise and these other factors.

It seems easiest to consider the elements of surprise in chronological order, beginning with originality. Well before the notion of *Fall Gelb*

was conceived, the Germans achieved originality in their doctrine, with the result that in the campaign of 1940 the *Wehrmacht* achieved total doctrinal surprise over their opponents. The German army had retained their faith in an offensive doctrine despite their defeat in the First World War, and had taken the opportunity provided by the intervening 20 years to transform their doctrine using the principles expounded by visionary military theorists such as de Gaulle and Liddell-Hart. The result was known as *Blitzkrieg*, and took advantage of the speed and shock of massed armour, the mobile firepower of aircraft and the flexibility of radio communications to create a method of waging war for which the Allies were totally unprepared. The ten *panzer* divisions of the German army fought and moved in corps of three or four divisions, and operated at a tremendous pace. Having brushed aside the defenders' positions in the narrow sector under attack, they rushed through the breach and caused panic and havoc in the enemy rear. This chaos caused paralysis in the enemy's command system, which left the *panzers* able to advance quickly, unimpeded by counterattacks. *Panzer* formations were not purely armoured, but contained mobile infantry, artillery and engineer units to support the advance once penetration of the enemy front had been achieved. The *Luftwaffe* played a major role in *Blitzkrieg* by providing intimate support to the tanks using the "Stuka" dive bomber. The German commanders were all trained in "mission-directed" orders, which allowed low-level commanders to use their initiative to achieve their commander's mission. This system was ideal for *Blitzkrieg* since it allowed operations to move as fast as possible, on the few occasions when Hitler or senior generals intervened, the advance was delayed.

By contrast, the Allied armies in France had suffered from decades of neglect. Economic problems had trimmed military development, and the prevalent liberal attitudes of the time had blighted doctrinal thought and development. Despite this, the British and French possessed significant numbers of modern tanks and aircraft on 10 May. The problem was that the Allied doctrine had failed to keep up with technical advances, and was unable to direct the use of these forces efficiently. The Allied tanks were never used *en masse*: Allied armoured attacks during the campaign were conducted by formations up to divisional strength, but these formations were not supported by other arms, nor did they have anything like the air support enjoyed by the Germans. Consequently they had nothing like the effect of their German counterparts despite being fairly similar in strength and in capability.

Whilst planning the invasion of the west, the German generals found themselves in a position where notable success could be achieved simply by following their own doctrine; there was no need to take unnecessary risks to achieve success. Thus, audacity cannot be considered as a key element in their surprise.

The Germans managed to achieve partial strategic surprise by maintaining secrecy in two respects; the Allies were surprised by the direction of the attack and by the suddenness with which it occurred. The original version of *Fall Gelb* envisaged an attack very much on the lines of the Schlieffen plan used in 1914. In this plan the German Army Group "B", supported by most of the *Wehrmacht's* armoured units, would drive through Holland and Belgium and into France. They would tackle the Allied forces head-on in Belgium and fight a decisive battle north of the River Somme. The Allies were fully aware of this plan since they had faced it once before, and the Belgian government had a well-placed intelligence source in the *Abwehr*, the *Reich* intelligence service. The Mechelen air crash incident prompted a swift rethink of the German plan, however, and General von Manstein took the opportunity to offer Hitler a new concept involving a strong push through the Ardennes. This version appealed to Hitler's desire to destroy the Allies' armies completely, and he insisted that it was the basis for the revised version of *Fall Gelb*. The Allied command, lulled by the capture of the enemy plan, failed to consider seriously alternative approaches for the Germans and made no plans for dealing with an attack in the Ardennes. Allied dispositions when the attack came on 10 May reflected this, since the Ardennes area was held by light cavalry and infantry none of whom included professional regular soldiers.

The second respect in which the German's maintenance of secrecy caused surprise was in the timing of the attack. The Belgian government was reluctant to enter a strong alliance with the Allies for fear of French duplicity and so as not to provoke the Germans into invasion. Consequently General Gamelin's "Plan D" involved the 1st Army Group

moving into Belgium when firm intelligence about the invasion became available. They were to link up with the Belgian army and hold a strong position on the Dyle Line after the Belgians had delayed the enemy on the fortified line of the Albert Canal. This manoeuvre would take up to eight days to carry out, but the Allies were confident that their intelligence would give them enough warning. In the original German plan they would have had four days to prepare after the German mobilization, but the air crash caused Hitler to panic and he insisted on a maximum period of 24 hours between mobilization and attack for the revised *Fall Gelb*. Consequently the Allies were caught well out of position when the attack began.

Concealment of intent will generally only be achieved if secrecy is maintained; as explained above, the German secrecy was compromised, but had unexpected results. The other sort of concealment is physical concealment. This concept is easiest to apply in defensive operations, and in an advance like that performed by the German *panzers* after the crossing of the Meuse was almost impossible.

The Germans made interesting use of deception by allowing the Allies to follow their misguided plan as far as possible. During the initial days of the campaign, the Allied 1st Army Group surged forward into Belgium and began to occupy its planned positions. This movement was made unimpeded by the *Luftwaffe*, but when the folly of the Allied High Command was revealed and the Army Group struggled to redeploy to the rear, its every move was hampered by a sustained bombardment from the air. The effects of this bombardment were worsened by the many refugees who fled in the face of the German advance, clogging the roads and taking from the Allied commanders their ability to move quickly and react.

Speed is the most important element of surprise in *Blitzkrieg*. The effects of speed were most often felt at the tactical level, where the pace and shock of *Blitzkrieg* meant that the German *panzer* units regularly achieved local surprise over their enemies: for example, the French 1st Armoured Division was caught refuelling at night by Guderian's XIV Corps and destroyed as a fighting entity; at this stage the *panzers* were covering up to 30 miles every day. Surprise in these situations was rarely deliberate, but came about more often because of Allied ignorance of the German rate of advance and of their own perilous situation. The speed of advance also meant that Allied armies were unable to redeploy or react in time; their deployment became twisted by the advance and their service and command facilities in the rear were left open to attack. Allied commanders were unable to receive and process information about the advance quickly enough for their orders to have any relevance to the battle; by the time units were tasked to block or counterattack, the Germans would have moved on or attacked them already. Speed was the principle at the heart of *Blitzkrieg*, and it allowed the German commanders to surround a full army group and destroy it in three weeks.

There can be no doubt that the Germans achieved surprise in their campaign in 1940. However, there are three other major contributory factors in their victory which will be examined below.

The first to be considered is the Allied plan before the attack commenced. The commander, Gamelin, made an unforgivable error in that he failed to keep a reserve. The original Allied plan had envisaged sending the British Expeditionary Force (BEF) and two French armies into Belgium to hold the Dyle Line with the Belgians, keeping the French 7th Army (six divisions) in reserve on the Franco-Belgian border. However, Gamelin became so sure that the German main effort would be in the Low Countries that he changed his plan and pushed the 7th Army forward alongside the others when the Belgians agreed to open their border. Consequently, when the German *panzers* crossed the River Meuse at Sedan and broke through the Allied line on 15 May, Gamelin had no strong force available with which to react. The Germans drove unhindered to the Channel and seized their swift victory. Had the 7th Army been available to counter the penetration quickly, things may well have been different.

The second factor which must be considered is the standard of morale, training and equipment in the armies concerned. The German forces of 1940 were professional and well-equipped, and following their earlier successes were keen and confident that they would succeed. The Allies, by contrast, possessed forces of variable quality. The BEF contained most of Britain's prewar regular soldiers and was a disciplined and effective force. Sadly, it amounted to less than one thirteenth of the Allied strength. The Belgian and Dutch armies were resolute in their intention to defend their homelands, but were pitifully ill-equipped. The remainder of the Allied 1st Army Group were French of whom most were conscripts, poorly

equipped, scantily trained and scared of meeting the enemy. Predictably enough, these men were no match for their aggressive opponents. Had the French planned their training better and ingrained in them a more aggressive attitude, they may have been less susceptible to *Blitzkrieg* and more prepared to counterattack.

Finally, the Allied command system was woefully ill-prepared to fight any kind of war let alone deal with *Blitzkrieg*. The governments of Britain and France never achieved a close understanding or a common set of aims, which resulted in hesitant conduct on both sides. The Belgian and Dutch governments prized their prewar neutrality, and were thus most unenthusiastic about entering a close alliance with Britain and France until German invasion was inevitable. Naturally, at that stage there was no chance to forge a unified command or to preposition Allied troops inside Belgium and Holland. In addition, the structure and systems adopted by Gamelin's headquarters made him isolated from the battle and unable to react quickly; orders were issued and reports delivered by dispatch rider and the planning system used by the staff was archaic. Had the Allied command been unified and responsive, they may well have made up for their other disadvantages.

For the reasons given above, the German victory in the west was by far the most likely outcome for the campaign even without the German element of surprise. Had the Germans suffered a total failure of secrecy, and had they attacked using the doctrine of 1918, it seems likely that their advantages in the training and morale of the soldiers, along with the commitment and efficiency of their leaders and generals, would still have given them military victories in the early battles, and the lack of an Allied reserve would have led to a German breakthrough eventually. A campaign of this nature, however, would have been long and costly, and it is inconceivable that all Allied forces would have been destroyed; a sizeable force would have escaped south of the river Somme, to re-equip and prepare positions to defend Paris. The key factor that brought about a decisive German victory was their success in achieving surprise.

German surprise was made up of many different elements which worked at different levels, but many of these were irrelevant to the final outcome. The German plan cannot be described as audacious since it was a straightforward demonstration of the *Wehrmacht's* war-fighting method and involved no special methods or risks. Similarly, physical concealment was a concept inappropriate to the German plan and played a minor role. They made very little effort to conceal their intent; the Allies were aware from the moment war was declared that a German attack was inevitable. The Germans employed one major deception by luring the Allies forward to meet what looked like the main effort, but it seems clear that this was not a campaign-winning ruse. These three elements are clearly secondary to the German success.

Secrecy was an important element, but in an accidental way. Had the initial version of *Fall Gelb* remained a secret, the German main effort would have been through the Low Countries, and would have been met by a strong force holding a defensive position. The key breach in secrecy at Mechelen had two effects; it made the Allies complacent and blind to German alternatives, and it prompted the Germans to change their plan totally. As a result, the Allies were caught unprepared and badly deployed when the attack began; to a degree they were defeated by their own good fortune.

Speed and originality were the two key elements of surprise which the *Wehrmacht* utilized to achieve their resounding victory, but the relationship between the two is complex. Speed, the central tenet of *Blitzkrieg*, was the factor which defeated the Allies. *Blitzkrieg* in turn was a product of German prewar originality. Thus original thought caused German operations to be conducted at speed, and so was the most important element in the German surprise.

Comparison of the value of surprise in the German campaign, and the other factors which coloured its outcome, leads to the conclusion that surprise at the operational level was absolutely crucial to the German victory. Once over the Meuse at Sedan, *Blitzkrieg* allowed the Germans to exploit speed and regularly achieve tactical surprise in the Allied rear, which led quickly to the final destruction of 1st Allied Army Group. Without surprise, victory would have been less complete, more costly and slower. Surprise was thus the paramount factor in the German campaign of 1940.

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Adventurous Training – The Jewel in the Crown of Military Training or a Financial Fraud?

CAPTAIN H T S RICKETTS

Captain Henry Ricketts completed Young Officer Course 105 in April 1992. During his posting to 38 (Berlin) Field Squadron, he held the posts of Troop Commander, Operations Officer and Second in Command. As a battle captain, he was attached to "A" Squadron, 14/20 Hussars for Exercise Medicine Man, *and during this period he also spent two weeks parachuting and one week mountain biking in the Rockies. He has been on two Exercises* Snow Queen, *which included eight days' ski-touring. He has run two adventurous training expeditions: a four-man mountain biking trip to Northern Spain whilst at the Royal Military Academy Sandhurst, and more recently the Royal Engineers British Army of the Rhine sports parachuting exercise to Florida, where he is returning shortly to lead the 1994/5 exercise.*

After attending the advanced free fall course at Joint Services Parachuting Centre, Bad Lippspringe, he was posted as 2IC 44 Headquarters Squadron, Hameln.

In July 1990 the Secretary of State for Defence announced *Options for Change:* the Government's far reaching plan to overhaul Britain's armed forces. Further cuts were announced in late 1993 despite lessons learned from recent operations. Many committees are trying to discover ways of achieving cuts without adversely affecting the way in which our forces go about their business. In the light of a "Front Line First" policy, one of the areas under serious scrutiny is adventurous training (AT).

This article hopes to explain why AT in its present form, albeit with some minor modifications, is an essential part of overall military training which could not be accomplished by using civilian alternatives. Parachuting will be used as an example but all points are relevant to the other nine forms of challenge pursuits (CP).

The aims of AT were laid down in 1957. They are to foster self-reliance, leadership, initiative and courage. On this basis substantial sums of public money have been made available to thousands of courses and expeditions, most of which have helped to develop the right sort of qualities in the men and women of today's armed forces. The experience gained on the expedition to Malaysia, so well covered in the press earlier this year, would certainly be beneficial during times of war. The will to survive is very hard to develop through ordinary training and it is this sort of quality that AT aims to cultivate.

AT in the services is a form of outdoor activity requiring participation in a CP which contains a risk to life and limb. By accustoming servicemen to danger, hardship and challenge it calls for and develops those qualities of loyalty, trust, team spirit, discipline, self-respect, courage, physical strength, endurance, resourcefulness, adaptability and good humour. All these qualities are described in *Training for War, Part 2, Individual Training*. Additionally, by strengthening self-confidence and by forcing those participating to accept responsibility and to make decisions, AT is invaluable in the training of potential leaders. It also provides an interesting counter-balance to routine training and can compensate for the reduction of service overseas. Together with specific military training and recreation it develops the individual and corporate qualities required by soldiers to be able to cope with the physical and mental stresses of active service.

In an article called *Stress in Battle*, published in the *British Army Review* of December 1980, Colonel Tony Jeapes, a former CO of 22 Special Air Service, examines the stresses and strains for which the professional soldier must be prepared and

Captain H T S Ricketts
Adventurous Training p319.

considers how to harden him to withstand them. Based on his own experiences, he looks at the various qualities required during war – physical courage, mental robustness, single-mindedness of purpose and physical hardness. In peacetime it can by very difficult to conjure up exercises which put these qualities to the test. AT, by providing an environment which the soldier is not used to, adds a dimension to training which forces him to rely on, and thus develop, these qualities.

For all the reasons given in this article, members of the Malaysian expedition did not give up. Any soldier who is scared of heights has had to face his own Everest when negotiating a "Klettersteig" in Bavaria or "Striding Edge" in a Force 8 gale. Alternatively, claustrophobics in a "cheese-press" pothole in Yorkshire, or a novice on a red ski slope, will have had to overcome considerable doubts as to whether or not they will survive their ordeal. Furthermore, AT will accustom a soldier to trust his fellows, often with his life. The importance of this in war is perfectly clear: how can either the brave or not so brave soldier hope to perform if he does not think that the rest of the platoon/troop is with him all the way?

All those who have done either a military or a sports parachute descent will, in all probability, have experienced an overwhelming feeling of fear. The look of exultation often seen on the faces of "first-timers" after their first descent derives less from being delighted to be alive than from the satisfaction of knowing that they have overcome their own apprehensions. AT teaches them to appreciate their own capabilities.

In my case a massive overdose of adrenaline helped to reduce the fear somewhat. However, on my second jump I can safely say that I have never been so petrified in my life. At the RAF Parachute School they claim that "knowledge dispels fear". If the knowledge is good then this may be true; however, a little knowledge is a dangerous thing. My brain, having had a total sensory overload on the first jump, knew only roughly what to expect on the second. It managed, in conjunction with my body, to decide that what it was about to repeat was not in its terms of contract. Instructors say that skydiving is statistically safer than flying so, the quicker you exit the plane the safer it is. This is not a comforting thought when facing an open door whilst in a steep bank at 3000ft.

I still find occasion to question my actions prior to a descent, but by concentrating on a formation any doubts are put aside. If a formation goes wrong it can usually be attributed to a wandering mind. By accustoming myself to stress through an unusual occupation I, along with thousands of others, can learn to conquer other stresses and so become more efficient.

Parachuting is only one of ten officially recognized CPs. All of them could be run by civilian companies if the aim was to produce world class parachutists, skiers or whatever. It is not, although the armed forces certainly have, in many cases, done just that by promoting CP courses. A civilian course is approximately a quarter of the cost of its military counterpart, but if they were to include the development of all the qualities required of the soldier they would cost three times as much. Service courses are designed specifically to cater for service needs. There is an instructional technique called the "Kolb Method". This concentrates on continuing development after the basic instruction. All lessons are reviewed, concluded and replanned to produce a unique package for each individual. It is during this period that a soldier will learn about himself and his fellows. A bonus is that the services have produced some excellent sportsmen who have gone on to represent their country in various events If we can re-emphasize the aims of AT, then maintaining it in its existing form should be a high priority on the list of what not to discard.

The Corps is very fortunate in having so many sports parachutists. The RE Sports Parachuting Association provides annual backing for expeditions to Florida and France and members have done extremely well in competitions in recent years. Almost half the Army squad, which came third at the National Championships this year, were Sappers.

There are five joint service centres in Britain, Northern Ireland, Germany, Cyprus and Hong Kong. They run basic and advanced courses most of the year and one-jump courses at weekends. The latter course is an ideal opportunity for a troop commander to command his troop away from his parent unit. If he feels that one or two (maybe even himself) need to acquire some "bottle" then there is no better way to find it than by being first out. The course also provides an opportunity for those who would probably never have given parachuting a go, unless they had been told to. From there, many may wish to continue and so we, as a Corps, will continue to maintain a high standard within teams. Financial backing from unit PRIs is most welcome and should be willingly given. Grants for expeditions are readily available.

To conclude, AT is not just a "swan". It forces servicemen to suffer stresses similar to those in war and to overcome them in order to concentrate on the real objective. It provides invaluable experience which can be drawn upon and, combined with military training, will help carry them through the stress of war. Colonel Jeapes sums it up by saying that "No matter how technically or tactically proficient he may be, if a man cannot withstand the stress of war, he will be useless". I have endeavoured to show that AT, run by the services, is an indispensable way of helping reduce the effects of stress in war. Politicians and civil servants may attempt to cut public spending by removing an apparent waste of taxpayers' money, but would there be any point in having armed forces if, when asked to face the stress of war, servicemen failed to meet the challenge for want of the sort of experience AT provides.

The Man-Lifting Kite – a Forgotten Invention?

COLONEL J E NOWERS BSc(Econ) FIMgt

The author joined the Corps from university as one of the last National Service Sappers. He completed the full career and now works harder than ever he did whilst serving, being responsible for the museum and library.

Introduction

The Victorian era was a time of great inventiveness. All kinds of devices appeared, many of which have since been further improved with the benefit of modern materials and technology.

The airship, for example, began its development with military experiments on captive balloons, was fielded as an operational system during the Boer War and progressed to the true dirigible in the early years of this century. Today, hardly a major public event takes place without an airship hovering over the proceedings as a platform for television cameras.

A parallel development which lead to the construction of the first British aeroplanes began with kites which subsequently seems to have been forgotten.

This article traces the history of the man-lifting kite and suggests that further development might be rewarding.

The Kite

The kite has long been a popular plaything for children although the flat kite is of course basically unstable requiring the drag provided by a tail to steady it, and wind the stronger the better.

However the invention of the box-kite by the Australian Lawrence Hargrave, in 1893, opened new horizons. Superior to all others in lifting power and stability it was used for lifting equipment into the skies, principally for meteorological research, frequently reaching heights of 3km. It was the Hargrave box-kite that formed the basic structure of the man-lifting kite developed by S F Cody.

