THE ROYAL ENGINEERS JOURNAL DECEMBER 1988 VOL

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DECEMBER 1988 VOL 102 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 witty.

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

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

Copy. Ideally the text should be double space typed and include the author's pen picture and captions for art work.
Photographs, should be black and white but colour and transparencies can be accepted. Quality is essential. A head and shoulders photograph of the author would also be helpful.

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

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

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

Contributions to the Journal *should reach the Editor by:*

6 January for the April issue
Early May for the August issue
Early September for the December issue

Submissions before the deadline will be particularly welcome.

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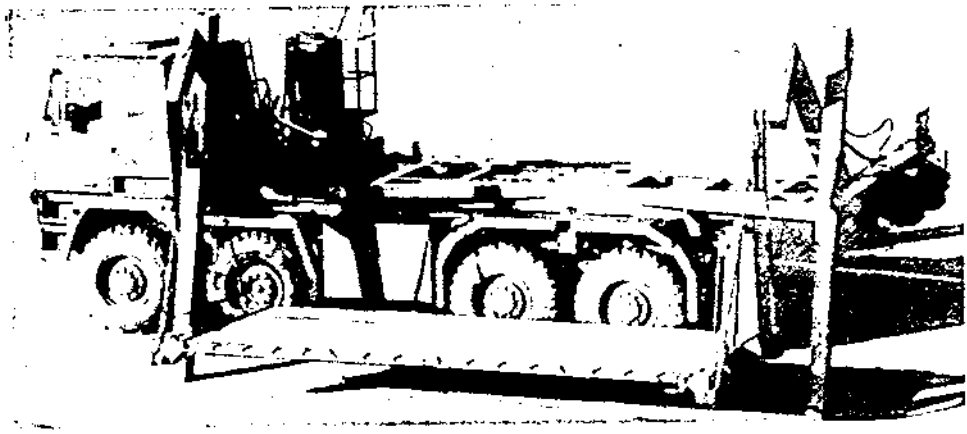

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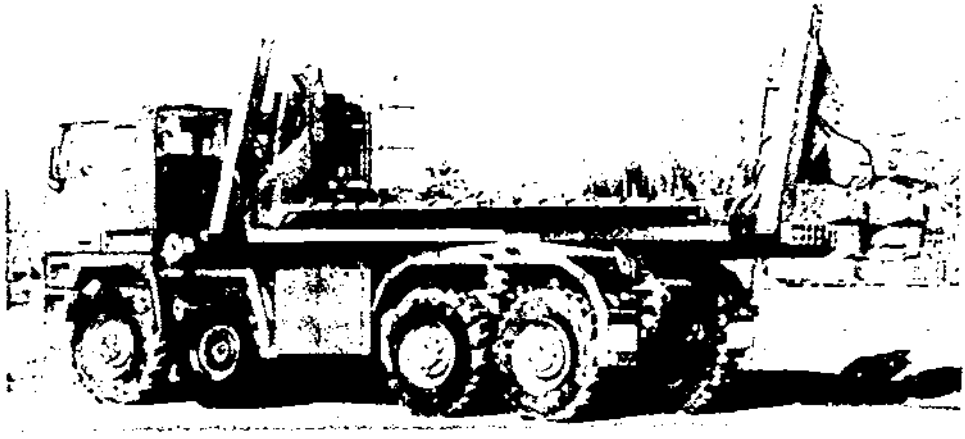

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ISSN 0035-8878

THE ROYAL ENGINEERS JOURNAL

Published in April, August and December by The Institution of Royal Engineers, Chatham, Kent ME4 4UG. Telephone Medway (0634) 42669

Printed by Staples Printers Rochester Limited, Love Lane, Rochester, Kent.

Volume 102 DECEMBER 1988 No. 3

Contents

4,350

Editorial

ANNIVERSARIES come thick and fast and this *Journal* recognizes several. The first part of Anne Cavendish's article, the last of her trilogy about Britain's nineteenth century affair with Egypt and the Sudan in which so many Sappers took a leading role, appears in the year of the 90th anniversary of the battle of Omdurman. Kitchener's reputation has taken something of a battering since that high point in his career. Perhaps the pendulum of historical perspective will swing again in time for the centenary in 1998.

Diving in the Corps celebrated its 150th anniversary this year and Colonel Peter Chitty's account of the early work of Charles Pasley graphically makes his point that Pasley's work should be compared as a marker of human achievement with the landing on the moon in our own century.

The Queen's Gurkha Engineers appear in celebration of the fortieth anniversary this year of the establishment of their particular mafia within the Corps showing us perhaps, that the Corps family is perfectly able to accommodate such specializations within the overall family without dire consequences. Major Taylor's article on this theme in the August issue has surprisingly so far prompted no response apart from the unanimous view of the Publications Committee that it merited the top special award of £75 for the articles in that issue.

RE 200 is again recalled in the pair of articles on solving the dispute over the relative positions of London and Paris, the 1787 and 1987 versions. We see that the reenactment was more than a bit of fun for last year's celebrations. But perhaps the point has yet to be made that Roy's achievement in the eighteenth century was all the more remarkable for the fact that France was then Britain's most obvious enemy. Sappers at the time were engaged round the coastline of Britain planning and building fortifications against the threat of invasion from across the channel. France was within two years of erupting into revolutionary chaos. The survey could be compared to the ideas for scientific cooperation on space research between Russia and America in our own day. The London-Paris connection in 1787 was certainly no harbinger of detente.

However, the greatest anniversary that we need to acknowledge this year must be Australia's two hundredth birthday. We offer two articles to mark the event, one on the early influence of the Corps from which we see that the first Royal Engineer to set foot in Australia did not arrive until 1835. Apparently such key strategic places as Mauritius took priority. Sappers seem to have made up for lost time however not only in the period covered by Simon Jones' article but also later in their involvement with the development of the forces that were eventually to develop into the Royal Australian Engineers. As always, however, it was a two-way process and the experience of Sappers in Australia fed back to the benefit of the home country in a number of ways. In particular the experience of handling and the treatment of convicts led to Sappers playing a leading part in prison reform in England and Scotland. Australia was also an active field for the development of submarine mining and the Brennan torpedo, the brainchild of an Irish Australian. It was the world's first guided weapon, the direct result of an operational requirement by no means limited to home shores.

We salute our fellow Sappers in Australia in appreciation of the part they have played in our own development, to say nothing of the sacrifices made together in defence of our mutual interests in two world wars.

But it is not the purpose of the *Journal* to hark back to the past except to provide a baseline from which to consider the future. Our second article on Australia makes the point well with its entertaining account of the futuristic New Parliament Building in Canberra. In offering our readers all good wishes for Christmas and for all that lies ahead in 1989, we express the hope that they will contribute to our columns in the same spirit of venturing into the future as engaged the likes of Charles Pasley and the early Australian pioneers.

British Military Engineers and the Birth of Australia

MR S R JONES BA(Hons)

After graduating with BA(Hons) in History and English from Sunderland Polytechnic, Simon Jones has been employed by the RE Museum since July 1987 as an assistant to the Curator. He has compiled this article at the request of the Editor to mark the bicentenary of Australia.

"THE appointment of a Captain of the Royal Engineers, if he be a highly competent, active, and zealous Person, is one of the first consequence in a Country where everything is new, — where everything is to be done, — and where there is a mass of labourers of the most depraved habits to be controlled, and to be compelled to work".

Thus wrote Sir George Arthur, Lieutenant-Governor of Van Diemen's Land, following the arrival in 1835 of Captain Roger Kelsall, the first serving officer of the Royal Engineers in the Australian colonies. In 1788 Captain Arthur Phillip had landed at Botany Bay having been sent by the British Government to establish a penal colony on the newly discovered continent of Australia. This he did at Port Jackson (later Sydney) and in 1803, partly to forestall French influence, a further penal settlement was established in Van Diemen's Land. In these colonies, however, there were no Sappers for nearly 40 years.

Transportation to America had ceased with the War of Independence and the consequent overcrowding of jails and prison hulks combined with a desire on Britain's part to establish a strategic presence in the Pacific led to this, the first phase of shipping criminals to Australia. It lasted until 1810, when about 9300 men and 2500 women had been transported, by which time the build-up in jails and hulks had been cleared and the war against Napoleon demanded convict manpower for dockyards and the armed forces. Between 1811 and 1830 a rising population, growing towns and (especially after 1815) high unemployment, marked the second phase in which about 44,100 men and 6100 women were sent. During the third stage, 1831 to 1840, 43,500 male and 7700 female convicts were sent but by the end of the decade liberal opinion was growing in Britain against the policy of transportation and, in 1840, all transportation to New South Wales ended. Between 1841 and 1850 26,000 convicts were sent to Van Diemen's Land but no more were sent after 1853. The last convicts sent went to the new colony of Western Australia following an appeal for cheap labour and 9700 arrived between 1850 and the end of transportation in 1868.

At Port Jackson and Norfolk Island, which were to become part of New South Wales, convicts themselves were used to oversee the work of the others and act as tradesmen. Military defences were organised by a succession of officers, seconded from the marine or infantry garrisons, acting as 'engineer and artillery officers'. In 1802

Mr S R Jones
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George Bellasis, was thus appointed. A former lieutenant in the Honourable East India Company, he was also a convict, having been transported for killing a man in a duel. Both civil and military works came to be supervised by military personnel and in 1826 Captain William Dumaresq, of the Royal Staff Corps, was made acting civil engineer and then inspector of roads and bridges. A company of the Royal Staff Corps accompanied him to supervise convict labour but, as they were more inclined to be corrupted by the convicts than to keep them working, had to be disbanded. Soon the other ranks of the Royal Staff Corps itself were absorbed by the Royal Sappers and Miners, the officers being placed on the half-pay list.

New South Wales 1833-1855

In 1833 the Governor of New South Wales, Sir Richard Bourke, made another of many pleas to the War Department for a Royal Engineer officer, on the grounds of the financial saving that would accrue. By this time there were more 'free' settlers — that is pardoned convicts, the children of convicts, officials and actual emigrants — than there were convicts under sentence. The Treasury decided that the Australian colonies could now support the cost of public works and that only the military establishment and the convicts should be financed by Britain. To supervise the military works Royal Engineer officers were sent to New South Wales and Van Diemen's Land.

Thus in December 1835 Captain George Barney arrived in New South Wales, with his wife and three of his five children. His previous service in Jamaica in charge of civil works provided him with some useful experience, as had inspections of the prisons around London. Barney's assistant, Lieutenant H W Lugard RE had arrived the day before when his convict ship had run ashore south of Jervis Bay. Just a few hours previously, the afore mentioned Captain Kelsall had landed in Van Diemen's Land.

The experience of the Royal Engineer officers in the colonies was to be broadly similar in that the duties of the military and convict establishment often overlapped the needs of the colony in general. Captain Barney's main duty was to safeguard and maintain the buildings and stores appertaining to the military and convict works but he was at once employed by Governor Bourke on a breakwater at Newcastle and on improving the navigability of the Parramatta River. Governor Bourke persuaded the Secretary of State to allow him to employ Captain Barney as colonial engineer on the grounds that it would cost half as much as paying a civil engineer. Barney was given a separate staff and the routine parts of the convict and military work were left to Lieutenant Lugard. The convict chain gangs used as labour in quarries and brickworks and to build roads were supervised by the infantry garrison overseen by Barney. He also took over responsibility for roads and bridges and some of the work of the colonial architect, with the result that he was badly overworked.

The new Governor of New South Wales who took office in 1838 was an officer of the Royal Engineers, Sir George Gipps. Described by the historian Robert Hughes as a "strikingly prudent and humane governor", Gipps served from 1838 until 1846. He was soon to complain of the lack of engineering ability of his staff when in August 1839 he told the Legislative Council that:
"I have not one Officer attached to the Service, who is capable of Surveying a Line of Road, of determining the Levels, or of framing a Report upon which I could act".

Barney spent half of his time with roads and had under him 2200 men, mostly convicts, including 900 in irons. By mid-1842 they were widely dispersed on projects with 271 convicts at work on a breakwater at Newcastle, 208 on a new road to Goulburn, 160 on an orphan school at Parramatta and 133 on a breakwater at Wollongong. When Barney was recalled in 1842 he had both family ties and business interests in New South Wales and Gipps decided in the meantime to retain Barney in the post of Colonial Engineer. This seems to have upset his successor, Lieutenant-Colonel James Gordon RE, who expected both the military and the colonial posts for himself. While Gordon supervised the virtual completion of Victoria Barracks in Sydney, Barney gave his full attention to the colonial work of roads and bridges, water supply and drainage for Sydney and the works at Newcastle and Wollongong. This freedom for Barney was to last just a year for in 1843 the Legislative Council of New South Wales refused to make an allowance to employ an engineer for 1844, the alleged reason being that "during seven years before, a most liberal allowance had been attended with little benefit to the Colony". The civil works

Victoria Barracks in Sydney

of New South Wales therefore ceased to be the responsibility of the Royal Engineers from 1844 and, after more than eight years strenuous activity, Lieutenant Colonel Barney departed for England.

Unfortunately it was Governor Gipps' liberality that was to make him many enemies in the colony. One of his first actions was to bring to trial a dozen cattle stockmen for the murder of twenty-eight unarmed Aborigine men, women and children in retaliation for the theft and stampeding of cattle. There was an outcry amongst many of the settlers when seven of the accused were hanged. Although successive governors had ruled against it no one had before been executed for murdering aborigines, indeed thousands had already been killed as the land on which they lived was taken for sheep and cattle grazing.

Governor Gipps presided over the phasing out of the use of convicts as workers assigned to private, often ex-convict, employers and the encouragement of genuine emigrants to take their place. Ironically, Gipps' attempts to make New South Wales a more attractive place to settlers made him even less popular. Norfolk Island, part of Governor Gipps' command but way out in the Pacific a thousand miles east of Sydney, was a colony within Australia. Abandoned in 1814, it was reoccupied in 1825 as a centre of punishment for those convicts who again offended: "Felons on Norfolk Island" instructed the then governor of New South Wales, Sir Thomas Brisbane, "have forfeited all claim to protection of the law". The practical reality of this was that convicts were completely degraded by means of relentless labour, little food and merciless flogging. Death could be welcomed as an escape from the regime and convicts are known to have formed suicide pacts: one would be murdered, the killer would then hang in Sydney.

Feeling against transportation in Britain led to its discontinuation to New South Wales in 1840. In that year the Colonial Office appointed a new commandant to Norfolk Island, a man with radical ideas which transformed it from a centre of punishment to one of reform. Alexander Maconochie introduced a system based on the earning of marks for good conduct which

was intended to teach the convicts that good behaviour was linked to self-interest. However, difficulties arose as the scheme was intended for prisoners new to the colony, not those on Norfolk Island who had experienced the worst of the system. A compromise was reached whereby a new group of convicts would be sent to Norfolk Island in addition to those already there. Lieutenant Lugard, probably the first Royal Engineer officer on the island, was sent to arrange for their accommodation and had temporary wooden barracks erected. Maconochie disobeyed Gipps' instructions and allowed the two groups to mix. The upshot was that Norfolk Island became so humanely run that it threatened to function no longer as the ultimate terror of the convicts, on the contrary if word reached the mainland convicts might commit crime in order to be a part of the experiment. In 1843 Gipps visited Norfolk Island and found that the system there had much to commend it, however the lobbying of Maconochie's opponents led the Colonial Office to recall him. The following year control of Norfolk Island was passed from New South Wales to Van Diemen's Land, and all men transported there were to spend the first portion of their sentence on Norfolk Island.

Barney's departure from New South Wales in 1844 did not mark the end of his involvement with the colony. He was appointed Lieutenant-Governor of a short lived colony in North Australia, intended as a new convict settlement to relieve the overcrowding of Van Diemen's Land, but was ordered to abandon it in April 1847 after only a few months. For the remainder of the year he was employed by the new Governor of New South Wales, Sir Charles Fitz Roy, mainly to advise on fortifications, until he was appointed Chief Commissioner for Crown Lands.

Fitz Roy's successor was Sir William Denison RE, previously Governor of Van Diemen's Land (now Tasmania).

The events leading up to the time of his appointment to New South Wales were as follows.

Van Diemen's Land

In Van Diemen's Land, despite the expression of approval from Sir George Arthur at his arrival in 1835, Captain Kelsall was to experience difficulties in his relations with the Lieutenant-Governor and with his successor, Sir John Franklin. The most serious dispute arose over the CRE's claim to an exclusive right to any skilled tradesmen amongst newly arrived convicts. These would be much in demand as the convicts were 'assigned' as workers to the Colonial Government and to the settlers and Kelsall's claim was regarded as unfair. Kelsall sent his report of the matter direct to the Master General and Board of Ordnance, refusing to divulge its contents to Franklin until ordered to. Kelsall required the labour for the building and maintenance of convict and military accommodation and lands; he also advised on fortifications for Hobart Town and Launceston. Van Diemen's Land initially having few civil works, the post of civil engineer was abolished in 1838. However by the time of the arrival of Kelsall's replacement in 1843, Major J C Victor RE, the volume of civil works had increased to the degree where Lieutenant-Governor Franklin proposed dividing the duties into two posts. This was rejected by the Secretary of State for Colonies who, having been impressed by the arrangement in New South Wales with George Barney, arranged that Victor also should be CRE and Director of Public Works. Unfortunately he showed little interest in civil affairs and "rarely visited the public works office". His orders from the Board of Ordnance prevented him from using Ordnance Department staff on colonial public works, but he displayed intransigence in his refusal to allow stores to be managed by others when these were required to build accommodation for convicts released into country centres on probation.

The Lieutenant-Governor of Van Diemen's Land from 1847 to 1855 was a Royal Engineer, Sir William Denison, who brought with him two other Sappers: Lieutenant Charles Stanley, nephew of the former Secretary of State for Colonies, and Lieutenant Andrew Clarke[1]; a son of the then governor of Western Australia. He

[1] *Later Lieut General Sir Andrew Clarke GCMG CB CIE. Passing out head of his batch at the RMA in 1844 and after service in Ireland, Clarke was sent, at his own request, to Van Diemen's Land. Whilst Surveyor-General of Victoria he became closely involved with the colony, eventually acting in 1900 as a delegate for Victoria's interests at the Colonial Office over the bill to settle Australian federation.*

soon had trouble with Victor, however, over his refusal to co-operate with the construction of Franklin Wharf. This was to be a stone quay backed by a large area of swampy land to be filled and sold for the benefit of colonial revenue. When Denison found little work in hand he asked Victor to supply plans and estimates for its completion but received the reply "that he did not consider this to be a service which came within the province of the Royal Engineer Department". Victor only carried out the work under protest, in reply to a complaint to the War Department from the Secretary of State for Colonies the Permanent Under-Secretary wrote:

"In justice to the officers of that distinguished Corps, his Lordship must express his belief that they almost universally show a strong desire to make themselves generally useful, and that the reluctance to do so manifested in this instance by Lieut Colonel Victor, is an exception to their usual conduct". Victor was soon recalled to England, but Denison was to have continued difficulty with his replacement, Captain John Twiss RE. In 1850 Denison asked that a Sapper on the CRE's staff, Lieutenant C S Akers, might be spared to survey a line of road from New Norfolk to Hamilton. Although Twiss allowed him to do the work he withdrew his extra pay and allowances on the grounds that he was engaged on work for the colonial government. This time Denison wrote privately to Sir John Burgoyne, the Inspector-General of Fortifications, who spelt out that Royal Engineer officers were generally "to furnish every assistance in their power toward Colonial Services which do not interfere with their primary duties for the ordnance services". During his term of office Governor Denison paid particular attention to the surveying of Van Diemen's Land. A board of enquiry, appointed by him, reported in 1850 that most of the existing survey was inaccurate. This was because the limited manpower of the Survey Department meant that triangulation had never been extended beyond the land required for settlement and because contract surveyors had proved unreliable. At Denison's request Captain John S Hawkins RE and fifteen Sappers and Miners, drawn from the companies engaged in the Ordnance Survey of Britain, arrived in Van Diemen's Land. By this time there were more pressing needs than a trigonometrical survey and, as Hawkins recalled, "I cheerfully undertook any duty that appeared to me conducive of the public benefit". This did not take into account the opposition of the Legislative Council to all things Imperial, including Hawkins and his Sappers and Miners. The council decided in the Autumn of 1855 that it would sooner employ civilian surveyors as a means of encouraging young men to enter useful and honourable professions. The men therefore were packed off to New South Wales where under Denison, the new governor, their services were more appreciated.

Lieut General Sir William T Denison, Kt, KCB

Governor Denison left Van Diemen's Land for New South Wales at the beginning of 1855. During his eight years in office he had seen the end of transportation, the introduction of representative government and the enactment of a new constitution. Despite being at times unpopular, it was accepted in both Van Diemen's Land and London that his administration had been a successful one.

The remaining history of the Royal Engineers in Van Diemen's Land, renamed Tasmania in

British Military Engineers and the birth of Australia (2)

1853, is not happy in so far as it consists of continuing friction between the CREs and the Legislative Assembly. An exception was the service of Captain F R Chesney RE who arrived in Hobart in 1862 and who, following the Volunteer Act of 1863, commanded the Southern Division. His departure in 1867 was widely regretted; by 1871 the Imperial garrison had been withdrawn from Tasmania.

New South Wales from 1855

Sir William Denison's arrival in New South Wales meant that engineering matters received the attention that they deserved at a time of expansion. He gave immediate attention to the defence of the colony, owing to the grave international situation, temporarily abandoning less pressing works for those giving protection to the town of Sydney. He next overhauled the Survey Department and instituted a commission of enquiry which included Captain Andrew Clarke RE, now Surveyor-General of Victoria, and Captain J S Hawkins RE, from Tasmania. As in Tasmania the commission reported that much of the survey work done during the past twenty-seven years was inaccurate and this resulted in Lieutenant-Colonel Barney RE being appointed Surveyor-General. Captain Hawkins' party were placed on arrival under the direction of Barney, who put them to work investigating possible railway extensions. Within twelve months, work accomplished included the surveying of a route from Campbelltown to Goulburn, another up the Hunter River from Maitland and another in the Moreton Bay district. The Sappers had to prepare much of their equipment themselves including the engraved copper plates for the graduation of levelling staves and protractors for plotting plans. After Captain Hawkins' departure for Britain, in 1857, the work continued for three years under the senior NCO Sergeant Henry Quodling and included a particularly difficult survey westwards by way of the Grose River Valley of which the Chief Commissioner reported:

"ravines and gulleys, never, it is believed, before entered, have been explored, and days passed in the necessary examination of valleys where it is dangerous for man, and impossible for a horse, to pass".

A third important step taken by Denison was to rationalise control of public works, in particular railway construction. The two private railway companies had been purchased by the Government during 1855 and a Sapper officer, Captain E W Ward, made temporary Chief Commissioner of Railways. Denison gained the approval of the Legislative Council to ask for a Royal Engineers officer to be sent to act as a permanent 'Superintendent of Railways or Chairman of a Board of Works'. After three or four officers had declined the post, Captain Martindale RE accepted, although by the time he arrived in New South Wales a treasury decision had withdrawn the military pay from officers in civil employment. A letter from Sir John Burgoyne gives an insight into the reputation that service in Australia had at this time, even fifteen years after the last convicts had been sent to New South Wales, when he refers to:

"the difficulty I have found in obtaining anyone whom I could recommend to undertake the service, the impression being that under the present working of the Constitution of the Colony the situation might be subject to many embarrassments, and be altogether too precarious in tenure and emoluments to induce men who had already become well known for their capabilities to venture upon it".

Martindale, in addition to his work on railways, was in charge of roads and the electric telegraph being installed in New South Wales. In 1859 his appointment became 'commissioner of internal communications', but — although 'zealous and intelligent' — he was unwilling to accommodate his actions to the hostile Legislative Assembly or the press. This led to his resignation after only three years service and a belated motion of appreciation from the Assembly. In the same year, 1860, Lieutenant-Colonel Barney also retired as Surveyor-General of New South Wales having served in Australia since 1835; he died two years later in Sydney.

An unusual role for the Royal Engineers had been the establishment in 1853 of a mint in Sydney, in the charge of Captain E W Ward RE, with sixteen Sappers and Miners. Captain Ward remained in the colony until 1865 and advised on a number of engineering projects, becoming a member of the Legislative Council and a respected member of Sydney society. The detachment remained in Sydney until 1868 when it ceased to

exist, leaving no Royal Engineers in New South Wales.

Victoria

In July 1851 the Port Phillip District of New South Wales had been created the Colony of Victoria. In this same month gold was discovered 100 miles from the capital Melbourne and then, the following September, just 75 miles away at Ballarat. This was the start of the first Australian gold rush and by the middle of the following year an estimated 50,000 people had flocked to the diggings. The Legislative Council became concerned that the colony, with its new found wealth, would become a potential target for an aggressive power and asked that the Lieutenant-Governor apply "to the British Government, to send out to this Colony immediately a sufficient body of Sappers and Miners, with their proper Staff of Engineers, to enable the Colonists to construct, at their own cost, the necessary defences to protect their noble harbour, and rapidly increasing Towns."

In the meantime Lieutenant Andrew Clarke arrived from Tasmania as Surveyor-General and Lieutenant Charles Pasley RE, son of the distinguished founder of the School of Military Engineering, arrived for duty as Colonial Engineer and Architect. When an officer, Captain Archibald P Ross RE, arrived to deal with the defence of the colony it was made clear that, unlike that of Clarke or Pasley, his was a purely military appointment. He was to depart from Victoria in 1855 being able to achieve little owing to the Legislative Council's reluctance to pay for his recommendations. Clarke, however, was to leave behind him a solid record of achievement, not only in surveying. He introduced local government, established the state railway system, installed the electric telegraph and founded the natural history museum. Pasley left behind him a number of public buildings and was also — amongst many other things — Chairman of the Central Roads Board, a member of the Board of Science, on the committee of the Zoological Gardens and first patron of the Victorian Institute of Architects. When Pasley retired, in 1860, Captain Peter Scratchley RE arrived with twenty-one other ranks again for the purpose of organizing the defences of Victoria. There was some delay when the Legislative Assembly again found his proposals too expensive; while he was supervising the limited works approved he devoted much time to the raising of the Victorian Volunteer Engineers.

General Sir John S Hawkins, KCMG

Western Australia

The colony of Western Australia was the last to receive convicts, after it appealed for them in 1848 to solve a labour shortage and depression. The task of Captain E Y Henderson RE, arriving in June 1850 with five Sappers and Miners, guards and 150 convicts, was first to find temporary accommodation for the convicts. Then he was to make them build a permanent barracks, after which he would be able to deploy them on the roads and harbours of the colony. Henderson reported favourably on his Sappers and Miners and his request that more be sent was complied with, 100 men of the 20th Company arriving during 1851-2. In addition to the company commander another officer arrived, Second Lieutenant

British Military Engineers and the birth of Australia (3)

E F Du Cane RE[2]. He was sent to take charge of the eastern districts where, in addition to constructing a bridge at Guildford, he was visiting magistrate. He is on record as objecting to having to administer the law without a copy of the Ordinances. "I have a personal aversion" he wrote "to administering justice like a Turkish Pasha, out of my own head." The Royal Engineers remained active in the public works of Western Australia until the only two officers remaining departed in 1863.

Sappers were to be involved with the establishment of colonial defence forces and volunteer engineer units in the developing colonies, including the formation of submarine mining units. Before that time Australia must have been a difficult posting, involving the management of convict labourers in a brutal system of punishment, liable to be attacked in the press and unpopular amongst the ex-convict population. The contributions of the Royal Engineers were the humane governorships of Gipps and Denison and the efforts of many officers and men in establishing colonies where 'everything was new'.

[2] *Later Major General Sir E F Du Cane RE. Like Andrew Clarke, he was head of his batch at the RMA in 1848. Du Cane's experiences in Australia led him to become involved in prison administration in England. He was appointed Director of Convict Prisons in 1863. This was on the recommendation of Lieut Colonel E Y Henderson, who Du Cane was to succeed as Chairman of the Board of Directors of Convict Prisons. A strong advocate of the devotion of prison labour to works of national utility, he also administered the major reform of the Prison Act of 1877 whereby county and borough prisons passed to government control. Du Cane pioneered the registration of criminals and advocated finger-printing.*

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Australia's New Parliament House

CAPTAIN C L WILKS MA MIEAust AMIEE RE

Carey Wilks was commissioned into the Corps in 1982 after reading engineering science at Lincoln College, Oxford. He served as a troop commander in 73 Independent Field Squadron and as support troop commander in 52 Field Squadron (Construction). Both postings included tours to the Falkland Islands. He has returned to the southern hemisphere for his civil attachment as part of 28 Professional Engineer Training (Electrical and Mechanical) and is now Adjutant of 28 Amphibious Engineer Regiment.

Once a little sugar ant made up his mind to roam,
To fare away far away, far away from home.
He had eaten all his breakfast, and he had his ma's consent
To see what he should chance to see and here's the way he went.