Man-Lifting Kites

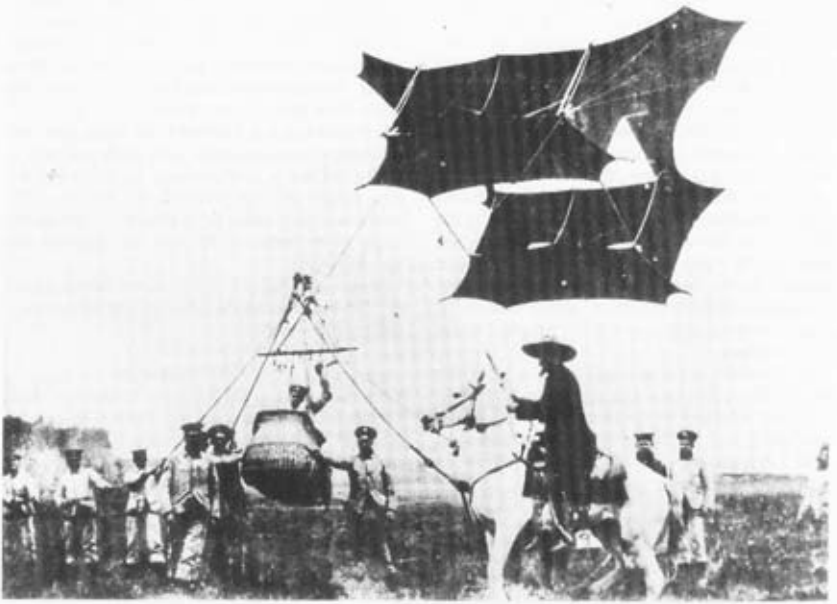
Captain B F S Baden-Powell, (brother of Lord Baden-Powell, hero of the siege of Mafeking and founder of the Boy Scout movement), developed the first man-lifting kite which lifted a man 10ft in 1894 and 200ft in 1895, using a six-sided flat kite of his own design. Stability was achieved using two lines connected to ground stations some distance apart.

In America in 1897 Lieutenant R G Wise, of the United States Army, lifted himself 50ft using four Hargrave kites and Hargraves himself did some man-lifting in Australia. But it was left to Cody to develop a successful man-lifting system.

S F Cody

Samuel Franklin Cody was born in Birdville, Texas, about 1861. He lived on the prairie, was an accomplished horseman and an expert with the gun and lasso. He spent two years prospecting for gold in Alaska then joined a wild west show in which he gave exhibitions of trick riding and

Col J E Nowers
The man-lifting kite - a forgotten invention p322



Colonel Cody (on horseback) with his man-lifting kite and Royal Engineers.

shooting. He came to England in 1890 and as a professional entertainer toured Europe with his own show until 1896, when he finally settled in England. He then wrote and produced a blood-curdling melodrama "The Klondyke Nugget", which was a resounding success and gave him financial security.

Cody's experiments with kites began in 1900 with a meteorological kite that he flew to a height of 14,000ft. His real interest however lay in man-lifting with multiple kite arrays and he filed patents in 1901 and 1902 for his system.

In 1903 Cody offered his invention and his services to the Royal Navy which, after extensive trials, declined his services but ordered four sets of kites and ancillary equipment. As a result of the order Cody established a workshop first at Alexandra Palace and later at the Crystal Palace, Sydenham. Later he offered his services to the Royal Engineers and in 1904 arrived at the Balloon School, Farnborough, where he remained for five years as the Army's kite instructor. On 16 May 1908 he made the first powered flight in Britain on Farnborough Common. He was killed in a flying accident there (Cody's Tree!) on 7 August 1913 and is buried in Aldershot Military Cemetery.

Before describing Cody's system, two points should be made. First, S F Cody should not be confused with "Buffalo Bill" Cody. Buffalo Bill was William Frederic Cody somewhat older than S F Cody who was often mistaken for him.

The second point is that, incredible as it may seem, S F Cody could neither read nor write. All his correspondence was written at his dictation and as a result, although he was famous for his aeronautical exploits, there are no descriptions of his inventions apart from one or two written by spectators.

The Cody War Kite

Although there is a dearth of detailed written descriptions, fortunately a number of general descriptions, and more importantly several photographs, have survived. From these and other sources, such as Cody's addresses to the

The man-lifting kite - a forgotten invention p323

Aeronautical Society, a reasonably complete picture of the Cody system can be built up.

The basic "war kite", as Cody called it, consisted of two Hargrave kites, one behind the other on a common frame. Cody extended the diagonal braces to carry wings and horns, considerably increasing the lifting power. The structure was made of bamboo and canvas or silk, and looked more like an early biplane than a kite.

Cody's method of actually raising a man in the air was remarkable. He established a ropeway in the sky and ran his man up it. Various methods had been tried by others, for instance Hargrave attached himself to the lowest of a train of kites and Lieutenant Wise, in America, pulled himself up using a rope passing over a pulley attached to the main kite line.

The first kite to be launched was the pilot kite which was carried on a light line some 300ft long. This was attached to the main cable which was also taken aloft by the pilot kite. Next came the lifter kites, the number varying from two to six according to the strength of the wind and the weight to be lifted. On the ground was a winch wagon for paying out and taking in the cable and providing a firm foundation for the whole system.

All the kites had a bridle consisting of four lines from the lower front corners of the front and rear box elements which joined together to form a single attachment point. The length of the four lines could be adjusted on the ground so that the angle of incidence at which the kite would fly could be preset.

Each lifter kite had a smooth ring or fairlead in the centre of the leading edge of the front upper surface. The bridle also terminated in a smooth ring. The two rings were placed on the main cable, then the kite was released into the wind and flew up along the cable until it reached its proper position. This was determined by a conical bulb attached to the cable against which the upper fairlead would jam. Rings and bulbs were graded in size with the largest at the top. Each kite thus found its proper position and transferred its lift to the main cable. A device on the winch wagon measured the pull on the main cable. When this was sufficient, the carrier kite was launched.

The carrier kite was similar in all respects to the lifting kite. Below it on the main cable was a traveller with wheels running above and below the cable. The traveller could be braked by pinching the wheels against the cable. Below the traveller was a crossbar. This prevented spinning of the car which was suspended from it. The kite bridle was connected to the ends of the crossbar. In addition, adjustable lines ran from the car to the front and rear of the carrier kite. The front line was known as the nose-down tackle and rear as the tail-down tackle. The purpose of these lines was to adjust the angle of incidence at which the kite would fly.

The lifter kite was attached to the main cable, the aeronaut would slacken the nose tackle and take in on the tail tackle, gently release the brake and the kite would take the traveller up the line. The whole assembly could be stopped by adjusting the angle of incidence of the kite and applying the traveller brake.

To descend, the tail tackle would be slackened off and the nose tackle taken in, the brake being used as necessary.

Cody's Experiments

Cody first approached the Army in October 1901. Details have not survived but it seems he got the attention of Colonel Templer, the Superintendent of the Balloon Factory then located in Alison's Road, Aldershot, next to the Basingstoke canal.

The Army showed little interest, being preoccupied with the Boer War which did not end until 1 May 1902. Templer appears to have kept in touch with Cody's work and a number of demonstrations took place on Woolwich common in 1903 in conjunction with demonstrations from the Balloon Factory. The Royal Navy was interested in the possibility of using the kite to raise a radio aerial and insisted Cody bring his gear to *HMS Vernon* on Whale Island in Portsmouth Harbour. Trials were carried out in March and April from land and from ships at sea. As mentioned earlier, the Navy declined Cody's services but ordered four sets of kites.

In June 1904 Cody carried out trials with the Royal Engineers at Aldershot and Farnborough. The work was supervised by Colonel Capper, Commandant of the Balloon School and Balloon Sections. He placed one NCO and 11 men at Cody's disposal.

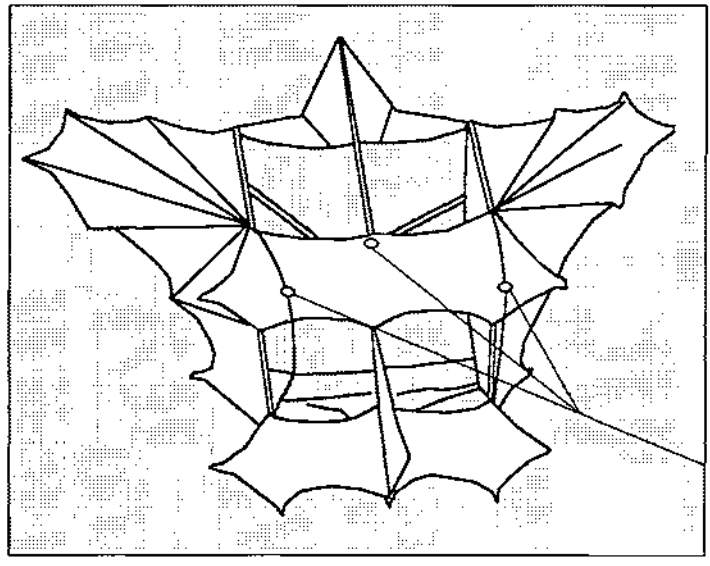
Over 20 flights were made by 22 different people. Lieutenant R V D Howell made most flights and reached 13,000ft on one occasion, and Colonel Capper flew, first with Cody and later solo, to 10,000ft. On one flight three men were carried. Man-lifting flights were possible in wind speeds ranging from 15-40mph.

A set of kites was purchased for the Corps and Cody was engaged as Kite Instructor. On 27 April 1905, Sapper Morton achieved 26,000ft.

By the summer of 1905, Cody had developed the glider-kite and was flying it. This was a man-carrying aircraft which travelled up the main cable like a lifter kite and could then be cast off to become a free-flying glider.

In 1906 and 1907 he was demonstrating his motor-kite, a development of the lifter kite powered by a three-cylinder 12-horsepower Bricket engine. It was not intended to carry a man.

In 1908 Cody again worked with the Royal Navy and although the trials were very successful, the Admiralty declined to invest in kiting equipment.



Sketch of Cody's lifting kite.

The Future

Using modern materials, the Cody system could be substantially improved. A kite set could be of value whenever an aerial platform is required and wind is available. By all accounts it offers a stable platform and, as well as lifting a man, could lift all manner of surveillance and detection systems, weapons and cast-off remotely piloted vehicles.

The main limitations are that the system is tethered and that it requires a constant supply of wind between 15 and 40mph to operate it. At sea a ship under way will generate its own wind and the kites could be streamed.

Conclusion

Cody's man-lifting kites were quite remarkable yet somehow they seem to have been forgotten. I feel however that with modern materials there could well be a role for them today.

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An Archaeological Project at Fort Cunningham, Bermuda

DR EDWARD HARRIS

Dr Edward Harris is the Director of the Bermuda Maritime Museum. Along with Dr Richard Gould, Professor of Anthropology, Brown University, he directed the 1991 archaeological project at Fort Cunningham.

At the entrance to the only ship channel through the Bermuda reefs lies Paget Island, which has been the site of four forts. Two of these structures, "Peniston's Redoubt" and "Paget Fort", were built by the first colonists from 1612 to 20; they survive only as archaeological features.

On the highest part of Paget Island, a new work was constructed in the 1790s by Captain Andrew Durnford, Royal Engineers, as a part of his refortification of Bermuda. This was a result of the American Revolutionary War which ended in 1783. The building was called "Upper Paget Fort", and it seems that some of its stonework was taken from the older Paget Fort on the shoreline below. In addition to his many military endeavours, Andrew Durnford became the first mayor of the town of St George, the first capital of Bermuda. The extent of his work and contribution to Bermuda is much maligned and underestimated: it warrants a full study from a modern historical and archaeological perspective.

Upper Paget Fort lasted about 25 years for, in about 1815, it was removed during the erection of an entirely new work, named after its designer, Captain Thomas Cunningham, Royal Engineers. Cunningham had been posted to Bermuda in 1811 to make a survey of the existing fortifications and to recommend changes and additions to the largely pre-1770s works. Fort Cunningham was his proposal for Paget Island and the defence of the mouth of the Narrows Channel; it was to be a modern work with a polygonal trace (possibly one of the first overseas uses of this method of fortification), a ditch and flanking galleries. Construction appears to have commenced under Cunningham around 1815, but was completed by his successor, Captain Thomas Blanshard, around 1822. The ditch was cut into the soft limestone hill, but the escarp and upper works, according to archaeological evidence, were carved in blocks of hard Bermuda limestone, probably taken from deposits at the site of the newly-forming dockyard at Ireland Island at the other end of Bermuda. The escarp is formed not as was usual practice, as a solid wall, but as a continuous series of arches, subsequently infilled: these survive on the escarp at ditch level, although most of the upper hamper of the 1820s fort was swept away in the 1870s.

Rifled artillery of the 1860s induced many changes in the design of fortifications, of which the new works of the 1870s at Fort Cunningham represent one major type. In this design, two flanks of the fort were constructed in sheets of wrought iron, interspersed with slabs of teak. The whole arrangement comprised an iron wall about 2.5ft thick. Behind this metal escarpment were seven casemates, the roofs of which were also formed in wrought iron, covered by 5ft of concrete. The final armaments placed therein were five 10in rifled muzzle loaders (RMLs) of 18 tons and two 12.5 RMLs of 38 tons. Two northern masonry casemates were designed for 9in RMLs, but these were never mounted.

In the last days of the reign of Queen Victoria, two 6in breech loading (BL) rifles were placed on the roof of the 1870s work. The casemates were kept as barracks, so that the iron fronts of the fort remained mostly unaffected by a major element in the 1900 remodelling of the site. In that work, four sides of the ditch of the 1820/1870s fort were filled with rubble to form the required glacis for the 6in BL guns.

The BL guns were removed after the First World War and the fort remained inactive thereafter, serving only as a detention camp during the Second World War. It was used as a borstal in the 1960s, and subsequently fell into disrepair. In the mid-1980s, the site became vested in the Bermuda National Parks, an outcome of which was an archaeological project under the aegis of the Department of Agriculture, Fisheries & Parks, sponsored by the American Earthwatch organization and the Bermuda Maritime Museum.

Fort Cunningham from the southeast, after the excavation of the ditch in January 1991; the seaward façade is in the foreground, the water behind being an inshore bay.

Archaeological excavations, largely using machines, (in what I refer to as "monumental archaeology") removed 5000 cubic yards of infilling of the ditch during January 1991. This material was spread over the ground in front of the fort to form a new glacis, making a viewing platform. Earthwatch volunteers carried out hand-excavation after the passage of the heavy machinery and clearance within the fort. Archaeological recording was commenced, but more work remained for a second season in 1992.

Aside from details not previously understood relating to all periods of the fort, there was a number of major finds. For those into "heavy metal," seven RMLs buried in the northern run of the ditch were obviously an explosive discovery. For the less expansive, not to say secretive, the survival of post-1870 and pre-1900 camouflage paint work on the masonry and ironwork of the fort (buried by the 1900 glacis at three points) was an unexpected highlight of the project. Aside from the general camouflage, false gun ports were also painted on the masonry. Lovers of the local hardstone masonry were delighted in their turn by the exposing of the superb 1820s stonework of the escarp of the fort.

The Royal Engineers affected radically the topography of Bermuda (the oldest of the western colonies) for over 150 years from the time that the Americans gained their freedom from George III. At least half of the 60-odd forts in these islands were built by the Corps; nearly all of them survive. Many of these works were built to guard HM dockyard against an attack by the Americans, described by a British officer in the 1850s as a nation "hitherto unable, if not unwilling, to control among its people a wild spirit of aggression dangerous to the maintenance of peace". They are of great interest to military and armament historians, to Bermudians, and to visitors to the "Gibraltar of the west." Never mind that complaints were made in the House of Commons that Fort Cunningham must be made of gold, such was its cost; and disregard the fact that the forts were never called to perform: the Royal Engineers have given Bermuda a monumental legacy in iron and stone which, finally, Bermudians are treating with the respect and care they warrant.

The seven rifled muzzle loaders found in the north ditch at Fort Cunningham.

The Texaco Oil Pollution Exercise

MAJOR S A BRADEN BSc

The author was commissioned into the Corps in 1974, attended No 58 Young Officer Course and moved from the regular to the Territorial Army in 1985. He is currently the SO2 Operations Engineer (Home Defence) in Headquarters 43 (Wessex) Brigade in Exeter.

Introduction

Over the past five years the role of the Home Defence engineer staff has changed. Five years ago the main effort was directed at "transition to war" planning, key point defence, and assistance to the civil authorities after an attack on mainland UK. Since the break-up of the USSR (Union of Soviet Socialist Republics) and the increases in perceived warning times the importance of these roles has diminished and, like many others, it has been necessary to examine and develop into new areas.

In No 7 Region (southwest) the first priority remains the engineer advice on and coordination of support to enable units to deploy to war, and assist with the civil infrastructure. These are derived from the Integrated Control Plan, the front end of which is support for emergency tasks. However a new emphasis has been to develop links with the civil authorities and emergency services and to explore their needs from the military in various civil emergency scenarios. To this end we have attended several command post-type exercises run by the emergency planning officers of the seven county councils in the region. At these exercises the reaction to a major civil emergency like Lockerby or the *Torre Canyon* oil spill is practised with the establishment of a "Gold" HQ manned by the chief constable, chief fire officer etc.

The Texaco Oil Pollution Exercise

This year we were invited to participate in the Texaco Oil Pollution Exercise, an annual test of the Texaco team, run in different countries and this year hosted by Cornwall County Council (CCC). The aim of the Texaco team is to react quickly to any oil spill anywhere in the world, regardless of who was responsible for the spillage. It allows the participating country to prove its stocks of oil booms and cleaning materials and to test its own responses and emergency services.

Although bulk handling of oil products has long been a Sapper skill, the problems caused by a major spillage have not been a high priority to most combat engineers. In order to understand the issues better, we took on the task of reconnoitring the river Camel estuary in north Cornwall, under the direction of the National Rivers Authority (NRA), designing the configuration of oil-prevention booms and of placing and designing permanent anchorages and moorings for them.

Siting Oil Pollution Booms

This task required a detailed study into tidal movements within the estuary as well as an awareness of ecological sensitivities. Within the estuary are three sites of special scientific interest where rare mussel beds, bass spawning grounds and bird sanctuaries exist. The priority was to

Major S A Braden
The Texaco oil pollution exercise p328

place a proposed boom as near to the mouth of the estuary as possible, bearing in mind the restrictions imposed by rough seas and the limit to the amount of boom available.

Booms are ineffectual in currents of more than three knots and are at their most effective when placed at an angle to the water flow. Indeed the greater the flow of water the more acute the angle required. The boom must be designed to direct oil to places where it can be recovered. These are called sacrificial beaches and require good vehicular access. The oil, if caught early, remains in a liquid form and can be recovered using a skimmer, tankered and driven away. Within a couple of days the oil becomes more dense and must then be recovered mechanically, bagged and removed by mechanical handling equipment.

Five boom sites were identified and prioritized. One of the more taxing problems was caused by the significant difference between high and low water when large areas of sand and mud were revealed. Booms come in two main forms, those which float with a skirt below, and those filled with water which can also be used on land. Whilst the former are more effective in deep water particularly in strong currents, they cannot be used on land. Because the sand and mud migrate, there are no up-to-date charts and it was therefore necessary to view the estuary at all states of the tide before boom positions and configurations could be decided. The final report which we produced will be used by the county council to position permanent boom anchorages (either rock bolt or massive concrete blocks) and by the NRA as part of its national prevention plans. As the sand and mud migrates, particularly in the Camel Estuary, it was necessary to consider the mix of boom types to ensure that, should there be any possibility of the boom resting on sand at low water, the appropriate type of boom was selected.

The Exercise Phase

The Texaco Oil Team was 40 strong and well practiced in all forms of oil pollution recovery. They have the capability of taking complete control of a situation anywhere in the world from the time a tanker has difficulties, to the removal and disposal of contaminated oil products. Each of the major oil companies has a like capability, though with an incident in the UK they are required to take a more consultative role with the local authority taking the lead.

The exercise scenario was for a tanker to go aground and begin breaking up somewhere off Falmouth in south Cornwall. Within a 12-hour period it would become obvious that a major oil spill was imminent.

CCC began setting up their joint response centre (JRC) at the County Hall in Truro. Primacy in these cases is not as clearly defined as with inshore emergencies when the police generally have control.

Responsibility rests on the coastguards, the harbour authorities, the county and district councils and the NRA, depending on where the oil is. However in most cases the county authority would coordinate the response especially as emergency planning officers are now only placed at county level.

The county invited those parties it felt necessary to form the JRC. It included senior representatives of all the "blue light" forces, the NRA, district and county engineers, harbour masters, Royal Society for the Protection of Birds, Texaco oil pollution prevention team, marine pollution control unit (MPCU), conservation group representatives and liaison officers (LO) from the three services. At its height the County Hall accommodated over 100 players and controllers.

The starting scenario was that a Texaco tanker, the *Starbergan*, had gone aground on the Manacle Rocks near Falmouth after an engine failure. It had lost 200 tonnes of fuel oil which was likely to wash ashore within 24 hours. Because of the complicated issue of primacy the organization of the JRC was not pyramidal. At the apex was a policy management team, not a single leader, with permanent representation from the CCC, Texaco, and MPCU, and occasional representation, according to the situation, from NRA, the military, coastguard, harbour masters, etc. Subordinate to this committee were six other teams:

Technical	Procurement	Administration
Environmental	Finance	Media

whose roles were to implement the priorities set out by the policy team. The finance team was of particular significance as all costs incurred during the spillage have to be billed and repayed by the ship's or cargo owner's insurance company.

Assistance provided by the services to the civil authorities is the responsibility of HQ 43 (Wessex) Bde, acting as HQ Exeter area. On this occasion the Comd Engr (Home Defence) staff formed the armed services liaison cell at county hall supported by the RAF Regional LO and a senior LO

on the staff of Flag Offr Plymouth. The Royal Navy led on matters below low water.

Military Involvement

There was considerable interest in use of the services, particularly in our "floating bulldozer" the Combat Engineering Tractor. This interest dulled after enquiries through the chain of command quoted the following prices for military assistance:

Helicopter	£2000 to £5000 per day depending on size
Officer	average of £200 per day
Soldier	average of £125 per day

These were viewed as prohibitive and effectively ruled out military usage except in the most extreme situations (if human life is at risk these charges may be waived). However senior staff in the county and emergency services are well aware of most military capabilities and expect to request the appropriate support when their appreciation of the situation indicates that the services are the only source capable of providing personnel to perform critical tasks. Whilst it is accepted that local authorities must be encouraged to use their own resources before calling upon the military, there is valuable training and good public relations coverage to be gained by being intrinsically involved in emergency situations.

Conclusions

In these times when the visibility of the soldier in society is more low-key than in the past, and when the justification for defence expenditure is increasingly difficult to argue, it seems to make perfect sense to be involved in civilian emergency planning and practice. This will require a rethink of the principles behind the scales of charges, and an acknowledgment that this participation will be rewarded by an enhancement of the military's perceived role in society.

The exercise lasted two days and included the physical booming of the Helstone Estuary. The principle lessons learnt included the need to practice the setting up of JRCs in order to practise control, communication, and particularly the bringing together of many disparate organizations which, in an emergency, will have to work with and understand one another. The military are not alone in their use of abbreviations and jargon. It is considered that the involvement of the CRE (Home Defence) team from HQ 43 (Wessex) Bde (No 7 Region southwest) not only improved their knowledge and initiated the development of a new skill within the Corps but also enhanced the image of the Corps' reputation with local authorities, the emergency services, industry and environmental groups.

An Airfield Too Far, Work of No 16 Airfield Construction Group in Holland – September 1944

LIEUT COLONEL T MITCHELL MBE

BETWEEN 9 and 12 September 1944, No 16 Airfield Construction Group (16 Gp), which I commanded, was moved from Melsbroek and Evere airfields in Brussels to work on a clutch of existing Belgian airfields lying between Brussels and the Dutch border south of Eindhoven. They were pre-1939 airfields and were situated at Diest, St Trond, Peer, and Bourg Leopold. I established my HQ at Diest. The airfields were repaired and the Royal Air Force (RAF) installed by 20 September in spite of 78 Road Construction Company (78 Coy) and 269 Company Pioneer Corps (269 Pioneer Coy) being driven off Bourg Leopold by the enemy on two successive days. Anxious to be based as close as possible to enemy ground troops, the RAF crowded aircraft on to these airfields the moment they were ready; so much so that on one of them I watched, incredulous, as three Spitfires, taxiing towards one another from three different directions, interlocked their noses and propellers in a collision. The airfields were in a salient created by XXX Corps, flanked by XII and VIII Corps on left and right respectively.

Our army was now making little progress against stubborn German resistance. We seemed to be set for another slogging battle as after the Normandy landings. Then I was summoned to a briefing of senior officers at XXX Corps HQ, where the Corps Commander, General Brian Horrocks, described a bold plan to bypass the enemy resistance in Belgium, opening the way into Germany. The plan was code-named *Market Garden.*

Operation *Market Garden* has been described in great detail elsewhere, but briefly, on 17 September the 1st British Airborne Division (1 AB Div) was to be dropped by parachute on the north bank of the Rhine to seize the Arnhem bridge and capture the airfield just beyond the western suburbs. 82nd US Airborne Division (82 AB Div) was to capture the bridges at Nijmegen and Grave while 101st US Airborne Division (101 Div) was to secure the road from Grave to Eindhoven. XXX Corps, led by Guards Armoured Division (Gds Armd Div), would force their way up the road to Eindhoven and thence to Arnhem, the road protected by 101 Div airborne troops. My task was to get men and equipment on to Arnhem airfield as soon as possible and do whatever was necessary to enable the second wave of 1 AB Div, supported by the Polish Brigade, to land aircraft and gliders.

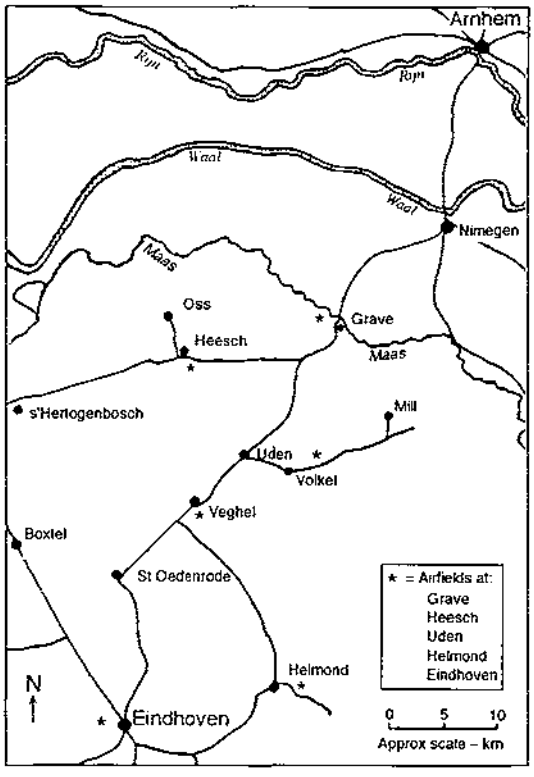
In their advance, XXX Corps was to be protected on either side by XII and VIII Corps. They, however, met fierce opposition and were never able to keep up with XXX Corps. The road remained unsafe for what seemed a very long time, being often cut and shelled.

On 16 September, 16 Gp companies were located as follows:

Bourg Leopold	78 Road Construction Company and 269 Pioneer Company
Peer	689 Road Construction Company and 231 Pioneer Company

The Gds Armd Div began to advance up the road to Eindhoven on 17 September and with them went my HQ recce party. The road was obstinately defended and the Guards did not meet American airborne troops of 101 Div at Eindhoven till 18 September. On 19 September, the Guards had not reached Nijmegen. My recce party, having got information that strong German forces were on Arnhem airfield and that the British airborne troops dropped on 17 September to capture it were in desperate trouble, enterprisingly went to Volkel airfield four miles east of Uden. My recce officer took a chance, as it was in territory not yet reached by any British or American troops. Luckily it was free of enemy.

Thereon this memoir can be continued most vividly by extracts from 16 Gp War Diary. The text in italics is amplification from memories which have remained clear and vivid. Permission to use the diaries has been obtained from the War Office. In the text "the road" means the road



Map of area in Holland, showing "the road".

Eindhoven-St Oedenrode-Veghel-Uden-Grave-Nijmegen-Arnhem. It had deep and wide ditches on either side along its whole length.

War Diary

Army Form C2118
Unit 16 Airfield Construction Group RE
September 1944
Commanding Officer: Lt Col T Mitchell, RE

Uden 19 September 1944
Recce of Volkel airfield. Work commenced with civil labour. Recce party the only troops in Uden.
The Dutch Resistance quickly contacted the recce officer, produced the civilian labour, and fixed him up with private billets in the village as it would have been unsafe to stay on the airfield overnight.

Bourg Leopold 20 September
78 Rd Const Coy and Det 269 Coy PC to Volkel 0200hrs, reached Eindhoven only as route cut by enemy. Worked at Eindhoven airfield.

Volkel 21 September
78 Rd Const Coy and Det 269 Coy PC arrived Volkel and commenced work. Retired to Uden for night.

Bourg Leopold 21 September
Gp HQ to move to Volkel 2330hrs – Club route cut.
"Club" was the codename for the road to be taken by XXX Corps. Impatient to be with my recce party and to see the state of Volkel airfield, I got a place for my staff car in movement up the road early on the 21st. I found myself travelling next to General Horrocks in a jerky procession like a gigantic modern motorway tailback. The village of Veghel, where 101 Div had set up their HQ was being shelled constantly. Arriving at Uden, I found my recce officer had requistioned, for 16 Gp HQ, the premises of a wealthy local builder who had been arrested and imprisoned by the local Dutch Resistance for collaborating with the Germans. Then down to the Volkel airfield, which had been heavily bombed. It had two brick-paved runways of 5000ft and 6000ft in length, and a large number of reinforced concrete hangers, situated in three widely dispersed locations near the perimeter of the airfield. All were heavily damaged, unusable and unrepairable. 78 Coy had started repairing one of the runways. A wide stretch of grass alongside the south taxi track had the biggest crop of field mushrooms I have ever seen. I filled the back of my staff car with them. I then returned to Uden. A large deserted building between Volkel village and Uden had been inspected and would be a suitable billet for 78 Coy. However, it would have been too dangerous to leave them and their equipment there so I withdrew them into Uden and organized a complete perimeter defence to be manned constantly. We concealed the equipment – bulldozers, graders, excavators, etc – in a shrub and tree-lined track and left all their diesel engines running, hoping to deceive any enemy scouts into thinking that the village was occupied by a strong detachment of British tanks.

Towards evening, Uden was shelled the shells exploding uncomfortably near my HQ. This continued daily until XII Corps had advanced far enough to silence the guns responsible. Airborne reinforcements for the troops defending the bridges were still passing overhead during my first days in Uden – aircraft carrying paratroops and gliders. Many were brought down by flak – a heart-rending sight. Later, I was able to see the fields to the east of "the road" near Arnhem, littered with gliders and other remnants of the airborne force. The abandoned camouflage-coloured silk parachutes had been snapped up quickly by the locals. It was said that every girl

in the neighbourhood had a pair of camouflage silk knickers.

Uden 22 September

78 Rd Const Coy and Detachment 269 Coy PC at work on Volkel – enemy stopped work.
As still no troops other than 78 Const Coy in Uden, and 2 Bn SS reported four miles distant, support requested from US Para Div. One Bn dispatched from Veghel. At 1000hrs, road cut and only two platoons of Parachute Tps reached Uden. Enemy stopped work on airfield by mortar fire and patrols. 15 enemy tanks occupied Volkel. 78 Rd Const Coy with two platoons parachute troops retired to Uden. Just before dark, some Guards Armd Div tanks arrived from North and laagered in Uden under protection of 78 Rd Const Coy.

23 September

Guards tanks were reinforced to a Battle Group. They attacked and cleared Volkel village by late afternoon and swung North West of Uden.

24 September

Volkel village occupied by 50 Div. Volkel airfield was now only 3 miles in front of FDLS. 78 Rd Const Coy therefore recommenced work. Household Cavalry patrols were contacted to give warning. Coy returned to man defensive positions in Uden at nightfall.

25 September

Work continued as above.

26 September

50 Div moved and Bde to Mill, East of the airfield, giving it protection. 78 Rd Const Coy were therefore able to sleep at night now after 3 days of working during daylight hours and manning defensive positions during darkness.
Gp HQ and 269 Coy PC move to Uden 1030hrs.
689 Rd Const Coy arrive Uden 2100hrs.

27 September

231 Coy PC move from Peer to Uden 1500-0100hrs.

28 September

231 Coy PC arrive Uden 0100hrs.

With Volkel airfield now protected by 50 Division of XXX Corps, and with the hope that XII Corps and VIII Corps forward troops might soon be abreast of Uden, we could get on with the job of making Volkel airfield fit for use. There was also urgent need to create new advanced landing grounds (ALGs) in the territory occupied by Allied troops between Uden and Arnhem for, apart from Eindhoven airfield which was now being repaired, 83 Group (83 Gp) aircraft were still in Belgium, with Brussels-Melsbroek their nearest large airfield with paved runways.

Something needs to be said about the period 21, 22, 23 and 24 September, to supplement the bare operational facts recorded in the War Diaries. Early in the morning of 22 September, as 78 Coy and the detachment of 269 Pioneer Coy were on their way to work on Volkel airfield, they were met by a German patrol opposite their future billet. The Germans fired on them, damaging and immobilizing one vehicle. In the ensuing skirmish, 78 and 269 Coys' troops were able to retreat to Uden without casualty. I got on to 101 Div HQ at Veghel. They obligingly dispatched a battalion of paratroops to help but although it was 101's task to keep "the road" open, it was cut between Veghel and Uden while the battalion was on its way, and only two platoons of the paratroops reached us. When these troops, together with 78 and 269 Coys reached the airfield, they found it occupied by 15 enemy tanks, and came back. We manned our perimeter defences, sent out patrols to get warning of approaching enemy, and reported the situation by wireless to 12 AGRE (Army Group RE) and to XXX Corps HQ. The information that the enemy had two battalions of SS (Schutzstaffel) troops advancing on Volkel village came from the Dutch Resistance HQ in Uden. In hamlets and farmhouses around Uden, the resistance had a network which kept them informed about German troop movements through people coming into Uden with farm produce etc. An extraordinary rapport had been established between my men and the local population, so, although the Dutch knew that they were liable to be shot by the Germans, information came not only to me officially from the Resistance, but simultaneously dribbled through to my troops rather as gossip flashes around English villages.

A Household Cavalry patrol, consisting of a single armoured car, called at my HQ daily to exchange information about the enemy. One day the Patrol Officer told how he had just come past a hamlet to the southeast where he had found a German force. While observing it from a distance he had watched, unable to intervene, while the Germans lined up some children and cut off their toes.

The OIC of the detachment of Gds Armd Div tanks that arrived in Uden on 22 September in response to my messages, was told that the immediate threat was from Volkel village. He sent a tank patrol there to investigate but it was

repulsed with one man killed. The next day, having been made up to a battle group, Volkel village was cleared and the enemy forced to retreat away from the airfield.

Our contact with 101 Div HQ over this affair had an immediate side effect. They sorely needed to know more about the ever-shifting location and movement of enemy troops. Could we make an Auster strip at their HQ? If this was possible, they could borrow a British Auster aircraft and pilot (who normally spotted for British gunners) and would then have eyes in the sky. We made them a strip; we had been making them en passant all the way from Normandy.

By 30 September, we had repaired one runway at Volkel and sufficient taxi track and hard standings for the aircraft of one RAF wing. We also reconnoitred for a new airfield north of Uden. Since Allied troops at that time effectively only held "the road", and that was constantly being cut by the ebb and flow of enemy troops, the site had to be where there was a force to defend it. This made somewhere near the bridge at Grave seem the only choice, as it was permanently guarded by 82 AB Div. Getting to Grave to have a look at the possibilities remained hazardous for a few days after the tank battle at Volkel. On my first attempt there was an eerie silence and no traffic. As soon as I had passed the last houses on the north of Uden, I drove on thinking that US paratroops must be around somewhere. Then suddenly, on rounding a bend, tanks ahead! My driver braked hard and simultaneously got the gear lever into reverse. Then a head rose from a tank turret and an arm beckoned. It was British. The first words the officer in charge said to me were "It's eggs and bacon for breakfast today," and then explained that this was a code phrase which meant that his detachment had not had to do a dawn patrol. He also said it wasn't safe to try to get to Grave that day.

When I eventually did get to Grave, I found that the land there was well below the level of the river Waal, protected from inundation by the usual high dyke. As the ground was flat and still dry and hard, an untracked grass runway would serve, we hoped, until we had repaired Volkel more fully, and until Allied troops had captured ground for the construction of more airfields capable of remaining usable throughout the winter. At Grave we would have to make a new access road and construct a flying control tower on the dyke as the RAF's mobile flying control caravans would be blinded by it. Grave would only be serviceable for a short period because, as winter approached, the water table would rise to the roots of the grass, and then vehicles and aircraft would only be able to move on hard surfaces.

Uden **28/29 September**

78, 689, 231 and 269 Coys work on Volkel airfield (B80). Party from 689 Coy work on Grave airfield (B82).

30 September

689 and 231 Coys work on Volkel airfield.

1 October

Work on B80 Volkel airfield, MR E5942 repairing 2nd brick runway and taxi track. Work on flying control at B52, Grave MR E5955 – All Coys.

2 October

Work on B80. Enemy ammo train adjacent to site unloaded. Work on B82.

The ammunition train was on a railway line from Germany which ran through Uden station (next to my Group HQ) and on to Tilburg and Breda etc. It had been carrying ammunition to enemy troops west of "the road". The RAF had immobilized the engine but the Germans could have pulled the undamaged wagons back behind their lines. I had reported the train to 12 AGRE and XXX Corps but nothing had been done. It seemed a pity to let the enemy have the the ammunition, so we unloaded it and I seem to remember that in due course a Royal Army Service Corps unit took it away.

About this time some men of the Dutch Resistance arrived at my HQ and announced that they had come to take away the Mercedes. They proceeded to take down part of the masonry rear wall of an open front equipment shed which was part of a workshop having its doors on the other side of the building. They soon revealed a sealed compartment between the back wall of the open shed and the back wall of the workshop. In it was a Mercedes car which the now jailed owner of our HQ had hoped to save from confiscation. We felt foolish for not having spotted the compartment.

Uden **3 October**

Work on B80. Flying control B82 complete.

Uden **4/6 October**

Work on B80. Recce proceeding in salient for new ALG.

XII and VIII Corps had now gained some depth of territory on each side of "the road" as far as Grave. A new ALG for the winter was needed urgently.

As it was now safe for "soft" vehicles to move in the territory gained, I visited XXX Corps HQ which

had been established near and east of Nijmegen. Getting to the HQ needed very careful map reading to avoid straying into enemy-held territory. There were reports of units losing, through faulty navigation, vehicles and men sent to collect rations.

Uden 7/12 October
Work on B80 and on access road B82. Recce continued. On 9th, bad weather delayed work.

We found a site for the new ALG at Heesch, seven miles northwest of Uden. It had many disadvantages from the construction point of view, but when completed would be superb for the pilots. It was an intensively cultivated piece of land stretching away from the very edge of the village. The top soil, which we would have to remove to reach a firm foundation, was of considerable depth. It was cultivated in strips which, because of the Dutch laws governing the inheritance of agricultural land, were multitudinous. All owners would have to be traced and compensation for land and crops documented before we could start. I shuddered at the thought of the possible delay. In the village, next to the start of the cultivated land, there were two windmills. The sails of one would have to be removed as it was in the aircraft approach funnel. I would have liked to remove the sails from both, but the village authorities said they had to have at least one of the mills for grinding the crops.

The very efficient organization which the Dutch had created for liaison with the Allied forces made light of the administrative difficulties. They measured and listed the cultivated strips, scheduled the crops on them and said they would trace the owners. All they needed from me was one signature to cover the lot. As for taking the sails off the windmill, that was easy. They would see to it, so I planned for a start at the new site and arranged for a RAF construction wing to take over finishing the work at Grave B82.

Uden 13 October
Work on B80 and on access road B82. Setting out new site B88 at Heesch E5199.

Colonel Tuck, Commander 12 AGRE, visited me to see how far the work on Volkel had progressed, to see the new site at Heesch, and to visit XXX Corps HQ. As I had already been there, he thought it prudent to let me take him in my staff car. I took very great care to direct my driver at each road junction. We arrived without incident. On the return journey, we were not paying attention to the scenery, and suddenly, on rounding a corner, I became aware of silence. My thoughts flew back to what silence had often meant during the fighting in the Normandy beachhead. No-man's-land. A long straight stretch of road lay ahead. At its end, there was a tank – unmistakably German. My driver managed to reverse back round the corner and turn the car before a shot was fired. We had narrowly escaped becoming prisoners.

Uden 14 October
Work on B80. 2nd runway complete. Work on access road B82. Levelling new site (ie taking levels).

16 October
B80 work on existing standing and drainage. Weather held up work. Levelling new site.

17/18 October
B80 work as for 16 October. Work on access roads B88. Levelling new site.

21 October
Work on existing standing and drainage B80. Work on access road B82 handed over to RAF construction wing.

Work on B80 continued to the end of October, much hampered by bad weather. We were now entering a period of continuous heavy rain which lasted for six weeks. The RAF had an unfortunate time on Grave airfield. The Germans had got ME262 jet aircraft operational. They kept making quick sorties over the advanced landing ground. One day they dropped a canister of antipersonnel bombs and killed a number of airmen on the ground. RAF aircraft couldn't catch them, they were not fast enough. We started work on the Heesch airfield on 23 October. One day I was told that the windmill sails were to be taken down next morning. I was anxious to see the operation, but by the time I got there, the sails were down and removed from the village. Unfortunately the wrong sails had been taken, "Don't worry," said the Dutch liaison man, and by that evening the mistake and been corrected.