ARRIVING at Australia's New Parliament House I felt very much like that sugar ant, joining the army of workers swarming over Capital Hill. Having completed my design attachment with John Holland Pty Ltd in Melbourne, I was fortunate enough to be sent to Canberra for my site attachment, working for a joint venture between Concrete Constructions and John Holland as Assistant Commissioning Engineer (Electrical). Within hours of arrival I went through a process called induction, which all personnel had to attend prior to going on site. Fortunately this process did not involve the use of forceps but, in addition to providing a general background covered key aspects of site safety and industrial relations. I was struck by the magnitude of the project; since September 1980 a workforce of up to 2500 have been employed on site, and it took me nearly a month after my induction to become familiar with the thirty-two hectare site.

The building is to replace the 'provisional' Parliament House, which was built in 1927 and had become too cramped for the legions of public servants and politicians (known to the locals as 'pollies') who inhabit it. The site for New Parliament House was easily decided upon, being part of the original plan for Canberra formulated in 1912 by the American landscape architect Walter Burley Griffin. The design was selected from 329 entries in a competition held in 1979 and was won by architects Mitchell/Giurgola & Thorp. The design features clear and simple lines, a sensible layout for the work of the two Chambers, and the prominent flagmast which rises 81 m above the roof and provides both a symbol and a landmark for Canberra and the nation.

Up and down a fern frond, round and round a stone,
Down a gloomy gully where he loathed to be alone,
Out along a bracken bridge, bending in the moss,
Till he reached a dreadful desert that was feet and feet across.
'Twas a dry deserted desert, and a trackless land to tread;
He wished that he was home again and tucked-up tight in bed.

Captain C L Wilks
Australia New Parliament House

Aerial view of New Parliament House, taken in December 1987.

THE organisation on site is complicated, and has almost as many abbreviations as the military. The client is the Parliament House Construction Authority (PHCA), a Government body established to manage the design and construction of the building. The architects Mitchell/Giurgola & Thorp (MGT) employ specialist consultant engineers, in particular the Associated Consulting Engineers for Parliament House (ACEPH) who are responsible for the majority of services. Other specialist consultants are employed directly by PHCA for non building items such as furniture, communications, 11 kV power, security and sound and vision systems. I worked for the Construction Manager (CM) Concrete-Holland Joint Venture (CHJV), a management consortium with a staff of up to 250 who administer and supervise the execution of all contracts to quality, time and budget targets.

The building was designed and constructed using the 'fast track' method, whereby construction proceeds in some areas while design is being fully developed for the remainder. This has resulted in a very fast build, aimed at completion in this Australian bicentennial year after only eight years of construction. In fact, by the time this article is read, the first sitting of parliament should have occurred in the new building. To provide the reader with some idea of the scale of the building, work commenced with the excavation of 170,000 m^3 of soil and rock from Capital Hill, much of which was removed to provide space for the three levels of underground parking. In the construction, 210,000 m^3 of concrete were poured over 24,000 tonnes of steel reinforcing. The project budget at current prices is A$1,048 million, of which A$250 million, is for mechanical/electrical services. (Exchange rate as at April 1988 £1 = A$2.43). The building provides 250,000 m^2 of gross floor space, with a usable floor area of 75,000 m^2; this compares with 10,000 m^2 for the provisional building.

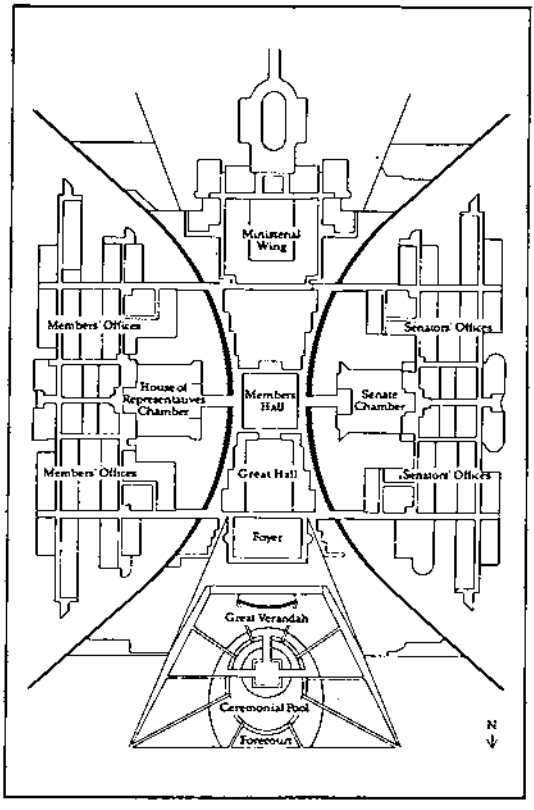


Figure 1. Layout of New Parliament Building

Parliament House will be occupied by 3500 people, with up to one million visitors expected each year. Key architectural features of the building are the two 460 m long curved walls which are 27 m high at the centre and are covered with slabs of polished granite, and the pyramid shaped stainless steel flagmast. The original outline of the hill has been retained by the use of gently sloping grassed ramps which roof the central region of the building.

Parliament's functions are accommodated in the new building along two axes which intersect at the Members Hall in the centre of the complex shown in Figure 1 and 2. The public and ceremonial spaces lie in the north and consist of the Forecourt, Great Verandah, Foyer, Reception Hall and Members Hall. To the south lies the Executive Government Wing, with the Prime Minister's Suite, ministerial offices and committee rooms. The north and south regions are bounded by the curved walls and are linked to the two houses by glazed corridors. Along the Parliamentary axis to the east is the House of Representatives' Chamber surrounded by three floors of offices for members and staff; to the west lies the Senate and offices as a virtual mirror image. Both Senators and Members are provided with central facilities including library, dining room, bar, indoor swimming pool and the Members Hall. The site is extensively landscaped with numerous courtyards containing trees, shrubs and fountains.

The engineering services provided in the building are substantial. I will summarise the more important systems to indicate the complexity and variety of services provided in a modern building. There are forty-three separate systems, ranging from heating, ventilating and air conditioning, compressed air, water and standby generators to advanced security, broadcasting and building monitoring systems.

The bulk of the air conditioning is provided by twenty-seven variable air volume air handling units, with a total of 1850 terminal reheat boxes giving zone control. Each air handling unit is controlled by regional stand alone 'direct digital control' (DDC) Honeywell microprocessor systems which incorporate all energy management and time control functions within a particular area. Global energy management is provided by a building monitoring system (BMS), which communicates with all the DDC systems directly. There are also a few constant volume air handling systems and a large number of extraction ventilation systems, mainly for car parks. In the event of a fire, sections of the building are automatically isolated and all air handling fans are controlled by special fireman's fan control panels to carry out smoke clearance operations.

Central energy plant for air conditioning and domestic hot water consists of five chillers providing an installed capacity of 15,000 KW of refrigeration, and six natural gas boilers with an installed capacity of 13,000 KW. A five cell induced draft cooling tower is located 100 m away from the south east corner of the House of Representatives. All the central energy plant is again DDC controlled, although the BMS does control load shedding and optimisation.

Electricity is supplied around site by a very versatile and reliable 11 KV ring main system. Currently two (future four) separate 11 KV

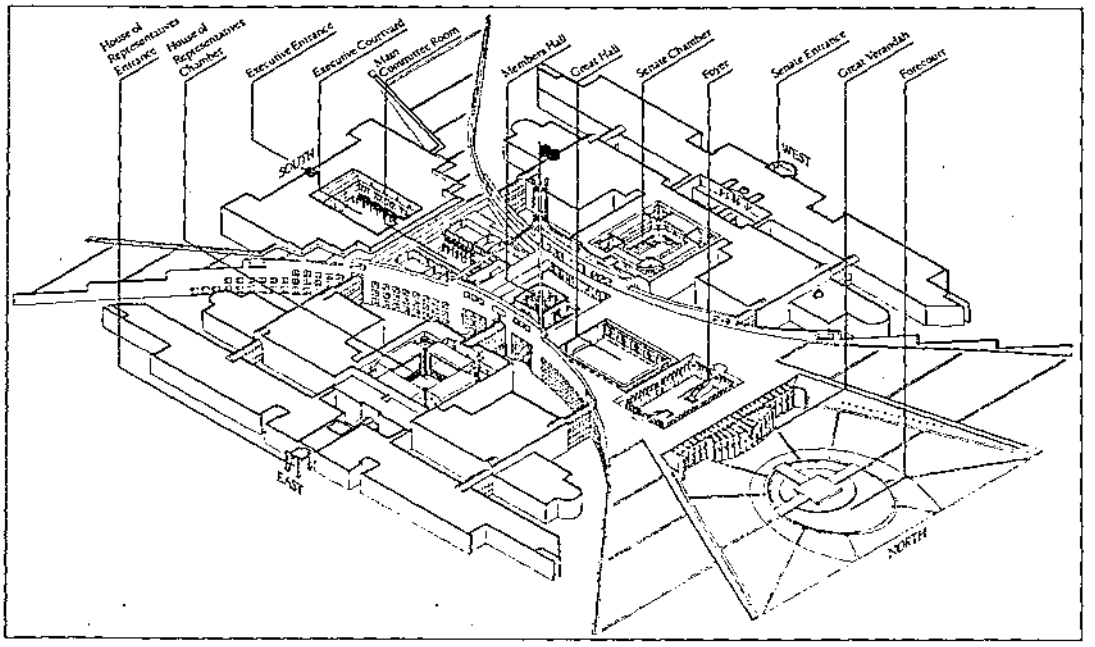


Figure 2. Isometric sketch of New Parliament House with sections of roof removed

feeders enter the building and distribute power through two ring mains. An additional emergency ring main provides power for essential loads such as lifts and smoke exhaust fans in the event of power failure. This 'E' ring is energised by two 1000 KVA diesel alternators (future four) which start up automatically on failure of all 11 KV feeders. Isolation of the 'E' ring from the other two rings occurs automatically. The estimated maximum demand for the building is 10 MW, and so the standby generators will only be capable of operating essential life support systems. Unlike similar installations in the UK, the Australian Capital Territory Electricity Authority (ACTEA) have full responsibility for the operation and maintenance of the entire 11 KV system and the low voltage bus ties. ACTEA remotely control the site with telemetry using their Supervisory, Control and Data Acquisition (SCADA) system. Twenty-three 1 MVA dry type transformers provide power at 415 KV for final distribution at eleven Area Main Switchboards (AMSB). All high voltage switchgear is SF6 vacuum circuit breakers, with low voltage switchgear as air circuit breakers with solid state protection. Power factor correction is provided by capacitor banks at each AMSB, with solid state automatic control providing up to 350 KVAR at 415 KV in steps of 50 KVAR.

Australian 'pollies', like politicians the world over, do not like to be left in the dark. To ensure this never occurs, a large proportion of the building general lighting is supplied through nine uninterruptible power supplies, ranging in size from 10 to 75 KVA. This arrangement is to cover that worrying twenty-five seconds between power failure and the diesel alternators coming on line, although the units have the capacity for thirty minutes operation at rated load.

If you think painting the Forth Bridge could get monotonous, consider the task of carrying out the relamping of the 32,000 lamps in and around the building. To meet the needs of the architects, some are placed in the most inaccessible spots imaginable, such as 80 m up the flagmast. Most of the luminaires have been designed especially for the building and come in a great variety of

shapes and sizes. Prize for the largest lamp goes to the two 2 KW spotlights for the coat of arms on the front of the building, which have been aptly christened 'bazookas'.

Transport systems provided in New Parliament House are multifarious. Forty-two lifts will operate between the three floors, or for more of a thrill you could try the steel cage which ascends to the top of the flagmast. A pneumatic tube system will transport small paperwork around the building, while a 'train set' provided for the more bulky paperwork, in the form of a dual track document movement system, will give hours of fun. Six kilometres of track wind their way around the maze of basement corridors to various stations, with the self-propelled trains chugging merrily along. Not only must the paperwork generated in the building be moved about, it also must be consumed in vast quantities. A central waste disposal system has been installed which will partially shred the waste at five strategically located chutes. The pulp is then conveyed through a pneumatic pipe to a central storage room, where it is baled before removal. The specification calls for the removal of 70 m^3 of waste weighing up to three tons per twelve hour day. Finally, an inward goods conveyor system will move packages from the loading dock into the heart of the building. Quality control and the commissioning of services are two areas of construction management which have been given top priority. Unlike many buildings in which commissioning and quality control have been carried out 'by complaint', special groups have been established within the Joint Venture which have set new standards for the Australian construction industry. Commissioning can be a monotonous task, but I have found it provides an unparalleled opportunity to work with the contractors to produce a completed system which is guaranteed to be fully operational in every respect. Engineering problems rise to the surface which were never envisaged at the design stage, and these have given me plenty of opportunity for developing practical solutions on site.

There is a lighter side to commissioning. In order to commission the 'flushometer', a pressurised lavatory flushing system, a diversity of 3% was selected as the maximum anticipated load after a long sitting of parliament. As there are nearly 800 lavatories at New Parliament House, it followed that twenty-four of them had to be simultaneously flushed at certain key points around the building. Stopwatches were synchronised, flushometer pumps were set to meet this requirement, and flushers stood to their posts. It was found that during mass usage long pauses were encountered between the flush and the onset of water, or alternatively the unfortunate lone flusher was nearly drowned in an exuberant torrent.

Commissioning the beverage reticulation has been one of the more popular activities amongst the commissioning group. The system dispenses wine, beer and spirits at various bars piped from a central coolroom/storeroom. Thirty litres of each spirit are needed merely to fill the pipelines, and as for the beer ...

I recently completed the commissioning of the irrigation control system, a microprocessor controlled system with 18 satellite programmable controllers linked to a master controller computer. As an Englishman it was hard at first to understand the need for such a system, but a few weeks of temperatures in the high 30s soon after my arrival on site convinced me of its necessity. The system controls nearly 1000 solenoid valves, and is obviously vital in the development of newly seeded or turfed areas, as well as for routine watering. As the only expert on the system after the departure of the Sydney based contractor, I was called in one Sunday to find a distraught landscape contractor surrounded by newly sown grass rapidly withering in the harsh Australian sun, and a programmable controller which had suffered a severe loss of memory. With no manual override, there was little I could do to help other than suggest a return to the old fashioned watering can.

His little legs were wobbly, his strength was nearly spent,
And so he turned around again and here's the way he went —
Back away from desert lands feet and feet across,
Back along the bracken bridge, bending in the moss,
Down a gloomy gully, where he loathed to be alone,
Up and down a fern frond and round and round a stone.

My main responsibility is the commissioning of the building monitoring system. As its name implies this system monitors, and to a limited extent controls, the functions of nearly every other engineering service in the building. Centrally controlled from a computer, the BMS communicates to all DDC systems and to special Remote Control and Signalling Panels (RCSP),

both of which provide the interface to the field devices. Approximately 3500 points are monitored or controlled through the DDCs and RCSPs. There is a full colour graphics facility and a variety of resident programmes for load shedding, maximum demand limiting, time block control and energy management. One of the major functions is the control of lighting through over forty different time programmes to provide a decorative effect at night and to minimise energy consumption and building heat load.

Commissioning this global system is fascinating, as it has involved me with every other building service, and means that I travel to every corner of the structure. The basement, which houses most of the plant, is like a maze which grows into a different shape each night. Areas become closed for the dreaded 'handover', concrete floors are sealed, locks are changed and every day presents a new navigational challenge. With no room name signs, everywhere looks the same and I walk confidently through a door to be confronted with the rock face and large area of no man's land: many of these areas are large enough to contain a Mess party, but are euphemistically called 'crawl spaces'.

New Parliament House, with its large number of electronic and computerised systems, has been called an 'intelligent' building. The definition of this, you may be interested to read, is: 'a building in which the building elements provide flexibility and adaptability to end-user needs, both present and future, by means of energy efficient systems employed in a cost effective manner'. However, the diversity of the systems installed in New Parliament House is such that there is little cohesion. Interface problems abound, and the need for the electronics industry to standardise communications is nowhere more evident than on this site. Despite this, a local firm has installed a sophisticated building monitoring system which should overcome many of these problems and will give the building a degree of intelligence.

Although inevitably it received a certain amount of criticism in its early days, Australia's New Parliament House is unquestionably an outstanding design. The distinctive shape has fitted well into Canberra's layout and has already become a landmark for the nation's Capital and a symbol for the centre of government. As it is intended to house Australia's Parliament for the next 200 years, the highest quality of workmanship, materials and finish have been employed throughout. The national character has been incorporated into the building in several different ways, for example the introduction of abundant natural light into the interior is a central architectural theme, with generous use of skylights above the major public and ceremonial spaces. The views over courtyards, gardens and water displays to brighten the interior spaces are a feature throughout the building, while shades of eucalyptus green and outback red have been chosen for the House of Representatives and Senate Chambers respectively. Generous use also has been made of native timbers on floors and walls. Works of art especially commissioned for the building include several by Aboriginal artists, and an Aboriginal has designed the large mosaic which is situated on the Forecourt.

Working on site is a real pleasure. The relaxed approach of the joint venture staff, and the 'no worries' atmosphere, hide an efficiency and professionalism which is difficult to fault. Friday afternoon happy hours, consisting of barbecued 'snags' (sausages) and a certain amount of the amber nectar, help to maintain good cooperation amongst the various branches of the Joint Venture.

A dreary ant, a weary ant, resolved no more to roam,
He staggered up the garden path and popped back home.

C J Dennis

Unlike the sugar ant I will be sad to leave both the project and the country to return to the UK. It has been a unique opportunity for me to gain engineering experience in an environment where quality is the keyword, and on a building which I believe will receive worldwide approval.

The Beginning Of The Gurkha Engineers

COLONEL K M ROBERTSON MA MICE

Colonel Robertson was commissioned in 1937. From 1940-42 he was in the Middle East, commanding 2 Field Company for a period when in Tobruk. From 1942-45 he was in the Far East commanding 54 Field Company and going with them into Burma with the Chindits. He graduated from the Staff College after the war. Returning to the Far East, he was Chief Instructor and, for a while, Commanding Officer of the Engineer Training Centre, Kluang, Malaya. He then held regimental and staff appointments in BAOR, where he designed "Queens' Bridge" and was Officer in Charge of its construction across the River Maas. From 1955-57, he was Deputy Assistant Adjutant and Quartermaster General at the Royal School of Military Engineering. There followed staff and works services appointments at home and abroad, culminating in 1965, when he was appointed Colonel AQ, Headquarters Northumbrian District in Catterick. He retired in 1968 and now lives in Suffolk. (The photo was taken in 1948 when he was at the Engineer Training Centre, Kluang).

The Engineer Training Centre, Far East — Kluang

Kluang, from its central position in the State of Johore, will be remembered as the place where the Gurkha Engineers had their beginning. In those days of 1948 Kluang offered no great attraction. A busy little township, peopled mostly by Chinese, it lay alongside the railway from Singapore to Kuala Lumpur. The main trunk road ran ten miles to the west. The town had grown up to serve the rubber estates and all around were seemingly endless tracts of rubber and jungle. Two features alone served to focus the attention. One was Lambak, a prominent jungle-covered hill, which had character and was distinguishable from a number of miles away. The other was an extensive grass airstrip with a concrete apron and some hangars, around which a camp of tents and bashas had sprung up. That was all — nothing more.

In that lonely and desolate place lived the Garrison of Kluang comprising 1200 men, shortly to increase to 2000 and sometimes more. They were not unhappy since everyone had plenty of work to do.

The Engineer Training Centre (hereinafter termed ETC) was the largest unit in the station. Its commanding officer, Lieutenant Colonel H Carington-Smith, was also the Garrison Commander. The unit was in many ways unique. The troops it originally comprised were as follows:-

a. HQ and HQ Squadron of British and Malayan Sappers. They found the instructional staff and administrative personnel.
b. A Malayan squadron for training Malays, Chinese and Indians who had enlisted locally as Sappers for service in Malaya.

In 1948 a Gurkha Squadron was formed to give a year's engineer training to the newly arrived Gurkhas. They came mainly as volunteers from Gurkha rifle regiments, but a few new recruits were included. It was planned that after a year's training they should break away from the ETC and form their own field squadron, which

Colonel K M Robertson
The Beginning of the Gukha Engineers

ETC sports: Major John Thornber receives the trophy for Champion Squadron from Mrs Catherine Robertson

should remain in Kluang. Meanwhile a new intake of Gurkhas would arrive at the ETC to repeat the process.

For all the different troops on its strength, the ETC had to administer three separate and distinct pay codes and terms of service. It also had to run a proliferation of cookhouses, mess halls, canteens and other facilities; each neatly designated by nationality and by rank. The ETC weekly ration indent was in itself quite a formidable document.

The complexity of the ETC establishment was not the only problem with which the unit had to contend. Its formation had outstripped the provision of resources needed to fulfil its role. Works services in particular were lacking and there were extremely few amenities to offset the isolation of life in the station.

Then the Malayan Emergency started and the ETC acquired a dual role. Apart from conducting its engineer training to schedule, the unit was required to turn out fighting patrols at frequent intervals to counter the activities of bandits. The reconciliation of these conflicting duties in rough and austere surroundings was therefore the first task to befall the Gurkha Engineers under their OC Squadron, Major John Thornber.

Training

Due to the different languages spoken within the ETC, it was not possible for ETC staff instructors to take all classes. Consequently the function of the training staff was limited to providing the syllabus of instruction and prescribing the number of hours to be spent on each subject. The training staff remained responsible for the allocation of training areas, the provision of stores and for overseeing the work. The actual instruction was given by the officers of the Malayan and Gurkha Squadrons in each case. They prepared their own training programmes based on the syllabus they had been given and devised their own methods of instruction. The division of responsibilities between training staff and squadron officers closely resembled the familiar division between "OIC the work" and "OIC the working party".

The training given to Gurkhas in their first year at the ETC covered all aspects of field engineering and bridging. Trade training was intended to follow in the second and subsequent years.

Certain tasks, which both the Malayan and Gurkha squadrons were given to perform, were intended to be not only instructive but also to improve the training area or provide other facilities required within the ETC. Foremost among these was the building of "Rochester Bridge". This was a multi-span Bailey bridge across a ravine and, when finally completed, it provided a much needed short-cut from the main ETC camp to the training area and the Malay and Gurkha married lines. Each span and pier illustrated a particular construction described in the Bailey bridge manual. The resulting design looked somewhat freakish but nevertheless served its dual purpose very well. Successive Malayan and Gurkha training parties each added a portion to the bridge until it was completed over a period of time.

Likewise, smaller single span bridges were built over a specially prepared gap and left in position as demonstration pieces. Thus training parties were able to view a bridge and have its construction explained before being called upon to dismantle it and erect it again. This method had an advantage when bridging training had to be curtailed, due to operations against the bandits being required. A bridge only needed to be partially dismantled before being erected again. It may be argued that the sequence of dismantling first, then building, is better than the usual practice in training when the sequence is the other way

round. Not only is the method of construction easier to explain but the accounting for components is simplified and storage space is saved. The same principle was applied to certain other equipments; notably a water tower made of Christchurch cribs.

There was one other task, of a works service nature, that was carried out as training. That was the building of a large TG shed to house fieldworks tools and stores.

Gurkha performance in watermanship was a surprise. Considering the mountainous nature of Nepal one might suppose the Gurkhas would not be familiar with the handling of boats and rafts, yet their results in watermanship training were remarkably good. Later they took part in a number of expeditions, covering many miles of treacherous river, and acquitted themselves extremely well.

The earliest impressions the Gurkhas gave as sappers were these. Firstly, their zeal for the work was never in doubt. Secondly, they succeeded in assimilating the subjects taught, but sometimes found it difficult to do so. Much depended on simple step-by-step methods of instruction. Nevertheless they persevered and on occasions invented their own somewhat circuitous ways of achieving the required result. Two amusing instances illustrate the above comments.

One concerned a class of Gurkhas being instructed in field defences. They found it difficult to understand a three dimensional sketch of a weapon pit on the blackboard. Their instructor, Captain David Tovell, had a bright idea. He went to the cookhouse and returned with a slab of cheese. On the surface of this he traced a weapon pit, then excavated it with the blade of a knife. Cutting through the cheese in one direction he revealed a transverse section of the pit. Sticking the cheese together, he cut it through again in another direction and displayed a longitudinal section. The Gurkhas were delighted. From then on they had a better understanding of three dimensional sketches.

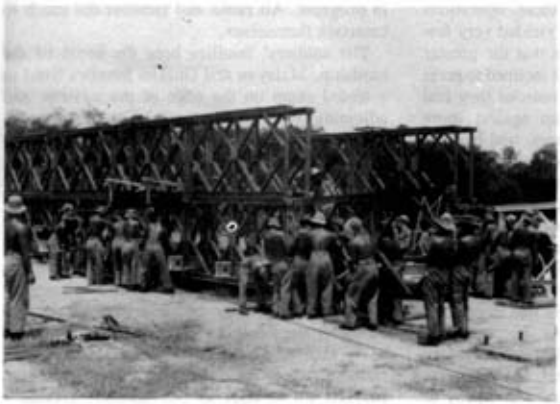
The other instance occurred during the Chief Engineer's first visit to the Gurkha Squadron. A party of them were engaged in the time-honoured ritual of tying knots and lashings. Turning to one Gurkha, the Chief Engineer bade him tie a reef knot. To the onlookers' dismay the man proceeded to enmesh his hands in a real cat's cradle of rope. When he was securely entwined and failure loomed, he suddenly gave a flick to his wrists. The enfolding coils fell away and there to behold was a perfect reef knot!

Operations

As the Malayan Emergency progressed the bandits grew bolder and more troublesome. Lack of intelligence about their intentions and movements, combined with the fear and reticence of the general public to lay information, were crippling handicaps. The period from 1948 to 1950 was a grim one in Kluang. The civil administrative officer for the district was killed. So was the senior police officer. Not much later his successor was critically wounded. Casualties occurred on the rubber and palm-oil estates, on the roads and in the town with regrettable frequency. Property was burned. The railway was attacked.

Not surprisingly the ETC became more and more engaged in counter-insurgency operations until a point was reached towards the end of 1949 when at least a half of all training time was being lost. Troops were scarce in Malaya and other training establishments and administrative units also became involved in operations. The CO ETC and Garrison Commander Kluang at that time Major Kenneth Robertson was appointed OC Operations in the Central Sector, Johore. That area stretched across the Malay Peninsula from Mersing on the east coast to Batu Pahat on the west. The Gurkha Squadron became as heavily engaged as anyone else. Their tasks were, of course, of the type at which Gurkhas excelled. With nostalgic relish they laid aside being sappers for a while and reverted to their original doughty role of being Gurkha riflemen. The list of the patrols they undertook is too long to record. Regrettably, due to poor intelligence, all their patrolling bore little result. Nevertheless, contact was made with the enemy now and again and on one occasion a spirited skirmish near Kota Tinggi took place.

Based on information from the police, the ETC called for some air strikes by the RAF and naval aircraft from HMS *Theseus*. The Gurkha Squadron put out a cordon and laid ambushes in an area to which it was hoped the air strikes might drive the bandits. The cordon caught no-one. But a few Chinese stragglers, lightly wounded by the air strikes, came into Kluang claiming they were innocent citizens who had been out logging in the jungle. There was no way of telling whether that



Bridging training

was true or false. However, bandit activity ceased in that area for a while, but broke out elsewhere.

In conjunction with the police, two sizeable operations were mounted to search through squatter areas, remove the squatters from their isolated and scattered dwellings and move them to a rehabilitation centre at Mawai in South Johore. Afterwards their crops were razed to deny them to the bandits.

Two extensive expeditions down rivers took place. One, under Captain John Parfect, went down the Sungei Sembrong to the East coast. The other, under Captain David Tovell, took place from Temerloh in Pahang down a river that ran through a very remote area to a swamp known as Tasek Bera. This was the country of the Malay aboriginal blowpipe tribesmen. A Japanese company had strayed down there during the war and none of them had returned. On both the present expeditions the Gurkhas were noted for their surprisingly good watermanship.

There was also engineer work to be done in support of operations. A number of light aircraft strips were reconnoitred and some of them were built.

Certain estates and a police station were encircled by grenades placed within protective wire and each capable of being fired electrically from a central strong point. Disconcertingly some of the grenades were detonated by thunder and lightning, but significantly the places they protected were never subsequently attacked.

On one occasion a Gurkha party under Captain John Allen rigged a villainous booby trap on a jungle trail reportedly used by bandits. A string of grenades connected by instantaneous fuze was slung in the jungle alongside the trail. A central trip wire across the trail ensured that anyone approaching the booby trap from either direction would be caught; as would anyone else who happened to be in file behind them. The booby trap was inspected at intervals. On the third visit it was found to have been fired. A close search of the surroundings revealed nothing. It was never discovered whether man or beast had set off the trap. If it were bandits it was presumed they had covered all traces. Certainly no animal remains were found.

One day a Chinese peasant cycling down the railway line saw a strange object with a cable leading to it lying half buried between the rails. In his own words, he continued into Kluang to sell his fish, then reported to the police! The object proved to be a 14lb charge of guncotton to which the fuze had been lit but had failed. (Old 1942 weather-worn stock: no doubt provided by the British to resistance fighters against the Japanese, before joining the Communists and becoming bandits!) The charge was placed just short of a bridge over the Sungei Sembrong and the Singapore Night Mail must have passed over it. Had the charge gone off, the front of the train would have gone into the river. But as it happened the charge was safely defused.

As may be surmised, all these operations entailed enormous effort which yielded very few tangible results. Yet it was true that the greater the effort the less the enemy were inclined to press home any attack. For obvious reasons they had no wish to find themselves up against more numerous and better armed troops, and become pinned down in a fire-fight. There was therefore no alternative but to redouble the effort and let engineer training take second place.

In early 1950, the ETC was visited by the Commander-in-Chief, Far East Land Forces, General (later Field Marshal) Sir John Harding. He said that he was impressed by the determination and skill with which all sappers had conducted their operations. Nevertheless he too was concerned at the training time lost and therefore gave orders for a relief to be sent. In due course a squadron of armoured cars and a company of British infantry arrived in Kluang to reduce the operational load on the garrison.

It is beyond the scope of this account, but it is worth noting that the Malayan Emergency continued for another ten years before the bandits finally gave up.

The Domestic and Social Scene

In early days, the great shortage of accommodation was the worst problem for the ETC with its increasing numbers. Bashas, tents and very primitive camp structures were all that were there. They were quite insufficient for a permanent training establishment. The CO, Lieut Colonel Carington-Smith, aggressively harried the powers-that-be and in due course a small number of works services were approved. That enabled a proper guardroom, arms-kotes, ammunition and explosives stores, a 30-yard range and an obstacle course to be provided. However, it was a very long time, before more and better accommodation, with more permanent cooking and sanitary arrangements, were built.

Amenities to begin with were nil. A cinema was the first to be built and was very popular providing as it did the only relaxation there was. A swimming pool was due to be installed but was a very long time in coming. More than anything else, it made an enormous difference for everyone in the station. Fortunately sports fields, were easy to improvise on the edge of the grass airstrip. Nevertheless despite the shortages morale was high, as is usually the case when operations are in progress. All ranks and families did much to entertain themselves.

The soldiers' families bore the brunt of the hardship. Malayan and Gurkha families lived in a tented camp on the edge of the airstrip, and adjoining the training area. Conditions were extremely rough and due to the climate the tents wore out in six months. Replacements were scarce and it was an uphill struggle to get any more. The married lines looked an awful mess with tattered tents, patched and stitched here and there, stained with mildew and weather-worn.

The patience and forbearance of the families under these uncomfortable and unworthy conditions may only be described as superb. However, the location of the married lines so close to the training area had one advantage. The men training, the women working and the children playing, all in sight of one another, created a mutual interest and lent some feeling of home.

If conditions were bad, the attention given to Gurkha families was the reverse. Medical facilities were excellent since a new hospital had recently been opened in Kluang. In the married lines nursing attention was available and a clinic was properly run. A great deal of invaluable welfare was contributed by officers' wives. It was as well, since the Gurkha families needed a good deal of reassuring and guidance. The climate in Malaya is very different to that in Nepal. The thick and woolly clothing the Gurkha families first arrived in was highly unsuitable and help was needed in its replacement by lighter garments. The necessity for frequent laundering had also to be taught. There was great difficulty in preventing women from having babies at home in their tents. Once, an ambulance set off for the hospital with an expectant mother. On arrival at the hospital the door was opened and the ambulance was found to be empty. The woman had sneaked out at a halt and made her way back to her tent.

A visit by Lady Mountbatten to the families was remembered as a great occasion. Her grace and charm are well known; so also are her outspoken opinions. She took a very poor view of the state of repair of the families' tents.

All knew the Feast of Dushera would be the first for the Gurkhas as Gurkha Engineers and as such would represent a climax in the life of their newly formed Squadron. It was therefore imperative that the predominant ritual, the head-cutting ceremony, should succeed and that the bullock's head should

Malayan emergency: interrogation of squatters

be completely severed at one stroke of the ceremonial kukri. This weapon is larger than a normal kukri and in fact looks more like a scimitar. In the event, the opening of the ceremony was so tense and laden with misgiving that few of the onlookers would wish to experience the like of it again. The man to perform the ceremony had not done it before. For upwards of half an hour he pivoted this way and that seeking a good position for his aim. The bullock was restive and not for a moment would it remain still. It seemed to sense the general feeling of unease, although of course it could have had no knowledge of its impending doom. The chanting of the assembled Gurkhas grew ever more doleful and lugubrious. Everyone watching began to wilt with almost unendurable anxiety. Then unexpectedly and most suddenly there was a flash of light. The blade of the ceremonial kukri moved so fast one did not really see it. One's first consciousness was the bullock's head falling into the dust with a thud. Meanwhile, separately the carcass collapsed sideways and rolled to the ground. The most tremendous shout of joy and triumph went up. The first Squadron of Gurkha Engineers had indeed found its soul.

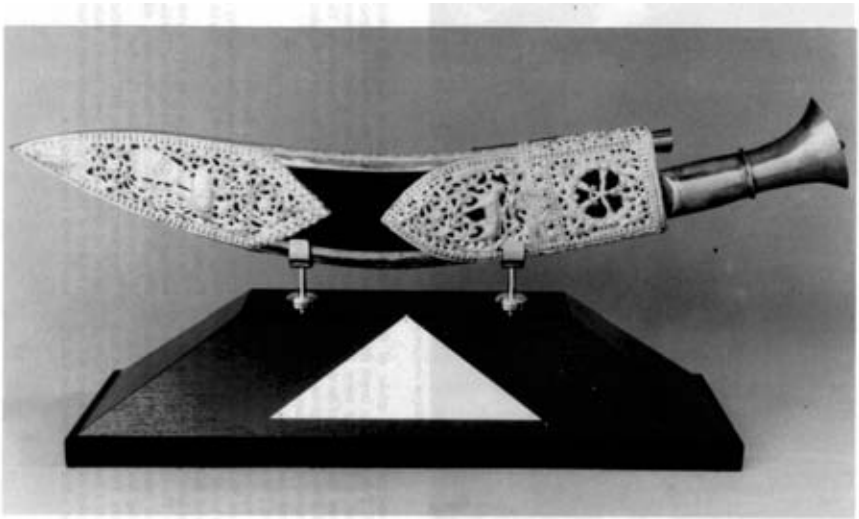
The End of the Beginning

Those last words on Dushera seem to portray a fitting end to the beginning of the Gurkha Engineers.

The Gurkhas who first came to the ETC in 1948 emerged in 1949 as 67th Field Squadron, Gurkha Engineers, (later Queen's Gurkha Engineers), still under command of Major John Thornber.

They were replaced at the ETC by a further intake of Gurkhas, who were placed under command of Major Colin Edwards and in turn became 68th Field Squadron.

The Beginning of the Gukha Engineers (3)



KOTHIMORA KUKRI

On Thursday 7 July 1988 the members of the Queen's Gurkha Engineers Association presented a magnificent *Kothimora Kukri* to the Officers of the Corps of Royal Engineers in celebration of the 40th anniversary of the enlistment of Gurkhas for service with the Corps.

A kukri is symbolic of the warlike skills of the Gurkhas and is presented as a mark of friendship.

Kothinora Kukbs.

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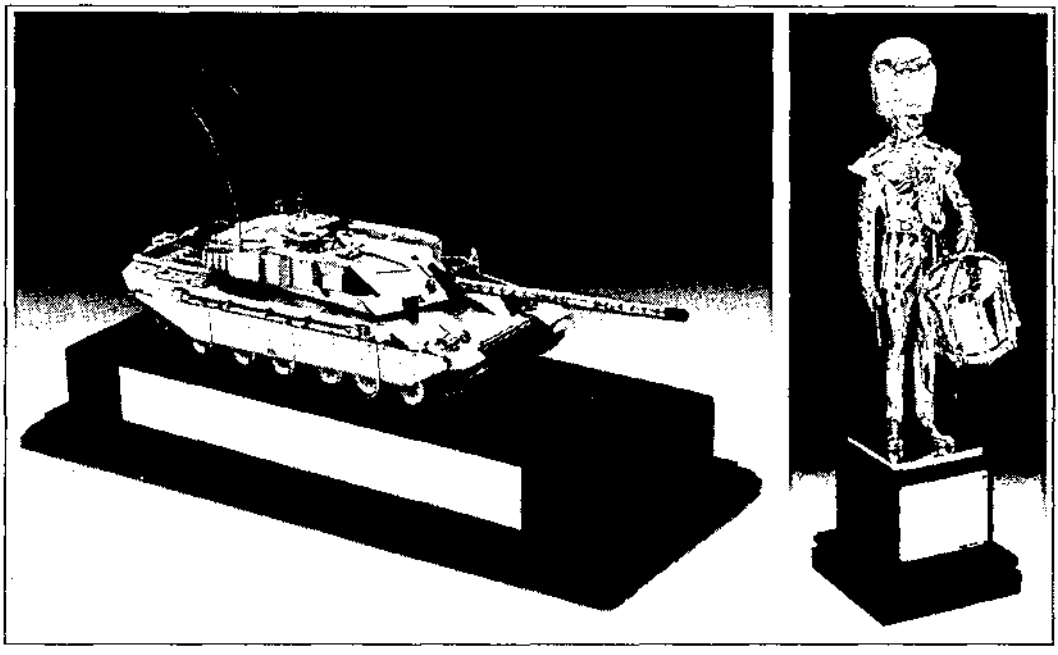

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Follow The Euro Nato Sapper
Part III — Equipment Standardisation

LIEUTENANT COLONEL G D BAILEY MI PLANT E MIHT

MY two previous articles have both been about interoperability for combat engineers in the Central Region and to some extent about standardisation. I purposely skated round the immensely difficult subject of equipment standardisation because it needs individual attention even though standardisation of equipment, standardisation of procedures and interoperability are inseparable. The fact that in the Central Region we as an alliance currently field fifteen different antitank mines and one hundred and fifty eight different mines, explosives and accessories, illustrates this point.

For many years there was little attempt to standardise equipment. The armaments industries of NATO's member nations enjoyed a free-for-all which produced a plethora of weapons and machines paid for out of public funds and on which manufacturers thrived. The US, UK and France were the main benefactors originally, but now Germany and Italy play a full part. The time has come however when this is beginning to change.

Although costs are escalating, little more money is available. How to pay for equipment development and its manufacture in the next ten years and beyond is worrying. From a military point of view there is little merit in diversity if a cohesive theatre battle is to be fought. Diversity is motivated by commercialism backed up by politics, and military arguments get lost in the face of such odds. In many cases shortage of money sharpens inter-service rivalries within nations and most military effort is devoted to getting a fair share of the national cake, leaving little time for international discussion.

The need to collaborate in order to save money and enjoy the obvious military benefits has long been recognised and become official policy of most NATO governments. Putting collaboration into practice is another matter. Quite apart from the bureaucracy, procedural difficulties and language problems that present themselves, manufacturers still think they can squeeze one last national generation of weapons or equipment out of the system. Even if they cannot sell it within NATO, other countries are always on the look-out for a good deal.

It is the European nations that will feel the pinch first and are already doing so. The vast US armaments industry could stand on its own for some time to come. This presents a dilemma for Britain as to whether it should enter into collaboration with the US or try to build up a collaborative rival European armaments industry with its EEC partners. Britain, France, Italy and Germany alone could establish a formidable industry if they chose to do so, and protectionism against the US is not necessarily a bad thing for the US or Europe.

Where Britain is concerned, the resources of fifty million people will never in the future be able to support the full spectrum of technologies and capabilities available. The choice of collaborating with our traditional ally or our former rivals is a difficult one, but the disparity in size between the US and Britain would seem to indicate a less frustrating future with our European allies. More opportunities for collaboration must surely lie this side of the Atlantic. Unfortunately it is difficult not to relive the contests of previous years and rid ourselves of deeply ingrained attitudes and prejudices that have existed for generations. These now manifest themselves as commercial rivalries within Europe. The US criticizes the European nations for not pulling their weight within NATO, so they would perhaps welcome a better organized European armaments industry. The biggest single factor that prevents pooling resources and eliminating duplication of effort is the prospect of job losses, and this spectre is not going to go away.

Time and skill are required to build up a collaborative effort within Europe, but it will come. Within the last two years the Independent European Programme Group (IEPG) has been hard at work to identify cooperative technical projects and has made significant progress. This is a slow, high level business which is going to have little impact in the immediate future. However, equipment development is slow, and

what is being talked about now is mostly for the late nineties or the next century in any case.

In my two previous articles I mentioned that engineers had some of the most diverse ranges of munitions and equipment of combat arm or combat support arm. For that reason efforts devoted to better interoperability have been considerable in past years. There is little chance that Exercise *MAKEFAST* or Exercise *CETEX/GENEX* will cease to serve a useful purpose in say twenty years time no matter what progress is made in standardizing engineer equipment. ENTEC need not feel threatened either.

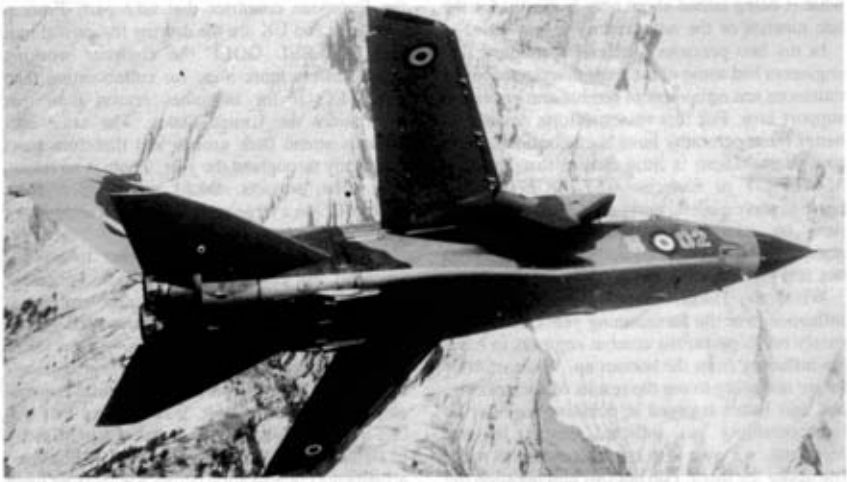
While the IEPG exerts its top downwards influence over the forthcoming years there must surely be scope for the combat engineer to exert his influence from the bottom up. While most of us are not going to see the results of such efforts, and feel better engaged in cobbling together an interoperability act inflicted on us by our forebears, we owe it to our successors to make life easier for them. I do not call into question the quality of British engineer equipment as we have it today, but future engineers in the Central Region may still be making do with 1980's equipment twenty years hence if collaborative efforts have not found a cheaper way of producing equipment in the meantime.

At this stage it would be worth summarizing the collaborative efforts that engineers are already making within NATO. There are two main groups that concern us, although there are others. Firstly, the NATO Army Armaments Group (NAAG) is the forum for NATO collaboration. It is divided into a number of panels, and Panel IX deals with engineer equipment. LSOR 5 of Operational Requirements (Land) in the Ministry of Defence represents UK interests. Panel IX does not have a good reputation for achieving positive results. Besides its bureaucratic nature it often serves as a forum for national delegates to sell their wares to others, or to pick up ideas to feed back to their own armaments manufacturers for possible future sales. Recently however, it has spawned special study groups which have created NATO Staff Requirements for which international groupings have been assembled to launch and oversee a particular project. If nothing else, this brings national representatives in frequent contact with each other, and these personal contacts foster mutual trust and understanding.

The second group is FINABEL, a mnemonic for the European countries that take part. France, Germany and UK are the driving forces within it and FINABEL GOLF the engineer working group, offers more hope for collaboration than Panel IX, if for no other reason than that it excludes the United States. The same individuals attend both groups and therefore meet frequently throughout the year. There is no reason why joint projects should not develop from FINABEL on a large scale in the high technology fields.

If three nations can get together to build a machine as complex as Tornado, engineer equipment should not present a problem. But it can go wrong as SP70, the self propelled gun on which Germany, Italy and the UK worked for so long, clearly demonstrated. Bi-lateral projects are safer and M2 and M3 present a successful example close to home. However, it is industry that will call the tune. Despite the fact that our Ministry of Defence is doing its best to encourage European armaments collaboration across a wide front there are too many vested interests which can block such good intentions. Engineers suffer from the fact that they often use relatively cheap gadgets and munitions, the products one might say of back-yard industries. However, future minewarfare and bridging are going to be complex and expensive. This brings us back to high technology as being the most suitable areas in which to collaborate. "Interoperability is a question of attitude", is a good motto for the man in the field, but "collaboration is a question of attitude" is likewise a good motto for those so involved and working in our central staffs. The knife edge course on which the European Fighter Aircraft has embarked has produced reports of national delegates describing each other as "cheeky", "rude", "chauvinistic" or worse. What happened over the tri-lateral "Bridging in the 80's" project is now history, and although it folded up for very good reasons there now seems little sense in UK and Germany developing similar bridges in parallel at enormous expense. We have to ask ourselves if some of the equipment projects being shelved or cancelled in current UK defence costings could not have been saved if costs were being shared with our allies.

With this in mind we must look to the future. The pattern is already set for much of the equipment that we and our allies will have well into the nineties. While there might be some scope



Tornado, a successful collaborative project of a most complex nature

to bring some national projects together by our equipment developers, there is clearly more scope if one looks beyond 1995. In defence the engineer has a major part to play in shaping the concept of operations. Combat development will produce operational requirements, and in the Central Region these are the same for many. While it might be too much for all seven nations concerned to produce even a standard shovel, two or three could produce a range of equipments for the engineer that would satisfy them all.

Germany is bound to play a large part in this. They field three of the on-line Corps and their Territorial Army plus Schleswig Holstein equate to three or more. The US and Germany are aware that between them they field six of the nine Corps committed to the forward defence of the Central Region, and the advantage to be gained from standardised or interoperable equipment are obvious. Belgium and the Netherlands are tending to purchase German equipment rather than British or US and perhaps the fact that they are tied into the European Monetary System has something to do with this. Canada is also buying German equipment, so that trend for predominantly US or German weapons and equipment on the Central Front is already well under way. This could become a considerable embarrassment not only to 1 (BR) Corps, but to the French forces as well who are in a similar position to the UK where equipment is concerned.

The UK needs to intensify its dialogue with Germany in particular if the proliferation of munitions and equipment is not to continue unabated, or if we are to be left with a puny range of weapons or equipment which is completely incompatible with our two most important allies. This is not an easy task for those members of the Corps who will find themselves in the forthcoming years in jobs, particularly in the Ministry of Defence, where they can influence the future equipment of the Corps. They have an immense responsibility to those who will be in the field in the future.

There is no doubt that as part of their training and experience younger officers are being made more aware of the shortcomings in equipment compatibility that we have with our allies, with a corresponding desire to make it better. Nevertheless, they will find themselves surrounded by forces within their own organisations wherever they go that will tend to frustrate any efforts they make to improve things. These forces are less strong than they have been in the past, nevertheless, they are there and will remain a challenge to meet for many years to come. The Euro NATO Sapper will no doubt be the best prepared to carry it through.

Slavonic Saga

M M DANECKI MC C ENG FI MIN E

Mr M M Danecki was born near Katowice in the Silesian industrial basin of Southern Poland. He grew up between the wars and, although his native land was barely a dozen years old when this story begins, it was already under threat of invasion by one or the other of its two powerful neighbours to the east and west. Mr Danecki trained at the College of Mining at Dabrowa and qualified as a mining engineer in 1935. From that point on, the article describes his own remarkable story. After the war, like many of his countrymen, he elected to stay on in Britain where he subsequently married and became a very successful mining engineer for the National Coal Board in North West England. He retired in 1974 and is now a very active Associate Member of the Southport Branch of the Royal Engineers Association. We are indebted to the Controller, Royal Engineers Association, Major Cedric Cooper, for editing this story.

As the 50th anniversary of the outbreak of the Second World War approaches, it is perhaps symbolic that the story opens in the late 1930s when the Polish navy was constructing underground shelters for its headquarters in Gdynia, close to the then free port of Danzig (Gdansk). There, at dawn, on the 1 September 1939, the German cruiser *Schleswig-Holstein*, during an official visit, suddenly drew out to sea and, without warning, bombarded the small Polish garrison based on the Westerplatte jetty, so firing the opening shots of the Second World War.

Engineering Experience in Pre-War Poland

In June 1935 the year that the military ruler of Poland, Marshal Pilsudski, died I qualified as an equivalent to the present British Engineering Council's status of technician engineer, between C Eng and Eng Tech grades, and began seeking suitable employment in the coal industry.

At this time a vacancy for a mining expert was announced by the Coastal Fortifications Office in the HQ of the Polish Navy in Gdynia, near Danzig. Poland has only a short coastline and it was a prospect out of this world to work at the seaside. I could not resist applying for the post and, fortunately, I was successful. The job was to undertake and supervise the construction of underground shelters for the Navy's HQ in the sand dunes, — a task originally started by army engineers but with mixed success. We had a lot of difficulties in rectifying the work initially carried out on the construction of an adit before we attained a satisfactory weekly advance in driving the access corridor to the shelter location. There were more difficulties during the opening of the wide area to accommodate the main chamber of the shelter 24m below ground level. Gradually the construction problems were resolved and I had the opportunity to relax a little; so in

M M Danecki MC
Slavonic Saga

1937, as a Rover Scout, I decided to attend the Fifth World Jamboree of Boy Scouts in Holland and had the privilege of seeing Queen Wilhelmina and Lord Baden-Powell at the opening ceremony.

Back in Poland, being close to reliable intelligence sources and realizing that the German *Drang nach Osten* was imminent, I took steps to enter the Military Engineering School in Modlin, near Warsaw (equivalent to the British School of Military Engineering at Chatham), to obtain a commission before the inevitable hostilities commenced.

On completion of my military service in September 1938, I returned to my previous employment and began working in earnest on the speedy construction of shelters. As the political situation was rapidly deteriorating, my pattern of shelter building, on the intervention of one of the Navy's commanders, was taken off the secret list of projects and I was allowed to expand business, in my spare time, into the private sector. The same commander was my first customer, and the shelter built for his family in Gdynia became almost a place of pilgrimage for anxious businessmen and a superb advertisement for this sort of enterprise.

Alas, Hitler, by starting the war so soon, prevented me from making my fortune. Towards the end of August 1939, just a few days before the German invasion of Poland, I received my call-up papers and reported to the Kazun Battalion of Army Engineers, across the River Vistula from Modlin. It seemed to me that we did not have enough time to organize and acquaint ourselves with our equipment and with the duties we were supposed to perform in assisting other units in their struggle against the rapid advance of the enemy's Panzer divisions.

On the 1 September 1939, the Germans invaded Poland.

The Invasion of Poland and Life as a Prisoner of War in Soviet Russia

During the first couple of weeks of hostilities, there was no question of constructing or demolishing bridges, blowing craters in the roads, or preparing minefields. The situation was so chaotic that if we had done anything of this sort we would have harmed our own retreating troops more than the enemy. I was attached to the 1st Engineer Company with the rank of sergeant cadet officer and moved out from barracks to Warsaw on the sixth day of the war to assist the local authorities after the city had undergone a heavy bombing attack.

The following day our Company was ordered to advance towards the east moving only by night to avoid the German air attacks. Travelling by night was like going through hell, with burning villages, bodies of people and horses sprawled in trenches and on roadsides and frightened refugees with their belongings crowding the roads with all types of transport.

On 17 September the President of Poland, Ignacy Moscicki, left the country and that was the signal for the Soviets to invade our territory from the east, according to the von Ribbentrop-Molotov Agreement of the 23 August.

So far our Company's war effort had been negligible and, on top of everything, we now came face to face with the Russian tanks, the enterprising crews of which did not take much time to disarm us and to strip off our black leather jackets, wrist watches and anything else which they thought was valuable. Raging with anger, a number of us decided to filter off to Rumania or Hungary and then to make our way to France and to join General Sikorski's Polish Army in exile.

On the way to Lvov we encountered and joined the Polish cavalry still fighting the Germans at Uchnow. With others, I was placed on the edge of the forest, operating a heavy machine gun to cover the withdrawal of our infantry. Meanwhile, the cavalry colonel despatched a detachment of his men to make a charge on the German flank positions. The cavalry detachment, while moving into position, fell into Soviet hands and the charge never materialised. Fortunately, we received a reinforcement of a regular infantry battalion and the cavalry commander withdrew his men for a rest to a major road crossing, an ideal target for the enemy's artillery fire. Within an hour of our arrival at the resting place, German guns subjected us to intensive fire for about five minutes, killing and injuring a large number of men and horses. We Polish army engineers were always of the opinion that cavalrymen had horses with big heads to think for them. Nevertheless, we had to admit that to make a cavalry charge on tanks and armoured vehicles required much dash and courage. By now the Soviets were at our rear and the commander of this frontal sector had no choice but to surrender and dismiss his troops, leaving them to their own devices. Yet again we resumed our pilgrimage to the West and arrived at Lvov,

where we prepared ourselves for the final assault by night in civilian clothes across the frontier to Rumania.

Unfortunately, all escape routes to the south were already well covered by the massive Soviet manpower and, even under cover of darkness, we walked straight into the trap and were arrested by members of the Russian Secret Service (NKVD). Wearing officer's jackboots and having a straight figure and a good set of teeth, they accused me of being a Polish colonel spying for the Germans. That accusation was rammed into me throughout the interrogations in six prisons, including Lvov, Kharkov and Dniepropetrovsk. There was much beating of inmates in prisons to squeeze out any information about espionage and the counter revolutionary movement. The Ukranian prisoners, who were supporting Hitler in his war efforts in return for the promised creationof free independent state of Ukraine, suffered particularly severely. My fellow prisoners, during this period, included Professor Szor, the Chief Rabbi of Warsaw, a Senator of the Government; Major Switalski, who was spirited out just before the Katyn massacre of Polish officers; and Budulak, a notorious international burglar.

On the first anniversary of the outbreak of war, we were evacuated in cattle wagons from Dniepropetrovsk prison, through Moscow and Leningrad, to a labour camp in Kandalaksha, south of Murmansk, on the Kola peninsular. The first priority on arrival was to establish a camp by digging trenches, and building roads and huts. We then devoted all our time to the construction of a huge aluminium smelter. One unexpectedly rewarding consequence of working in the open on night shifts above the Arctic Circle was the sight of the magnificent displays of the Aurora Borealis in winter and spectacular colours of the midnight sun in summer.

When the time came for concreting the column foundations, I applied for the job, hoping that the site engineer would employ me on designing reinforced concrete beams in a nice cosy office. Instead, a group of us were given large shovels, a concrete mixer and aggregate to achieve "Stachanovite norms", (that is to say working targets at least 25% above the normally accepted maximum output) casting concrete in the open air at temperatures down to -40°C. Yes, we *were* casting concrete at that temperature, but the shuttering boxes were wired inside and electric current switched on to maintain the necessary heat during the first seven days of the hardening process of concrete. However, the required output and the consequent rewards in kind which they brought could not be attained under those conditions so I applied for, and obtained, a job as a steel erector which proved to be more interesting and better paid.

One day a large mechanical crane was passing our place of work, and one of my colleagues had a chat with the driver and presented him with a pullover. The driver, in turn, brought us a few large bundles of steel, and in that particular week we attained norms of 275% each; that was the "Recordist Rate". At the same time, the Camp Commandant, in order to speed up the urgent construction of the smelter, introduced a privileged catering scheme for the "Recordists". In the camp hall, a stage was erected and arranged in a manner of a top restaurant dining room. The tables were covered with white cloths, with comfortable seats and the more attractive women prisoners serving as waitresses. The food was excellent, while the starving "convicts" below, clasping their rusty tins, were queuing for two spoons of porridge per meal and 800gms of bread per day. In the following week only very few newcomers joined our privileged class and, although our performance was no longer up to the norms required, we carried on with the "show" on the stage for six weeks. My next appointment as site surveyor also enabled me to retain this standard of life style for a little longer, but it was not to last!

Reading *Pravda* (Truth) and *Isvestia* (News) was essential in my employment, although there was no truth in *Pravda* and no news in *Isvestia*, but the papers were much appreciated and used solely by workmen for making twist cigarettes with "Machorka", a rough tobacco. The Russians always told us that when the Germans and the British destroyed themselves by fighting each other, they would just walk over and conquer the whole of Europe.

But Hitler had a different idea.