Enemy Action

Uden – 0400hrs 5 October
2500lb British bombs in bivouac area Uden MR E5341.

1400hrs 12 October
A/P bombs in Plant Park Volkel airfield.

2200 hrs 14 October
1 flying bomb on B80.

The bombs on 5 October had been intended to hit the railway, and station adjoining our HQ. Whoever sent the bombers obviously didn't known that use of the railway had been denied to the Germans. We suffered no casualties from the bombs, but windows were shattered.

The antipersonnel bombs on 12 October caused no casualties or damage to plant. They were dangerous

to remove, but luckily 108 Bomb Disposal Unit was still part of my HQ. The flying bomb on 14 October was a V2 which had obviously misfired (the launch site was quite near Heesch). It fell into a wooded area on the east side of Volkel airfield, causing no damage or casualties, but making a mighty noise.

Uden 1-19 November

Working on reconstruction of Volkel airfield MR E5942 and construction of Heesch airfield MR E5199.

19-25 November

Working on reconstruction of Volkel airfield MR E5942 and construction of Heesch airfield MR E5199 including night work under floodlights up to 2359hrs.

25-30 November

Working on reconstruction of Volkel airfield MR E5942 and construction of Heesch airfield MR 5199.

4 November

One canister antipersonnel bombs on Volkel airfield.

10 November

CE Second Army, Brig Campbell visited this HQ.

It was now a race against time to complete Heesch and to create on Volkel enough aircraft and vehicle hardstandings, taxi tracks, motor transport (MT) roads etc for the number of aircraft the RAF needed there. The imminent abandonment of 83 Gp's two grass airfields would mean overcrowding on Volkel. The existing German aircraft hardstandings were in useless concrete hangers so heavily reinforced that they were impossible to demolish without explosives – impractical in the circumstances. The existing runways and taxi tracks were paved with bricks laid loose on sand. This was the obvious method to use for our new aircraft standings etc, but the only brickworks in the area were in enemy-held territory. Nijmegen suburbs southwest of the bridge were now held by British forces, but were deserted. Their streets were paved with bricks laid on sand. I had them but even though I stripped every street, there weren't enough. We learned of a factory which made precast concrete paving and helped it back into production to make square blocks thick and strong enough to take aircraft. When we had finished, I estimated that we had laid the equivalent of a 3ft wide path stretching from Uden to Berlin – an exaggeration no doubt, but it felt true at the time.

Every surface had to be properly drained, not least the paths to the pilot quarters. Group Captain Tim Morice, OC 121 Wing, went for me one morning because there was a puddle on one of these paths. "Do you realize", he said, "that flying boots are not watertight, and that if one of my pilots gets a cold in the head, I have to ground him and lose an operational aircraft." It was a very small puddle and I have often thought of it since as I negotiated much larger puddles on the pavements in London.

At Volkel we had existing hard surfaces from which to make the new hard standings. At Heesch there was nothing but beautiful black top soil. It was deep and glutinous. Rain was continuous, with frost at night. The runway, taxi tracks and MT roads were to be surfaced with pierced steel planking (PSP). The nearest store was in Normandy; we needed 5000 tons. At first we had no hard material for making access roads and these were kept serviceable by continuous use of a blade grader, which even coped with the low loaders heavily laden with PSP. The reason we had no hard material was that locals normally used gravel dredged from river beds, but that source and the brickyards were now inaccessible because of hostilities. We had to find substitutes. Brigadier Campbell's personal visit on 10 November underlined the importance the staffs placed on getting Heesch operational. Brigadier Campbell told me that the Americans had completed an airfield in a week. He thought I ought to have a look. I did. Their aviation engineers had found an area of level heather-covered heath on which they had laid PSP direct. It was true that they had got aircraft flying a week later. They hadn't had to cope with rain – it was sunny there on the day of my visit – but, because of the varying height of the heather plants and the springy nature of their stems, the PSP was being damaged by the weight of the aircraft using it – Mustang fighters. The apparently level upper surface concealed ground which was anything but even. To construct their airfield, the Americans had used a whole aviation engineer battalion, approximately the same size as my whole group. Their whole battalion was pinned down doing constant maintenance, whereas my group was working on two airfields simultaneously and would be free to tackle another when Volkel and Heesch were finished.

Meanwhile we kept talking to the Dutch liaison organization about the problem of material for a foundation to spread under the PSP. They said that beds of gravel were sometimes found beneath the top soil of heather, and that we ought to talk to an organization called Koninklijke Nederlandsch Heidemaatschapij, which turned heath land into rich soil such as we had at Heesch. Where gravel was found, it was excavated and sold to the building trade. Did they know of any deposit in British-held

territory? Yes they did but it was still lying under untouched heath, and their equipment for getting it out had been taken away by the Germans. No problem, we said. If they would show us where it was, we would do the rest. We graded and compacted the subsoil under the runway exactly to levels to give good drainage and a smooth surface that would not cause Spitfires to "hop" on touchdown. We covered the graded surface with a layer of straw, to prevent frost damage at night, then on the straw a layer of gravel carefully checked for uniform thickness, and PSP on top. Subsequently Bob McGregor, the Canadian group captain whose wing occupied Heesch, declared it was the finest runway upon which he had ever landed. Dispersal aircraft standings and MT roads were similarly surfaced with PSP, but the refuelling, rearming and engineer servicing areas were paved with bricks on sand and the taxi track and MT road leading to these were surfaced with concrete. Just as we were nearing completion, Brigadier Campbell paid another visit to the site to say that the RAF now wanted to put an extra squadron on the airfield, but they still wanted work to be finished by the date forecast. This was going to be awkward. The only possible site for the additional dispersal aircraft standings, taxi track, etc had at this stage of the work great access difficulties.

In Uden during November we had a respite from enemy action, and I could relax in the evenings to play bridge with my officers. The Air Force officer attached to my HQ, Captain Corbisier, a Belgian Air Force fighter pilot, was French speaking, so we played in French. Twice Colonel Tuck had me down to dinner in 12 AGRE Mess and to play bridge in his billet – very welcome breaks.

Uden **1 December**
Working on construction of Heesch airfield B88, and repair of Volkel.

1330hrs **6 December**
Aircraft flew in to B88.

The last minute instruction to make provision for a further RAF squadron had threatened to prevent occupation of the airfield in its originally planned form. We had, however, solved the problem of access etc. The additional squadron area was now under construction.

Uden **20 December**
Recce for new site commenced.

Future attempts to cross the Rhine were to be aimed directly at the heartland of Germany. For that the staffs wanted another new airfield as near as possible to the area of their intended crossings. The recce extended over the whole area occupied by VIII Corps from Uden to and over the Dutch border into Belgium. It was now very cold, with heavy frosts.

Uden – 2300hrs **22 December**
Information of enemy paratroops landing between Eindhoven and Boxtel. Stand to.

23 December
Coys withdrawn to within perimeter of town to form garrison defence.

The position of the paratroop landings, north of Eindhoven and near the west side of "the road", seemed to indicate that the Germans were out to capture it and trap the Allies in the narrow salient stretching from Eindhoven to Arnhem. Our grapevine warned us and, having organized our defence, I was in the square in Uden, my driver manning a Bren gun beside me, when from the south in walked the Chief Staff Officer of Second Army. He had been flying to XXX Corps in an Auster which had been disabled by small arms fire but had made a forced landing on "the road" up which he had seen German tanks advancing. I gave him my staff car and driver and sent him on his way. From my HQ I contacted 12 AGRE and 83 Gp RAF HQ at Eindhoven and asked for Typhoons to be set up to deal with the tanks. My men were ordered to lay on the ground the coloured silk squares, issued to each man for identification, to enable Allied close support aircraft to distinguish between friend and foe. This was the first time we had used them. I put mine down on some grass at my HQ and lay beside it. It was comforting to think that the threat from tanks would soon be over, for the time being at least. All along the way from Normandy we had seen German tanks destroyed and tossed aside by rockets from our Typhoons. I never imagined what it would be like to be near the receiving end during a rocket attack. We could hear the noise of the approaching tanks. Then came the Typhoons, circling overhead. Now the tanks could only be a few hundred yards away. Then the most terrifying noise as the rockets screamed down, seemingly aimed at me. It went on for a long time as pilots tackled the tanks one by one. I had heard many big bangs at close quarters but none equalled the extraordinary noise of these rockets. I walked out next morning to see the damage. The German tanks, shattered and burnt, were lying on their sides in ditches alongside the road. However, the threat from the German offensive wasn't over yet. We had reports of fierce fighting in XII Corps area and soon found that the Germans had cut our supply line. We couldn't get to the ration store. The German ration store was at Oss, a town only two miles north of Heesch, and the Gds Armd Div reckoned that they might capture this store sooner than they could free the way to

the British store. So they captured Oss, and the British didn't miss a meal. The Germans also didn't want to be hungry, so they recaptured the store at lunch time and held it until next morning when the Guards again captured it. This performance was repeated for several days during which we all existed on German rations. The British signed the storekeeper's book for all they took. That book was in a Guards Mess in London before the recent Army reorganization.

Uden **28 December**
Heavy black frost. Sanding.

We were now having to sand a runway at Volkel every morning. To try to intercept and destroy V1 enemy missiles, Tempest aircraft had been introduced. They were difficult to control on the runway during "take off". Pilots said they tried to slew sideways. One said the aircraft tried to wrap itself round its huge propeller.

Some V1s were aimed at London, others at Antwerp. They passed low over our heads at Heesch where I frequently saw the sudden appearance of a vertical white column of air, seemingly not far away. Each white column marked the launch of another V2 rocket.

Meantime the German offensive in the Ardennes against the Americans, which came to be known as the Battle of the Bulge, *had started. The Germans quickly achieved a penetration of 50 miles. It became impossible for General Bradley in his HQ in the city of Luxembourg to communicate with his armies. Our men were able to listen to the British Broadcasting Corporation news of the battle on the portable wireless sets which Philips of Eindhoven had donated to companies in Holland. A palpable gloom spread among all troops around Uden when it was realized that the British in their Dutch salient might be cut off from all supplies and eliminated. At this point General Eisenhower decided to place the American armies on the north side of the Bulge, as well as British troops, temporarily under the single command of General Montgomery. XXX Corps, now out of the line, was to be moved to a reserve position in Belgium. A ripple of confidence immediately washed through all ranks following this news. Gds Armd Div tanks began moving down "the road". I got caught up in this traffic one day on my way to visit our new site at Petit Brogel in Belgium. General Montgomery, in a jeep trying to edge ahead, came alongside my car, but also had to wait. He immediately gathered round his vehicle all who were near, propped up his plastic covered map showing the latest reported formation positions drawn on with coloured chinagraph pencils, and proceeded to give his view of the battle and what he meant to do about it. "They're after my petrol" he said. Then he distributed cigarettes all round. His jeep was full of them, although he didn't smoke himself. I had exactly the same experience somewhere on the way through France, when he had behaved in the same way – an impromptu briefing to anyone near, irrespective of rank. Very good for morale.*

Uden – 0915hrs **1 January 1945**
Fifty plus enemy aircraft attacked B88 – damaged one plank of PSP. 16 shot down by aircraft of 126 Wing RAF of B88.

0930hrs
6 enemy aircraft attacked B80, no damage – 1 shot down.

This was the famous New Year's Day attack on 16 Allied airfields in Belgium and Holland and France. The outstanding performance of 126 Wing RAF on Heesch was due to their CO Group Captain McGregor getting all his aircraft airborne before the attackers arrived. Rapid scrambling was helped by our airfield design. How he got warning of the approach of the attackers flying in low-level formations in complete radio silence can be gleamed from the official German Air Force publication which describes how the raid was carried out. It is fascinating reading. On Eindhoven airfield, where two RAF squadrons were lined up ready for take-off when the enemy struck, 71 RAF aircraft were destroyed or damaged according to the official 83 Gp RAF history.

Uden **1 January**
Group employed on maintenance and final completion of B80 airfield (Volkel Holland), B88 airfield (Heesch Holland) and Group Control Centre of 83 Gp RAF (Erp Holland). Recce of Petit Brogel, Belgium, B90 site, continued.

4 January
Small advance party moved to B90 for surveying and setting out.

5 January
Advance parties of Road Con Coys and Pioneer Coys moved to B90 area.

6 January
Coys moved to B90 area – rear parties left at B80 and B88. Advance party of 5352 Wing RAF arrived to take over B80 and B88.

Wychmael, Belgium **7 January**
Gp HQ moved to B90 area – opened at Wychmael at 1600hrs.

Postscript

I NEED not have been so concerned about the enemy ammunition train on 2 October. The Germans probably could not have spared a railway engine to pull it back into Germany. When flying was possible, the RAF was disabling every train that moved by day.

The significance of the shooting down of Second Army's Chief Staff Officer on 23 December has only just occurred to me. His journey was the consequence of General Eisenhower's decision to place American troops under General Montgomery's command to halt the German advance in the Ardennes. He was flying to give General Horrocks' orders to move XXX Corps into a reserve position west of the Meuse. Communication by road was impossible then, and a coded message by wireless or telephone could have been intercepted.

The unique collision of three Spitfires on a Belgian airfield in September 1944 was embarrassing for the airfield controller and for the pilots concerned, one being a British top scoring fighter pilot. Aircraft are often most vulnerable when taxiing on airfields. In the 1930s, Bert Hinkler, who had created records flying to Australia and elsewhere, was killed in his aircraft by colliding with another while taxiing on Croydon airfield. Because of the way Spitfires cock their noses in the air when on the ground, their pilots cannot see directly ahead.

50th Anniversary Articles

The Editor of the *Journal* would be pleased to receive further articles from anyone who took part in World War Two, with a view to their publication on or near to the 50th Anniversary of the event. Now being considered are articles about 1945, but accounts of later events are always welcome as they can be kept for publication in the appropriate issue,

The Making of a Sapper

COLONEL A J REED SCREEN OBE BSc

After reading Civil Engineering at Birmingham, Colonel Reed Screen was commissioned into the Corps in January 1966. Following 2½ years in Malta, he commanded the Corps Mobile Display Team, prior to four years in Strategic Reserve.

After Staff College he was appointed Brigade Major of 30 Engineer Brigade and subsequently commanded 16 Field Squadron. A tour at Royal Armament Research & Development Establishment in the Mines and Fuzing Branch was followed by six months in the Falklands in the immediate postwar period.

On promotion to lieut colonel he spent two years in York on the staff of the newly formed Headquarters North East District and 2nd Infantry Division. He then commanded 3 Training Regiment, after which he had a varied year as Commanding Officer Exercise Snow Queen *in Bavaria and Chief G3 (Organization and Deployment) Headquarters British Army of the Rhine.*

On promotion to colonel he was appointed Commander Royal Engineers 1st Armoured Division, and took part in Operation Desert Storm *during the Gulf War. He assumed his last appointment in Gibraltar in September 1991 and, after a short language course in Beaconsfield, takes up his next appointment as Defence Attaché Harare, in March 1995.*

He is married with two daughters who are in their early twenties. His outside interests include rugby, skiing, sailing, music, drama and gardening.

In 1704 when a combined British and Dutch force captured the Rock of Gibraltar, the first engineers arrived and 290 years later there remains a presence. However, it was not until 1772 that the first company of artificer soldiers was formed in Gibraltar, thus laying the foundations for their presence. For 212 years there have been formed units of Sappers continually on the Rock, leaving their mark in the numerous bastions and fortifications, many buildings in the city and not least in the 30 miles of tunnels within the Rock. However, in 1993 cost-saving exercises and rationalization plans reduced the Sapper presence to below that required to sustain an independent unit. The die was cast and the sad decision was taken to disband First Fortress Specialist Team Royal Engineers, by 1 July 1994.

The decision to disband was not taken until late summer which left little time to plan and implement a farewell parade. However, 61 Field Support Squadron was due to visit the Rock in the spring and fortunately the Corps Band was available at the same time. We could thus exercise our Freedom of the City and say farewell in style; but there remained the question of a more tangible memorial. After various proposals it was agreed that a statue depicting a soldier artificer in period dress mounted on a natural rock base would be ideal. Finding a suitable model presented no problems as two figures were already on the Rock; a silver centrepiece about 8in high and a smaller 4in high enamelled model presented to the author by the Warrant Officers and Senior NCOs of the Training Regiments.

Armed with these two models all we had to do was find a sculptor to get on with the job. Six months was not long but seemed quite adequate and the local stonemason had already shown interest to some earlier enquiries. A month later with November fast approaching the outlook was gloomy. The local stonemason, when offered the commission, said he would need at least nine months which ruled him out. The Regimental Colonel, who had been trawling for suitable sculptors in the United Kingdom, had had no success. However a chance meeting at a lunch party for General Sir William Jackson, one time Governor of Gibraltar and President of the Gibraltar Heritage Trust, led us to Jill Cowie Sanders, a sculptress of repute who lives in Facinas in Spain,

Col A J Reed Screen OBE
The Making of a Sapper p340

about an hour's drive from Gibraltar. She was very interested in the commission, she had the time and we agreed a price. It was now early December. A suitable site in the centre of Gibraltar had been identified and received blessing from the Minister of Tourism and Environment, the Gibraltar Heritage Trust and the Director of the Gibraltar Museum.

Jill Cowie Sanders came to view the two models. The silver centrepiece (above left) was immediately disparaged; effeminate, weak, with a decided paunch. Luckily the enamelled model (above right), a much more robust and chunky figure, was as well received as the centrepiece had been dispatched. This was used as the basis for a quarter-size plaster model to be prepared as the first stage in a process which was far more complicated than envisaged at the outset of the project.

Because clay tends to crack when it dries out and also because Jill Cowie Sanders is a sculptress rather than a modeller, a quarter-size clay original was made, which then had to be cast in plaster, ready for the detailed work achieved by carving.

The quarter-size model was cast into plaster by the waste mould process, which essentially consists of covering the clay with a thin layer of blue plaster and then building up the walls to approximately ½in thickness.

For this process the clay model was divided into three sections by brass shims to make it easier to remove the clay from the plaster mould. After cleaning out the clay the mould was ready to receive the plaster. Detergent was used as a separator and the three sections of the mould rejoined and bound with hessian ties and plaster. The mould was then filled with plaster, reinforced where necessary by metal bars and hessian. When it had set the outer mould was gently chipped away, the blue plaster clearly defining the outline to work to. This quarter-size model was a valuable aid to agree details of clothing and accessories; once approved, it was time to construct the full size, 6ft statue.

Discussions had been held at Chatham, and staff at the RE Museum scoured the archives for details of dress and designs of various accoutrements. Much of the research was based upon Connolly's excellent descriptions of the uniform but in addition, local experts in Gibraltar also gave invaluable assistance and approved individual items on the spot. Jill Cowie Sanders was relentless in her search to ensure that every detail was as correct as possible and that the statue was truly authentic. Armed with this information it was back to clay and the full size statue constructed on a steel armature from which wooden butterflies were used to support the clay. This clay model, which weighed about 350lb, was then used as the original for the plaster model which was cast in a similar manner to the quarter-size model. At this stage mould and model were weighing in the order of 700lb, a considerable bulk for a lone sculptor and her young assistant.

In early January I visited Facinas to see the plaster statue. After my previous visits to see the clay statue I was disappointed. It didn't seem to have progressed as well as I had hoped although there were some excellent detailed accoutrements which had been separately modelled in wax. It was much later that I found out that progress had been delayed because Jill had dropped the top half of the statue and had been working nonstop for three days prior to my visit to repair broken arms and a severely dented head!

The sculptress with the quarter-size plaster model.

By the end of January it was time to take the plaster statue to the foundry in Madrid for casting. The foundry has combined the traditional casting methods of sand and lost wax casting into one combined exercise reducing time and cost. Very basically, having cut the plaster at the waist and biceps, a plaster negative was made from the statue which was then lined with a thin silicon rubber membrane. The resulting mould was lined with a ½in layer of wax, which was later to be replaced by bronze, and filled with a silicon investment made mainly of sand. When the investment and wax had hardened, the silicon rubber lined plaster mould was stripped off.. The sculptress could now retouch, refine, add breastplate, buttons and other accoutrements. The silicon rubber liner reduced the number of pieces required for the plaster cast because after the wax had set the mould could be removed easily due to the flexibility in the rubber. If no liner had been used a very complicated mould, taking much more time to fabricate would have been required to account for every undercut. The wax models were then placed in a sandbox surrounded by stones and then filled half way with the investment material, and a separator applied, to enable the mould to be split, and filled completely. These were placed in an oven and taken to 600^{0}C to burn out the wax. The bronze, melted in a crucible, was then poured into the space left by the wax, the investment knocked off and the bronze was ready for finishing.

On parade in Main Street.

Prior to the use of silicon rubber, this process was much more complicated entailing cutting off numerous gates and vents and then chasing (ie chiselling off surplus bronze and hammering into shape) taking two men weeks to complete. With the new method there is only one gate and one vent. The three pieces were welded together and the joint disguised by chasing. Meanwhile the wax accessories and musket had also been cast and were welded onto the figure. The smooth bronze areas were then polished to contrast with the textured surfaces. The figure was ready for the patina: acids being brushed on and heated with a blow torch giving the required brown finish – and finally it was waxed and hand polished, ready for its journey to Gibraltar.

In Gibraltar the site had been prepared, a suitable rock, which weighed 16 tonnes, found and placed and all that remained was to wed statue and rock. For this the local mason, Mr Charles Anes, who had not been able to take on the sculpting of the statue, was our saviour as he finished and trimmed the base. All was completed for the Chief Royal Engineer to present the statue to the people of Gibraltar during a moving and memorable ceremony. Space does not permit me to acknowledge the assistance I had from so many quarters to bring this project to its timely conclusion or to go into detail over changes, such as the replacement by 60 Field Support Squadron of 61 Field Support Squadron late in the day, but I hope I have managed to convey a little of the complexity of this seemingly simple little project.

Postal and Courier – 1944

VARIOUS

The following short items are recollections written by individual members of the Postal and Courier services recounting their activities during the period May to September 1944.

Overlord

Lieut Colonel W Smart MBE

In May 1944, the postal officer of the Special Service Group (Commandos) reported to Headquarters 21 Army Group for special duty. That special duty was to go to Southampton to find a suitable and conveniently-placed building that could be used within a few days as a postal depot. The whole project was absolute Top Secret.

The officer's knowledge of Southampton was invaluable as the town had been virtually razed to the ground and to find a building intact that was not fully occupied was impossible. He knew a drill hall which would be ideal, convenient to the docks and to the main railway station. However, on arrival he found to his horror that it had no roof, only three very badly damaged walls and heaps of rubble blocked the entrances.

The local Ministry of Works (MofW) official naturally said that it was impossible to make the building habitable within a few days and in any event he would require authority of the highest level; even then it would take months. Returning with the authority, the MofW had the building ready in record time, but even so mail for troops began to arrive whilst the workmen were still there.

Our postal officer, with one sergeant and seven sappers, began organizing the handling of mail for the "Invasion Force". He was the only subaltern in the British Army to be entrusted with all the prelocations and landing points of the whole invasion force. The hour arrived and the loading of the first batch of mail was made in the presence of the Chief Planning Officer, Movement Control, and the Military Police, on 4 June 1944, D –2. (It would of course have been D –1 but as history recalls D-Day was postponed 24 hours because of bad weather.)

The officer, satisfied that the planning and handling of mail for the invasion forces was working smoothly, handed over to another detachment and he and his eight men joined 8 Base Army Post Office (APO) which was preparing to embark on D +3 for Normandy. They arrived on Gold Beach D +6 where fighting was still very fierce, landing in 6ft of water and were fortunate to have no casualties.

The Base APO was the largest marching party to arrive in the invasion force. The Reception Point was unprepared and no suitable accommodation was available, so they repaired to an orchard at Banville on foot (no transport being available), to spend the night under trees and a few bushes. The next day the OC, Major Jimmy Hyde, caught up with them; he had been in Normandy a couple of days with the advance party. The Base then moved to a farm in Crepon where they were allocated two fields to set up shop. Their troubles were only just beginning. The whole of their G1098 and vehicles had gone down when the convoy was hit, leaving them without tentage, equipment or transport. The order of the day was survival and self-help, so it was a case of beg, borrow or steal from other more fortunate units.

In the meantime, our postal officer from Southampton was appointed Dock and Air Liaison Officer. As the former was the more important task he concentrated on the beaches. He "acquired" an amphibious jeep and was soon down on the beaches picking up mail that had been dumped (some of which he and his men had dispatched from Southampton a few days before). Soon the beaches were cleared but further delays occurred because bad weather made unloading impossible. At Base a huge barn had been requisitioned for use as a sorting office and several outbuildings for accommodation.

Life at the Base was not too pleasant, as pockets of the enemy occupied parts of Crepon and the surrounding countryside. Snipers were in the village church tower and it was some days before they were cleared out. The locals were not too friendly towards the British and it was at Crepon the Base suffered its first casualty. A sapper was found shot in one of the outbuidlings being used as a billet, this remains one of the Base APO unsolved mysteries.

Footnote: In September 1944 during those breathless weeks when the British Army was storming its way from Caen and the Falaise Gap to Brussels a test was taken of the length of time employed to deliver some 50,000 letters consigned to the British Liberation Army. The average time per letter, from posting to delivery, worked out at two and a half days.

By Glider at "H" Hour

The changes in attitude towards mail priorities which occurred as planning for Operation Overlord *went ahead, is perhaps best illustrated by an account of the personal experience of the officer who commanded 6th Airborne Divisional Postal Unit, Captain J C G Hine, in his own words:*

I joined 6th Airborne Division as Postal Officer and Commanding Officer of the Division's Postal Unit in 1942. At first there were very few members of the Divisional Staff prepared even to entertain the idea of the Division's "postmen" taking part in the actual airborne assault on the Continent. But by about the beginning of 1944 it was accepted that elements of the Postal Unit should go in with the Division's airborne assault forces prior to H-hour.

We began to train. First in gliders. More often than not we made up "live" loads for the trainees of the Glider Pilot Regiment! This experience was not without its trials! The first gliders used for training purposes were relatively small and as often as not at least one of the "load" would be air-sick! (Later gliders were bigger and much steadier.) Nor was the training without its alarming side. It was, for example, far from reassuring to find that one's pilot of the day was a gentleman who, when last seen the night before, had been resisting all attempts to get him out of the local hostelry at closing time! But those were the days of youthful exuberance. My own chaps were full of enthusiasm and wanted to be in the swim and to show what they could do given the chance. Two of them eventually became glider pilots. Others went on a parachute jumping course at Ringway and came back "on top of the world". So, the training and the preparations went on until finally the time arrived for "briefing".

OCs of units were briefed individually. When my turn came I was summoned to see the AA & QMG (Assistant Adjutant and Quartermaster General). He asked me whether we could maintain postal deliveries after the marshalling camps were sealed and right up to D –1, and could we then "set up shop" again on the far side on D-Day or at the latest on D +1. The first requirement presented no special difficulties and I said I thought we could carry it out successfully – as we did in the event. The second requirement should be practicable too if we were going in with the airborne assault troops.

In the event we were given half a dozen "places" – three in the gliders and three with the parachutists. A "follow-up" of 12 men was to come in by sea on D +1 or 2.

In the days following briefing there was a noticeable tension in the air in the sealed camps. I sat talking one evening with a close friend of mine. He told me what he had to do on *Overlord*. He would be going over in a glider with a bulldozer. He had the job of uprooting the obstacles the Germans had been busy erecting in the fields in which gliders might land. He would be setting out at 2200hrs on D –1 and had to finish his task before the main glider force was due to arrive. He told me his wife had just had a child and that he hoped he'd come through. He hoped letters would get through alright. For the first time I began to think about the hazards involved for all of us. My friend seemed suddenly to become a lonely figure and there was little I could do to help him. But suddenly the importance of the mail for men like him became more sharply fixed in my mind.

Compared with him I was fortunate. The requirements of the mail service kept me fully occupied and I had precious little time to think about what might lie ahead.

It didn't seem long before we were on the way to the airfield. I was in the back of a lorry looking out over the tailboard. Amongst the many people who were lining the roads to watch us go through there was a little old lady who looked as though she was well into her 70s. She took one look at me and called out "Cheer up, son; it mayn't be so bad; and it'll soon be over!" I didn't quite know which way to take the latter part of the remark; but I'm sure it was well meant.

We took our seats in the glider. There was a minimum of fuss and I thought how routine it all seemed. Then we were off and with nothing to do for the time being my imagination began to run riot. After a time I thought to myself I wonder where we are now? We must be well out over the sea! I couldn't swim a stroke and I kept going over my life belt to make sure it was properly adjusted. I wondered how long it would be before we made land – and what sort of reception we'd get when we made it. The seasick pills I had been given stopped me from feeling sick: but they gave me pains in the stomach! I worked out that we'd be in the air for something like three hours. That was a long time, and it started me thinking about our being attacked from the air. I recalled that gliders are sitting targets. Then I remembered

we'd been told that there would be complete air protection. As the time wore on I began to think about the landing. I hoped and prayed it would be a soft one. And I began to wonder whether my friend had done his stuff with his bulldozer and the "obstacles". Had I known it he was already dead – killed just after he'd cleared his allocated zone. All this time I kept telling myself that the last thing I must do was to let anyone else see that I was in any way scared!

Suddenly someone shouted that we were over the coast. I felt cold. A few more minutes and I felt the tow rope go and then we were down to a rough landing. The glider was groaning, cracking, and splitting open. Someone was shouting "out." There seemed to be a hell of a noise going on. I grabbed for my tin hat and marvelled at the sudden sense of security which it seemed to give me. Then I was out. Nearby a glider went up in flames. Another straddled a wall. It seemed as though all hell was let loose. I thought if I ever get out of this I'll be lucky! I wondered how my "jumper" lads had fared (suddenly I found to my dismay that one had been wounded in the leg and thigh and another in the backside). I'd no idea where we were but subsequently discovered we'd come down west of Ranville and close to one of the bridges over the River Orne which had been seized earlier by men of the division who'd crash-landed in gliders right on target. The chances of ever getting a postal service started seemed to me at the time to be about as good as the chance of winning the pools!

Then, all at once, the organization began to take over! Someone was shepherding us off the landing zone. I remembered I'd somehow got to make my way to division headquarters wherever that might be. I saw a military policeman and asked him if he knew where division headquarters was. "Up there", he said, pointing to a lane. I set out and after walking what seemed to be about half a mile came to a house which – wonder of wonders – turned out to be division headquarters. And who should be standing there but the Deputy Assistant Quartermaster General. He wanted to know what sort of a trip I'd had and which way I'd approached division headquarters. He said "You're lucky to have made it old man: the snipers are busy along that road and they've already got seven or eight chaps". He added that there was a lot of enemy activity between the division area and the coast and that it was out of the question for the time being to think of getting back to the beaches to collect or dispose of mail as had been planned.

A short time afterwards one of my corporals turned up. He'd left the UK with a stock of stamps and other postal equipment but had become parted from it in the shock of landing. Having reported in he went back to the landing zone and after a search lasting some time returned with the missing items intact.

Soon others of my lads reported in and we "set up shop" in a barn in the division area. Conditions were pretty primitive and we spent a lot of time in slit trenches. But from D +1 on, the unit post orderlies called daily and we dispatched outgoing mail regularly. How we got back to the beaches to make the dispatches is another story. But we did and I have personal proof that the mails we dispatched got home on D +4. My mother (a widow) received a kilo of Ranville butter wrapped in cabbage leaves in my emergency ration tin!

Recovery of troops across the Neder Rijn

CSM F J Petrie MM RE

The story of Operation *Market Garden* and the Arnhem Bridgehead has been well written up, but not so the recovery of the Arnhem force back across the Neder Rijn, in Holland, by 43 (Wessex) Division Sappers on the night of 25 September 1944.

The 43(W) Div (General Thomas) led by 214 Brigade (Brigadier Essame) eventually reached the area south of the river. They were ordered by General Horrocks XXX Corps to carry out an assault crossing by one battalion, followed by elements of the Polish Airborne Brigade, plus as much stores and ammunition as possible, to assist the hard-pressed airborne troops now surrounded in Oosterbeek. The main limitation was the capacity of the boats that could be mustered. The one and only road back to Nijmegan was continually being cut by German armour of 10 SS Panzers. (The road did in fact remain closed for four days at this crucial time.) So on the night of the 23/24 September, 204 Field Company RE ferried 4th Battalion of the Dorsetshire Regiment and the Poles across. By the next day it was obvious that their position was so tenuous that the whole force would have to be evacuated, and Operation

Berlin was set-up under Lieut Colonel (Brigadier) Sir Mark Henniker CB DSO MC as CRE, with 20 and 23 Field Companies Canadian Engineers on the east end sites, and 260 and 553 Field Companies RE on the west ferry sites. The Canadians were to use storm boats which were prefabricated and complete with outboard motors, whilst the British were to use assault boats made from canvas (fold flats) with fitted supporting wooden struts, which could be paddled or rowed.

During the late afternoon of 25 September, No 1 Platoon 553 Field Company RE was engaged in the construction of a bridge over a canal south of Driel. For this reason I missed the full "O" Group when details were given of the operations planned for that night to evacuate the survivors of the 1st Airborne Division across the River Neder Rijn. 553 Fd Coy was to be responsible for the western ferrying site at the place where, during the previous night, the 4th Dorsets had crossed the river to reinforce the airborne bridgehead.

Initially two assault boats were to be put in the water on the Company's front, the first boat at 2130hrs timed to arrive on the far bank ten minutes later. The boats were to ply back and forth until 40 minutes after midnight. The limits of the ferrying sites were to be marked by bofors anti-aircraft guns firing tracer shells on a low trajectory. I was not aware of this fact at the time of the first of my crossings of the river, otherwise I would have been alarmed at our position directly under the line of these shells, the current having swept us to the extreme edge of the ferrying site.

My platoon was given the task of taking the first boat across. Normally a crew of two would have been enough but I took three men with me because of the strong winds and the expectation of a swift current. The crew had sten guns (for some reason wire cutters were also taken) but otherwise we were unencumbered. I remember thinking that my life belt which I had carried on all river crossings since landing in Normandy, was with my personal kit back in Nijmegan. Having fallen into the Seine at Vernon and Meuse (Maas) at Liege I was more than apprehensive about my chances of avoiding a wetting in the Neder Rijn.

The night was pitch black and there was a strong gusting wind with occasional heavy showers of rain. A dozen or so sappers heaved the boat on to their shoulders and carried it through an orchard to the top of the river bank, the way being marked by white tapes. We were heartened by the gunfire of the divisional artillery firing over our heads intermixed with the business-like sound of the Vickers machine guns of the Middlesex Regiment. On reaching the river flood bank we became aware of the return fire from the enemy side of the river including tracer bullets which seemed almost lazily to be coming towards us. We slithered and stumbled our way from the high bank down to the water's edge where we appeared to be below the line of fire although an occasional mortar bomb dropped in the river or behind us. Inky blackness prevailed in all directions except for the artillery flashes and the glow of a fire downstream.

My boat having been made ready for the water was quickly pushed off, the crew paddling side by side in a kneeling position with me in the bow. The current immediately took control and within seconds we were swept far downstream. Only by strenuous efforts were we able to set the craft back on line for the far bank.

Several times we were hailed by men floating or swimming past, some shouting "Tommy". At first I wondered what Germans were doing in the water, then I realized that some of the men must have been with the Polish Parachute Brigade. Any thoughts of attempting to pick them out of the water were quickly stifled by the fear of capsizing the boat, and moreover my orders were to reach the other side of the river, so we paddled on.

A large burning building to our left cast sufficient reflected light on the water to show the nearness of the enemy bank and we also then saw flashes and came under automatic fire from straight ahead and above. As soon as the boat grounded we jumped into the water and took cover behind a groyne until the firing stopped. I observed that the land rose steeply from the water's edge and disappeared into a dark mass of trees which merged high above us into the blackness of the sky. Several shapes came into view which I thought must be the enemy: then more optimistically that they were our waiting passengers. Anxious calling brought no response and the figures disappeared. A cautious "recce" disclosed nothing more sinister than stones and tufts of vegetation between the river and the wood. Being concerned at the fact that our craft had been carried downstream we waded back into the river and with some difficulty pushed the boat against the current and round many groynes until we came across a DUKW stranded half on the bank. A quick investigation revealed two soldiers hiding inside. They told us they had been sheltering for

some time and that they knew nothing of any other men in the vicinity. Another look round and further questioning of the two survivors indicated to me that it was time for us to return.

The extra weight of the two men and the experience gained on the outward journey helped us to make a faster return crossing although the current was even stronger and we needed to make a detour to avoid an area which was suffering from enemy mortars.

On arrival our two passengers quickly disappeared amongst the troops gathered around the ferrying point. Several other boats arrived soon after, the paddles of the crews being supplemented by passengers using spades or trenching shovels.

Captain Hall, of the 4th Dorsets, who had slipped back across the river after delivering orders for the evacuation, was amongst the party waiting for our return. I had known him when we had been on exercise together in Kent and he appreciated that we had carried out our orders to the full. However certain comments were made as a result of which I concluded that if doubts were being cast upon the extent of our efforts, I had better make a repeat crossing. My contentions that I had the feel of the river and knew the lie of the land on the enemy side were accepted as valid, and I paddled off with a fresh crew, but a thorough search of the same stretch of bank, despite enemy activity around, failed to reveal any more survivors and we returned satisfied that nothing more remained to be done.

During the night it was recorded that 75 men of the Dorsets, 2163 men of the Airborne, and 160 Poles came back across the Rhine.

"These Duties May Be Considered as Being Similar to Those of a Fire Brigade."

MAJOR J D BEAUMONT

PLEASE note that the caption on page 213 of the August edition of the *RE Journal* is incorrect. It should read "Bomb disposal during World War Two – a 1000kg Hermann made safe." We apologize for this error.

Well Drilling in Bosnia

MAJOR T W WYE MIHIE MIMGT

A TEXT reflow error occurred during the production of this article in the August edition of the *RE Journal*, causing it to be published minus the very last line. This should have read as follows: "... we now look forward to summer in the Balkans." We apologize for this error.

Out of the Frying Pan – an Account of the Breakout and Escape from Fort Mechili in April 1941

WILLIAM HARRY FACER

Born 1917. Educated at Central Secondary School, Birmingham, and later took a five-year course in Production Engineering at the Birmingham Central Technical College. Obtained a City and Guilds Final Certificate in Machinist, Turners and Fitters Work, and became a graduate of the Institution of Production Engineers in 1938. Called up in January 1940, he joined 4th Field Squadron RE, 7th Armoured Division. At the end of the North African Campaign in 1943 was sent on a War Office posting, against his wishes, to Deputy Director Works Production Headquarters in Cairo, obtaining the rank of Mechanist Quartermaster Sergeant, Warrant Officer Class 2. Returned to England in 1945, married, and later became a director of two companies. Retired in 1981.

MANY accounts of the North African Campaign in World War Two have been written, but one episode that took place in April 1941 has been virtually ignored. The recapture of Fort Mechili by the Germans was the first major success by the Axis Forces under command of Field Marshal Rommel. The Allies lost nearly 5000 men, including General Gambier Parry. What follows is a true description of how approximately 320 men broke out of the stranglehold on the Fort, and escaped to reach Al Adam.

4th Field Squadron (4th Fd Sqn) landed in Egypt on 16 November 1940. After several weeks' training, the men were yearning to join the successful troops of General Wavell, who were chasing the Italians across North Africa, but it was not until 21 March 1941 that orders were received to move. The Squadron was minus 3 Troop (3 Tp), which had left on 15 March to join in an attack on the Italians at Jirabub.

Generals Wavell and O'Connor, had devised a plan to bypass Benghazi, drive across the desert towards Agedabia, thus cutting off the Italians escaping down the coast road towards Tripoli. Mechili was captured, and the British tanks pushed straight on to Beda Fomm. In spite of being outnumbered five to one, the enemy was engaged successfully. Two hundred thousand Italians were taken prisoner, along with their tanks and stores.

The British troops were tired out, had few tanks left, and no reinforcements were being supplied. British Intelligence reported that the Germans, fed up with the retreating Italians, were dispatching supporting troops across the Mediterranean to Tripoli. The number of Germans was given as 4000, but a nought had been missed off as the number was nearer 40,000. These troops were hand-picked by Rommel and equipped with tanks and guns far superior to any the Allies had. In addition, they were supported by Stukas and Messerschmidts of the *Luftwaffe*.