The friendship of sly comrades in crime came to an abrupt end when the Germans invaded Russia on the 22 June 1941 in Operation *BARBAROSSA*. The ordinary Russians could not believe that the mighty Red Army could be so easily defeated by the German panzer divisions and the Luftwaffe. Our target for completion of the smelter was to have been the end of July 1941 but, with the

German invasion, we were now called on to dismantle and destroy such a valuable potential prize to the enemy. My idyllic and luxurious life (in the circumstances) was shattered once more as we were hastily moved out to Petchora and up the river to Ust Usa, thence about thirty kilometers up the River Usa beyond the Arctic Circle to establish a new labour camp, construct roads through the tundra and assist the retreating Russian armies towards the Ural Mountains.

Meanwhile, the Western leaders, in return for helping the Soviet Union, obtained certain promises from Stalin. One of these was undertaking to release all Poles from prisons and labour camps in order to form a Polish Army to fight the common enemy alongside the British.

We were released in September 1941 and it took us a month of travelling by train through the arctic regions through Kotlas, the Ural Mountains, Sverdlovsk, Chelyabinsk and Orenburg to arrive at Tashkent the capital of Uzbekistan. Prior to joining the Army, we were given employment wherever it was possible and I managed to get a job, first on a farm in Schachriziab, and then as a helping hand at the vineyards in Kitab. In the latter employment, I imagined the work would amount to driving tractors on the sunny slopes and eating lots of grapes, but instead I was given two decrepit oxen, with a hefty cart, to load and transport the manure out of the stables, and once nearly got buried in it when the oxen strayed into a deep trench. After further trials and tribulations I acquired a more sophisticated job as a geodetic engineer at the station of tropical medicine in Turtkuhl, with personal responsibility to carry out the field work in surveying and preparing a project for de-watering several small lakes into one, in order to minimise the breeding of the malaria-carrying mosquito.

TRAINING WITH THE POLISH FORCES IN BRITAIN

No sooner had I settled down to these very interesting and enterprising activities, than the time came to join the Polish Army and we were evacuated from Krasnovodsk, through the Caspian Sea to Pahlevi in Iran, and later through mountainous and treacherous territory to Khanakin in Iraq.

According to the Russo-Polish agreement of 30 July 1941 and the consequent military agreement signed on 14 August in the same year, the organisation of a Polish Army in Russia under the command of General Anders would commence in earnest with its headquarters in Buzuluk, about a hundred miles east of Kuybyshev. At that time, there were one and a half million Poles in Soviet hands and an estimated army of two hundred thousand was planned.

By October 1941, only 46,000 Poles had enrolled in the army and out of 10,000 officers expected, only 406 reported. The reason for the serious shortage of officers was clear. In April 1940 the year when the Soviet Union was Hitler's helpful ally, supplying Germany with vast quantities of grain and fuel, Stalin ordered the execution of 4500 Polish officers in the Katyn Forest, about 250 miles south west of Moscow. Seven divisions of the Polish army were also organized on Russian soil, but only one was equipped with small arms and the other six divisions shared 200 rifles between them! In Khanakin, after a spell of work in the construction of the camp, I volunteered for training in the Secret Service for deployment behind the German lines in Poland. So a number of us started the long journey to Great Britain through the capitals of the Middle East countries to Suez and by boat to Durban and Cape Town.

While on the high seas some RAF officers "adopted" us individually to teach us English. My tutor was Wing Commander R E Ridgeway, Officer Commanding the 40th Bomber Squadron from April to December 1942. We were most grateful for this very first experience in learning English, which stood us in good stead when we eventually reached Britain.

In Cape Town we embarked on the *Aquitania*, built in 1913 and equipped, in the fashion of that day, with four funnels. As we left Cape Town we were told we were sailing north, with the Atlantic to our west. However, a few days later, as we suspected from our brief observations of the Southern Cross, we cast anchor just off Rio de Janeiro. I did not know exactly where we were, of course, and came out on deck and, to my astonishment, saw Christ walking on the clouds. The low cloud had obliterated Rio completely, including the top of the Sugar Loaf Mountain, so that only the statue of Jesus Christ was visible and, at first sight, I thought that I had been blessed with an apparition. The *Aquitania's* captain did not waste much time at Rio and we sailed on to New York to embark an assignment of GIs for transportation to the UK. In New York, where the

ship remained for about a week, we had an opportunity to meet and to be entertained by the old Polish immigrants. This hospitality included a visit to the Rockefeller Centre Theatre on the day which happened to be my thirtieth birthday at the beginning of May 1943.

My long journey came to an end when we landed in Glasgow the same month and promptly started intensive parachute training with General Sosabowski's brigade in Leven. On arrival in Great Britain I was informed of my promotion to the rank of second lieutenant with substantial back pay and an entitlement to a load of clothing coupons. With such wealth I felt like a contemporary yuppie. On completion of training in Leven we did our parachute jumps from Whitley aircraft stationed at Manchester Ringway, the last jump being an exercise, by night, involving three planes, carrying fifteen French and fifteen Polish paratroopers. At the briefing for the night exercise, I opened my mouth too wide and was given the responsibility of leading the first plane as number one and, after jumping, was to organize the reception committee for a fourth plane, bringing two agents half an hour later. While on the ground, I observed that the two French girls had landed on trees, and despite my shouting, "Tout le monde voici", the remainder of the French contingent ignored my call and insisted in going to the rescue of their mademoiselles. Consequently the rest of the exercise had to be cancelled.

We then moved back to Scotland, near Fort William, to continue training in sabotage and survival, thence to Southampton for street fighting and silent combat and on to Hertford for training in specialized demolition work. Nearing the end of my training, I sustained a minor knee injury during a low level night drop near Cambridge but, after a brief stay in hospital, I rejoined my colleagues at Pollard Park, near Amersham, for the long awaited flight to Poland. I learnt that my assignment on arrival was to work as an electrician, while supplying arms to the Warsaw Ghetto and performing general sabotage work behind the German lines.

Meanwhile, the Allied forces were advancing well on the Italian Front and a part of Yugoslavia was recaptured by Tito's forces. Our commanders consequently considered that it would be much easier and safer to fly the Polish agents to the suburbs of Warsaw from Brindisi. In June 1944 we were therefore shipped to Southern Italy to an assembly area close to the Brindisi airfield where, at that time, there was quite a backlog of agents waiting for flights to Poland. In spite of the improved military situation in Europe, it was still necessary to make the long and hazardous return flight without a refuelling stop, because the Russians, who were by then approaching Warsaw, refused to make the necessary facilities available. Two of us were alerted several times for the flight and one night we thought it was the real thing until our Czechoslovak plane returned from a previous mission, perforated with shrapnel, without having been able to fulfil its task.

When the Soviet armies advanced to the gates of Warsaw, they prompted the Polish underground movement to rise against the Germans. On the nights of 1 and 2 July 1944 they called upon the underground army (controlled by the Polish Government in London) to rise in arms against the German forces in Warsaw and the adjacent provinces. As soon as the Warsaw uprising developed, the Soviet armies halted on the east bank of the River Vistula, thus permitting the Germans to destroy any force on Polish soil that had any connection with the exiled Government in London. The heroic Warsaw uprising failed with great loss against the savage odds on both sides.

However, the thrust of the Soviet armies was now unstoppable and there was little point in sending any further agents to harass what was, as far as the interest of the Polish state was concerned, a defeated Germany. All Polish agents were therefore returned to their original units and I found myself in the SME in Capua and Caserta, engaged in training Sappers and retraining Poles, many of the latter being deserters from the compulsory service in the Germany Army.

Some weeks before Christmas 1944, I was transferred to the HQ of the 3rd Carpathian Divisional Engineers and, soon after, we took up front line positions on the River Senio, the first of the seven rivers before Bologna, facing General Heinrich von Vietinghoff's formidable defence line. Having a working knowledge of the English and Italian languages, I was appointed as Liaison Officer between HQ 3rd Carpathian Divisional Engineers, the 1st Polish Infantry Brigade and a British tank unit supporting our sector. Prior to the April 1945 offensive, I was given the task of rendering the Appian Way, from Pideura village to the River Senio, suitable for tanks and heavy

vehicles. We were to make use of the good weather and to take advantage of the early morning fog for working on the road sections close to the German lines. Indian and Italian Sappers, using tipper trucks and three ton lorries for transporting rubble from Faenza, were deployed in this operation.

At last the time had arrived for the offensive. However, on the 9 April, in the early afternoon on my way to inspect the Sappers, my jeep collided with another vehicle at a road crossing. My driver emerged unscathed, but I was slightly injured and had to go to the First Aid Post, where I remained for about half an hour. During that time, the American Air Force bombed our front line and I was informed that one of our sappers had been killed and nine injured. In retrospect therefore, my road accident was a blessing in disguise. The cause of the error was, apparently, the faulty attachment of a bomb on the leading plane. Unfortunately, the arrangement was that, if the leading plane dropped a bomb, those following did the same. Following more precise bombing and a spectacular concerto of artillery fire early in the evening on the German positions behind the banks of the River Senio, our infantry captured first the east bank and overnight the west bank of the river.

At dawn on the 10 April the Sappers started building a Bailey bridge for the supporting units, interrupted every so often by the enemy artillery and mortar fire. German SP guns became quite a menace when, under cover of darkness, they came very close to our positions. During the day our intelligence intercepted a German message ordering the remnants of their army to assemble in the small village of Solarolo. Our command hastily, and perhaps thoughtlessly, arranged for the bombing of the village. The Germans were already retreating to get behind the River Santerno defensive line as quickly as possible. There seemed, therefore, little justification for the resultant saturation bombing which reduced the little village to a heap of rubble and which killed its few inhabitants.

In the evening the infantry approached Solarolo and overnight captured the east side of the River Santerno. Orders given to me were to follow the infantry to the river, select a suitable site, procure the necessary materials and construct a Bailey bridge as soon as possible. During my reconnaissance of the river bank, my British radio operator was killed by a sniper and his assistant wounded. We actually began work on the bridge at 2200hrs on 11 April, but the approaching darkness did not stop the enemy artillery from continuously shelling the site, resulting in very slow progress. At first light the next morning the infantry, already firmly established on the west bank of the Santerno, were still waiting for the tanks to support them in their pursuit of the enemy.

Fortunately, in the vicinity of our location we discovered a ford with a reasonable access road to the river which, according to the local population, the Germans in their hasty retreat had not mined. The Commander of the 2nd Company of Sappers and I promptly approached the British CO of the armoured regiment at about 1300hrs on the 12 April and informed him of our discovery. We proposed that he sent his tanks over the Santerno through the ford. The CO appeared to be sceptical about the whole situation. However, he undertook to send his tanks across to the west bank of the Santerno using the ford, provided we sent one of our bulldozers across first to prove that there were no mines. We did just that with a D7 armoured bulldozer. There were no problems and no mishaps and within minutes 28 tanks started rumbling and churning the ground towards the ford. In my role as Liaison Officer, I grabbed the motor cycle which I had found much easier to use on the crowded roads and tracks than the Humber Scout Car which I had been allocated, and reported the good news to the Commander of the 1st Polish Infantry Brigade. He was delighted and the planned dawn attack was promptly rescheduled for later that afternoon. The Santerno River defensive positions were elaborate and difficult to overcome. However, once the Germans were crushed there, the remaining five rivers on the way to Bologna became only minor obstacles and, consequently, this city was captured on the 21 April.

On Tuesday 24 April 1945 our front line activities came to an abrupt end with the end of hostilities, followed by celebrations of the occasion with flares and rockets.

With the end of the War, my time in Italy was drawing to a close. After further tours of service with HQ 2nd Polish Armoured Division and the 3rd Carpathian Division, I embarked on the troopship *Madina Victory* at Naples on the 7 June 1946 and landed at Liverpool six days later. Many of my compatriots elected to return to Poland but I had no wish to return to a country now dominated by Stalin's Russia. On the 14 June, we arrived at

Hodgmoor Camp, half way between Amersham and Beaconsfield. The camp eventually became a Polish Resettlement Centre, where everyone was to undergo preparation for civilian life. Meanwhile, to earn our living, I and a detachment of Sappers and Pioneers were sent to Latimer House, Chesham, towards the end of the year, to carry out extensive renovation and refurbishing work, preparing it for housing the Joint Services Staff College, planned for opening on 21 January 1947.

On a more personal note, in April 1947, 3½ years after we had first met at a party, I married a young lady from Manchester, Margaret Campbell.

The Post War Years

With my new responsibilities as a married man, I now had to make a quick decision as to how I was to make my living in my adopted country. It was, in fact, a fairly obvious one. With a background of mining training and the nationalization of the British coal industry in 1947, I joined the National Coal Board as a junior engineer and mine surveyor.

My major problem was that, unlike in the medical profession, foreign engineering qualifications were not recognised in this country, so I had to go back to school. It was hard work but the combination of a correspondence course with the British Institute of Engineering and Technology and part time tuition at the Wigan Mining College enabled me to pass the succeeding hurdles of Mine Surveyor, Colliery Under Manager, Colliery Manager and, finally, Member and Fellow of the Institution of Mining Engineers with Chartered Engineer status.

At this time the National Coal Board decided to adopt the costly Continental horizontal mining techniques and my pre-War mining experience in Poland now fortunately stood me in good stead. In 1957, I became Area Tunnelling Engineer for my region in the North of England and ten years later came my last appointment as the headquarters Outstation Explosives and Tunnelling Engineer in the North West, which involved regular visits to pits in an area extending from Cumberland to Birmingham and out to North Wales. During this period in my career I was fortunate in having the full support and encouragement of both my colleagues and my superiors. With the aid of my colleagues I organized four British record tunnel drivings, the best of these being in Cronton Colliery, the only pit in Lord Wilson's one time parliamentary constituency. Here we planned an advance of 70 yards in seven days and, in fact, achieved 89 yards of a "dipping" tunnel. To my superiors I owe a debt of gratitude for encouraging me to pass on my professional experience in the form of lectures and papers. Some of these were published abroad and one "High Speed Tunnelling in Lancashire" was awarded a medal by the National Association of Colliery Managers.

Conclusion

It has been said that the English consider you as equal, provided that you consider them as superior. That has not been my experience. I can only say that I have been very fortunate to have spent most of my life in one of the world's few well established modern democracies, second to none, among people of fairness and compassion. Most of all I am grateful to my own ever supporting family; my wife Margaret, my son Charles and his wife Denise, together with my delightful grandchildren, Alexandra and Paul.

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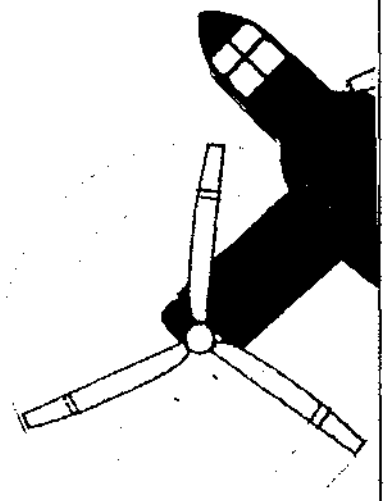

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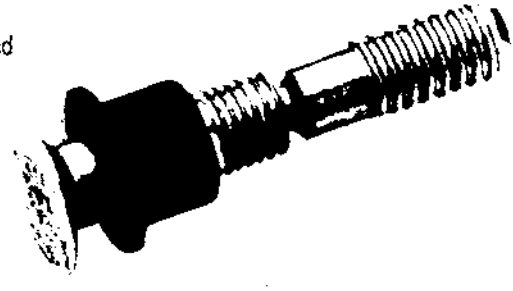

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Ubique — Subaqua

LIEUT COLONEL P O M CHITTY MBE

Lieutenant Colonel Peter Chitty was commissioned into the Corps in 1948 from Sandhurst. He served as a Troop Commander in Hong Kong, long enough to build one road and a Dragon Gate, and then less eventfully in BAOR, before spending nine years in Intelligence and BRIXMIS, from where he was removed as a gesture towards detente.

He posted himself to the embryo RE Diving School which was near his home in the New Forest, and in his four following regimental and staff appointments he was awarded the MBE for the 1969 SW England Flood Disaster, and dived his way around the Caribbean, the Pacific and the Mediterranean.

By now totally unemployable, he returned to spend eight years reorganising the RE Diving Establishment and Army Diving before unilaterally involving the Corps in the Recovery of the Mary Rose.

He retired in 1982 and has since acted as a Consultant to the Receivers called in to dispose of the firms in which he had intended to pass his declining years.

We shall never know what was in the mind of that one-armed colonel of the Royal Engineers as the murky waters of the Medway closed over his head on the 28 April one hundred and fifty years ago. Certainly there could have been no fear. A veteran of the wars against revolutionary France and having been severely wounded by shot and bayonet at the Siege of Walcheren he had had his share of hand to hand fighting. Possibly there was some puzzlement as to why he, the Director of the Royal Engineers Establishment, was risking his life at the tender age of fifty eight. But being of a highly inventive disposition, he was probably congratulating himself that the honour of being the first service diver in the world had fallen to him. Possibly even, this scholarly senior officer with the schoolboyish sense of humour was amused that he, Charles Pasley, was turning *UBIQUE* into *SUBAQUA*. Certainly he must have known the risks involved, as Mr Deane's Common Diving Apparatus was still relatively unproven, although John Deane and his brother Charles had been diving on the *Royal George* since July 1832.

John lived at Whitstable some twenty miles along the Thames Estuary from Chatham, and it is suggested that he and his brother first became involved with underwater diving through a combination of Charles' caulking firm in Deptford and as the result of a fire on the family farm in 1830. After early attempts to pump water from a pond onto the fire had proved ineffective, John Deane reputedly removed the helmet from a suit of armour standing in the hall, secured the pipe to the inside, and instructing the labourers to pump slowly, placed the helmet on his head and walked into the stable through the dense smoke to rescue the horses.

How true this story from the *History of Three Kent Parishes* may be, what is fact is that in 1832 Charles patented an "Apparatus to be worn by persons entering a room filled with smoke or other vapour for the purpose of extinguishing fire or

Lieut Colonel POM Chitty MBE
Ubique -Subaqua

extricating persons or property therein". But in the two years that had followed the fire, John Deane had adapted the helmet for use underwater and, after an early mishap when the air in his helmet upended him, he added some pieces of lead to the soles of his shoes. So equipped he was able to join the "sweepers", searching for and salvaging the many anchors and mooring chains that littered the shallow seabed of the Thames Estuary.

So confident were they of the Common Diving Apparatus and of their diving abilities, they tendered to the Admiralty for the major underwater salvage of the *Royal George* at Portsmouth. This unfortunate vessel had been the victim of early cuts in defence expenditure, and although she had been recently boarded as unseaworthy, the thirty-six year old three-decker had been commissioned to join the fleet attending the Siege of Gibraltar. However, before she could sail from Portsmouth, her rotten timbers gave as she was being heeled over for a minor underwater repair, and she sank at her anchorage, joining two other naval wrecks there, and seriously blocking the harbour entrance.

It was two other wrecks, those of the collier *William* and the schooner *Glenmorgan* lying off Tilbury and making navigation of the Thames extremely hazardous, that caused the Royal Engineers to become involved with diving and underwater demolitions, leading later and inevitably to the formation of the Royal Engineers Submarine Mining Service.

The Corps had been responsible already for a number of shallow water demolitions as a result of Colonel Pasley developing an effective waterproof fuze for initiating charges underwater in 1825. His method was to seal the charges in metal containers which were then contained in timber casks. The initiation was fraught with difficulties to say the least. It required the train to be fed through 1.5 inch diameter lead tubes which could be up to thirty feet in length. This and the immense difficulties in locating and fixing the charges in any appreciable current caused Pasley to change from using a number of small charges, to concentrating on a few, larger charges.

In his first attempts to remove the brig *William* in the late Autumn of 1837, Colonel Pasley employed the traditional salvage techniques used by the Master Attendant of the Dockyard at Chatham, but to little purpose. Along with a very obvious need for improved and reliable underwater demolition practice, clearly some more satisfactory means of reaching the site was required. For the 1838 operations, Pasley decided to continue to use the Dockyard diving bell for taking the charges to the site, but to use divers for placing them. He appreciated that the logistics of operating and positioning a bell were daunting, for nearly sixty seamen and four lighters would have to be employed in mooring and moving the bell, whose bulk proved unmanageable in currents approaching one knot. By employing divers for taking the charges from the bell to the site, he hoped to reduce considerably the lengthy and manpower-heavy operations in fine positioning the bell.

This was a bold idea, a logical one, but also an idea closely related to the urge to use the new technology that was burgeoning in Victorian Britain, and nowhere more so than off Spithead, where the feats of the salvage divers working on the *Royal George* had caught the nation's interest. In 1835 there had been a frenzy of diving fervour, and two forms of diving dress had been patented by "gentlemen divers" called Fraser and Bethel. Other pioneering divers were borrowing ideas and developing their own equipments, but the Deanes were preeminent in experience and the proven safety of their equipment, so it was to them that Pasley turned.

But diving was a chancy and hazardous business and was being undertaken by individuals using their own equipment and being paid by results. Those early divers were first and foremost in the salvage business, and as salvors, they secured from the Board of Admiralty or the ship owners, the right to dive on wrecks, their profit being made on what they could recover.

The Deanes, however, were much in demand around the country, and so although Pasley noted that "they urgently requested to be employed", he could not get them to name their terms! Open ended contracts were even then frowned upon by the Board of Ordnance, so he decided that the Corps would have to do its own diving. Therefore in February 1838, whilst new demolition techniques were being tried and tested in the Medway, demonstrations were given of various diving equipments, and that produced by Mr Kemp was selected.

By April Colonel Pasley and his volunteers had completed their dry training and familiarisation with the equipment, helped no doubt by the excellent Diving Manual that the Deanes had published. The trainee divers would have noted from it that not only should "the diver dress in two pairs of stockings, two drawers, and two Guernsey frocks, with a handkerchief tied around the neck to keep the frocks well up", but more importantly that "NB No person should on any account whatever, be suffered to descend in the Diving Apparatus, or to attend the signals, unless they are perfectly sober, calm and collected". The signals that the Deanes had devised to communicate with their divers by a hand line, are remarkably similar to those still used today. "One Pull" being used by both signalman and diver to indicate that all was well, and a constant jerking of the line indicating that the diver was to be brought to the surface at once.

So on the 28 April 1838 Pasley decided that the Corps was ready to make that "small step for man", but in this case, underwater. As a man who had always led from the front in battle, and was now pioneering this new discipline of diving, who had a better right than he to be the first underwater? But whilst rank has its benefits, few of the sappers on site would have wanted to change places with Pasley and risk their own lives on this unnatural venture into the murky waters of the Medway. On returning to the surface, the Colonel remarked that the equipment had been "comfortable". He then gave the helmet to Sergeant Young who was already dressed for diving, and who then became the second serviceman to dive. By 5 May, and possibly in strict seniority. Corporal Mitchell was given his first dive, and fixed two eyebolts in a baulk of timber placed on the river bed. Colonel Pasley recording at the time that Corporal Mitchell, "had never used a diving helmet before, and yet he remained under water for three quarters of an hour, which has satisfied me that there is neither difficulty nor danger in the use of this apparatus, which I also know by my own experience, having gone down first myself, which I thought was the best way of forming an opinion of the practicability of the proposed operation".

All was now ready to begin the demolition and removal of the brig *William* and the collier *Glenmorgan*, so Pasley sent his road party to the barracks in Tilbury, whilst the Admiralty lumps for the diving bell, and the RE pinnaces and cutters sailed out past Sheerness and westwards up the Thames. The Port Admiral had been instructed to send some naval riggers to assist in the bell operations, and the Water Bailiff of the Port of London arranged for the steamer *Swiftsure* to be in attendance, and to fly and fire the necessary warning signals when the river had to be closed to ships whilst the demolitions were being fired.

The operations started badly, when on 21 May the now possibly over confident Corporal Mitchell had overstayed his dive time on his second dive of the day. His attendant had become increasingly worried that Mitchell had not been responding to his signals and reported this to Captain Yule who was supervising the diving operation. One last "pull" was given, but by the lack of any response, the worst was assumed. Colonel Pasley was informed and personally took over the rescue attempt, risking his life in the diving bell which became increasingly unmanageable as the tide had started to run. The bell dive had to be aborted, and on the next attempt at slack water, they found that Corporal Mitchell had become entangled and suspended in the collapsed rigging of the *William* and being unable to cut himself free, had drowned.

Within the week the first of the two 2,500 lbs powder charges that Pasley had prepared had been laid on the brig *William*, but it was to be fired by an improved fuze consisting of a linen tape filled with gunpowder. It still had to be enclosed within a tube, but although this was of lead and gave a degree of give, it was extremely difficult to join to the charge and to support through the water. The fuze was the most vulnerable point of the operation, but Pasley was sufficiently confident to publicise the proposed demolition day, and many city officials joined the vast crowds who had come to watch the explosion.

"A beautiful explosion" wrote Pasley afterwards, for parts of the brig's timbers and rigging had been carried upwards in the column of water from the blast. To have got it right first time was an achievement, but the really satisfying part was when a check next day from the diving bell showed that the *William* had "ceased to be an obstruction", and that the channel depth had been increased to five fathoms clear of any debris.

A confident Pasley now attacked the *Glenmorgan* with his second charge, and this too was successful, exceeding his wildest hopes. The Thames was now clear of obstructions, and a

grateful Lord Mayor presented Pasley with the Freedom of the City and a gold medal.

In spite of his success, the problems of the underwater fuzes continued to concern Pasley. He knew he had been lucky on these two very public occasions, but their innate unreliability and difficulty of handling, made him turn to a relatively new invention then interesting the scientists and inventors: electricity. He himself had presented a Paper at the Institution of Civil Engineers on "Blasting by Galvanism", and he now stepped up the experiments being carried out at the RE Establishment under Captain Sandham RE, and using Mr Daniell's Voltaic Cell.

Over at Portsmouth, the Deanes were continuing their salvage operations on the *Royal George*, but the main thrust had been in the year 1834-36, during which they had removed most of the salvageable, but essentially sellable, material and guns. Now they were slowing down the work as the remaining salvage was deep within the wreck and could only be reached using demolitions. The Deanes had been following Pasley's Thames operations and particularly his experiments with electrical initiation. In early 1839 they were trying to get hold of the same batteries that Pasley was proposing to use for a much larger, and altogether daunting project that he was considering—the clearance of the *Royal George*. Success on so grand a scale and on such a public site, would confirm the RE Establishment as being in the forefront of Victorian technology.

He had not wanted to be rushed in planning this project, but the active interest being shown by the Deanes in wanting to use his electrical initiation, prompted Pasley into taking rapid action. In March he lodged a letter of intent with the Board of Ordnance, asking that he be allowed to approach the Admiralty directly with a view to "forming a plan of operations, and computing the cost of its destruction by blowing the woodwork to pieces, and weighing the guns and waterlogged oak timber".

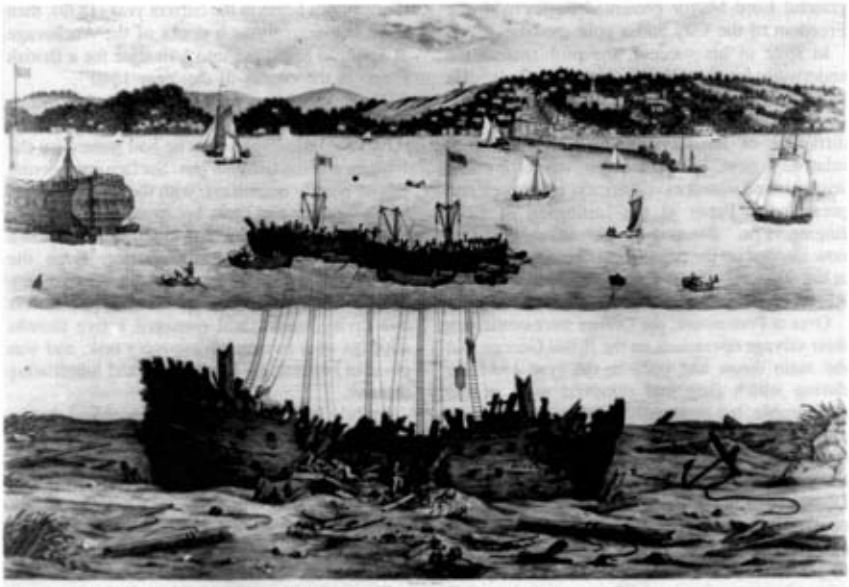
By 25 May he had completed his plan for the operations. It was a carefully considered and calculated plan based upon his experiences in the Thames operations the previous year. He estimated that he could carry out the clearance within two working seasons, using RE and civilian divers, a diving bell manned by the Navy, and a working party of about twenty NCOs and sappers. "The whole cost would not exceed £2,500; and if operations begin in the current year (1839), then there can scarcely be a doubt of the Anchorage at Spithead being put into a fit state for a British Fleet, in the course of the Year 1840".

These were brave words, far braver than Pasley could then realise as they were based on the relatively little experience he had gained on the *William* and the *Glenmorgan*. Surface engineering can be readily quantified, with the only variables being weather and luck, but even to this day we fail to appreciate the unforseen and unknown problems of operating underwater. Even the recovery of the *Mary Rose* with all modern diving and recovery techniques available to the planners and diving teams, still managed a five months slippage on a five month recovery task, and was close to becoming a very public and humiliating disaster.