No 1 Troop (1 Tp), 4th Fd Sqn pushed ahead to take up position near Agheila. The remainder of the Squadron followed and was attacked by Messerschmidts, suffering three or four casualties. Resting for the night near Agedabia, we heard, that the Germans had launched an attack and recaptured Agheila. Our area was bombed several times by Stukas. Everywhere was chaos, our front line was in disarray and in full retreat. We were ordered to lay mines in the Sebchet Segira area, blow up wells, and crater the roads. We were

William Harry Facer
Out of the Frying Pan p348.

bombed almost at will, and the absence of our air force was apparent. General Wavell had been recalled, and the desert forces were under command of two main Generals, O'Connor and Neame. It was a serious blow when both were taken prisoner. The British were then without any constructive command.

It's difficult to describe the chaos of the period from 30 March until 3 April. Agedabia had fallen after stout resistance, and all our troops were in retreat, either towards Benghazi or across the desert towards Beda Fomm and Mechili. 1 Tp had rejoined us, and 3 Tp was expected on 3 April, returning after the recapture of Jirabub. Just as their vehicles were within hailing distance, they suffered a terrific bombing raid. When the Stukas left, 15 of the troop were dead, and many wounded including the OC, Captain A R K Weston.

Our squadron transport was very depleted, and instead of six or seven men to a truck we were carrying ten or eleven. With 143 Field Park Squadron, our stores suppliers, we were ordered to get to Mechili. Before we arrived, we were attacked by nine Stukas and 22 lorries, all carrying diesel fuel, were destroyed. Without opposition, except our rifle and Bren gun fire, they flew up and down the columns undisturbed. Later during the day we were bombed again; our 3-tonner explosives truck was hit and blew up. We had little to cheer about, but it was a joy to see a Beaufighter bring down a Messerschmidt in flames.

On Sunday 6 April, after very little sleep and the minimum of food, we reached the perimeter of Mechili which was held by 3rd Indian Infantry and some men of the King's Royal Rifles, equipped with a few Vickers machineguns. There was no heavy artillery or tanks, only some 2-pounder guns of the Australian Antitank Regiment. The situation was so confused that any approaching vehicles were suspect, and we were actually fired on until we proved we were friendly. It was a great relief to get inside and have a brew-up.

We kipped by our trucks that night, our rifles at hand and bayonets fixed. We had very little sleep as a German desert column arrived in the early hours, and all hell broke loose. The attack was beaten off and six German tanks and some of their armoured cars were put out of action. Our cooks then did a grand job, and we had a hot meal, our first for 72 hours.

On high ground north of Mechili the Indian Motor Brigade reported that enemy patrols were approaching Mechili to demand the surrender of the Garrison. To combat these, offensive patrols were sent out, which were successful, returning with six prisoners. The German forces then took up positions north and east and poured shells into our fortified area. Further patrols were sent out to scour the area for stores and to try and salvage lorries, but Jerries seemed to be all round, and they had little success.

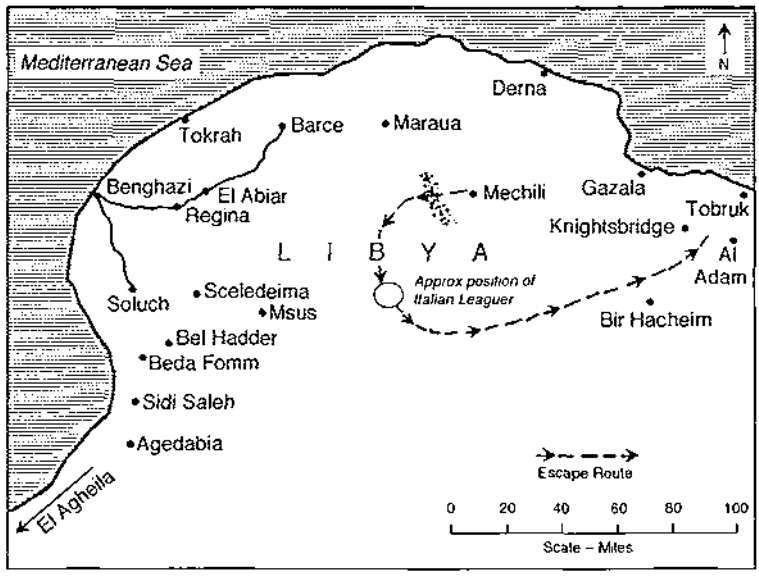
A German 8-wheeled armoured car.

It was a long night, and we were relieved to be ordered back to our vehicles. A breakout had been attempted but had failed. A British plane flew over and dropped a message to the General Officer Commanding, General Gambier Parry, to the effect that all routes out were closed, and surrender was recommended. He had no alternative, and was later taken prisoner in his tent.

Now we could see the German guns flashing and enemy infantry vehicles closing in. We were sick at being told to surrender and when I saw our Squadron Sergeant Major still firing a Boyes antitank rifle, I called out "What's the drill Sir?" He replied "If you can get to hell out of it, have a try!" That was good enough, so, men of my section and I jumped in our truck and got going. We headed west, all firing our rifles, and so surprised the Jerries that we made it out into the open desert. A number of others had had the same idea, and soon we had a fleet of vehicles, and some 2-pounders, flying across the "blue". We had travelled about 10 or 12kms when we saw in front of us the squat figures of tanks. Not knowing their fate at that time we thought they were tanks of 3rd Armoured Brigade, but these were actually left stranded because the diesel carriers mentioned earlier failed to arrive, and headed towards them. Suddenly they opened up, and shells dropped round us but nothing was hit. We swung right, and accelerated away. An Italian plane flew over, but paid no heed to us, even though we "slung up" hundreds of bullets.

Out of the Frying Pan p349.

Still heading west we fairly jumped for joy as we ran into a troop of the Royal Horse Artillery with 11 2-pounder Portee guns. The major in charge was Major Eden, cousin of Anthony Eden, and he escorted us to an almost circular wadi or depression, where we hid for the rest of the day. In all we had 15 2-pounders, as a few Australians had brought out four from Mechili, and these were placed strategically round the wadi.



Map showing route taken from Mechili to Al Adam.

The day got hotter and hotter, but we were still in good spirits. The Lord must have looked kindly upon us, as Jerry did not discover our presence, even though, by peering from the top of the wadi, we could see their vehicles in the haze. Towards dusk Major Eden called us together and said we would move out as darkness closed in. He drew out a diagram of the order he wanted the vehicles to travel in, with the guns covering the flanks.

In North Africa the sun seems to be pulled down by a string, one minute it's light, and the next, quite dark. The guns pulled out in the darkness and all other vehicles formed up as planned. We headed west, but oh so slowly, and as quietly as possible. After a mile or two we turned and headed south. It was a terrific strain, especially for the drivers, and we took turns at the wheel every two hours. The speed was so slow, we frequently had to stop to let the engines cool. Some of us closed our eyes during one stop, I did but came round with a start to see the middle line moving by. Our driver was also sound asleep, but was shaken awake and we soon got back into formation.

After what seemed an endless night, the first rays of the sun appeared in the east. To our dismay we saw in front many enemy vehicles leaguered up for the night. Immediately Major Eden gave a signal, and the 2-pounder guns went out, some right, and the others left. The enemy vehicles were Italian, a "soft" supply echelon. Thinking that there was no danger from the Allies, they had no sentries posted. Major Eden drove straight into the middle firing his Bren gun, and the Italians came out like rabbits; most in their underpants and vests. Amongst them were 30 German NCOs who we took prisoner. They were distributed amongst the trucks, and we went on again without the Indians, who stayed behind long enough to smash up every vehicle, and take away the Italians' boots.

Now we were heading east, and making much faster speed. We reckon that we must have been at least 100 miles behind the German front line, when we met the Italians in their leaguer. We were so tired, hungry and thirsty that the day seemed endless, but every mile brought us nearer to safety, or at least we hoped it did. As light faded we saw three armoured cars tearing towards us. Luckily they were from 7th Armoured Division Support Group, and they escorted us to Al Adam, which was still in British hands. We drew lots as to who should be in charge of the guard over the German prisoners, and I drew the short straw. It did not seem to matter, I was so exhilarated by this time, sleep seemed unimportant.

It only remains now to explain the title of this story. We were discussing what would happen next, and I suggested that we could be sent back to Alexandria, or Cairo, for a rest – what a supreme optimist! The following morning orders were received to take our vehicles and the German prisoners to Tobruk. We arrived at the perimeter of Tobruk with one officer, 93 other ranks and 30 prisoners, and almost immediately the gate was closed and the siege of Tobruk began. Hence "Out of the frying pan ..."

Memoirs

LIEUT COLONEL P F WHITE OBE

Born 22 April 1899, died 14 January 1994, aged 94.

In the early morning of a July day this year I stood on the quiet deserted beach of Ver sur Mer (King Sector of Sword Beach) to reflect upon the long life of my father who drove ashore at that spot on 6 June 1944. Apparently he did not get his feet wet, nor did the padre with his folding bike, who was perched upon the bonnet of my father's jeep.

The substantial field command of 24 Airfield Construction Group had come relatively late in my father's army career. He had been very much the staff officer during the earlier years of the war. He took command of the Group in June 1943 and brought it home in 1945.

Following a posting to Malaya and Singapore, my father retired in 1949 after 32 years service. He enjoyed 45 years in retirement. At a mess dinner we both attended at Chatham a year or two ago, my father mingled with other senior retired Sappers who had not even joined by 1949.

My father was born a Victorian and to a large extent remained one until the end of his days. He experienced at first hand the extensive reach of the British Empire and never doubted that it was right. He was somewhat of a loner and yet intensely loyal. He stuck to the moral and spiritual values by which he had been raised, even though sometimes considered out of place in the second half of the 20th century.

He was not ambitious but much approved of competition and success. He considered himself to be a very lucky man and at the end was very grateful for his life.

My father was educated at Rugby (his father, a Carthusian, had won an England Rugby Cap and so considered that his son should have a better advantage than he whose school did not play the game!) As it happened athletics appealed more and I still have quite a collection of medals. However he was no match for the great. He remembered watching Harold Abraham's back view receding into the distance in a schoolboys race they had run together.

From an early age the army was his chosen profession and so in 1917 he joined the young officer batch at Chatham being commissioned on 6 June 1918.

His training and circumstances must have been influenced by what was going on across the Channel. Many of his school friends went over never to return. However all that he recalled was living the fairly high life of a young officer with London life within easy reach.

Courses followed and he did not have to endure the horrors of France. His first posting, together with his great friend, George Boyd, was to Gibraltar. Between them, they commanded a group of reinforcements, travelling by ferry to Boulogne, train to Marseille and boat to Gibraltar.

Then in 1920 it was an attachment to 1st Connaught Rangers in India, to the NE Frontier region and the Bengal Sappers and Miners, a short detachment from there to Iraq, thence back to Waziristan and eventually home in 1924.

My father was selected for Cambridge and had two of his happiest years at Jesus College. He was made a "native", a term known well to Jesus alumni.

In the summer of 1926, he was chosen to join J M Wordie's expedition to Greenland to carry out topographical, geological and ethnological surveys of the coasts between latitudes 72° and 74° 30' north.

Lt Col P F White OBE

Apart from the scientific work, the party got a taste for walrus, bear, musk ox and other polar delicacies. They even brought a bear home to London Zoo. My father received a fellowship of the Royal Geographical Society.

After further courses there followed surveying of a different kind, this time in the virgin jungles of Sierra Leone for three years, with long leave spells during the wet season. It is difficult, now, to imagine a young RE officer being transported in a canopied hammock through the unexplored hinterland of Sierra Leone with 30 or so porters coming along behind with everything, including a wind-up gramophone, loaded upon their heads.

After a posting as Adjutant of the Training Battalion at Chatham in 1930/31 there followed 11 years of staff appointments in London District, Scottish Command, AA Group Territorial Army and the War Office where he found himself at the beginning of the war.

He briefly commanded 278 Field Company before taking over his airfield construction group.

In the early summer of 1943, he became involved with Operation *Fortitude*, the deception plan. His role was to oversee the construction and dismantling of the dummy landing craft to which he allocated two of his pioneer companies. The work that was done along the south and southwest coasts in the summer of 1943 was then repeated in greater earnest by others on the southeast coast in early 1944. It proved, with the other elements of *Fortitude*, to be a resounding success.

My father seems to have got on well with those who came under his command, but from a distance. He commanded respect for the intellectual approach to his job and for his fair-mindedness.

When his opposite number, who commanded 25 Airfield Construction Group was blown up on a mine, the men of his LAD scrounged armour plating to fit to his Humber staff car so that the same thing did not happen to him.

When he was appointed OBE, he gathered his whole group together to tell them that the award was theirs but he had to wear it.

On retirement my father and mother bought a small farm and a 16th century Wealden farmhouse where they lived in blissful semi-retirement for the next 24 years, as their family of four grew up and went their own ways.

My father's principal and abiding hobby was genealogy, especially the investigation of his own family. He transcribed many local parish registers. He was elected a Fellow of the Society of Genealogists for his work. He was also a livery man of the Worshipful Society of Apothecaries for 72 years.

He survived his wife Joan (née Ellis) of 56 years. She had a profound influence upon his life giving it a zest which he would not have found for himself.

For 38 years, "the Colonel", for that is how he was known, became an integral part of the village and church life of Benenden, the village in west Kent, where now he lies.

MW

MAJOR HENRY CHARLES MC

Born 25 August 1917, died 1994, aged 76.

MAJOR Henry Charles was awarded a MC in April 1945 for his ingenuity and courage in ferrying troops, guns and vehicles across the fast-flowing, mile-wide river Elbe, an operation conducted under heavy shellfire and dive-bombing.

Charles worked out that if he mounted outboard motors on the corners of the rafts (to counter the river's flow) and monitored them carefully, he could produce a right-angled movement.

At this stage in the Second World War it was vital to overtake the Russian army and divert it from overrunning Germany, and occupying Denmark and nearby countries. Charles' plan for crossing the river proved a brilliant success.

The citation recorded: "The example he set to his men and complete disregard for his own personal safety was an inspiration to all around him. His determination and enthusiasm never wavered throughout the operation in spite of casualties to his men, and his conduct, under the most adverse conditions, was directly responsible for the successful carrying-out of his task."

Henry Curtis Charles was born in Carlisle, and educated at Carlisle Grammar School. Although the family had a civic and academic tradition, young Henry decided to enter the building trade.

In 1940 he enlisted in the Royal Engineers and was commissioned in 1943. The following June he was in the first wave of troops landing on the Normandy beaches, where his task was to clear mines and other obstructions, then to mark paths for tanks and infantry.

After the war Charles toured the Middle East on foot and by jeep, mapping areas and acquiring technical information for Foreign Office records. In Cyprus he devised a successful way of removing Archbishop Makarios from that island to the Seychelles in March 1956.

Later that year he was on the Planning Board for the invasion of Suez. Subsequently he was Adjutant of the RE detachment which prepared Christmas Island for the first British atomic tests. He also served in the Gurkha division which played a vital part in the elimination of Communist terrorists before Independence.

On retiring from the Army in 1961 Charles travelled widely, making many friends during his research into healing through homeopathy, and study of the great religions of the world with a view to identifying their underlying universal principles. He kept an open and inquiring mind but was unswerving in his own religious convictions. In the words of a friend, "he always kept his Army boots firmly on."

He married, in 1963, Mary Kathleen "Marcia" Salwey, who died in 1978.

COLONEL JAMES VAUGHAN-WILLIAMS DSO OBE KStJ TD JP

Born 25 October 1912, died 11 April 1994, aged 81.

COLONEL James Vaughan-Williams was a particularly well-known, popular Territorial Sapper of wide experience. He will be long remembered by many friends in the engineering industry, by Sappers who served with him in the BEF, in North Africa and in Italy, in 21 Army Group and finally as a CO and in the county fraternity in Glamorgan after the Second World War.

Vaughan, as he was always known to his friends, was born at Merthyr Tydfil in 1912, the youngest of three sons. After Quakers Yard School there, and qualification at Newport Technical College, he became a civil engineer. He was initially articled to the Borough Engineer of Newport and in the mid-1930s worked in regional planning for Leicestershire with Messrs Allen & Potter.

From early youth Vaughan was attracted to the TA and he remained a loyal Territorial Sapper for the whole of his life. He was commissioned in 1934 in 246 Field Company of 53rd (Welsh) Division Engineers. On the outbreak of war he was embodied and soon moved out to France with the BEF where, during the phoney war, he was employed in construction of defensive works. By 1940 he was 2IC of 7 Field Company, which played a full part in 4th Division's fighting withdrawal to the beaches of Dunkirk. A party of 7 Company Sappers under Vaughan, swam out to sea to join a ship which evacuated them to rejoin the unit in England.

After a few months in RE staff appointments in the UK, Vaughan was posted in 1941 to the Middle East, where he was appointed to command 209 Field Company of 44th (Home Counties) Division in the 8th Army. In October 1941 the Company played a major part in the breaching of enemy minefields during the battle of El Alamein, to permit the passage of 7th Armoured Division in the breakout. The breaching had to be done silently, without much infantry support and was subject to very heavy enemy indirect fire. For his gallant leadership and dogged perseverance, which ensured the success of the operation, Vaughan was awarded the DSO.

Col James Vaughan-Williams DSO OBE KstJ TD JP

After El Alamein he continued to serve in the Middle East, on the RE staff at GHQ and in Italy as SORE to Chief Engineer XIII Corps, when he was continuously committed in the planning and staff work involved with engineer support to operations. He was Mentioned in Despatches in 1942 and 1943. At the end of 1944, he qualified "psc" at the Staff College Camberley, and after a brief period in HQ 21 Army Group and in Berlin, he was released early in 1946.

Immediately after the war, he was employed by the Colonial Development Corporation in West Africa as Chief Engineer, primarily in Nigeria. He then returned home to South Wales, ultimately living in Swansea, and not far from where many of his relatives and friends had settled. He worked for Messrs R M Douglas, on construction of the tin plate works at Velindre and subsequently became engineer to Loughor Urban District Council, which he much enjoyed for a number of years.

In the 1950s, when the TA was being reconstituted, Vaughan became one of the mainstays of its Sapper establishment in South Wales, commanding 109 Army Engineer Regiment in Cardiff and then 108 Field Engineer Regiment (the 53rd Welsh Division's Sappers) in Swansea until 1959. On his retirement he was appointed OBE and became Honorary Colonel of 108 Regiment which he had joined on first commissioning in 1934. He was an ideal Territorial CO, who by then had acquired far more experience of engineering and of battle than anyone else in his regiment; he knew the recruiting area intimately and everyone with any influence in it. His cheerful, happy disposition and practical attitude to life did much for standards of training and recruiting. He loved the social side of the TA and was the life and soul of all parties and guest nights in the Mess at Richardson Street, Swansea, and at annual camp.

In 1961 he joined the civil engineering firm of Andrew Scott, as managing director, becoming deputy chairman, and retiring in 1981. During this time notable contracts included a new steel plant for steel and aluminium industries, major land relocation works in South Wales following the Aberfan disaster, the new North Stand at Cardiff Arms Park, and the British Telecom building in Swansea, which was then the tallest structure in Wales. He was a Fellow of the Institution of Civil Engineers, chairman of the South Wales Association in 1969 and he represented the Institution on the governing body of the Glamorgan College of Technology (now the University of Glamorgan).

He was appointed a deputy lieutenant of Glamorgan in 1959, subsequently lieutenant of West Glamorgan and Lord Lieutenant in 1985. In these roles he involved himself enthusiastically in the industrial, cultural, voluntary and civic life of the county, becoming vice chairman of Glamorgan T&AVR committee, and president respectively of the Swansea branches of the Royal Engineers Association, Royal British Legion, Dunkirk Veterans' Association and of the Scout Council of West Glamorgan.

Vaughan's beloved wife, Edith, died in 1972 and he remained the centre of a proud and united Welsh family. He is survived by his two daughters and his brother, Will.

Thus was James Vaughan-Williams, a fine Welshman, a dedicated and accomplished engineer and a proud and gallant Territorial Sapper, who served his country exceptionally well and enriched the lives of his many friends and brother officers.

DJNG

COLONEL KENNETH WILLIAM MERRYLEES OBE BA FIMechE

Born 7 October 1896, died 1 July 1994, aged 97.

COLONEL Kenneth Merrylees, the water-diviner, worked during the Second World War as a bomb-disposal expert, when he used his dowsing skills to find bombs with delayed-action fuzes which had penetrated deeply into the ground.

Many such bombs left no trace of their presence on the surface, and would have caused great disruption if Merrylees and his team had not detected and defuzed them. One 500-pounder which he discovered in September 1940, had burrowed under the swimming pool at Buckingham Palace.

During Merrylees' early years as a dowser, he used hazel twigs and whalebone, but after women ceased to wear corsets, and whalebone became unavailable, he changed to nylon rods. He did not attribute his astonishing success to any special gift, but to a knowledge of practical engineering combined with an ability possessed by many.

When Merrylees was in the Middle East and India, his skill at finding water in barren areas gave him the title "God of the water". He could even detect the presence of water from maps of places he had never visited, and proved it at a demonstration, with a map of Corfu.

Merrylees' skill was not limited to detecting the presence of unexploded bombs, but extended to inventions for defuzing them safely. Several of his methods and devices – such as the fuze extractor – are still in use today. In his nineties he still regarded himself as on the active list in case he was needed for an unusually difficult bomb.

Kenneth William Merrylees was born at Launceston, Tasmania, where his father was a successful banker. Young Kenneth was sent home to be educated at Charterhouse and Woolwich, and was commissioned into the Royal Engineers in 1915.

He served in France in 1916, seeing action at the Battle of the Somme, and was wounded in July 1917 when leading a night raid to blow up an enemy strongpoint which was blocking the advance of the British infantry.

A piece of shrapnel penetrated his shoulder and ricocheted around his body. When it was extracted it carried the imprint of the RE badge, worn on his shoulder, which it had struck before entering. Merrylees later had the shrapnel mounted on a silver plinth.

After recovering from his wounds, Merrylees was posted to Italy where again he was wounded, this time by artillery fire. After the war he was in charge of the workshops at Chatham for a while before going up to Corpus Christi, Cambridge, where he read mechanical sciences.

He then returned to Chatham to complete an electrical and mechanical course, became an instructor at the Electrical School, and was posted to India as garrison engineer, constructing roads and bridges. From 1929 to 1930 he was employed on the construction of the Kalyan Power Station, and for the next five years served in the Punjaband Frontier Province, working on roads and water supplies.

For two of those years he was stationed at the Khyber Pass, entrusted with maintaining 200 miles of road. He was field engineer in the Mohmand Campaign in 1935.

The next year he returned to Britain and spent three years at the War Office, working on such projects as the underground refrigeration plant and guns at Gibraltar, and other installations abroad, from West Africa to Singapore.

In 1939 he went to France with the BEF, on the EinC''s staff, and was evacuated the following

Col K W Merrylees OBE

May. He then joined GHQ, Home Forces, as an experimental officer on the staff of the Director of Bomb Disposal.

His next posting was to the Middle East to construct lighter wharves at Suez, camps and roads in Syria in 1941, 30 bomber and fighter airfields in Turkey, and 300 miles of roads through the Thurus Mountains to Ulukisla. As the Turks were officially neutral, and did not wish to antagonize the Germans, political delays compounded the engineering difficulties.

In 1944 he moved to India to build more airfields for use in the projected invasion of Malaya, and the following year returned to Britain to become DCE in Scottish Command. Subsequently he became DCE in Pakistan, responsible for all the roads, camps, cantonments and airfields in the North-West Frontier Province during the partition.

In 1945 he retired from the Army and joined Sir Alexander Gibb and Partners, building airfields and water supplies in Iraq.

In retirement he moved to Lavenham in Suffolk, where his sympathetic and sensitive reconstruction and conversions, of cottages, earned him the Civic Trust National Award for "outstanding craftsmanship and infinite care".

Kenneth Merrylees was a talented watercolourist and etcher, skills he inherited from his mother, Mary Eyres, who was an artist. During the Second World War he produced posters for those engaged in bomb disposal.

His military skill was noted from an early age. When he was serving in Italy in the First World War, he was described by a senior general as: "One of the most talented and capable young officers I have ever met." He not only possessed initiative, courage and sound common sense, but was unusually kind, considerate and patient.

Merrylees' talents at dowsing were undoubtedly exceptional – he could detect a bomb 50ft below the surface, and differentiate between different types of water supplies – but he considered he was always learning. He was adamant that his ability to find water did not extend, as people often assumed, to finding minerals, detecting diseases, or tracing missing people or lost objects; he believed that a single person rarely possessed more than one skill. He was in great demand as a lecturer and appeared on television, but never sought publicity or fame.

Success in dowsing, he said, required "effort, study and practice". He felt that dowsing was sometimes discredited because dowsers made avoidable mistakes.

In Rawalpindi a borehole for a hospital ran dry but Merrylees found a source 50yds away which is still flowing. He believed that there were vast underground supplies in many countries, and that when modern boring methods had failed to locate them dowsers should do so. He was chairman of the British Society of Dowsers.

He was appointed OBE.

He married, in 1938, Nina, daughter of Sir Theophilus Shepstone, who had arranged the annexation of the Transvaal, but who the Zulus called Sontseu (white father). She died in 1980. He married again in 1988, Diana Stedman.

BRIGADIER E V DALDY

Born 22 January 1901, died 9 July 1994, aged 93.

BRIGADIER Edward Victor Daldy, as a colonel, had sole control of all tugs on the UK coast for the move of Mulberry Harbour sections to Normandy after the D-Day landings. Following this he was appointed Chief Engineer 10 Corps in Italy.

A quiet man, he was a shrewd judge of people, liked to be independent and self-reliant, thought very clearly and logically, loathed idleness and had no time for inconsequential chatter. He had a well-developed sense of humour, which stayed with him to the end, and had a way of inspiring those with whom he came into contact, a quality which served him well throughout his career.

Victor, as he was known to his friends and relations, was born in Shanghai, China, one hour before the death of Queen Victoria, and in the middle of the Boxer Rebellion. An inauspicious start to a long and distinguished career and, due to the rebellion, he and his mother had to be locked up daily in an upstairs bedroom until his father came home.

On returning to the UK in 1910, he was educated at Cranbrook Preparatory School, and Charterhouse, where he became head of house, played cricket and football for the school and, as a member of the Shooting VIII, was placed third in the Ashburton Shield in 1918. On passing out of the Royal Military Academy, Woolwich, in July 1920, he had been awarded both the King's and Pollock medals. At the time he received these medals, the treasury could not afford to produce gold ones and were issuing pewter replicas, referred to by him as "putty" medals. It was much later, when he was in India, that he received the actual ones.

Posted to Dublin to gain experience during the Irish troubles, in October he returned to Chatham to attend the two-year Junior Officers Course.

Following a tour with 29 AA Company in Gallipoli, in 1923, he was posted to the Royal Bombay Sappers and Miners Depot, Poona. Throughout the next seven years, Victor held various appointments with Military Works in Bangalore, Agra and Simla/Delhi, during the latter as assistant to the Chief Engineer RAF HQ, when he was involved in reconnoitring airfield sites as the air route to Australia was in the process of being opened.

On the way to India, he played bridge and made friends with an engineer to a local maharajah. This resulted in an invitation to the Maharajah of Bharatpur's Christmas tiger shoot. Arriving by train, at a tiny station in the jungle, he was met by three Rolls Royce cars – one for him, another for the bearer, and a third for the baggage.

Returning to the UK in 1930, Victor was first appointed 2IC of 17 Field Company and then Adjutant 3rd Division Engineers. In 1936 he joined the staff of CRE Jamaica. Summoned back to England in 1939, he joined the staff of Chief Engineer BEF, and moved with the advance party in 1939 to the Arras area. Having been Mentioned in Despatches, and promoted to lieutenant colonel, he was evacuated by destroyer from Dunkerque in June 1940.

Landing in England, with a written order to report to the War Office two days later, he was hustled into a train by harassed RMP staff, who took no notice of his orders. He ended up in a temporary detention centre for deserters. He and another officer, also holding a War Office Order, failed to convince the Camp Commandant that there had been a mistake so, under cover of darkness, they climbed the perimeter wall and got a taxi to London, where they made their appointments. He often chuckled at the thought of the hunt that must have been instigated when their absence was noticed.

Brig E V Daldy

From 1940 to 1943, Victor carried out various engineer duties including six months in command of the engineer section of the Combined Operations School, before being moved to the Senior Staff College as Combined Operations instructor. Following his involvement with the Mulberry Harbour and the preparations for D-Day on the staff of Supreme Allied HQ, Victor was promoted to brigadier and appointed Chief Engineer 10 Corps.

The postwar years, before his retirement from the Active List in 1954, saw him holding a number of key appointments, including Senior Administration Officer and later Chief of Industry Division in Berlin, and then Director of Plans at HQ Rhine Army, where his primary task was the reconnaissance of northern France for a suitable site for an army base for World War Three!

On retirement he held various retired officer appointments before running an educational agency for foreign students in Brighton until 1979.

A keen sportsman, he played hockey, cricket and golf for the Corps and was captain of the Corps officers' soccer team 1921/22. He played golf until he was 88 and was captain of the veterans, and handicap secretary at his club in Hove. He was also a keen stamp collector.

He married Hazel, in Simla, in 1929. Sadly she died in 1988, but he is survived by his children, Shirley and Guy. RIR

LIEUT COLONEL J T STOKES CEng MICE MIMgt

Born 11 February 1935, died 12 September 1994, aged 59.

JOHN Stokes was the eldest of three children, whose father died when HM submarine *Thames* was sunk by a mine off Norway on 23 July 1940.

Evacuated from Portsmouth to Scotland, John won a scholarship to St John's College, Southsea, and one of his early sporting achievements was to represent the English Catholic Schools at football.

Selected for entry to the RMAS in 1953, he was commissioned into the Corps in February 1955, in Leonard's (14 YO) Batch.

His first tour of regimental duty was in Maidstone, from where he travelled to Christmas Island with a bulk petroleum team as part of Task Force *Grapple*, in support of the UK hydrogen bomb tests. Returning to the RSME in October 1964 to complete his professional engineer training, he worked as a section engineer for Fairclough, building the Mancunian Way, and for consulting engineers C S Allotts in Cheshire.

Posted to 54 (FARELF) Support Squadron in late 1966, he worked in Thailand on Operation *Post Crown*, and whilst there became a Member of the Institution of Civil Engineers in 1967. Following a tour in Barton Stacey, during which he was detached to Gibraltar for the construction of the sports stadium there, in 1971/2 he commanded 45 Field Support Squadron in BAOR. After a tour at Chatham in 1973/4 as the Senior Instructor Design in the Civil Engineer Wing, he served in HQ EinC. Promoted to lieut colonel in 1977 and posted to SHAPE, John worked in the special projects office on the construction of underground command facilities. He commanded 62 CRE Works from November 1979 to February 1982; there he was involved in design for projects in Canada, the Falkland Islands, Italy, Kenya, Northern Ireland and Malawi before returning to the RSME for his final appointment as Chief Instructor Plant, Roads and Airfields Wing.

Lt Col J T Stokes

Retiring from the Army early in 1987, John immediately returned to work for the MOD, there to apply his technical skills in the field of protective security.

The keenest of sportsmen throughout his life, in his youth a fine cross-country runner, John played cricket and football for many clubs in many lands. He played in the cricket team of 12 RSME Regiment in both 1983 and 1984; in 1984 this team won the RE, SE District and Army cricket cups.

Throughout his life, John was involved in the organization of sport for others, still serving on the committee of the Hampshire Cricket League at the time of his death. A very private person, with a delightful dry sense of humour, expert in the design, construction and hardening of public service buildings, John was one of that select group of Sappers whose career was spent building facilities and installations; his works in many countries will stand as a testimony to his ability – surely the best and proper memorial for a RE. To his wife Monica, and to their children Claire, Julia and Andrew, we offer our heartfelt sympathy. With them, the many who knew John mourn the loss of a good friend and fine Sapper officer.

JNSD, BRR, DWW, EW

COLONEL N F HUGHES TD ERD MA ScD FGS

Born 4 August 1918, died 18 September 1994, aged 76.

Col N F Hughes

NORMAN Hughes was known internationally for his contribution in the field of palynology, the study of plant microfossils – mainly pollen and spores.

Hughes took the rare opportunity afforded by the Natural Sciences Tripos in Cambridge to become a geologist with a thorough biological training and wide interests in the life sciences. In his chosen field his rigorous work led to original methods and insights. Focusing on Mesozoic stratigraphy and the origins of flowering plants or angiosperms, he developed methods for recording data and was early in employing the electron microscope, which yielded a new wealth of information beyond what could previously be seen.

The electron microscope's much greater magnification allowed a higher level of discrimination between different kinds of fossils, revealing small evolutionary changes which had previously been undetectable. Hughes argued the advantages of microfossils, which are sampled in their thousands, as compared with megafossils from which species are erected often from few or even only one specimen.

His "biorecords" related individual characters to their stratigraphic context showing how much critical information is lost when only species descriptions are employed for purposes of comparison. Many traditional palaeontologists mistakenly perceived this as a threat to the time-hallowed Linnaean system of nomenclature in which so much had been invested. Hughes advocated his biorecords as a supplement rather than a replacement to this system, whose bands of classification are far less detailed. Regrettably his rigorous reasoning was too often ridiculed rather than countered. Hence he suffered, not by his own choosing, as an anti-Establishment figure.

He argued against the common neontologists' practice of deducing evolutionary lineages from living material, on the basis that only the fossil record can provide reliable evidence. After

authoring (and editing) more than 70 scientific papers and books, his last work, *The Enigma of Angiosperm Origins* (1994), throws down a methodological challenge to the biological community, with the possibility of no explanation in a single lineage. It remains to be seen how far this challenge will be met.

Hughes was born in 1918 and educated at King's College School, Wimbledon, and Queens' College, Cambridge, where he won the Wiltshire Prize on Part I of the Natural Sciences Tripos before serving in field and survey regiments of the Royal Artillery in North Africa and Italy. He completed his Part II in 1947 with First Class Honours and won the Harkness Scholarship. His military service continued, however, till 1970 in the Royal Engineers Specialist Pool of Geologists of the Territorial Army, rising to the rank of colonel and advising on terrains in many parts of the world.

On graduating, he became lecturer in Geology at Bedford College, London, and in 1952 he moved to a university lectureship in Cambridge, where he remained until his retirement in 1985. During this period, entirely on his own initiative and working with a succession of some 25 research students, he developed an internationally recognized school in palynology. He served as President of the International Commission for Palynology in the early seventies and on many other international organizations, including two subcommissions of the Commission of Stratigraphy of the International Union of Geological Sciences, and he led projects in the International Geological Correlation Programme.

Hughes was one of the founding members of the Palaeontological Association and served it many years in various capacities. He was active in other bodies, notably the Geological Society of London, especially chairing the Stratigraphy Committee. He was awarded an ScD degree for his research in 1977.

Hughes was elected to a Fellowship at Queens', Cambridge, in 1963, and continued, till his death, serving in several college offices, not least as an expert on wine. As Steward he figured in the BBC television series on the college in 1984.

Not long before his death he and his wife Pamela, who survives him, celebrated their golden wedding anniversary. They had no children. Together they enjoyed the countryside, especially bird-watching, and he actively supported her career as an artist.

As a person Norman Hughes was a heavyweight, not easily ignored. Perhaps in the eyes of some he could appear outrageously authoritarian. But in personal contacts he was exceptionally unselfish and generous with his time, especially to students. He belonged to a diminishing university tradition where teaching is primary, requiring hours of meticulous preparation of materials.

Conscientious in all he undertook and expressing himself with economy and precision, he was one of the rocks on which the excellence of a university system is built. W B Harland

Correspondence

SINKERS

From Brigadier J N Holden

Sir, – I wonder if you or any reader knows anything about "Sinkers".

I recently met, for the first time, a wartime Sapper, Simon Hart – commissioned from Newark at the end of 1943. Talking about June 1944, he remarked that his unit, 65 Field Company had provided landing stages on the beaches before Mulberry was assembled; and after it had been damaged during the storm. He observed somewhat whimsically that this crucial contribution to maintaining the build-up had gone completely unrecorded.

The landing stages were made up of 6ft mild steel cubes called sinkers. Each cube had a long elbow pipe let into the bottom, which could be moved between the vertical and the horizontal. They were bolted together in sixes and motored across the Channel with outboard engines; the pipes being kept vertical. When in position at high tide, the pipes were moved to the horizontal; and the sinkers sank. The pipes of those above the low water mark were raised to the vertical as the tide turned. At intervals along the stage, extra sinkers were bolted to the landing stage to form quays. Thus at all states of the tide the various landing craft could come alongside the quay and unload.

I was struck by two things. First, what a splendid Sapper idea! Any damaged sinker above the low water mark could easily be dealt with: just lower the pipe, wait for the tide to go out, raise the pipe to the vertical, and when the tide comes in, float the damaged cube away for repair. And second, I had indeed never heard of sinkers, nor read anything about them.

So – did they exist? If so who invented them? And were they really motored across the Channel, if so how many were used? And lastly where, if at all, is this genuine Sapper "twigs and string" device recorded? (Or is it all an old Sappers tale?) Yours sincerely – Jim Holden

REs

From Major G R Gout

Sir, – A cold shiver ran through me when I read in the October *Supplement* on p101 on line 26 of the changes in the REs – I also felt a sudden pain in both ~~knes~~ knees. (The memory of the pain made me make that mistake.) In 1943/4 I was on my "University Short Course" at Birmingham where the 2IC of the RE Wing was WOII G A Reid RE – later major and now deceased. During a lecture from him on the organization of the Corps I answered a question from him and apparently talked of REs.

I can remember – almost word for word – his next remark to me, as follows:

"Gout we are both very privileged to be serving together in the Corps of Royal Engineers, the abbreviation of which is RE. If we were in the REs, we would be in the Royal Engineerses and there is no such animal. Come and see me in my office at 1400hrs on Saturday."

I duly reported to him and he said "Here is a bucket, soap and scrubbing brush. I want to see this floor (wooden) spotless when I return at 1700hrs. As you scrub the floor, repeat to yourself "The abbreviation for the Royal Engineers is RE. REs would be Royal Engineerses and there is no such ... animal."

You may see why I now go cold and get pains when I hear of or read of REs! Yours sincerely – Roy Gout

ICE AND RE JOINT PROFESSIONAL MEETING "THE 50TH ANNIVERSARY OF D-DAY" – 16 MAY 1994

From W D A Waters DSC (former Lieutenant RNVR)

Sir, – I refer to *The RE Journal* Vol 108 No 1 containing the article *The Mulberry Harbours* by Professor Sir Alan Harris, discussed at the above meeting. During this meeting, I queried Sir Alan's statement that the 5-fathom line where the Liberty ships were intended to moor in the shelter of the detached mole, was nearer the shore than expected. In reply Sir Alan said that the pre D-day surveys were inaccurate and that because of this the Phoenix units had to be placed in deeper water than had been originally planned, resulting in some of the units being eventually overtopped and destroyed by bursting. A detailed examination of the post D-Day hydrographic surveys has revealed that the 5-fathom line in the

vicinity of the detached mole is in fact some 200/300m further from the shore than had been anticipated thus enabling the harbour area to be increased by some 54 acres by relocating the Phoenix units further out to sea. (see ICE publication – "The Civil Engineer at War "– Vol 2 – *Docks and Harbours – Breakwaters at Arromanches* by J H Jellett – 1948). These units were finally placed in a depth of about 5½ fathoms at MLWS which, with a design height of 60ft, led to some units being overtopped. (The Port Authority must have accepted this situation as a calculated risk.)

It has to be accepted that there were discrepancies between the pre and post D-Day hydrographic surveys, which is not surprising considering the differing conditions under which they were carried out. The pre D-Day surveys carried out under the direction of RN hydrographic surveyor Berncastle, were of necessity preliminary sketch surveys in order to enable planning of the Mulberry Harbour to be undertaken. At the outset it was realized that the information obtained might necessitate modification of these plans after D-Day. (Jellett page 292.)

The question to be asked is whether planning of Mulberry B could have proceeded so well in the absence of the pre D-Day surveys? The value of these surveys was certainly appreciated by Admiral Sir Bertram Ramsey who, prior to D-Day, wrote: "on these operations depended to a very great extent, the final success of Operation Overlord." Yours faithfully – W D A Waters

A NEW BRIDGE FOR THE CORPS

From Colonel J H Joiner

Sir, – In my letter in the April 1994 issue of the *RE Journal*, I expressed the hope that the Corps' 75 years at Christchurch might be suitably marked in some way. With the acceptance of a new bridge for the Corps in August of this year, such an occasion has presented itself.

The concept for the new bridge evolved at RARDE (Christchurch) during studies for a Bridging System for the 1980s, known as BR80. With the passage of time the project became BR90, by which name the bridge is now commonly known in military circles. The continued use of this name would however date the bridge forever more, bearing in mind that it will remain in use well into the next millennium.

Thompson Defence Projects Ltd undertook the further development of the project, and are now proceeding with the manufacture of the new bridge, which they intend to market as the Thompson Modular Bridge.