By July he had been given the approval that he needed. Within the month he had a fleet of three dockyard lighters moored on site and with his divers and work force quartered on board the hulk *Success*. Captain Williams RE was in charge, but inevitably Pasley spent much of his time in the early days on site, and shuttling between Chatham and Portsmouth.

The great good luck that had shone on Colonel Pasley's underwater endeavours at last deserted him, temporarily but humiliatingly. On lowering the first of the two 2,500 lbs charges to the wreck, the first became irrevocably caught up in some obstruction and had to be recovered to the surface. The second was successfully placed by the divers, the fuzes prepared, the warning flags flown and the bugles sounded, the electrical contacts made — and nothing. A complete nothing that was being watched by Royalty and many distinguished personages.

As a result of the wash-up conference afterwards, Pasley sacked his chief civilian diver, dispensed with the naval diving bell that was clearly unable to meet the task and restrengthened the casings to the charges which had breached and leaked at the 16 fathoms depth off Portsmouth. Diving continued throughout the three weeks delay whilst the problems were resolved, but using smaller charges and the traditional powder tube fuzes. On 17 September, Pasley felt confident enough in the improvements that he had made to try electrical initiation again. With an eye to his future, or perhaps as a let-out should there be



Wreck of the Ronal George

another failure, the officer in charge of the demolition, Lieut Symmonds RE tactfully allowed Pasley's seven year old son to "complete the circuit" on a small charge of 260 lbs, and this time it worked. Within the week they were able to use the now strengthened 2,500 lbs charges which whilst proving very effective underwater, became one of the earliest tourist attractions. On firing days, crowds lined the foreshore in front of Henry VIII's Portsea Castle, with the inevitable amateur yachtsmen entering the site area and on occasion ramming the workboats.

"It must be considered one of nature's miracles", wrote Captain Basil Hart RN in the *United Service Journal*, "for certainly nothing can be more surprising than the tap of one wire against another in a boat or vessel should instantaneously ignite gunpowder and break to pieces the strongest masses of wood and iron at the bottom of the sea, at a great distance from and with perfect safety to the operator". This last remark was more perspicacious than the gallant captain realised, as the act of igniting a fuze, even a modern one, from a small boat anchored immediately above an underwater charge, remains one of the more interesting experiences of today.

Work resumed on the *Royal George* in 1840, but Lieut Symmonds RE and a small detachment were tasked with the removal of the wreck of the frigate *Edgar*. Fire was always the main hazard in wooden ships in war and peace, and the *Edgar* was one of many where a chance spark had rapidly turned to a raging fire which on reaching the magazine, had blown the vessel up. She now lay on the Mother Bank off the entrance to Wootton Creek.

Once a working routine had been established, Pasley turned his attention to improving the diving equipment. The Royal Engineers had been using two of the Deanes' Common Diving Apparatus since the start of the *Royal George* operations, although he himself had originally dived in Mr

Wreck of the Ronal George

Kemp's dress and used it for the removal of the *William* and the *Glenmorgan* in 1838. Recently he had introduced two sets of Siebe's design, which proved very popular with the military and civilian divers. They objected strongly however to Bethell's equipment which was tried out, as it took some twenty minutes to undo the twelve cumbersome locking nuts and remove the helmet. The divers were making between three and seven short dives a day, and as they liked to be able to take off their helmets and breath fresh air on surfacing, they found Bethell's equipment too time wasting.

Augustus Siebe was a remarkable man. A former Austrian Gunner, he had come to this country and was practising as an engineer of some skill and inventiveness. He had a number of patents to his credit already, from papermaking machinery to hydraulic apparatus, but his greatest contribution was as a production engineer. He was adept at improving other people's ideas and manufacturing them. As such he proved invaluable to the Deane brothers when he collaborated with them and was responsible for major improvements in their air pumps, enabling them to work at far greater depths. It was this facility for improvement coupled with the strong possibility that one of the brothers parted with his rights to their invention, that made the manufacturing firm of Siebe Gorman preeminent in diving equipment for a century, and also started the myth that Siebe had "invented" the original diving apparatus.

By December 1840, Pasley was able to complete his technical evaluation. In his *Report to the Inspector General of Fortifications, WO44/613 dated 30 December 1840*, he praised the Deane's Apparatus, "which is simplest of all, though very efficient for common purposes, and highly approved by many of the best divers, (it) does not admit a man lying down or stooping his head lower than his body, without a risk of his helmet filling with water, and if he should by accident, or by neglect of his assistants fall over into a hole, or down the Side of a Wreck head foremost, he will be drowned, if not hauled up immediately".

Pasley came down strongly in favour of Siebe's apparatus, which he himself had helped to modify, and he recommended it for "Public Service". It is essentially almost the same design which is in regular use around the world today, due to the simplicity of operation, maintenance and training.

Work on the *Royal George* continued slowly but surely, but the original over confident target date of completion in the season 1840 was long past before the Royal Engineers were able to withdraw. The problems of working underwater off Spithead in mostly nil visibility, the complex vagaries of the strong tidal currents, and the effects of pressure on the divers working at depth had not been anticipated or evaluated properly. The bends, or caisson disease when it was first identified in tunnellers working in compressed air, was unknown. With hindsight it is interesting that Pasley's civilian divers had some gut feeling about the dangers of repetitive dives, and he had to sack them as they showed a marked, and instinctive, reluctance to work the long hours that he expected from his disciplined military divers. These were known to have suffered from repeated attacks of "acute rheumatism", one of the simpler definitions of the early stages of the bends.

The incredible effects of seabed scour off Spithead were not understood. The unfortunate Lieut Symmonds RE had "destroyed" the wreck of the *Edgar* in 1840, blowing it into three pieces and leaving no major part of the superstructure intact. But in 1844 a check sweep revealed that whilst the bow and stern had gone, the centre section had now been uncovered from the mud, and stood proudly almost 13 feet high! Lieut Barlow RE was detailed to deal with it and finally blew it that year as a conclusion to the Royal Engineer operations off Spithead.

It had been a prolonged affair, which must have become really tedious and repetitive after the initial euphoria of 1840 had worn off. True there had always been something new to occupy the divers and the support team. Major General Pasley, for he had been promoted on 23 November 1842, persuaded the Navy that the improved diving apparatus and techniques had surpassed any benefits that they had obtained using diving bells in the Dockyards. So in 1843 he had detached Lance Corporal Jones to instruct thirteen petty officers and seamen from *HMS Excellent* in the "discipline of diving", which had been included in the RE Establishment training since 1839.

He had insisted too that meticulous records were kept of all the artefacts recovered, following the lead of the Deanes who were the initiators of underwater archaeology. Some of the watercolour drawings by sapper draughtsmen are now in the Science Museum. He tried out variants on

electrical initiation based on his experiments with land line telegraphs. Under his direction, Captain Hutchinson RE had tried using a single cable with a water return, "in which", wrote Pasley, "he was very zealous" but to little effect, as the method required "a battery of double the power".

His attempts to initiate multiple charges underwater proved ineffective and costly, as "we lost a great deal of powder, as we never succeeded in firing more than two charges simultaneously out of a great number, and the cases containing the second charge were generally burst, and the powder spoiled, by the explosion of the first that happened to prove successful. We therefore in all cases used a voltaic battery and two conducting wires to every charge in our operations against the *Edgar* in 1844".

When you consider the complexities and the enormities of the underwater projects that Colonel Pasley entered into, mastered and conquered, buoyed by the enthusiasm of the Victorian drive for scientific knowledge, then the audaciousness of his enterprise can only be likened to the 20th Century race in outer space. Like that first astronaut on the Moon who claimed that "it was but a small step for man", Pasley's first dive in the Medway on 28 April 1838 was a physical step which was to change the face of working in inner space.

His contribution, through scientific and methodical engineer expertise, confirmed the new discipline of diving that the Deanes had pioneered. His efforts are now largely forgotten and unappreciated, but they formed the firm base for future diving and underwater engineering, from the North Sea Oil operations to the recovery of the *Mary Rose*. Perhaps this last, involving so great a contribution by Sapper Divers, would have pleased him most.

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but principally invaluable help from Alexander McKee, Historical researcher, diver, photographer, writer and friend, without whom the *Mary Rose* could not have been found, nor raised.

Diving Silver Centrepiece

This new silver centrepiece was commissioned by the Corps to commemorate 150 years of diving (1838 to 1988). It was made by John O'Dell of Gravesend and will normally be kept at the Royal Engineers Diving Establishment at Vernon, Portsmouth.

Ubique -Subaqua

Research into Electronic Detection of Minimum Metal Mines Laid in the Falkland Islands

MAJOR J A CRAIB QGM BA RE and DR R J CHIGNELL MSc PhD CEng MIEE MIEEE DIC AKC

Major Alistair Craib joined the Army on Guy Fawkes night in 1965 and was commissioned into the Corps in 1966. He has enjoyed a varied career ranging from Armoured Engineering, training Junior Leaders, being an MIO, to EOD work. He was Operations Major of 33 Engineer Regiment (EOD) from January 1984 to July 1986 after which time he assumed command of the Defence EOD School. Within the scope of these last two appointments, he has been involved in, for example, the creation of REDFIRE and, more particularly, the development of the technique which is the subject of this article.

Dr Richard Chignell led this project for ERA Technology where he was formerly employed for eleven and a half years. He has recently launched Emrad Ltd, a new company based at the Surrey Research Park, Guildford. It aims to further his wide technological interests especially ground-probing radar, an area where the Falklands project described in this article generated significant experience.

The opinions expressed are those of the authors and are not necessarily agreed or supported by MODUK.

Introduction

There exist many good accounts of the conflict in the Falkland Islands (FI) from the All Arms and Sapper points of view. Similarly, much has appeared about the minefields that were laid by the Argentinians which, to a large extent, still remain. It is not the purpose of this article to repeat what has previously been written in this *Journal* and elsewhere, except to give a background which will hopefully make clearer the reason for the specific research undertaken.

It is well known that in addition to minefield records of varying quality, many of the mines laid were what are known as 'minimum metal mines'. All the mines contained some metal although the amount in some was insufficient for conventional metal detectors to be successful even under

Major J A and Dr R J Chingnell

Mine	Type	Country	Case	Explosive Content (Kg)	Metal Content (gm)
FMK1	APers	Argentina	Plastic	0.152	0.7529
FMK3*	A/Tk	Argentina	Plastic	6.252	0.7529
ATMC	A/Tk	Argentina	Metal	2.787	2086.0000
P4B	APers	Spain	Plastic	0.100	0.1410
C3B	A/Tk	Spain	Plastic	5.115	0.1410
SB33	APers	Italy	Plastic	0.035	0.7041
SB81	A/Tk	Italy	Metal	2.191	0.8610
No 4	APers	Israel	Metal	0.188	65.0000
No 6	A/Tk	Israel	Metal	6.045	2000.0000

* Includes the FMK1 as the initiator

Table I. Details of mines used in the Falkland Islands

ideal conditions. However, as those who have been to FI will know, conditions are far from ideal and following a number of injuries, including two majors each losing a foot, the Government stopped clearance operations. The MoD instigated a search for a suitable solution. In the beginning it was hoped that some comparatively simple modification to an existing system would provide a speedy solution, and many ideas were initially investigated. At that time, one of the authors proposed the use of ground-probing radar, but it was generally recognized that this approach required considerable research and development before it could be deployed into a live minefield. Although realizing the limitations the MoD pursued this avenue and awarded a small investigative contract. The work led to a simple demonstration of the potential of ground-probing radar for this application on Dartmoor in October 1983. The MoD then reviewed all the available approaches to the problem and subsequently awarded a significant research contract in February 1984. This article summarizes the work undertaken on that contract which made considerable advances in the state-of-the-art regarding ground-probing radar. The authors were respectively the user and the project leader.

Before discussing the work some of the popular misconceptions regarding clearance will be dismissed. Scores of suggestions have been received over the years since the conflict, giving methods for opening up the land presently containing mines. The vast majority of these ideas centred around mechanical systems, ranging from flails, ploughs, explosive overpressure, helicopter towed rollers to walking sheep through! None of these methods can give a sufficient guarantee that all the mines have been destroyed. Such methods may be acceptable in war as a means of breaching but not in peace for clearance. Would you allow your family to walk across such ground after a mechanical 'clearance'? A detection technique is the only way of getting the required degree of guarantee. How to deal with those mines, once detected but hidden from view in the ground, is an interesting subject on its own but is not addressed any further here.

The Task Set

The basic requirement was that the technique must be capable of detecting every type of mine used in FI, down to a depth of 200mm, with a permissible 'miss' of one mine in 20,000. There were nine mine types; three Argentinian, two

Israeli, two Spanish and two Italian, of which four were anti-personnel and five minimum metal (see *Table 1*). It was believed that the concept of ground-probing radar would satisfy these requirements, and the technique had already been developed for other purposes.

In April 1984, Richard Chignell and his Managing Director, Dr Alan Rudge, visited FI and were taken to see the vast majority of all the minefields so they could see the scale of the problem. A laboratory system was one thing, but could they translate that into practical equipment which could be used safely and reliably behind minefield fences? Having established an early link with the eventual user of any equipment they produced, the contact was maintained throughout, and indeed beyond, the life of the project. This was considered to be essential because they were working on the edge of the known technology in this field and it could have taken them into esoteric rather than practical areas. In a sense, the entire project was technology led since no one knew for certain how the system might be configured and how effective it would be. The Staff Requirement, such as it was, developed in step with the technology.

The Technique

Ground-probing radar, like any radar, generates signals which are transmitted, reflected from a target and then analysed. However, unlike the conventional radar seen at airports where signals are transmitted through air, with this technique the signals are transmitted vertically into the ground which is not uniform but highly structured. Like the conventional radar, all signals are reflected, to varying extents, from objects with which they come into contact, for example, the surface of the ground (this was to prove a major problem), wet peat, dry peat, stones, voids and mines. The problem was to recognize which signals were generated by what targets. In order to achieve this all the returning signals had to be digitized and then sent to a computer for analysis, a simple statement but demanding to implement.

Firstly, the basic radar proposed for operational use carries out one million measurements a second and each measurement is made to 12 bit accuracy, in other words 12 million bits can be generated each and every second. For a vehicle mounted system designed for area search, a number of radars could be used further multiplying the data rate. For a hand-held system the analysis had to be fast enough to prevent the man working with the equipment, behind a minefield fence, treading on a mine which had been sensed electronically but not yet declared to him. To achieve this real time processing speed, dedicated processors were required and, on an area search vehicle, a mainframe computer.

Secondly, a database was necessary to enable returning signals to be continuously compared with signals which it was known came from mines. Having isolated the important signals, it could then warn the operator and plot the precise location of the mine.

A laboratory equipment was quickly developed which could be used to test and develop the entire package from radar through to the signal processing. With this equipment, specially modified for field use, a data collection programme was started mainly using specially laid minefields in FI. At the same time much investigation into the nature and composition of the peat on which many of the Argentinian minefields were laid was done by a specialist from Exeter University.

The full details of the electronics within the system are not appropriate for this *Journal*, but an outline description is presented in the following paragraphs.

The Equipment

Two equipment configurations were always envisaged — a vehicle mounted system for large scale clearance and a hand held version for clearing areas not suitable for a vehicle. The major research and development effort was directed towards creating the vehicle mounted system to provide a wide area search capability. For both configurations many of the modules are identical and it is the common components that will now be described. There are three major modules:

Antenna
Radar including its digital circuitry
Central processing station

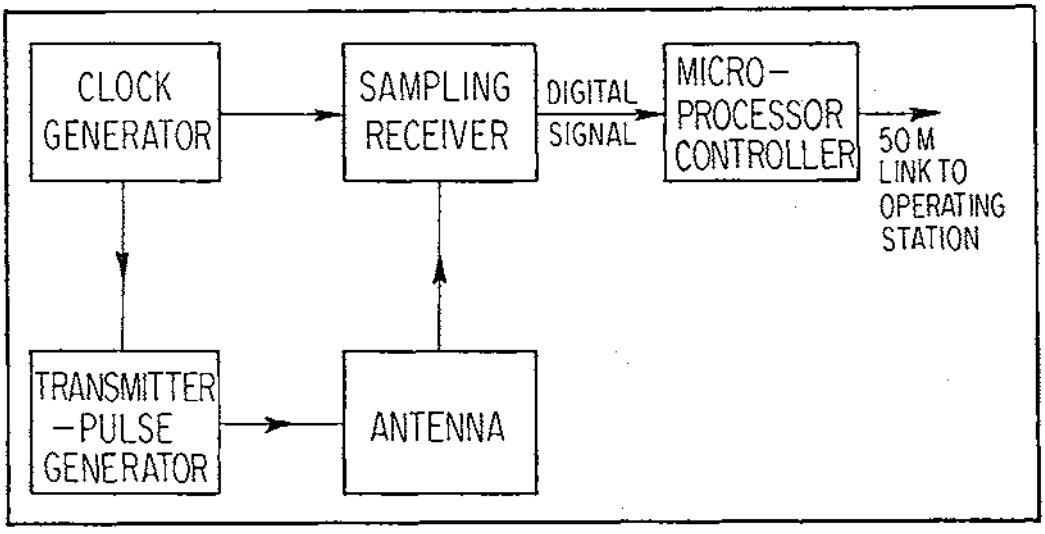

Figure 1. Block diagram of time domain ground-probing radar system

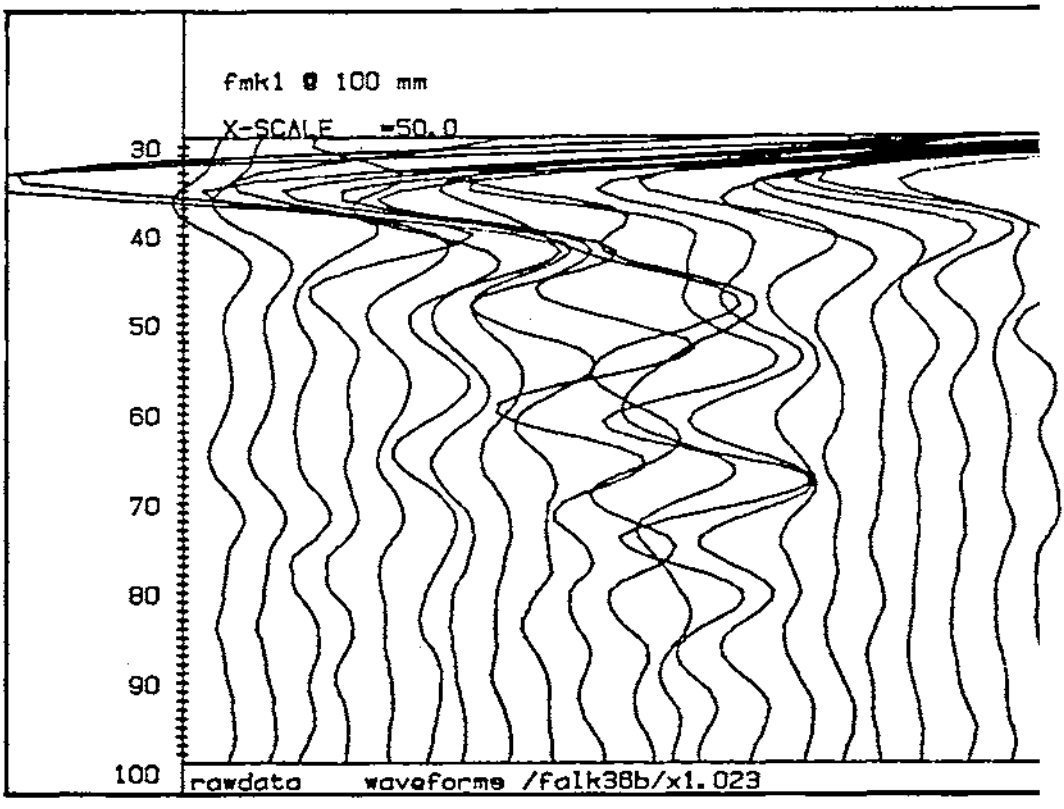

Figure 2. A set of 21 raw waveforms recorded at 5cm intervals on a 1m long baseline passing over an FMK1 mine at a depth of 100mm

In any ground-probing radar application the antenna is a critical component through which signals must be both transmitted and received. Many antenna types were investigated as possible candidates but eventually one using a pair of resistively loaded dipoles was chosen. The antenna is contained within the head shown in *Fig 6*. The detailed design of antennae is a science in its own right and not considered further in this article.

The design of radar modules is necessarily complicated but some explanation is necessary better to understand the technique. Readers with no understanding of electronics may wish to miss out this paragraph. The basic principles of this time domain carrierless radar are similar to other systems. A fast rise time pulse must be radiated, with its amplitude and rise time being selected to span the characteristics of mines in FI terrain. The scattered energy returned by the targets is captured by a sampling system. The processes characterized are too fast for a complete waveform to be captured in one measurement. With a pulse repetition frequency of 1 MHz it takes only 1 micro-second to capture each point on the waveform. The transmitted pulse is radiated to capture each point on the waveform. Pulses are therefore radiated many times and the received waveform built up by sampling one point of each waveform received. The pulse generator and the receiving system must be synchronized, and the time at which the waveform is sampled precisely controlled. The block diagram of a typical ground-probing radar system is shown in *Fig 1*.

The radar clock controls both the pulse generator and the receiver. The fast rise time pulse is fed to the antenna elements through an RF switching network, which provides a calibration path between the transmitter and receiver. All the radar electronics are usually incorporated in an integrated module. The radar was designed to operate over an extreme range of ambient temperature in harsh, wet or dusty environments. The outer case was therefore totally sealed and temperature stability ensured by a pumped liquid system.

The development of ground-probing radar is based upon many improvements in a wide range of technologies, but the most important single advance has come from the availability of digital hardware to process rapidly and economically many waveforms. Without this key step, real time systems capable of area search, such as required by plastic mine detection, would not be possible. As mentioned earlier, ground is not uniform, but frequently highly structured, leading to cluttering of the radar return by many unwanted signals. The extraction of the target signal under all operational conditions is a demanding task. The highly dangerous nature of small plastic anti-personnel mines means that a high reliability of detection is essential and a range of techniques has been developed which are applied in an interlinked manner. They range from simple energy detection procedures which are fast in operation requiring little computer hardware, through spatial domain procedures, to sophisticated frequency domain target recognition algorithms requiring significant computer resources. The simple procedures are incapable of providing the necessary performance, but if the most sophisticated algorithms were applied to all waveforms, the resulting systems would not be practical. The approach adopted therefore has been to apply the simpler techniques to all waveforms, monitoring some parameters which are employed as triggers to initiate the next layer of processing.

Rather than go into a technical description of the processing system it will be better to look at examples of the end products. *Fig 2* illustrates the typical form of a set of 21 raw waveforms recorded at 5cm intervals on a 1m long baseline. The vertical axis is waveform data point number, within this case 204 data points representing 30 n secs. The disturbance centred between data points 60 and 70 on the central traces can be clearly seen and is caused by the presence, in this example, of a FMK 1 anti-personnel mine buried in the ground at a depth of 100mm. On these waveforms there is some modification of the waveform at earlier time caused by disturbing the ground to bury the target. However, from the traces it is obvious that the maximum signal occurs early in the waveform between data points 30 and 40, and is predominantly caused by clutter generated at the air-ground interface. One of the most demanding signal processing tasks faced by ground-probing radars is operating at zero range to detect surface laid targets, or targets buried only in surface vegetation. The target and clutter responses then overlap. The methods of reducing this problem demand most advanced signal

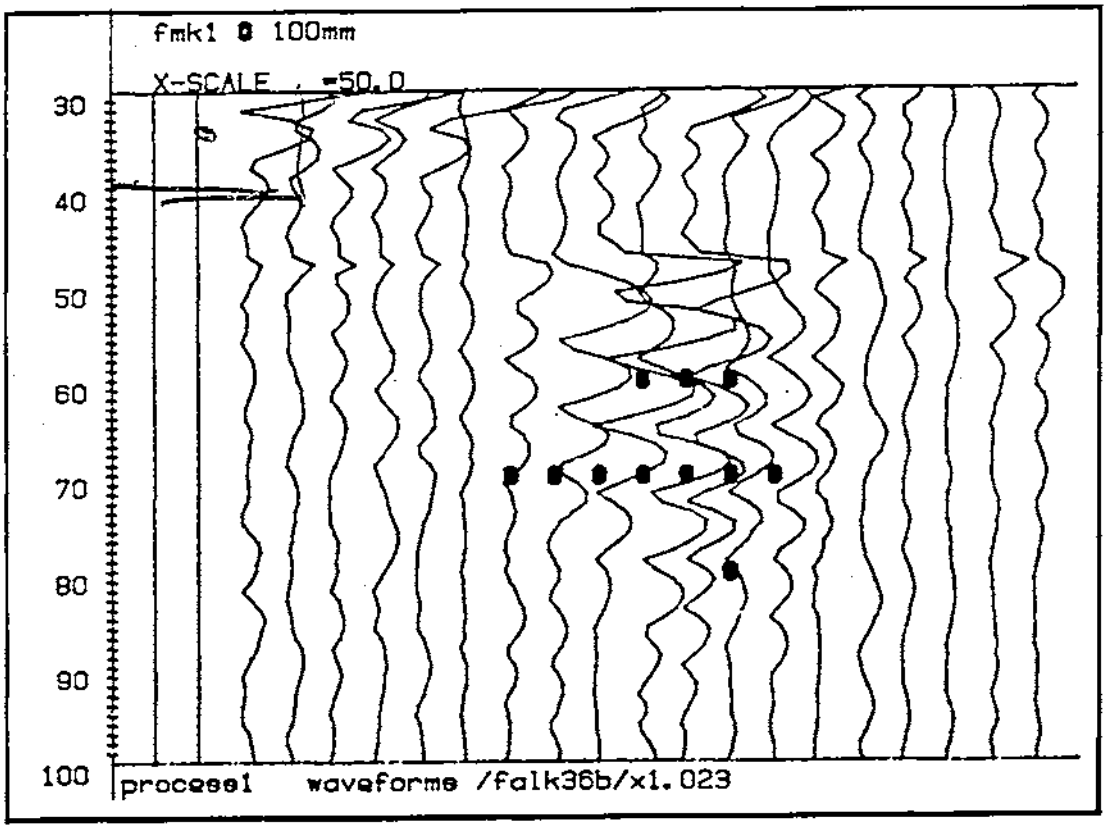

Figure 3. The waveforms of *Figure 5* after a simple signal processing algorithm is applied

processing algorithms which need not bother us further here, and *Fig 3* shows the result after a simple signal processing technique has been used. *Fig 4* and *Fig 5* show further possibilities, again using simple processing techniques.

The project reported in this paper has shown that ground-probing radar is successful in searching minefields laid with both plastic anti-tank and anti-personnel mines. In an 'unseen' minefield trial, every mine laid was successfully found and the overall false alarm rate was so low it was difficult to quantify.

The User Equipment

Quite apart from the major electronic problems, the technique had to be capable of being applied to the ground to resolve the problem which existed. There were two concepts, the most expensive of which receive the greater attention. These were — a vehicle borne system which could cover the ground reasonably quickly and — a handheld system. The major research effort centred on the premise that the vehicle system would be the one brought into use and a hand held system could relatively easily be created from this.

Figure 6 shows a conceptual layout of a vehicle borne system. The need for and layout of the complex array of articulated positioning arms merits some explanations. Each radar head can scan an area of only 5 cm^2 at a single instant and therefore, to give the vehicle a worthwhile rate of ground coverage, an array of radar heads was designed. Each head would independently be able to move vertically to accommodate variations in the ground profile. However, they would maintain their exact lateral position relative to the other heads. This would enable a path of up to

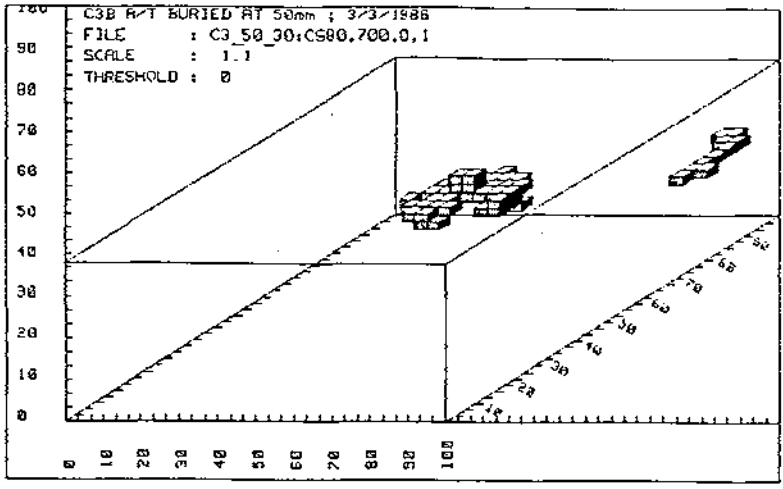

Figure 5. A simple image of a C3B anti-tank mine

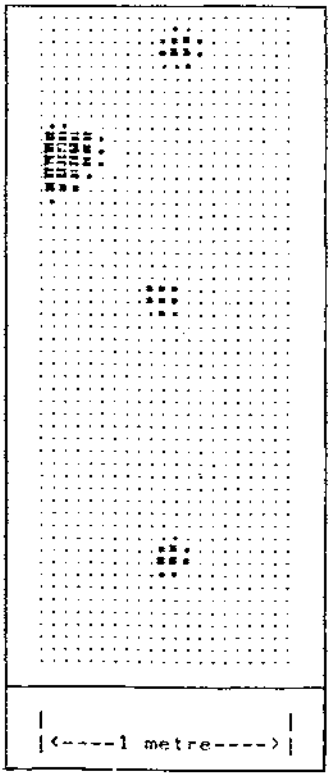

Figure 4. A map of a searched area showing the position of three anti-personnel mines and part of an anti-tank mine

1.2 metres in width to be covered. Following detection of a mine, the colour marker array would mark the spot with paint to assist in the subsequent safe disposal of the mine.

The hand held system would be little different from a conventional mine detector and would be used in a similar, and thus familiar, fashion. It would employ a single radar head linked to the processing electronics, which could service many heads simultaneously, and give either an audible tone or a visual warning as required. As the vehicle borne system would be unable to cover all the ground in a minefield, such as rocky ground, the handheld system was always seen as a necessary supporting equipment.

The Future

Despite the progress made on this project by co-ordinating the research effort with the real needs of the user, and general agreement that the major electronic problems had been overcome, the costs of clearing the FI minefields caused MoD not to renew the contract. This may seem like the British yet again developing a technology in which they are world leaders but failing to do anything about it, leaving the spoils to other countries which will catch up soon enough. In fairness, it should be borne in mind that MoD has always declared that there is no military requirement to clear the

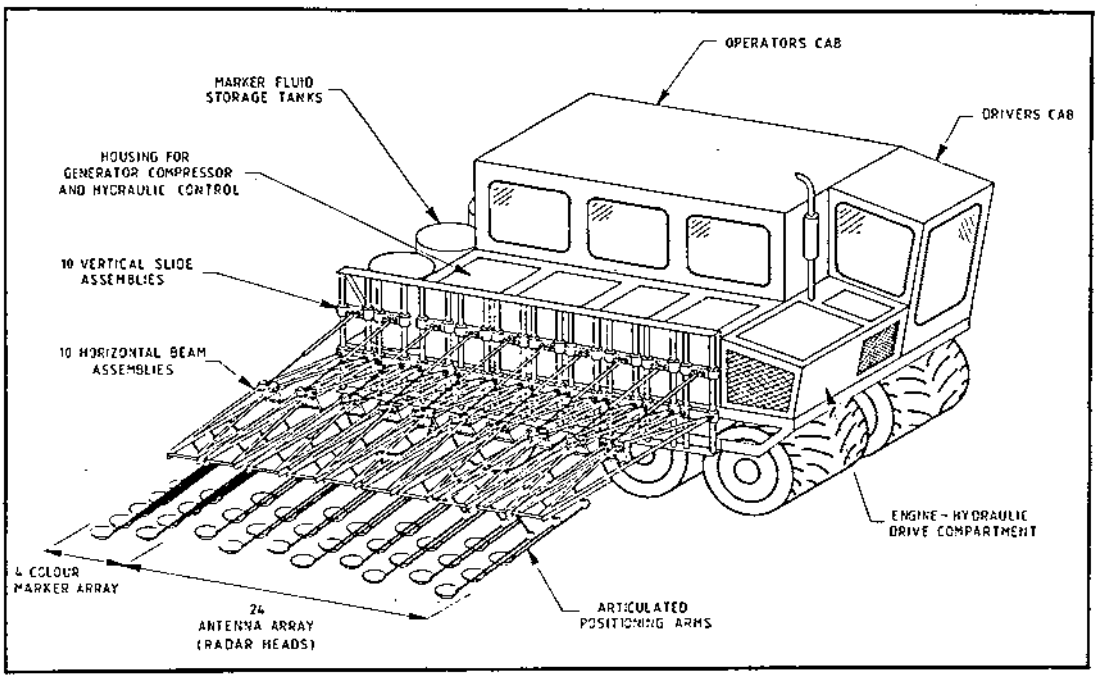

Figure 6. Conceptual view of FI area clearance vehicle

minefields and the Foreign Office has, more recently, declared that there is no political reason.

Nevertheless, it makes little sense to spend millions of pounds creating the only feasible technology capable of reliably detecting plastic mines and then putting it 'on the shelf'. The problem of plastic mines will not go away. They are cheaper to make, easier to transport and are likely to increase in popularity. The statistics of deaths and injuries caused by mines in, for example, World War 2, Korea, Vietnam and Rhodesia are a matter of public record. It is quite conceivable that Sappers will find themselves in a future conflict, whether in Europe or elsewhere, having to breach or clear minefields containing such mines. There will then be no time to develop a new technology or to 'dust off' this one and create a practical operational system, even hand held. It is surely prudent to benefit from this technology now and create an operational capability which currently does not exist. It would enable us to remain in touch with the problem and give us a system upon which we could build in the event of an emergency. More immediately, such an equipment would have proved most useful in operations recently undertaken by 33 Engineer Regiment (EOD) in the UK, involving items which were not detectable by conventional means.

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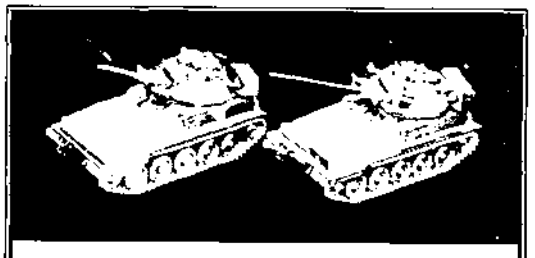

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The Road To Khartoum

ANNE CAVENDISH

This is the third in a series of Journal *articles written by Anne Cavendish. The first "Tel-el-Kebir" was published in the September 1982 RE* Journal, *and the second "Nile" in the December 1984 edition. Anne Cavendish worked for many years in the Directorate of Military Survey MOD and in Egypt and then at Episkopi. She is now retired and lives in Cyprus where she pursues her hobby of military history.*

IN the wilderness which had once been the garden of the Governor's Palace in Khartoum, an army was assembled. Representatives of every regiment and unit which had fought its way up the Nile from Wadi Halfa to Omdurman were drawn up facing the ruined steps on which, many thought, Gordon, bible in hand, had met his death. The British and Egyptian flags, scarcely fluttering in the still air, were raised above the crumbling roof. The anthems of Great Britain and Egypt were played. Salutes were fired by the gunboats on the river. The band of the Grenadier Guards played the Dead March from Saul. The Sudanese band played the march from Scipio. The Presbyterian minister read the 15th Psalm. The Anglican padre led the congregation in the Lord's Prayer. The pipes of the Cameron and Gordon Highlanders, accompanied by muffled drums, broke into a lament. Clustered at the back of the parade, about a hundred Sudanese who had served Gordon raised a shrill wailing cry. The band of the XIth Sudanese played Gordon's favourite hymn in which thousands of voices joined:

"Where is death's sting? Where grave thy victory?
I triumph still if thou abide with me."

As the last notes died away, the Roman Catholic padre stepped forward to give the blessing. The "Last Post" rang out. The ghost of Charles Gordon was laid to rest. It had been a long, hard journey begun by Garnet Wolseley in 1884: a journey during which many brave men had perished before it ended, here in Khartoum, fourteen years later.

INTRODUCTION

THE end of Wolseley's unsuccessful Nile campaign and his departure from Egypt in 1885 left Egypt largely responsible for her own defence. To Lord Cromer, British Agent and Consul General, this appeared to be all that was required. He saw no reason to reconquer the Sudan. His only object was to get Egypt onto an even keel by replenishing her treasury. With reluctance he admitted that Egypt must have an army, but this army would be used only for the defence of the Egyptian frontiers. Events forced him to change his mind. In 1889 the Italians signed a treaty with Ethiopia and laid claim to the town of Kassala on the river Atbara. In December, Cromer wrote to Lord Salisbury that once in Kassala the Italians would soon be in Khartoum and, though the savage tribes ruling the Sudan lacked the knowledge to do harm to Egypt, if they were replaced by a civilized powers, that power could reduce the water supply so drastically that it could bring about the ruin of Egypt. "Whatever powers hold the Upper Nile Valley must, by the mere force of the geographical situation, dominate Egypt." Before any thought of reconquest could be considered, two conditions had to be fulfilled: an efficient Egyptian army had to be created, and not only must the solvency of Egypt be assured but funds had to be provided for the extraordinary expenditure which the adoption of an offensive policy would involve. This, very briefly, summarizes the circumstances which led to the expedition to recapture the Sudan and to avenge the death of Gordon (not a priority for Cromer but of importance to Kitchener and the Army).

THE MAKING OF THE EGYPTIAN ARMY

SIX days after the battle of Tel-el-Kebir, in 1882, Tewfik, the Egyptian Khedive, issued a decree: "L'Armée Egyptienne es Dissoute." There was

some disagreement among the British occupiers as to whether the Egyptians should have an army at all. Some thought that it would be useless as a fighting force but that it might well provide a breeding ground for discontent and rebellion. It was suggested that either Turkish or other European mercenaries should be formed into a defence force. Lord Dufferin who had been given the job of rehabilitating Egypt after the battle, was against such a scheme and rejected "the enrolling of Albanians, Circassians or other waifs and strays of the Mediterranean." He decreed that the new army, some 6000 strong, would consist mainly of Egyptians and, since "Egypt has had enough of mamelukes and their conquerors" the officers and drill sergeants would be drawn from the British Army. In the 1830s, Ibrahim Pasha had commanded a disciplined and courageous force of the fellahin and there seemed no reason why such an army should not be resuscitated. The task of building the Egyptian army was given, in 1883, to Sir Evelyn Wood who was named Sirdar (C-in-C) with 26 British officers under his command; among these were Grenfell and Kitchener, each of whom would, in his turn, follow as Sirdar.

Conditions in the Egyptian Army were so appalling that any improvement was received with incredulous joy. The improvements were spectacular: to begin with, the soldiers were paid; they received rations and were given a medical service. Their accommodation, though spartan, became clean and decent. Shortly after the rebirth of the Egyptian Army, Cairo and its immediate environs were ravaged by a cholera epidemic. The newly created medical services were inadequate. The RAMC resources were stretched to the full in caring for the many British sick. The Egyptian army doctors were far from eager to risk catching the disease. Major Wortley "Wortles", one of the most colourful and engaging officers seconded to the Egyptian army), who nursed his men devotedly throughout the epidemic, reported that at least one doctor examined his patients through field-glasses from outside the hospital hut. The cholera epidemic resulted in the welding of the soldiers to their British officers and NCOs, who attended them day and night, encouraging and caring for them. From this experience the Army emerged as an entity.

On 30 December 1885 a joint British-Egyptian force faced and defeated the Dervishes at Ginnis on the Egyptian frontier. This small battle did much for the morale of the Egyptians. The IXth Sudanese regiment fought beside the Cameron Highlanders and formed a friendship with them which led to their being nicknamed "The 2nd Cameron Highlanders". The Camerons presented them with a set of bagpipes, and the friendship was cemented when the Camerons, arriving at Shereik before the battle of Atbara, were welcomed by the IXth with ceremonial cups of coffee. The battle of Ginnis was the last occasion on which British soldiers wore their red coats in action. After Ginnis, the Egyptians held their frontier unaided, and in two battles — Saras on the 2 April 1887 and Toski on the 3 April 1889, they defeated the Dervishes decisively. The size of the Army was steadily increased from the original 6000, bringing the strength up to 12,000, including cavalry and artillery, by 1890, until, in 1898, at the battle of Omdurman, Kitchener had 17,600 Egyptian and Sudanese regular troops under his command. The Egyptian Army was reborn. In 1885, Sir Evelyn Wood had handed over the position of Sirdar to General Grenfell, and in 1892 Grenfell had handed over the command to Kitchener. When, in 1897, Grenfell was appointed C-in-C of the British troops in Egypt, Kitchener feared that, as Grenfell outranked him, he might be given overall command of a campaign to recover the Sudan. His fears were groundless. Grenfell made no attempt to rob the Sirdar of his glory.

The Recapture Of Dongola Province And The Part Played By The Railway

Clashes between the Italians and the Dervishes began in the early 1890s with raids into the new Italian colony of Eritrea. In December 1893 the Italians defeated the Dervishes at the battle of Agordat, and in 1894 they attacked and occupied Kassala. On the 1 March 1896 they suffered a disastrous defeat at the hands of the Ethiopians at Adowa, which left them so hard pressed that they asked Egypt for help. On Christmas Day 1897 the Italians handed over Kassala to the Egyptian Army. Meanwhile it had been decided in Cairo that the province of Dongola should be recovered. Both the British and Egyptian governments knew that eventually they would have to go on and

occupy Khartoum, but both were terrified at the thought of the expense (Cromer with perhaps some reason, but it is difficult to understand why Great Britain, one of the richest countries in the world, should find it almost impossible to contemplate the modest expenditure needed to ensure the safety of Egypt, one of its most valuable assets). In November 1896 the House of Commons approved a loan of £800,000 to Egypt with an interest rate of 2¾ per cent. They also agreed to send some British troops to support the Egyptians. The scene was set for one of the most miserly campaigns in our history.

On the 12 September 1896 the Egyptian army began its advance on Dongola, under the command of the Sirdar, Major General Herbert Horatio Kitchener, who was pledged to the maintenance of the most rigid economy. To solve the problem of supplies, he planned to continue the Sudan railway, which ran from Wadi Halfa to Akasha but which was in need of repair. At the beginning of 1896 the repair and construction of the railway was entrusted to the Royal Engineers, first to Lt Stevenson and then to Lt Girouard, (Kitchener preferred to employ junior officers in such tasks, keeping them under his personal command). Girouard was a French Canadian, son of a supreme-court judge. He was 29 years old, good looking, cheerful and often flippant. He was a brilliant railway engineer who had learned his trade on the Canadian Pacific Railway. He refused to be overawed by the mighty Sirdar and, knowing that he was indispensable, got away with much. He constructed and ran his railway with amazing speed and skill. He built it under the most daunting conditions. Burdened by obsessive economy he was compelled to use forced labour consisting of convicts and prisoners of war supervised by foremen and technicians who did not spare the lash. The railway was protected by an Egyptian infantry battalion. By early June the railway had been repaired as far as Ambigol Wells, and Kitchener concentrated a force of 9,000 at Akasha, planning to attack the village of Firket which was held by the Dervishes, who had been suspiciously quiet and had made no attempt to hinder the advance to Akasha. The Dervish leader, the Emir Hamuda,was a man of little ability and no enthusiasm whom the Khalifa was already planning to replace. On 7 June Kitchener attacked. It was a model operation. The army was divided into two columns. The river column, under Major General Hunter, Second-in-Command of the Egyptian army, consisted of the First, Second and Third Infantry Brigades commanded by Colonels Lewis, Hector MacDonald and John Maxwell. The desert column was under the dashing command of Major Brian Murdoch of the Royal Dragoons, Commander of the Egyptian cavalry. His column of 2000 men included seven squadrons of cavalry, eight Camel Corps companies, a horse artillery battery and the Maxim guns of the North Staffords and Connaughts, the only British troops to take part in the battle. The two columns marched from Akasha on the afternoon of 6 June. The desert column swung south west, away from the river, to outflank the Dervishes at Firket. The river column marched south along the Nile to deliver a frontal attack. After a difficult night march both columns reached their selected positions at dawn. Their arrival was a complete surprise and a complete success. The Dervishes, though they fought with their usual savage determination, were driven out of Firket and chased by the cavalry. Many of them, however, reached Dongola where they prepared to fight another day. A thousand Dervish dead were left upon the field and 500 were captured. The Emir Hamuda was among the dead. The Egyptian casualties amounted to twenty dead and eighty wounded. Though a minor battle, Firket was important as a great boost to the morale of the Egyptian soldiers and as a first step on the road to Khartoum.

The river was still too low for it to be possible to bring the gunboats over the cataracts with supplies, so Kitchener camped his Army at Firket and at Sarras to await the rising of the Nile and the arrival of sufficient supplies to enable him to continue his advance. The railway reached Kosheh, 116 miles from Wadi Halfa, by 4 August 1896. Then — disaster! — a violent and unseasonable storm, accompanied by torrential rain, arose on 26 August. It lasted for three days, and caused such havoc that twelve miles of the hard-won track were swept away in a few hours.

Colonel Sir Edouard Percy Cranwill Girouard KCMG, DSO

By unbelievable exertions Girouard and his team restored the railway in a week. During this same month a severe epidemic of cholera broke out among the soldiers, and killed several officers and 900 NCOs and men. According to Lord Edward Cecil (major of the Grenadier Guards, ADC to Kitchener, and son of the Prime Minister) the medical services available to care for the troops were practically non-existent. The sick were all stuffed into one tent, and left in the heat and stench, uncomforted and uncared for.

As soon as the railway was working again, the advance continued and by 16 September the whole force had reached Fereig, just above the third cataract, where they were joined by a British contingent consisting of the 1st Battalion North Staffords and a further battery of Maxims. Five gunboats and three steamers had been brought up the Nile, and all was ready for the taking of Dongola province. The Army was ready for a fight. Hardly any resistance was met with. On 19 September the gunboats shelled Hafir and drove

The Road To Khartoum.

out the Dervishes, who made no attempt to defend it. Nor did they defend Dongola but abandoned it and the entire province, which Kitchener occupied as far south as Merowe. The first phase of the campaign was over. It had been short and inexpensive. Kitchener was promoted to Major General (British Army) and awarded the KCB. Among others decorated, Girouard received a well deserved DSO.

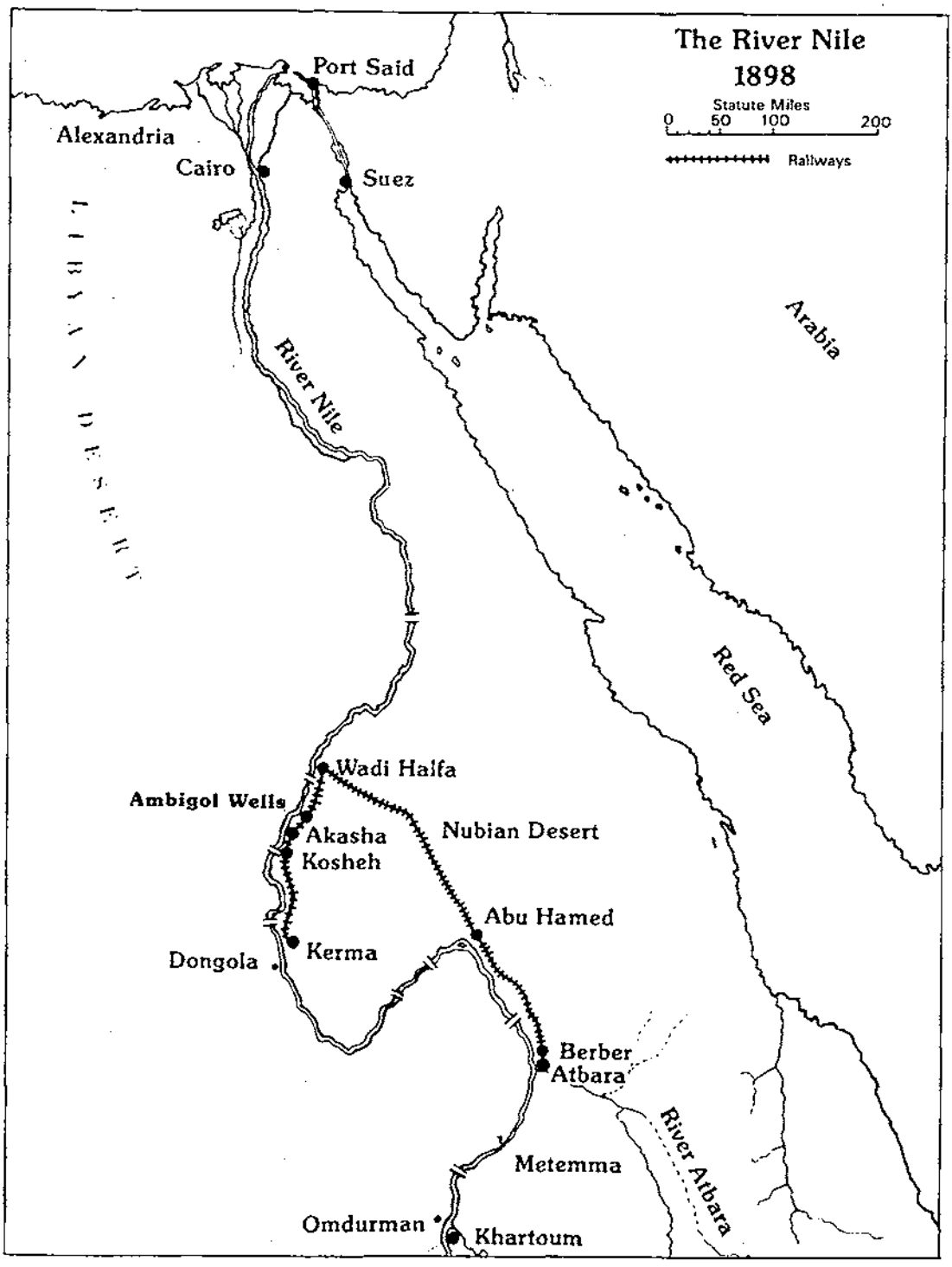
The occupation of Dongola did not reduce the pressure on Girouard and his team, who now undertook the extension of the railway for the hundred miles from Kosheh to Kerma. This important extension was completed by May 1897 and enabled supplies to reach the Army while the Nile was still low. The railway was halted at Kerma but Girouard's work was not done. A second line was to be built south from Wadi Halfa through the Nubian desert to Abu Hamed. By great good fortune a survey revealed that it was possible to sink wells along the route of the railway. Had this not been so, the builders would have faced hideous difficulties. The new line progressed rapidly. The desert through which it ran was level, and in one place it was possible to lay 45 miles of track without putting in one curve. By the end of July 1897, 115 miles of railway had been built, and as it was now running into Dervish country Kitchener decided to capture Abu Hamed before pushing the railway any further.

Abu Hamed

The Dervishes in Abu Hamed were led by the Emir Mohamed-el-Zein, one of the Khalifa's trusted commanders. Major General Hunter was ordered to march south along the Nile with one Egyptian and three Sudanese battalions, a troop of cavalry and a battery of artillery. He left the village of Kinnegar, near Merowe, on the evening of 29 July, and on the morning of 7 August arrived at Wadi Gerub, two miles west of Abu Hamed: a march of 131 miles undertaken at the peak of the hot weather. Leaving Lt J F Wolseley with half the 3rd Egyptians to guard the transport, Hunter circled the village to the north and then wheeled his troops to face west towards the river. He sent an Intelligence officer to reconnoitre the zariba. This was not another Firket. The Dervishes were alert and prepared, and the officer was greeted with a hail of bullets. Hunter immediately deployed his force in a curved line facing the river. The Emir had dug trenches and fortified the village houses. His 700 Dervishes were well disciplined and, inevitably, brave. They held their fire until MacDonald's brigade, led by its commander, was within a hundred yards of the trenches before opening a heavy and co-ordinated fire. Despite this, and many casualties, the brigade rushed the trenches and entered the village, where fierce house-to-house, hand-to-hand fighting ensued, in which the Sudanese soldiers fought with particular zest; their hatred of the Dervishes had been long and bitter. The Egyptian casualties were heavy: over 80 killed and wounded. Countless Dervishes lay dead in the zariba. The Dervish relief force, which was on its way from Berber, hearing of the defeat at Abu Hamed, returned to Metemma where it was joined by those who had managed to escape from Abu Hamed. Hunter advanced and occupied Berber, meeting neither Dervish nor resistance. Girouard immediately pressed on with his railway, completing the 234 miles to Abu Hamed by 31 October. The line was then continued to Berber.

Atbara

By the end of 1897 a considerable army was assembled at Berber. The Egyptian Army had been reinforced by a British brigade from Cairo, under the command of General W Gatacre. His brigade consisted of four infantry battalions, an artillery detachment with Maxim guns and a section of the 2nd Company RE. They arrived in Berber in January 1898 and camped at a point about twenty miles south of Abu Hamed until all was ready for the advance against the Dervishes. To add to the heat and hard going, another hardship was inflicted on the British troops. The boots issued to Gatacre's brigade were of very poor quality. According to G W Steevens, the Correspondent of the *Daily Mail*, "The brigade had only been up river about a month after all and no military boot ought to wear out in a month. We have been campaigning in the Sudan off and on for over fourteen years; we might have discovered its little peculiarities by now. The Egyptian army uses a riveted boot; the boots our British boys were expected to march in



Map of area covered by article

had not even a toe-cap. So that when the three battalions and a battery arrived at Berber hundreds of men were all but bare foot: the soles peeled off and instead of a solid double sole revealed a layer of shoddy packing sandwiched between two thin slices of leather... It is always the same story; knavery and slackness strangling the best efforts of the British soldier." The controversy aroused by Steevens' despatch was raised in parliament and with the War Office. The official reply stated that the boots were very good boots, but that the work done by the brigade over bad ground had tried them too severely. "It is a strange sort of answer," wrote Steevens, "to say that a military boot is a very good boot only you mustn't march in it." Even more serious, another scandal was brought to light by Bennet Burleigh of the *Daily Telegraph*, who denounced the bullet of the Lee-Metford rifle: "... the soldiers have no faith in the stopping qualities of the Lee-Metford bullet. Under local orders large details from each regiment were engaged daily in filing off the tips of the bullets. One million rounds had to be filed and the work was also being carried out in Cairo arsenal." (This was a sorry but not a unique tale: the left boots in the Crimea, the rotten bayonets supplied to Wolseley's troops in the first Nile campaign and the dud radios issued to the Armoured Corps at Arnhem are only a few other examples).

The Egyptian Army already encamped at Berber was a formidable one: three infantry brigades, eight cavalry squadrons and four artillery batteries. By 15 March the entire force was concentrated between Berber and the Atbara river, where, at Nakheila, they constructed a zariba on the north bank about thirty miles above the confluence of the Nile and the Atbara. Kitchener's force moved to Ras-el-Hudi, about fourteen miles from the Dervish zariba, to await a move by the enemy. While they waited the gunboats made several sorties up the Nile and drove the Dervishes out of Shendy. The army waited, but the Dervishes remained in their zariba. Then, suddenly, the Sirdar lost all his confidence. He dithered for days, trying to make up his mind whether or not to attack. On 1 April he begged Cromer for advice. He consulted his commanders: Gatacre thought they should continue the advance; Hunter thought that perhaps they ought to wait. Cromer, who was in no way a military man, referred Kitchener's telegram to Lord Salisbury. Lord Salisbury passed it to the C-in-C at the War Office Wolseley (who had never in his life relied on any judgement other than his own) sent a signal on behalf of the British Government, saying that they would support whatever action Kitchener took. Cromer telegraphed Kitchener on the 2 April suggesting that perhaps he should wait for a little and "allow events to develop". Before this telegram arrived Kitchener had wired Cromer that Hunter had changed his mind, and that now he and his two commanders favoured an attack on 6 April. This was Good Friday, and for some reason Kitchener was sure the Dervishes would not expect an attack on such a sacred Christian day. This crisis was to have a dire effect on Kitchener in the future. He undoubtedly greatly overestimated the numbers of the Dervishes and their ability to withstand modern weapons. When later, in 1900, during the South African war, he was faced with a similar situation at Paardeberg, he looked back to Atbara, underestimated his enemy, and acted in a rash, unplanned way, losing many British lives and suffering his first defeat.

At sunset on 7 April the Anglo-Egyptians bivouacked in a mass of brigade squares about three miles from Emir Mahmoud's entrenchments. The troops were eager to attack; they were tired of sitting in the baking sand, devoured by insects and without even a glass of beer (for the Sirdar had decreed that the campaign should be "dry" for the soldiers). The great squares stood to arms at about 1.00am and plodded forward by starlight until at 3.30am they deployed in line of battle. The artillery, hauled to the front before first light, opened fire at 6.15am. At one time during this bombardment the Dervish cavalry burst from the zariba and rode at the waiting army. Withering fire soon checked this heroic charge and the few survivors galloped away into the desert. At 7.40am the bombardment ceased and the buglers sounded the advance.