May I suggest that the objective expressed in my first paragraph could be achieved if the new bridge were to be renamed the *Twynham-Thompson Bridge* (or the *Thompson-Twynham Bridge*), Twynham being the ancient name for Christchurch.

I might add that there is an excellent precedent for this, dating back to the 1930s. Mr A Hamilton patented his ideas for a new bridging system, based upon the Meccano principle, in 1933 and 1934. The new bridge was adopted by the British Army as the Unit Construction Bridge, but was almost universally known as the Hamilton Bridge. Manufacture of the bridge was undertaken by Callender's Cable and Construction Co Ltd and the bridge then became known as the Callender-Hamilton Bridge. It is under this name that the bridge is still in production today, by the Balfour Beatty Power Construction Ltd, and is in use in no less than 46 countries worldwide. Yours sincerely – Jim Joiner

GIANT VIPER

From Colonel M J Payne

Sir, – It is good to see that amid all the changes presently under way in the Corps, there is at least one element of continuity. As a young officer in 1960, I heard that the Giant Viper had had too many problems during an overlong development but that these were being solved. It was therefore comforting for a retired officer to read in the Engineer in Chief's report in the August 1994 *Journal* that the Giant Viper is still having development problems but that these are being solved. *Plus ça change* ... Yours sincerely – Michael Payne

Reviews

ISLAMIC SCIENCE AND ENGINEERING

DONALD R HILL

Published by Edinburgh University Press
Price – £16.95 (paperback), £39.95 (cased)
ISBN 0 7486 0455 3

THIS book is an introduction to the physical sciences and engineering of the Islamic world covering the period 750-1500. Doctor Hill is an established expert and author in this field and in description the book appears somewhat academic. Learned it may be but it is certainly not dull. It covers subjects in which all Sappers should take an interest, such as mathematics, astronomy, siege engines, bridge and dam construction, and irrigation. All show the extraordinary ingenuity of the Islamic engineers and stimulate the imagination of anyone who may be faced with contriving solutions where modern resources and equipment are scarce. There are also some fascinating examples of devices such as water clocks, musical automata and trick vessels – all good fun as well as incorporating basic scientific principles. All are carefully explained and delightfully illustrated.

GWAN

VALOUR ON JUNO BEACH

T ROBERT FOWLER

Published by General Store Publishing House,
1 Main Street, Burnstown, Ontario,
Canada K0J 1GO – $14.95
ISBN 1-896182-02-X

THIS book is unusual in that it tells the story of D-Day on a more personal basis by linking a historic narrative with the personal acts of gallantry, endurance and leadership as described in the citations of those members of the Canadian Forces who were awarded Orders and Gallantry medals.

The first two introductory chapters, giving background information on the Canadian Forces taking part, and on Operation *Overlord,* are concise, factual and interesting.

The linkage between historical narrative and citation appears somewhat contrived in the chapter on the "Assault from the Sky" but gets into its stride and works quite well in subsequent chapters. There is a logical sequence to the events recorded and they demonstrate how courage and leadership are not the sole privilege of the assaulting infantryman. The bravery of chaplains, medical teams, the supply services, gunners and sappers are all represented in the awards given on that day.

The citations particularly demonstrate the true leadership qualities of many who were involved, as well as the acts of heroism. They also demonstrate the latent initiative and leadership to be found in those who hold no rank – a tribute surely, to the high quality of the rank and file, and to the training which they received.

Some may find the style of the linking narrative somewhat "clipped" at times, and a number of errors have crept in unnoticed – the award to Captain Paterson (p29/30) would surely have been the Military Cross and not the Military Medal?

The illustrations, both photographs and photographs of paintings, are well chosen and some perhaps have not been seen in the UK before. The cover photograph is of the Canadian Memorial Cross given to the widows and mothers of those who lost their lives on D-Day – perhaps a note to that effect could have appeared on the inside front cover. There are lists and appendices giving the formations and units involved, notes on the various awards, a list of the awards, and a note on the abbreviations used, together with a bibliography.

An interesting approach to the subject and very readable.

GH

L'EAU A LA SOURCE DE LA VICTOIRE 1944

PHILIPPE BAUDUIN, ANDRE HEINTZ, EMMANUEL POISSON AND GWENAEL QUERE

Published by Normandie Information Impression, 12 Rue Laplace, 14300 Caen, France – FFr59
ISBN 29507 853-2-8

THIS nicely put together paperback was produced by the Agence de L'Eau Seine – Normandie to mark the 50th Anniversary of the Normandy landings. The text is in very readable French and the volume is very well illustrated with some fascinating archive photographs with captions in English.

The book tells the story of the part played by water during the Normandy campaign both as an

obstacle, the Channel, marshes and rivers, and a vital resource for the Allied armies. The story starts with exploits of the beach reconnaissance teams with their midget submarines and bubbleless breathing sets. There follows an excellent chapter on the Mulberry harbour at Arromanches before the story continues ashore. The civilian infrastructure had been badly disrupted by bombings and water supply became an important Sapper task. There are sections on water supply points, pumping stations, a fascinating section on the part played by water in the construction of the early airstrips and finally a chapter on the constant struggle for the civilian population to provide, distribute and ration water.

This small book puts a pleasing spotlight on something so easily taken for granted but neglect of which could so easily be the "source of defeat". Copies of the book are available on loan from the Corps Library and are recommended to anyone with an interest in water as a vital commodity.

TJWR

THE LONELY WAR

ERIC WAKELING

Published by Square One Publications, Saga House, Sansome Place, Worcester, WR1 1UA – Price £14.95
ISBN 1-872017 843

THIS book as described on the dust cover, is based on the personal experiences of the author and that of his friends and colleagues in the bomb disposal companies of the Royal Engineers during World War Two. As such it makes fascinating and at times exciting reading. It describes both the functions and dangers of the various bomb fuzes and the bomb disposal personnel's means of combating them.

Colonel Wakeling pays due credit to the countless Sappers who spent the war years digging towards unexploded bombs with little or no official recognition. The book is particularly interesting when it describes the author's personal actions in disposing of so many of the extremely dangerous "butterfly bombs" after the historic raid on Grimsby in 1943.

The book is written in the first person, which is excellent when describing the author's actions, thoughts and experiences. However, although he makes a disclaimer that the book is not autobiographical, it irritates a little when he uses the first person to describe actions carried out by those known to be other than himself.

This book is well worth buying and reading as it presents a personal view of the dangerous, courageous and at times amusing way of life of the men of the RE bomb disposal units during World War Two. Colonel Wakeling tells it as it was, a dirty and dangerous job with no room for mock heroics.

ASH

REFLECTIONS FROM THE BRIDGE

KEITH H CIMA

Published by Quotes Ltd, The Book Barn, Church Way, Whittlebury, Northants, NN12 8 SX – Price £17.95
ISBN 0 86023 245 9
This book may also be purchased through Corps Enterprises at a special reduced rate of £14.35 + p&p

COLONEL Keith Cima's long awaited book has been published in a limited edition, with a foreword by the Chief Royal Engineer. It is sub-captioned "The Victorian Sapper in photographs" and that is just what it is, a glorified photograph album, and none the worse for that.

Keith Cima has made extensive use of the Corps' archives, as well as other sources, and has produced what he himself calls "an informative and entertaining rehearsal of a splendid couple of Sapper generations." In no way can it be called a pictorial history, as the author readily admits, but it does give an insight into a fascinating period.

Though Kodak had brought the camera within reach of the masses by the end of the last century, photography was very much a Sapper art in its early days, going back to the Crimean War, and was taught to all young officers as well as to soldiers. The author reminds us that the Sapper photographer had six roles: to record public buildings, to copy maps, to illustrate experiments and trials, demonstrate drill positions, record international boundaries and, finally, to provide portraits of remarkable people. These roles are all portrayed, though with so many thousands of photographs to choose from, one does wonder why there are no less than seven of gabions!

The introductions to each section are necessarily brief, but the preamble to bridging, and the subsequent photographs, show how extraordinarily slow the Army was to develop these types of operations. Many of the bridging and rafting

illustrations are quaint and one can't help thinking that many resemble the type often built as initiative training in World War Two and later. "Sticks and String" have always been a prerequisite for the Sapper officer and one essential ingredient is the square lashing – if photographs are anything to go by, they were not very well taught in Victorian times!

As a vignette of the period, this is an excellent book but your reviewer was left with a slight sense of disappointment: perhaps it was caused by noticing that some of the captions were misplaced and one or two small errors had not been corrected. Nevertheless, it is a great achievement to have brought so many wonderfully evocative photographs into the public domain, rather than leaving them to fester in some dusty archive. As the Chief Royal says "The sheer breadth of the Corps' achievements is well illustrated."

Perhaps a postscript is permitted: a certain Lieutenant C H Foulkes RE, on his own initiative, established the Photo Recce Section in the Boar War – it is nice to see that his grandson, Colonel T H E Foulkes, seems to be carving out a similar niche almost exactly 100 years later with his photographs adorning military publications including the Sapper magazine! GLC

SAS WITH THE MAQUIS

IAN WELLSTED

Published by Greenhill Books, Lionel Leventhal Limited, Park House, 1 Russell Gardens, London NW11 9NN – Price £17.95
ISBN 1-85367-186-X

IAN Wellsted was an unconventional soldier who started life in the Royal Tank Regiment at the beginning of World War Two. Based in England, but longing for excitement, he volunteered for the Parachute Regiment in 1943, eventually joining the Special Air Service (SAS) and being parachuted into France. After the war he transferred to the Royal Engineers, retiring as a colonel in 1967 to live in Australia.

He was dropped behind the enemy lines, in the Morvan, on the night of D-Day with three companions to act as the reconnaissance party for the rest of "A" Squadron of First SAS Regiment. Adopting the nom de guerre of "Gremlin", the book was originally entitled "By Guess, By God, and by Gremlin!", surely a better title than the one insisted on by the publishers, but then this is the year when almost anything to do with the SAS sells! This book is no exception and covers a little known period of the SAS's history, when momentous events were taking place elsewhere in France.

This very modest account was written almost immediately after the events described and, nearly 50 years later, has been printed with only the smallest amendments and corrections. This is evident in some of the text, which reads at times like a "Boys Own" story, but there is so much unsaid and one only has to read between the lines to imagine the excitement, the fear and the sheer exhilaration of operating behind the lines in German-occupied France.

What makes this book so unusual is that the author tells his story, warts and all. He tells of their successes but also of their mistakes, his own foolishness, the quarrels and the insubordination. He relates how one of his junior NCOs, a man highly trained in the individual skills demanded of the SAS and of undoubted courage, refuses to do as he is told and how, several months later, in the presence of two sergeants to see fair play, they settle their private feud with bare fists. Truly an unconventional soldier!

He describes the boredom, waiting in dripping woods for parachute drops or for an operation to begin, days with little to do, days that are so common in war but are then transformed into periods of intense activity, of fierce battles, of deadly peril. All this is related in such a matter of fact manner that it is sometimes hard to realize that this is happening several hundred miles behind the enemy lines. There were Germans everywhere and one is suddenly aware of the danger when he tells how reprisals were meted out to those who helped the *Maquis* or the SAS: in Dun-les-Places, the *curé* was hung from his belfry in full view of the whole village. This was followed by the murder of 27 others. It was a fierce and bitter contest with no quarter given by the *Maquis*.

These memoirs cover little more than three months and end with the squadron driving back through the German lines and joining up with the advancing Allies breaking out of the Normandy bridgehead. It is an epic tale but it would have been greatly improved if there had been better maps, especially as some of the incidents are described in great detail and are difficult to follow. Where exactly is the Morvan?!

GLC

ARNHEM 1944
THE AIRBORNE BATTLE
17-26 SEPTEMBER

MARTIN MIDDLEBROOK

Published by the Penguin Group – Viking Penguin Books Ltd, Harmondsworth, Middlesex
– Price £18
ISBN 0-670-83546-3

MR Middlebrook was commissioned to write this book by the head of Penguin's Dutch office for the 50th anniversary of the Battle of Arnhem. He had already written 13 full-length books on various military subjects, which were characterized by meticulous research. This book is no exception. It is the most comprehensive book on the subject that has yet been written. Its blend of meticulous research based on original documents, and the personal accounts of 500 participants give it very wide cover of every aspect of the operation, and the feel of the terrible fierce fighting. As one gets into the book one is lost in admiration at the valour of our soldiers, who hurled themselves again and again against the blocking German defences. The injuries they sustained were horrendous, and the casualties were enormous. Parachute battalions which dropped at a strength of 550 were reduced to 30 men in two days of this fighting.

Mr Middlebrook starts with the strategic background and planning of the operation. From this it is clear that the operation was doomed to failure from the start if there was any German opposition – and there was plenty.

The brilliant strategic plan is well known. A carpet of airborne units would be laid, capturing the bridges over the rivers and waterways in Holland from the Belgian border to Arnhem on the Lower Rhine (64 miles). Up this would rush the 2nd British Army, debouching on to the north German plain, a single thrust to Berlin (Montgomery's plan) or the northern pincer of the encirclement of the Ruhr (Eisenhower's plan). There would be a subsidiary thrust to the Ijsselmeer (Zuider Zee) to cut off all the Germans to the west. It would have worked but the execution was faulted. The cardinal principle of airborne operations, to land the whole force in one lift on the objective was ignored. The RAF insisted on landing the 1st Airborne Division seven miles from the objective in three lifts spread over four days. Yet the week before for Operation *Comet*, a one-division operation from which the three-division Operation *Marker* grew, the 1st Parachute Brigade was to drop on the area just south of Arnhem Bridge. Had this plan been maintained the outcome would have been very different.

Because the Division was split into three lifts, only the 1st Parachute Brigade was available to capture the bridge on the first day. Only 600 (of which 100 were Sappers) reached the bridge, and held it for three days against fierce attacks by infantry and armour. The 1st and 3rd Parachute Battalions, save C Company, could not get through the German defences, initially set up by SS (Shutzstaffel) Major Kraft's SS Battalion, which was exercising in the area at the time of the landings, and set up their blocking positions by the time the airborne troops left the dropping zone. Kraft was subsequently backed up by elements of 9th and 10th Panzer Divisions also in the area.

The half of the Airlanding Brigade Group which landed on the first day, was retained in the landing zone area to protect it for the second lift due on Monday morning. The second lift was late, and suffered considerable casualties from the German flak batteries, who were expecting them. Further attacks were launched by the 4th Parachute Brigade and gliderborne battalions through the woods at Oosterbeek to reach the bridge, but it was too late. German armoured reinforcements had arrived and blocked all attempts by the lightly armed airborne battalions to break through. The fighting was fierce, and there were heavy casualties on both sides. The infantry battalions of the division were destroyed.

The battered remnants of all units were withdrawn to form a perimeter based on the fast flowing Neder Rhine (200m wide) and reaching up to Oosterbeek one mile north of the river. The perimeter was half a mile wide. It was hoped to reinforce the Oosterbeek garrison with the 1st Polish Parachute Brigade, but the weather was bad in England. Only about 1000 Poles dropped in the face of fierce fire on Thursday evening 21 September, at Driel, on the south side of the river, but there were no boats to get them across. By Sunday elements of the 43rd Wessex Division arrived. An attempt was made to get the 4th Dorsets across, plus some Poles, at 1am on Monday morning. Only 315 Dorsets got across, 200 being captured

The same day it was decided to evacuate the remnants of 1 Airborne Division. Some storm boats manned by Canadian engineers arrived, and the 43 Divisional Engineers manned assault boats. 2500 men were evacuated in difficult conditions with the rearguard under attack.

There is comprehensive information on air operations including a chapter on the resupply flights, and complete appendices on the orders of battle of the RAF 38 Group (superseded bombers for glider towing and resupply) 46 Group C47 Dakotas (parachute dropping and resupply) and US Air Units carrying parachutists. These appendices include figures for sorties made, losses in aircraft and aircrew. The RAF paid dearly for a policy of multiple lifts, 64 aircraft being lost on resupply flights alone. After the surprise of the initial landings on Sunday 17 September, the Germans brought in numbers of flak units, including a brigade of five flak batteries from the Ruhr. Resupply flights ended on Thursday 21 September.

This is a big book, 477 pages of text packed with information and personal accounts. There are comprehensive appendices showing the order of battle of every unit that took part, their commanders, strengths and casualties. There are 13 excellent maps, which enable the reader to follow the complex nature of the fighting, and 38 photographs illustrating the type of men who fought there, and many of the places where they fought.

This is a book for anyone who wants to know what went wrong in the last major defeat in battle suffered by the British Army. It unfolds with the dreadful certainty of a Greek tragedy.

EMM

THE FIGHTING NATION
Lord Kitchener and his Armies
A J SMITHERS

Published by Leo Cooper,
Pen & Swords Books Ltd, 47 Church Street,
Barnsley, S Yorks, S70 2AS – £16.95
ISBN 0 85052 389 3

KITCHENER has had a bad press in recent years. It has been fashionable to disparage his achievements across the board as soldier, administrator and statesman. Often backed by detailed research, critics have analysed particular episodes such as the Nile Campaign of 1898-99, the Second Boer War and the row with Curzon over control of the Indian Army, to present a picture of a man who as a field commander was indecisive and indifferent to casualties or human suffering, as an administrator was given to fatal over centralization and as a statesman was guilty of underhand dealings and using social contacts to achieve his ends. This picture is often embellished by observations on Kitchener's personal lifestyle such as his idiosyncratic attitudes to the individuals he chose for his staff, his chaotic working methods and disinclination to delegate; and outside of his work, the magnificence of his tastes and his love of collecting objects of fine and decorative art.

In "The Fighting Nation" A J Smithers has risen above all that to point out what really matters about Kitchener. He invites us to look at the whole wood and not simply the trees. His message is that, in a sense, all that happened before 1914, the triumph of Omdurman, the uncompromising struggle to bring the Boers to submit and even the Olympian contest with Curzon was trivia set beside the task that confronted Kitchener when he arrived at the War Office as Secretary of State. "The Fighting Nation" is no great tome with pages of footnotes, references and bibliographies. It is 200-odd pages of limpid common sense by an author who has a vast knowledge of evolution of the British Army of the 20th century and the characters of the personalities involved. Moreover his own experiences as an infantry officer in some of the worst fighting of the Second World War when Kitchener's work was barely a generation old, lends some conviction to his views on what armies should be like.

Jack Smithers is a friend of the Corps as anyone will testify who has read his affectionate and enjoyable account of the enduring work of the Corps, "Honourable Conquests", published by Leo Cooper for the benefit of the Museum. However "The Fighting Nation" is born of a deeper conviction, arising out of his personal knowledge of the experiences of a First World War subaltern, Charles Carrington, that the British way of life was then only saved by a hairsbreadth. This work is perhaps more focused than "Honourable Conquests" but the readable style is there, laced with wit ("The best was always good enough for Lord Curzon") and apposite quotations. Some of the latter are surprising, for example Kitchener, not noted for admitting error is quoted as saying after the battle of Paardeberg, "If I had known yesterday morning what I know today I would not have attacked the Boers in the river valley; it is impossible against the modern rifle."

The first three chapters of this book make as good a summary of Kitchener's career up to 1914 as anyone could wish – required reading perhaps for troop commanders wondering what sort of a man it is that glares down at them in the HQ Mess dining room. Such a summary could not investigate the

detail of the more controversial events but issues are not ducked. The story makes it quite plain that, as in any great man's career there are other interpretations to be read by those who wish to do so. Wellington made many mistakes on the road to Waterloo. Kitchener's Waterloo was the hair-raising challenge that confronted him in 1914, a situation which like the great Duke before him, few others had the vision to grasp let alone the capacity to handle. That story, occupying the rest of the book, is both an invaluable reference of how the armies were created (an excellent summary of all the divisions forms an appendix) and a gripping account of the events in Europe which seems to give full justification to Jack Smithers' claim that "If we in these islands ... still retain any freedom to decide how we shall be governed and what manner of lives we shall lead it is because of the existence of one man, above all others". Extravagant? Read it and see.

GWAN

Abbreviations used in this Journal

CO	Commanding Officer	m	metre/s
cm	centimetre/s	mm	millimetre/s
etc	et cetera	mph	miles per hour
ft	foot or feet	mpg	miles per gallon
HM	Her/His Majesty	NCO	Non Commissioned Officer
HMS	Her/His Majesty's Ship	OC	Officer Commanding
hr/s	hour/s	RE	Royal Engineers
HQ	Headquarter/s	SNCO	Senior NCO
in/s	inch/s	TA	Territorial Army
JNCO	Junior NCO	UK	United Kingdom
km/s	kilometre/s	UN	United Nations
Lieut	Lieutenant	USA	United States of America
M	Million/s	yd/s	yard/s