Mahmoud's zariba was round, and its eastern and western approaches were covered with thick scrub. To the south there was some vegetation and the almost dry bed of the Atbara river. While Kitchener dithered at Berber the Dervishes had been given time to fortify and to entrench. The

zariba was no mean obstacle to assault. Kitchener decided to attack from the open country to the north, risking heavy casualties rather than a muddled approach through the thick scrub.

With bands playing, pipes skirling, and shouts of "Remember Gordon", the army began to advance along a curved front of 1500 yards. At the east end were the eight squadrons of Egyptian cavalry, then the British brigade under Gatacre, the 2nd Egyptian Brigade (IXth, Xth and XIth Sudanese and 2nd Egyptians) under Hector MacDonald, and the 1st Egyptian Brigade (XIIth, XIIIth and XIVth Sudanese and 8th Egyptians) under Maxwell. In reserve was Lewis's 3rd Egyptian Brigade. Two batteries of artillery were positioned to the right of Maxwell's Brigade and two between Gatacre and MacDonald. A rocket battery under Lieut David Beatty RN† was a formidable addition. The Maxims were with the cavalry. General Gatacre placed himself at the head of his brigade and led it into battle on foot, drawn sword in hand. Beside him were his ADC, Captain Ronald Brook, and his chief clerk, a lance sergeant of the Army Service Corps, carrying a Union Jack. His orderly, a private in the Cameron Highlanders, completed this rather self-conscious little party. Behind them, in line abreast, were the Camerons, and behind them the Lincolns, the Warwicks and the Seaforths. The brigade marched forward as if on parade, their NCOs continually dressing the ranks. On their right, Hunter's brigade was advancing very fast with all six Sudanese battalions massed at the front. Hunter, Maxwell and MacDonald were mounted, knowing that, on foot, they would have no hope of keeping up with the Sudanese. The Dervishes held their fire until the advancing army was about 300 yards away. Their discipline was magnificent, but their weapons were old and their fire was inaccurate. The assault was overwhelming: it crashed through the defences into the zariba. British and Egyptians competed to be first over the ugly thorn bushes. The Dervishes fought with desperate ferocity but were soon overcome, and in half an hour the zariba was taken. Three thousand Dervishes perished and the Emir Mahmoud and many of his followers were captured. Some escaped, but the local tribesmen, who hated the Dervishes, fell upon and slaughtered them, avenging years of cruelty and oppression by the Khalifa. The Emir Mahmoud, before being hauled away to prison and an early death, was brought before Kitchener whom he defied proudly. He was then dragged through the village in chains amid shouts of abuse and showers of stones and rubbish. Throughout this lamentable display he held his head high and conducted himself with dignity. The Anglo-Egyptian casualties were heavy: 570 killed and wounded, including five British officers. Among the killed was Gatacre's chief clerk, with his conspicuous burden. When the zariba was cleared of Dervishes, Kitchener gave the Sudanese permission to loot. The pick of the plunder he took himself, and a collection of swords, spears and chain mail was despatched to his house in Cairo. The care of the wounded after Atbara was a disgrace. Inadequate medical facilities, shelter and transport left the wounded to swelter in an unsheltered First-Aid Post outside the zariba for twelve hours or more after the battle. Eventually they were carried away by Egyptian stretcher bearers to the Field Hospital at Umdabia, eight miles away. Many died of their untreated wounds before they arrived there. One of Kitchener's staff officers, Captain Sir Henry Rawlinson, contrasted the British medical services unfavourably with those of the Egyptians. The fact was that the British medical services scarcely existed. Though both Kitchener and Gatacre were hard and callous men, most of the blame must be laid at the door of Lord Cromer whose insistent and implacable economy forced Kitchener to cut his expenses to the bone. Perhaps a less ambitious commander might have refused to conduct a campaign under such conditions.

Part II of this article taking the story to the battle of Omdurman and its aftermath, will be published in the April 1989 issue.

† Later Admiral of the Fleet The Earl Beatty

Another Rush Job for Rheindahlen

MAJOR D W TAYLOR BSc(ENG) C ENG MICE

Major Taylor was commissioned in 1975. After a degree and regimental duty in 39 Engineer Regiment (twice) and 1 Training Regiment RE, he attended 32 PET(C). His attachments were to John Mowlem, where he was the Section Engineer for the Dockland Light Railway bridges over the West India Docks, and to Sir Frederick Snow and Partners, employed on urban highway planning. After a brief tour as DCRE(Wks) NI, he moved to MES (Wks) BAOR. He now commands 65 Corps Support Squadron.

THE Rheindahlen Military Complex (RMC) was planned and built in twenty five and a half months, ending in October 1954. This unique project for a military town of eleven thousand souls on a greenfield site was realized in haste for financial reasons: after nine years in temporary accommodation the principal Headquarters of British Forces in Germany (BFG) required permanent homes, and Germany was obliged to pay for such construction only until the formal end of Occupation status. The scope, timescale and difficulties of the project were broadly similar to the more recent construction of Mount Pleasant Airfield.

The Chief Engineer (Works) was Colonel H Grattan CBE, and his account of the project was published in the *RE Journal* in 1956. It is the perfect supplement to theoretical instruction on project planning. He mentions both problems overcome and problems unresolved, the latter including:

- An excessive dependence on single-storey, system built barrack blocks.
- The almost universal requirement for single-service not joint facilities.
- The friction caused by an Army organisation building an RAF Headquarters, to 1948 Army scales less 20%.
- The low scaling of married quarters and schools, and the superabundance of messes and canteens (twenty-nine in all).
- The impossibility of justifying necessary but unscaled facilities in time.

Many small steps have been taken over the years since 1954 to rectify some of these problems. This article is only concerned with the lack of scaled facilities for private cars.

The original approved plans included single garages for brigadiers, a hundred and eighty parking spaces at the Headquarters building, and not so much as a lay-by anywhere else. Many more garages have been added, and roads widened to allow street parking, all at British expense. New parking spaces were still being squeezed into gaps between buildings in 1987, when BFG adopted a policy of banning parking within twenty-five metres of buildings. The thousands of spaces lost elsewhere in the RMC were enough of a problem, but those serving the Headquarters building were a critical loss.

In 1987, somewhere between nine and twelve hundred cars converged daily on the Headquarters building from outlying quarters, nearby towns, and the Low Countries. Some three hundred of the eleven hundred parking spaces then available within the Headquarters' compound had been closed due to an earlier ten metre rule. The new ban closed most of the rest. A tolerable shortfall

Major D W Taylor
Another Rush Job For Rheindahlen

gave way to a chronic one. Temporary parking was authorized on grassed areas, but a permanent solution was required before winter.

The Author was appointed the Property Services Agency (PSA) Project Officer in early July, with a verbal Client's Requirement from the BAOR Quartering staff. (The anachronistic term, 'Q' Brief, lingers on long after 'Q' ceased briefing 'E'.) It was quite clear that one or two corners would have to be cut if two years for planning and another for construction were to be squeezed into five months. The scope of the project might be trivial compared to Colonel Grattan's, but the timescale was rare if not unique for work subject to both British parliamentary accountability and German planning procedures.

At this point, a few words of explanation may be needed for readers whose immediate reaction is that twenty-two weeks was time enough to lay a bit of asphalt.

- Parking for six hundred cars (the estimated requirement) covers nearly two hectares, or the area of three football pitches.
- Works Service planning times in BFG can be double those in the UK. This is because the Federal Government, as owner of Allied forces bases in West Germany, insists on the use of its construction agencies to plan and supervise the work. There can be multi-stage agency arrangements, with consultants working for a Federal agency, working for the Federal Government, working for PSA, working for BFG.
- German construction practice has not evolved in the same way as Britain. General contractors are rare, and almost unknown on government work. Small, single-trade firms predominate. Whereas a general contractor can get one trade started hours after the previous one finishes, it is prudent to leave a couple of weeks between separate contracts, thus extending the time on site.
- RE units might have been suited to the work, and the pressure of time. However at such short notice the retasking of Mobile Civilian Groups or the removal of field units from other commitments was considered too difficult a problem to address.

Working backwards from the planned completion date, it was considered that a general contractor could complete the sitework in three months. An absolute minimum of one month was required for tender action. This left one month for British and German planning; long enough only for unstaffed sketch plans based on whatever record drawings were available, and thus a design-and-construct contract. However it soon transpired that the local planning committees would not be sitting at the right time.

The result of much urgent negotiation was a phased programme, with only half the Works handed over by the Christmas deadline. This allowed the start on site to slip one month, thus doubling the planning time. It was nevertheless a commendable achievement for the German agency to complete final sketch plans and the detailed design in that time, thus avoiding the need for design-and-construct.

An electronic survey of the site was carried out over a weekend by a team from PSA Headquarters in Croydon. The results were available halfway through the planning. The comparison of old and new plans confirmed that the former had stretched, but also showed that a mature chestnut tree in the middle of the site had mysteriously moved ten metres. The value of time spent on reconnaissance was again demonstrated.

Working fast and without a written brief is fun, but fraught with danger. The more so at a time when the relationship between client and agent was under review, and postures were being struck. The more normal dangers included the pressure to make decisions without proper consultation, and the usual accusations of gilding the lily. The latter may seem strange when levelled at engineers, who aim 'to do for sixpence what any fool can do for a shilling': it is nevertheless true that clients sometimes think that designers benefit by over specifying. These dangers were largely overcome at the siting board.

The formal siting board took a few days to convene, due to the number of specialists required to attend. (Quite what contribution the hygiene inspector was supposed to make remains unclear). These few days were put to good use, and the board was presented with reasonably detailed options rather than big hands swept over small maps. Under the guise of 'factors affecting siting', ten proposals from drainage to security were made and agreed. Given alternative internal layouts, the board selected the suggested one. But on the matter

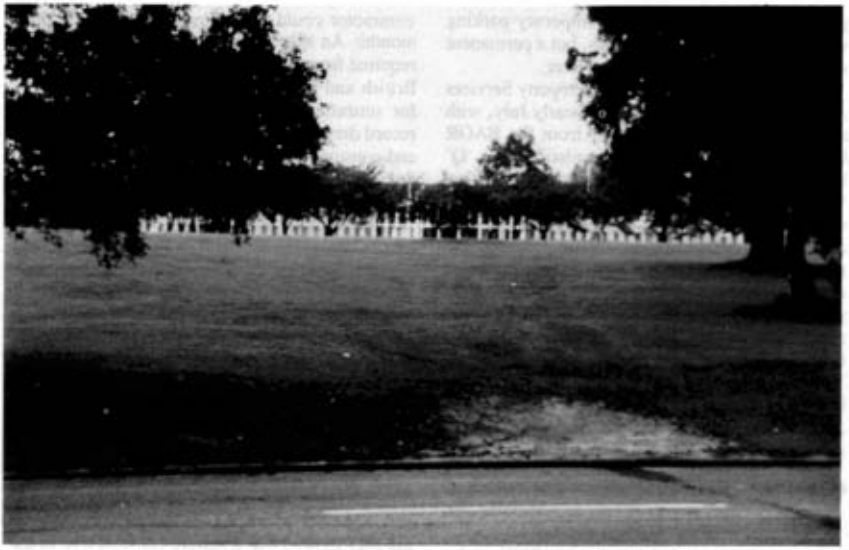


Photo 1. June 1987: an attractive public open space with an apparently secure future

of which part of the golf course in front of the Headquarters should be used, the board exercised its independence, and chose site 'B'. That this more closely corresponded to the Commander-in-Chief's proposal is of course a coincidence. Had lighting and pedestrian access been considered by the board a great deal of subsequent correspondence would have been avoided. That apart, the Quartering staff quickly endorsed the board's findings thus defining the scope of the project in an unusual but efficient manner.

The choice of site 'B' generated a number of undesirable features which may provoke future criticism. Colonel Grattan had sited the Headquarters facing open grassland. Site 'B' is in front of one half of the building, producing an anti-symmetric view to and from the symmetric building. The car park is as far as possible from the night entrance to the building. The location encourages secondary usage only by people heading for buildings on the other side of the RMC spine road, creating a traffic hazard. While undesirable, these features are tolerable.

The client's endorsement of the board's findings virtually signalled the end of the PSA design stage. The initial sketch plans were tidied up and presented to the German agency. The plan had been fixed in four days, representing something like DM1300 (£450) worth of work decided per man-minute of design time.

Hasty designs can be untidy due to lack of consideration as to how different factors interact. In this case, the pressure of time meant that ideas had to be thrashed out when only half formulated, which prevented any one aspect being fixed too soon. Subjective opinions were modified by approximate calculations based on woefully inadequate data, particularly for the capacity of junctions. The result is a tidy internal layout, and simplified traffic patterns. The least satisfactory aspect is the proximity of one exit to adjacent junctions on the RMC spine road.

The geometric standards adopted were a compromise between textbook recommendations, Army guidelines, and British and German national standards. This was done to achieve sensible

Photo 2. May 1988: a 600 space car park landscape and in use

economies: German roads can be unnecessarily wide, and curves too gentle, while British parking spaces are similarly generous. The lack of complaints from users indicates that the design was generally satisfactory. Roads are no longer blocked by peak hour queues, but buffer areas are often full. Speed is regulated by the geometry. Circulating and parking vehicles are segregated, and users are unconcerned at parking on a 3.5% crossfall.

Drainage of a large paved area usually presents significant problems, and this project was no exception. The existing stormwater drains could not cope with the extra load calculated in accordance with the simplistic German regulations. Holding ponds are dangerous for children, and tank sewers are expensive. An early bright idea was to use porous concrete block paving, which generates no runoff. This had to be dropped due to the possibility of objections from the planning authorities that engine oil might pollute the groundwater. Even had there been time to overcome such objections, there was still the fact that the subgrade is very silty and has a history of soakaways becoming choked. The solution adopted was to add the load to the existing drains, and to divert other flows out of them into an open ditch.

The problems associated with the paved areas were generally anticipated, but the measures required to offset the environmental impact were initially underestimated. All German local authorities are sensitive to environmental issues, and none more so than the one responsible for the Ruhr conurbation and surrounding areas like the RMC. Most of the RMC is both a water catchment and 'green belt' area so it was quickly established that an exemption from planning regulations would be required. In order to facilitate this, the initial concept included narrow strips of unspecified greenery dividing the car park into eight sections and one-for-one replacement of felled trees with semi-mature (four metre tall) oaks. The outcome of negotiations which continued right through the planning and construction phases was threefold. The green strips were to be filled with specified

Another Rush Job For Rheindahlen (2)

native species of shrubs and trees. A broad swathe of additional trees was to be added on the only side not already tree-lined. The redundant parking areas within the Headquarters' compound were to be turned back to grass, to compensate for the loss of grass on the golf course. Some people consider that providing forty plants per parking space, and breaking out perfectly serviceable concrete, is an unreasonable cost to pay. What is certain is that it forms 20% of the budget, and that nothing short of a diplomatic incident could avoid it.

The car park was planned and constructed, inclusive of seasonal landscaping and a relocated landing site, in eleven months and just within budget. Partial occupation was achieved by the five-month deadline. While hardly remarkable in commercial practice, such speed was quite exceptional for publicly-funded work subjected to rigorous local government planning procedures. It compares with the two year, £7 million replacement headquarters building for RAF Support Command. For the project officer it was both unusual and gratifying to see the whole project through in one posting.

It must be emphasized that this was a very straightforward project, on a greenfield site. There was space to lay out efficient access roads and road junctions. However it is axiomatic that simple plans, designed to reduce construction time, cannot be the cheapest. In this case, a minimum of changes in gradient made earthworks and drainage work simple, but increased the overall earthworks quantities. Avoiding cut-to-fill work likewise increased these quantities. The balance between speed and cost was purely subjective.

Cost economies were principally achieved by the selection of an efficient layout, thus minimizing the paved area. Parking spaces were made 15% smaller than normal British practice. Aisles were reduced 14% by making them one-way.

Photo 3. Two hectares of orderly parking between the senior officers' car park in the foreground and the shops and married quarters in the trees

Another Rush Job For Rheindahlen (3)

Perpendicular parking was adopted as being marginally more efficient than herringbone within the constraints of the site. The tidal flow of commuters meant that a large area of access roads was required, but this was minimized by the use of four road widths and seven kerb radii, some sub-standard.

The lifetime maintenance cost of painted road markings is considerable. Previous attempts in the RMC to use coloured concrete blocks to mark out car parks were unsatisfactory due to a lack of colour contrast. White ceramic blocks were available but prohibitively expensive. For a small premium it was possible to obtain white concrete blocks, and these were used in dark red paving. Only time will tell if this is a satisfactory solution.

There are few lessons of value to the Corps to be learned from this project. Being involved in such work is certainly a good way of finding out how the German government machine, on which we depend in war, works. It is gratifying to find that the Works Service bureaucracy, established to prevent unnecessary expenditure, can work extremely fast when required. It may be of interest that, while most civil engineering is 10% design work and 90% paperwork, on this project the figures were more like 5% and 95%. But the most compelling lesson is that 'instant experts' are not confined to the Army: The project officer was selected on the strength of one vaguely similar project.

PQE at RDO RHQ PSA(G)

MAJOR D W TAYLOR BSc (ENG) C ENG MICE

Major Taylor's biographical notes appear at the head of the previous article.

READERS of the preceding article may wonder what a sapper officer is doing on such unmilitary work as building car parks for commuters. This article puts that work into context.

Avid readers of the Corps *List* will know that, of the sixty tied posts for Professionally Qualified Engineers (PQEs) in the ranks of captain and major, only a dozen are overseas. In late 1986 those dozen were spoken for and the author was sufficiently confident of a UK posting to buy a tax-paid car. About a week later, a new post was created in Military Engineer Services (Works) (MES(Wks)) in BAOR.

The majority of MES(Wks) posts — at home and overseas — are for Clerks of Works and Garrison Engineers and most of those in BAOR are closely tied to war roles. These posts are mainly in the lower two tiers of the four-tier PSA organisation: routine maintenance and site supervision of major projects, based in District Works Offices; and minor project work based in Area Works (now Group Managers) Offices. PQEs have on occasions worked in the top tier at Croydon and in Regional Headquarters (RHQs), but these have been one-off attachments for specific projects. This new post is a permanent one, with general duties in the Regional Design Office (RDO).

Germany is the largest of the six overseas regions of PSA. Being concerned purely with military work, these are rather different from the UK regions. This is reflected in the chain of command, for they report at four-star level to the man responsible for defence services not the one responsible for the regional organisation. Germany Region is further set apart by the fact that the Federal Republic has standards, practices and procedures which vary markedly from the British ones. The differences are all-pervasive, and can be as fundamental as reinforcing steel not being available in UK preferred sizes or the absence of electrical ring mains. The planned harmonisation of the European internal market and the introduction of Eurocodes will reduce the differences in the long term, but for the moment British designs must be reworked to avoid paying a premium for work that does not follow local practice.

Within a region, the largest part of the works budget (maintenance) and the smallest (minor new works) are delegated to the Districts and Group Managers, with RHQ performing normal headquarters functions. With the exception of the very largest projects (such as the Trident works programme) which are controlled from Croydon, major new works are run from RHQ by the RDO.

Major new works means any projects valued at £150,000 or more, a sum which corresponds roughly with the equivalent figure used by the German government.

An RDO is much like a provincial office of a large multi-disciplinary consultancy: about a hundred staff in total, the vast majority engineers, architects, quantity surveyors (QSs) and technicians. Most staff can be directly employed on project work since specialist advisors are available in the head office. An alternative comparison is with the Military Works Force (two CREs, each of two STRE(Wks)s plus many specialists). RDO Germany has four multi-disciplinary design teams, each of (on average) six single-discipline sections plus a QS section.

RDO Germany handles about DM180M (£60M or nearly £1000 per soldier or airman) worth of work annually, and also provides national supervision of NATO-funded projects at British installations. This might be a reasonable workload if each of the sections were ten strong, but they are only three strong (equating to the OC, 2IC and GE of an STRE). The detailing, drafting, taking off, obtaining of planning permission and the letting and supervising of contracts is all done by the German equivalent of PSA. In Germany, each state's finance ministry includes a property and building division, which plans, builds and holds state property. These organisations also act in a more limited way at agents of the Federal Government to plan and build Federal works, which are handed over on completion to the Federal Property Office. In the case of British projects (and similarly for other NATO allies) this is a purely paper transaction: the physical handover used to be to PSA to hold, maintain, and release to the client for use; the recent transfer of estate surveyors to MOD relieves PSA of the holding function.

There is a significant difference in the balance of disciplines between Army and RAF work, as shown in Table 1. Army work is predominantly architectural. In practice it is architectural work of the most utilitarian nature due to a combination of factors. The noble pursuit of economy demands utilitarianism. The Army still generally occupies the barracks taken over in 1945, whereas the RAF moved all but one station to new accommodation in the 1950s; consequently there is a greater pressure for barrack modernisation on the Army's quartering budget. The Army is more reluctant than the other two services to declare special needs: projects to support Challenger and Warrior are fitted into the normal budget whereas those to support Tornado were justified as a package. Barracks are a mere peacetime encumbrance for the teeth arms, and are abused as such. Since the Army is the larger client, the overall balance is also inclined to the architectural.

Client	Design Disciplines by percentage			Others pro rata	
	Architect	Civil Engineer	M&E Engineer (ie E&M)	QS	Secretariat
Army	41	27	32	16	
RAF	20	40	40	20	
Overall	38	29	33	17	4

Table 1. Balance of staff levels at RDO Germany (excluding senior staff)

In passing, one might contemplate why the Corps trains so many PQEs in civil engineering. Table I takes no account of either the difference between peacetime and wartime work or the altered balance of facilities required in war, but indicates that civil engineering is not the dominant discipline. Adding architecture to civil engineering restores the familiar balance with the M&E/E&M engineers. While architecture *per se* is irrelevant in war, building technology is not, so perhaps the course should be B&C to match E&M.

The design team dealing with RAF work is the only one where civil engineers are not outnumbered by either of the other two disciplines. Only a small part of its effort is devoted to strengthening and replacing the thirty-year old pavements of the airfields, in marked contrast to the dominant role of runway repair in wartime. The largest part of the work is a continuing programme of hardened buildings, many with integral NBC decontamination areas. This currently takes half the entire RAF new works budget, and this work is certainly an excellent introduction to effective modern fortifications.

For a combination of reasons, the new MES post is in this RAF-oriented design team. It is but a member of one of the design sections, however this has the advantage of keeping it relatively unencumbered by PSA administrative procedures. It is enough of a distraction from productive work to become familiar with PSA and German design procedures, the more so when Army postings are shorter than PSA ones. With luck the forthcoming change to commercial accounting in the PSA will reduce the extent of the agency's special procedures.

Having identified the differences between Army and RAF work, it should be noted that they remain separately sponsored a quarter of a century after the formation of the single MOD, thus accentuating the differences. While the quartering staffs report to their separate departments of MOD, not the central staff, the anomalies will continue: airmen and soldiers pay the same rates of accommodation charges, but there are concurrent programmes to convert the Army to four-man rooms and the RAF from four to one. The same information is presented in different formats on different forms by the separate Services. The whole business is overdue a rationalisation, which fortunately is in hand.

Historically, construction projects have taken long times to plan and to construct and government projects have taken longer than most. Commercial pressures are causing these times to be reduced, but PSA is responsible to Parliament for its expenditure, while client ministries are also responsible for the budgets which they transfer to PSA. This dual responsibility requires dual systems of approval at all stages in the life of any PSA project, with either system able to cause a delay. The use in Germany of two agencies — PSA and German — means that the planning has to be fitted into the workload of both, neither of which is allowed to hire and fire staff the way private firms do. The result is that major new works projects are rarely less than two years in planning, and are often more. This produces low-intensity work in the RDO, with staff working on perhaps a dozen projects each. The undoubted inefficiencies of such diluted work does make life more interesting for the staff involved: the author has been involved in all stages of projects from feasibility studies to final accounts and a wide range of work — radar towers, hardened buildings, explosive stores, a missile test complex, airfield pavements, an electronic workshop REME and a car park.

The use of German agencies affords an opportunity to observe how German planning procedures operate without becoming too involved in the detail. A bilateral agreement (Principles for Ordering Construction Work) made under the terms of the Status of Forces Agreement lays down who does what, and how. Whereas such a document might be taken as a basis for discussion in UK, the German concept of areas of responsibility is absolutely rigid: documents have been rejected for the lack of the correct number of copies of an appendix. In the same way the agencies must get their paperwork absolutely correct when applying to the local government for planning permission. All this rigidity has the advantage that when a decision is made it is a firm one.

In theory, the quartering staff could do the paperwork themselves, cut out the PSA and deal directly with the German construction agencies. They would, of course, require control of the budget and this they will recover in 1990. In practice, they would also require sufficient knowledge of British and German construction practice and the ability to read drawings, to judge whether the plans were just sufficient. The

Government has denied MOD the opportunity to subsume sufficient of PSA's technical staff to do this. Equally importantly, planning procedures in Germany relegate structural design to a comparatively minor role. This results in simple, easily constructed, robust but expensive structures. PSA is able, at initial sketch plan stage, to influence the plans to achieve the cheaper British requirement.

By comparison with commercial practice any government work, with its emphasis on public accountability not profit, is bureaucratic and can be frustrating. When German procedures are superimposed, the work is distinctly plodding. The positive side of this is that RDO Germany is less involved in the detail and more involved in project management.

No article in 1988 about PSA would be complete without mention of the changes now in hand. In essence, the great experiment has failed. The agency was set up to relieve ministries of all responsibilities for property services from land purchase to boiler fuel. It was intended to apply common standards and benefit from the economies of scale. Sadly, removing responsibilities encourages irresponsible behaviour: a recent survey attributed 80% of cost increases on major projects to late changes of brief or late supply of critical information by clients. Also partisan resistance from clients prevented the rationalisation necessary to set common standards: even now there are three separate directorates dealing just with MOD. The agency has had too much responsibility and too little control, gaining thereby an awful reputation.

The most important change is the returning of accountability to the client ministries and the adoption of commercial accounts by PSA: the dual approval system will end and PSA will be freed from the wasteful annuality of the present arrangement. The 'untying' of ministries from PSA will work both ways: ministries may contribute to consultants' profits, while PSA may refuse unprofitable work currently forced on it. All this will simplify the work of design staff in RDOs, but widen the gap between client and agent. Quite how it will work in Germany, where government policy is to keep design and supervision 'in-house', is as yet unclear.

A practical disadvantage of the changes is that the new works and maintenance functions will be contractually separate. At present clients benefit from PSA initiatives to reduce the lifetime costs of buildings they maintain. Persuading the designer to spend extra unpaid time increasing the profitability of maintenance contracts will not be easy.

Perhaps the most important change is that PSA now recognises project management as a separate discipline from design. This balances the evolution of management contracting as a separate part of the contracting world and puts the agency ahead of its competition. Perhaps this is a subject the Corps should consider, and it need not be the preserve of PQEs; if civilian engineers consider that on-the-job training alone is no longer adequate, then perhaps the same applies to engineer staffwork, for projects and operations alike.

Five conclusions may be made from the above:

- The work in a PSA regional design office is interesting, challenging and rewarding for a PQE. RDO Germany is of particular relevance to the Corps.
- The type of work in RDO Germany is a step up from the attachments on long engineering courses, as it is less involved in detail and consequently has a greater scope. (In purely numerical terms, the author has been involved in the planning of twelve projects and the construction of works worth £4M, compared to four projects and £2M in an identical period).
- The new MES(Wks) post is not directly related to a war role but is an excellent vehicle for learning about works services, the quartering staffs of two services, PSA, the German construction agencies, and the NATO infrastructure staff.
- While the Army, with a mobile concept of operations, shows little interest in fortifications, the RAF (still predominantly statically based) is acquiring ever more defensive works and the expertise to use them. Their knowledge of what is required to defeat modern weapons ought to have a wider distribution.
- The major changes now in hand have made this a thought-provoking posting. In particular, it is suggested that the Corps lacks regular officers with qualifications in building technology and project management.

A Signaller in France 1914 — 1918

J C CRAVEN

John Clayton Craven was born in 1887 in Hull and was employed as a post office telegraphist at the Hull Post Office prior to 1914. He served in the 4th Battalion, East Yorkshire Regiment (Territorial Army) 1908-1912 and in the Royal Engineers, Special Reserve 1912-1914. From 1914 to May 1919 he saw active service in RE Signals during which time he became Brigade Signals Officer and was awarded the Croix de Guerre for his services in keeping the lines of communication open.

After the war he returned to Hull Post Office and in 1929 was appointed to the Telegraph Branch at the General Post Office Headquarters, Aldersgate Street, London, maintaining telegraph communications in peace and throughout the 1939-45 war. He helped train many telegraphists for service in the armed forces. He became a sergeant in the Home Guard and spent many hours fire-watching at St Paul's Cathedral.

We are indebted to Patricia Lister, John Craven's granddaughter, for presenting his memoirs to the RE Corps Library; and to Derrick Vernon for making this abridgement of a part of the full 72,000 word narrative.

THE 3rd Battle of Ypres took place from 31 July to 6 November 1917. The battle is better known now as Passchendaele after the ridge and village in East Flanders captured by Canadians on 6 November 1917 and recaptured by Germans in the spring offensive of 1918.

> Still wept the rain, roared guns
> Still swooped into the swamps of flesh and blood
> All to the drabness of uncreation sunk
> And all thought dwindled to a moan ....
>
> Third Ypres
> Edmund Blunden — *Undertones of War*

It was a fine sunny morning with crystal clear visibility, we could see in sharp outline the whole semi-circle of hills: Hill 60, Tor Top, Mount Sorrel, Jackdaw Tunnels, Stirling Castle; landmarks familiar to every soldier in the salient. To the south the waters of Zillebeke lake sparkled in the sunshine. An ideal day in a region bare as the mountains of the moon, no green thing burgeoned and no birds sang. Having completed the cable laying we returned to the dugout to install the switchboard and connect the circuits in readiness for use when the batteries came into action.

After dinner at night I would join the doctor and padre in censoring letters, then after spending half an hour in the exchange depart early to bed.

Night was made hideous by raiding aeroplanes. In such a bomb-stricken area sleeping in a bell tent was far from pleasant; but once in my sleeping-bag it ceased to worry me. The only time I worried was when the alarm sounded whilst I was having a bath in my tent; one feels so much more vulnerable with nothing on!

At the beginning of October came the attack we had been preparing for. I was to take charge of the forward exchange, and the morning before set off with Wyatt, my batman, for Yeomanry Post. As had happened during all major offensives in the salient that autumn it rained, steadily and

J C Craven
A Signaller In France 1914-1918

relentlessly. The lorry crawled through Ypres, passing columns of infantry marching silently and out of line, groundsheets over shoulders and rain dripping from steel helmets. I left the lorry near Hell Fire Corner to slither over the wet ground and arrived at the forward exchange wet and muddy.

The afternoon passed uneventfully, although not comfortably, in the narrow confines of the dugout. Outside our guns were firing at their allotted targets; there was some spasmodic shelling over the area. My job was to pass targets to batteries. At intervals Major Thomas would ring from brigade with instructions, which I passed on to the batteries concerned: "X battery — at such and such a time — so many rounds — on Terhand or Molenhoek, or some other place".

At about 2100 hrs we drew the gas curtain over the doorway and prepared for the night, taking turns to attend the switchboard. I was wakened every time a brigade call came through, being responsible for the correct retransmission of the targets. The German artillery was very busy all night, heavy shells dropping just below in the vicinity of Dormy House, shaking the dugout. In the darkness they seemed much nearer. However, we knew we could do nothing about it, and in the intervals between calls slept soundly.

At daylight I took a party to lay a new line to the battery at Valley Cottages. Shells were falling between the exchange and the battery and several times we had to lie flat whilst the bits whizzed over. It was vile going over the rugged ground bogged by the previous day's rain and we were glad to get back to the dugout where the man appointed as cook was ready with a dixie of tea, cooked bacon and fried bread.

Soon after breakfast the Colonel rang wanting me immediately at brigade. When I presented myself he said there was to be another attack the following morning and that he had been instructed, if it was successful, to be ready to move off with his guns along the Menin road; I was to make arrangements for the signals section. It struck me as very unrealistic, the brain child of some bright staff officer at Corps Headquarters! I could not imagine how those 8-inch howitzers, stuck in the mud round Dormy House, could be pulled out and impelled along the Menin Road within twenty-four hours.

It was, however, the kind of job I had been waiting for. Since leaving England I had had no chance of effecting the preparation of operational instructions and I set about it with enthusiasm, detailing men, stores, and equipment. I inspected the horses and cable cart. Later the Colonel asked me if all was ready and seemed slightly taken aback when I showed him my schedule. "That's all right", he said, "there's little likelihood of us having to go, but if we do Heaven help us".

The following morning it was pouring with rain, I turned out at 0500 hrs to learn the projected move would not take place. There had been a small advance along the Menin road, almost as far as Gheluvelt, and greater advances further north, capturing Broodseinde and approaching Passchendaele, but nothing to justify the movement of heavy artillery. In any case, if in fact the Menin road had been cleared, it would have taken a week to make it fit for heavy traffic.

There were further sporadic attacks throughout October, mainly in the direction of Passchendaele, the only eminence of importance still remaining in German hands, and our batteries were heavily engaged. I visited the forward exchange every other day, taking a sapper with me, proceeding on foot through Voormezeale and along Towse's Track. It was always a dangerous journey as there was usually shelling on some part of the route, necessitating detours. I was now pretty confident of the communications, having provided each battery with two circuits, differently routed, to the forward exchange, and as an additional precaution arranged for circuits linking batteries. When changes were made I sent out diagrams to battery commanders indicating their available means of communication. I was always made welcome at the battery positions, where officers and men lived uncomfortably in shelters improvised from sheet iron, sandbags, and any rubble they could find; splinter proof but no protection against a direct hit. They never failed to give me a drink, but I should not like the visits to be regarded merely as pub crawls.

In the middle of October, Colonel Comyn left the brigade to become Divisional Liaison Officer and Colonel Hayward took over command. He brought with him Colonel Forrester-Walker, attached temporarily to the brigade. They had been with us only three days when both were wounded

whilst visiting the batteries and Colonel Comyn returned.

As I shall have much to tell about Colonel Comyn I must make it clear that although at times he may have appeared harsh and inconsiderate such was not his nature. His apparent severity was, I suppose, a mask every colonel must wear. He was a handsome man, with the authoritative bearing of his rank; a regular soldier who had spent most of his service in India.

I was to know him particularly well. No officer or man was supposed to visit the forward areas alone, and soon after his return to the brigade, he said he would take one of my signallers as escort, I volunteered to accompany him myself. From that time I became his invariable companion on his daily visit to the batteries; we had the most uncanny luck in avoiding trouble.

In the middle of October a new battery joined the brigade, 146 Siege Battery, it was to take up a position on the borders of Zillebeke lake. I went along to discuss communications and found a subaltern who took me to the command post under the ruins of Zillebeke church.

"I'm Craven, the signals officer," I said.

"And I'm Veitch", he replied.

A sufficiently uncommon name, so I queried: "Colin Veitch?"

He smiled. "The same."

Colin Veitch was the best known footballer of his time. He was captain of the then phenomenally successful Newcastle United Club, and for several seasons was also captain of the England soccer team.

I met him many times after that and we contrived one or two visits to Poperinghe together for lunch at Skindles.

On 23 October the Colonel said he was sending two observation officers to Fitzclarence Farm to report on an attack planned for the morning of the 25th and he wanted me to arrange communication.

I arranged a party for the purpose, two of my own men, four signallers and a gunner from 117 SB, the latter to carry some pigeons.

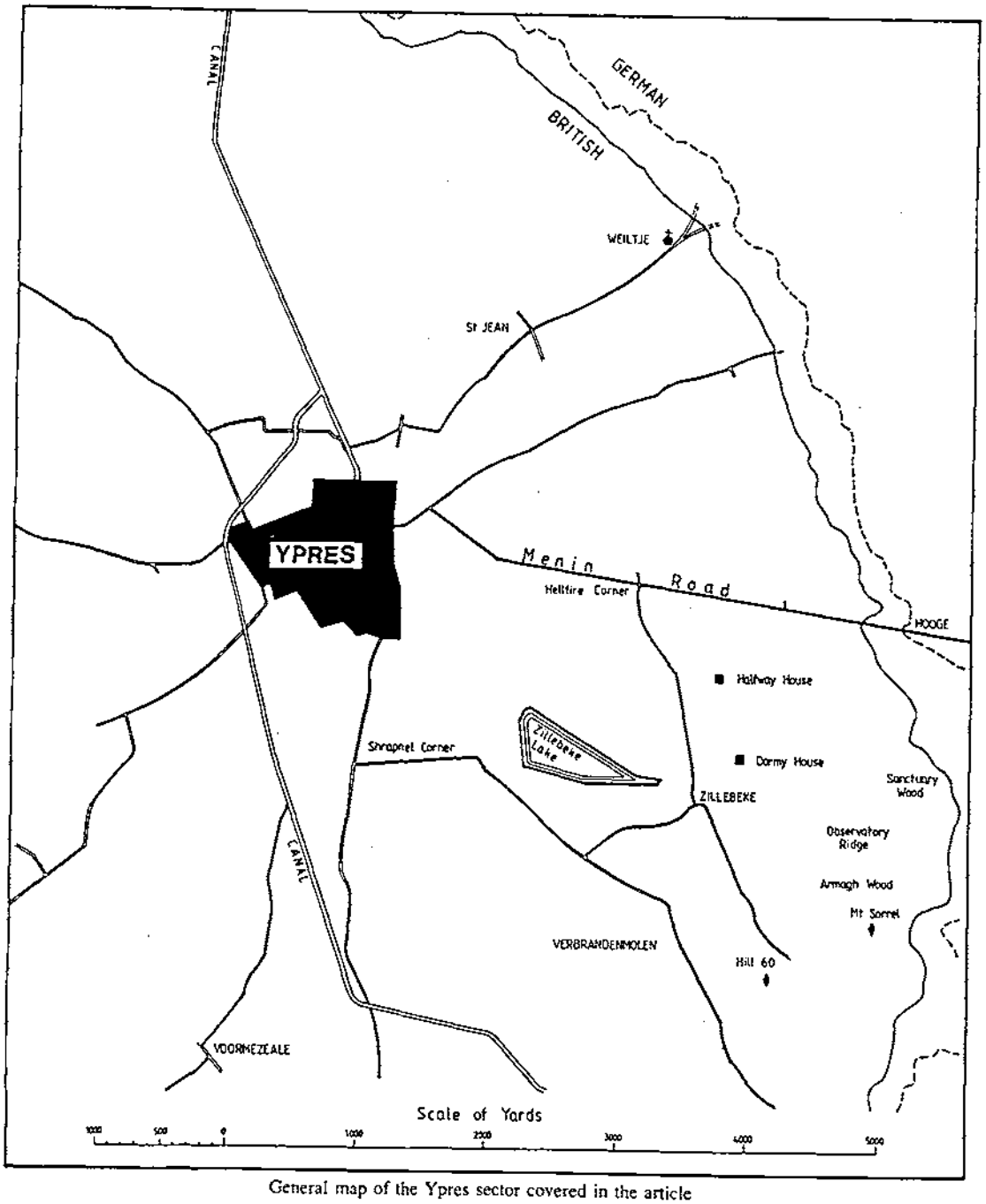
We left the lorry at Transport Farm and proceeded along the plank road in the direction of Sanctuary Wood. We had not gone far before it became apparent that the way ahead was being heavily shelled, so we advanced as near to the barrage as we could and then took shelter by the side of a water tank. After a time the shelling seemed to slacken and we decided to push on. It was a fortunate decision, for looking back I saw the water tank go up in the air. We continued along the track as fast as we could, although the weight of the cable drums hindered rapid progress; shells continuing to fall on all sides, splinters whining through the air like angry bees. We got through the area of charred stumps which was all that remained of Sanctuary Wood and mounting a slope came to the entrance of Jackdaw Tunnels where, after seeing the track ahead scatter in the air, we decided to shelter.

"Better get down the steps," advised a man who was standing at the mouth of the tunnel, "some men were killed here not long ago". There were two entrances so we divided forces, myself, the two observation officers and three others going into one and the rest of the party into the other. The tunnel was crowded, men packed together all the way down the stairway, and we were able only to squeeze into the entrance. The bombardment continued, many shells falling very close. Once the duckboard in front went up and I saw a human leg falling with the debris. After about twenty minutes the shelling seemed to die down and I decided to continue the journey.

Outside I went over to the other entrance, but found it quite obliterated and some men hastily digging around it. On the ground was a corpse without a head which I recognised from the medal ribbons as the infantryman I had spoken to at the entrance to the tunnel. I asked if any signallers had been seen and one of the diggers nodded towards a mound of earth.

We clawed at the earth and disclosed a mass of bloody flesh and a lump of bone and blood which I could recognise as a head only by the teeth embedded in it. Meanwhile two other signallers had been disinterred, one already dead and the other died immediately on being uncovered. There was no trace, however, of the young gunner who had been carrying my pigeons. I was particularly concerned about his fate as I had been walking with him on the way and he had confided it was his twenty first birthday. I learned subsequently he had been wounded lower down the sap and died later in hospital.

We had lost our pigeons, the cable drums left outside the tunnel had been smashed up and I decided to carry on with the depleted party hoping to get more cable at our destination. The shelling continued; it was very unpleasant as we ran along in the direction of Stirling Castle, but we were



General map of the Ypres sector covered in the article

keyed up to the point of no longer caring and went on regardless. In front the terrain sloped down to boggy ground from which black stumps of trees protruded, with a pill box here and there. On the left and extreme right bare hills rose, and between them could be seen in the distance green country, with houses and churches, the country occupied by the Germans. The whole valley was deserted, being in full view of the enemy. We decided after consulting a map we ought to be on a hill to the left and hurried over the ground, finally to pull up at an empty pill box for a rest. Here we enjoyed some wine and bully beef, which we needed.

It was now three o'clock and it became urgent to move quickly if we were to reach our destination before dark. We stumbled down the hill, got into difficulties in the mud, but finally found a duckboard track where we were able to make better progress, despite the many dead lying along its length.

There was the stump of a tower in front with men nearby, an officer pointed the direction to the Menin road where shells were falling methodically. We crossed it at a run and sheltered in a pill box. Then we made for two disabled tanks prominent on the skyline, wherefrom we could see our destination, a group of pill boxes at Fitzclarence Farm.

I left the two observation officers and their remaining signaller there and set out to find the bury test box, which I discovered in a concrete shelter some distance away. It was crowded with men and seemed to serve as a brigade battle headquarters in addition to its purpose as a testing station. From it buried cable ran back to a test station at Hooge Crater. When, after a long wait, I finally got through on the service line to Hooge Crater I found that Overton, who had been with me on the cadet course, was in charge and he agreed to allot me a line on the bury through to Yeomanry Post for extension to my forward exchange. There was still, however, the problem of extending the circuit to the observation post at Fitzclarence Farm, for which no cable was available; I decided that my best course would be to return to Brigade and bring up more cable. I borrowed a pigeon from the signals officer of the infantry brigade and despatched it reporting our casualties and what I proposed. This was one of the few occasions I used a pigeon. Every morning a basket of pigeons arrived at headquarters which we kept for twenty-four hours and released when another basket arrived. They were kept without food so that when released the call of hunger would lead them straight back to their lofts at Corps Headquarters, from which any messages would be transmitted to the units concerned. It was a very reliable service, and the message arrived at the 43rd Brigade within an hour.

I returned to Fitzclarence Farm and found the FOOs sharing the pill box with some machine gunners. It was a miserable wet place, but it seemed like home compared with the conditions outside. I explained the position to the FOOs and said that if I was not back with some cable they were to make their reports from the test point on the circuit allotted.

I confess the prospect of the journey back, in the dark, over the desolate country in which we had lost our way in daylight, was not alluring. I had with me my two signallers, Corporal Cavell and Sapper Milne, and we set off relying more on a general sense of direction and what duckboard tracks existed than any certainty of the way. I stumbled over two corpses with the moon shining on their white upturned faces. The whole area was utterly deserted; the only living thing encountered being a solitary infantryman who could not explain himself. He tagged along with us for a time and then disappeared, leaving us to wonder whether he was a wraith and had not really been there at all. After interminable walking we reached a plank road that I recognised as Plummer's Drive. This led us to Transport Farm where a column of motor ambulances awaited the events of the morning. We arrived at brigade camp about ten o'clock and I reported to the Colonel, but he would not listen: "Go and get something to eat and drink first, then come back and report". I made my way to the mess for cold beef and pickles, and whisky with very little water; never had whisky tasted so good!

The Colonel would not hear of my going back when he heard my report. "You have done all that is necessary, now go and get some sleep".

The attack on the following morning led to some further gains and was the last of the main battles for the ridges. The FOOs reported the progress of the operation from the test station and returned safely to their batteries. I was very sorry to learn subsequently that Overton, who had fixed up the circuit for me, was killed at Hooge Crater that morning.

About this time I paid a visit to Poperinghe. After a month in the line it was a great occasion.

Throughout October and early November our guns had a very bad time. Battery positions being one of the chief targets of enemy fire, guns were manned no matter what retaliatory measures the enemy was taking and casualties were very heavy. To meet the situation batteries maintained rear positions well behind the front and sent a minimum number of men for limited periods to serve the guns. One of the worst positions was the battery in Armagh Wood, almost a swamp, which could verily be called the Valley of Death. The battery was under constant shell fire and casualties amounted to fifty per cent of the total strength during the time it was in action. The boggy nature of the ground made it difficult to keep guns in position for accurate shooting and they had constantly to be moved or shored up. On our second visit we found men clearing up a mess of flesh and blood near a gun which had been knocked sideways.

The Colonel asked the battery commander what had happened. "Two men killed here a short time ago," he replied. The men serving the guns were in a state of exhaustion and had a look of hopeless endurance. The decimated battery was withdrawn at the end of October, and we closed down the forward exchange in the Verbrandenmolen sap. Some months later the sap was crushed by a heavy calibre shell and a large number of officers and men were buried alive. The battery at Zillebeke also had a particularly bad time. Zillebeke was a favourite target of enemy guns; whenever possible its vicinity was to be avoided. It was however on the most direct route to the battery positions, and we always passed it with eyes and ears alert. The guns were mounted between the road and the borders of the lake; it was very rare that all were in action at the same time. Fortunately the battery had very good shelters beneath the ruins of Zillebeke church, and it was always a relief to reach the safety of the command post.

The brigade observation post was at Tor Top, situated on a high point of the ridge honeycombed with tunnels occupied by troops in reserve. I set off with the Colonel to visit it one misty morning and ran into a general area bombardment when we got beyond Zillebeke. It was high velocity shelling from a long distance, the speed of the shells decelerate as they neared their target; the gradual approach could be heard and kept one in suspense until the final swoop to earth. In clear weather their direction and probably destination could be judged, but that morning the mist magnified and distorted the sound; the effect was very disconcerting. Several times the explosions appeared too close and we went to earth to escape the fragments. It was impossible to pick out landmarks on account of the mist, but eventually we reached a plank road which was the main highway towards the front. Even on the planks the going was difficult, as many planks were loose and tipped to scatter mud and water when trodden. Finally we saw a rough signboard "To Tor Top" and ascended a bleak hillside. Notices indicated various entrances to the sap, but where in those miles of tunnels we should find the FOO I had no idea. Leaving the Colonel I penetrated underground and found a subaltern who claimed to be the Town Major, but he had only taken over the previous day and knew nothing of the place. Finally I had the luck to come across a linesman belonging to the OP and he led me through a maze of passages crowded with men to the particular cubby-hole occupied by the FOO who became alarmed when I told him the Colonel had come to inspect. And he had cause to be.

The Colonel had been fuming up above at the long delay and when I took him down and he saw the filthy condition of the FOO's hideout his remarks were blistering and searing; the subaltern expected to be shot at dawn before the Colonel had finished with him!

A shaft led up from the dugout to the observation point; there was little to be seen owing to the mist.

In the middle of November a halt was called to major operations in the salient. There was an exodus of troops and artillery, leaving only those necessary to hold the line. The 98th HA Brigade with which we were grouped was withdrawn, and we became a single Brigade with a four battery establishment. In saying goodbye to Young, the signal officer of the 98th Brigade, I congratulated him on being awarded the MC for his work on communications during the offensive.

Relative peace settled on the salient. The roads ceased to be crowded with traffic, and little movement could be seen in the lowlying plain bounded by Zillebeke, Yeomanry Post, Sanctuary

Wood, Tor Top and Hill 60. Artillery activity died down except for the occasional bark of a gun and shriek of an incoming shell. Batteries were no longer moving, but sitting tight. Divisions stayed in the line for weeks; reliefs were regular and carried out at night. We had been transferred to 9th Corps.

I walked to Tor Top with a Colonel from Corps who wanted to survey the area; it didn't seem to be the same place we had known a few weeks before. Armagh Wood was deserted and Tor Top and Mount Sorrel places of peaceful resort.

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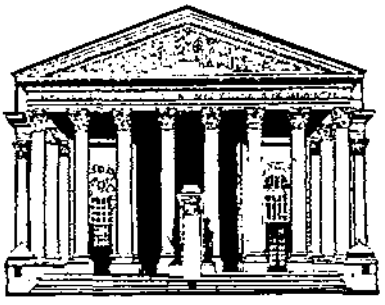

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The Shortest Distance

MAJOR G E AUSTIN MICE FCIT RE

Geoff Austin enjoyably served with the Corps from 1952 to 1969, readily admitting to becoming both a Sapper and civil engineer by the 'back door'.

A permanent commission followed within twelve months of enlisting as an OR "short service sapper". Attending a long civils course and passing the odd ICE examination in lieu of a degree got him into 'the civils'. Field service covered battles with Twynham huts and desert airstrips in Aden and geriatric Parker Starmix asphalt and Howard Train soil stabilization plants on Operation Crown airfield in Thailand — in its 'black' days — but that's another story.

Skirmishing with duty rosters as Adjutant, Engineer Base Group, Singapore was followed by civil engineering as ACRE (Civil) 62 CRE, Barton Stacey. Apart from OPMACC in Scotland the design and construction of a swimming pool at Long Marston (masquerading as a flotation test tank) was the finale to an all too short but satisfying career of Royal Engineering!

Now with over ten years as British Airports senior aircraft pavement designer, several years as airport civil engineer Hong Kong International Airport and various airports projects with consultants from Zaire to Ecuador, taking in Belfast en passant, Geoff still believes 'gut feeling' is more reliable than the computer.

THERE was a famous occasion when a party of eminent people and their retinue arrived at Heathrow only to have to wait four years to complete their connection to Paris! This was not 1984 but 200 years earlier in 1784.

William Roy, Fellow of the Royal Society and member of the Antiquarian Society, a Major-General of the Army and Lieutenant-Colonel of Engineers, and his retinue had arrived at the site of the Magpie Inn on the Bath Road — just to the north-west of the little hamlet of Heathrow consisting of half-a-dozen dwellings bordering a track across Hounslow Heath.

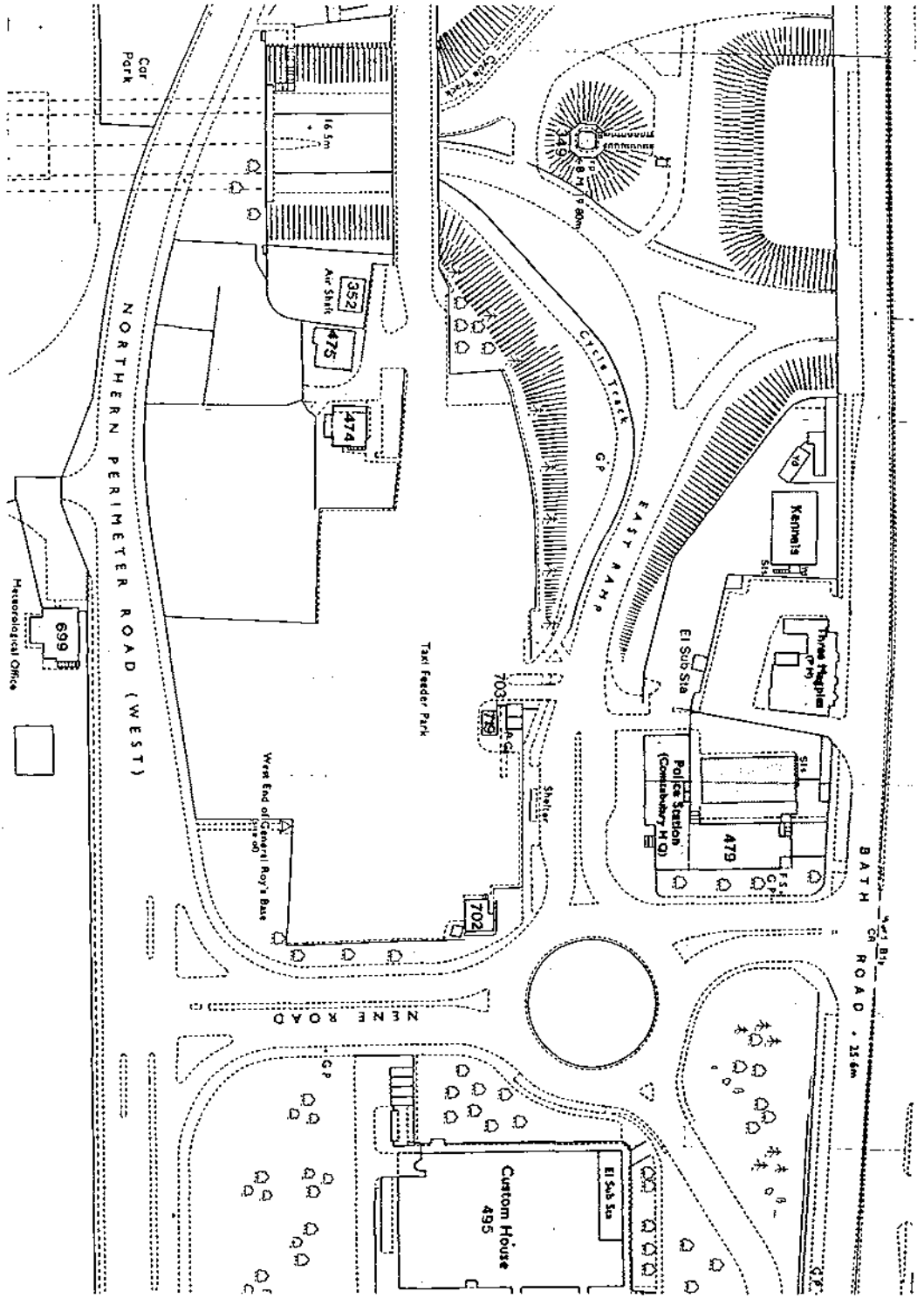
They had just completed, for the third time, a meticulously observed measurement of the distance between a spot near Hampton to another some five-and-a-half miles to the north-west in King's Arbour, now the corner of Heathrow Airport's north perimeter road alongside the Heathrow Penta Hotel and the airport police station.

SURVEY

OBSERVERS of the location plan of Heathrow Airport, based on the Ordnance Survey 1:25,000, will have noted a line of dashes passing between Hatton Cross and East Bedfont in a north-west direction. Against this is a clue to the scene described — 'General Roy's Base'.

In 1784 on this line, marked later in 1791 with two upended army surplus cannon from Woolwich, the trigonometrical survey on which Ordnance Survey Maps are based, was begun.

Major G E Austin
The Shortest Distance



Present day site of General Roy's base at Heathrow

As early as 1766 Roy had spoken of the need for a trigonometrical survey of England and Wales to tie together the various local and county maps being produced piecemeal by 'county surveyors', the Board of Ordnance and others.

Roy's extraordinary cartographical skills are thought to be a result of an apprenticeship as a civilian draughtsman in the Board of Ordnance engineer establishment employed surveying roads for the post office mails.

From 1747 to 1755 a most detailed survey of Scotland at a scale of one inch to 1000 yards was effected by Roy, often as the sole trained surveyor in the field. It was the most extensive survey to be yet made in eighteenth century Britain. Fair copies are to be seen in the Map Library of the British Museum.

In 1755 Roy began his long military career. He was appointed a practitioner — engineer in the then all officer, Corps of Engineers.

When he later became a major general of the general staff at the War Office (Horseguards) he was also a lieutenant-colonel in the engineers and in command of the first military company established for the purpose of military surveying.

From this twin military power base he niggled away at the authorities on the need for better mapping in the defence of the realm. It would be '...based on extending the great triangles quite to the northern extremity of the island...'. Detail would be filled in from the county maps and his own original map of Scotland. Towards the end he advocated in 1766 that '...it would be useful to trace on the ground a Meridian line thro' the whole extent of the island, marked by Obelisks from distance to distance ...' to stretch from Dorset to Caithness!

He costed the first year of what he saw as a six to eight year programme at £2,227-12 shillings — a saving of £200 being offered if soldiers assisted the engineers instead of '...not so obedient country labourers ...'. But the Government, being pre-occupied with the colonial rebels in the American War of Independence, did not take him up on this.

In 1783 an historic opportunity arose for Roy — and ultimately for us all. There was, at the time, a scientific dispute between the Royal Observatories in Greenwich and Paris. They could not agree on their relative positions as fixed from astronomical observations. The difference was some 11 seconds of latitude. After an often acrimonious disputation between the two directors, Cassini de Thury in Paris proposed the matter be finally settled by computation based on a triangulation from near Greenwich to the coast at Dover. From thence across the Channel by observations to the already completed French triangulations to Calais.

The essentials of these triangulations were, an extremely accurately measured base line and similar accuracy of angular measurement of lines of sight to objects at great distance. To these measurements had to be applied all means of corrections for temperature, heights above sea level, curvature of the earth and instrumention errors, to name but some.

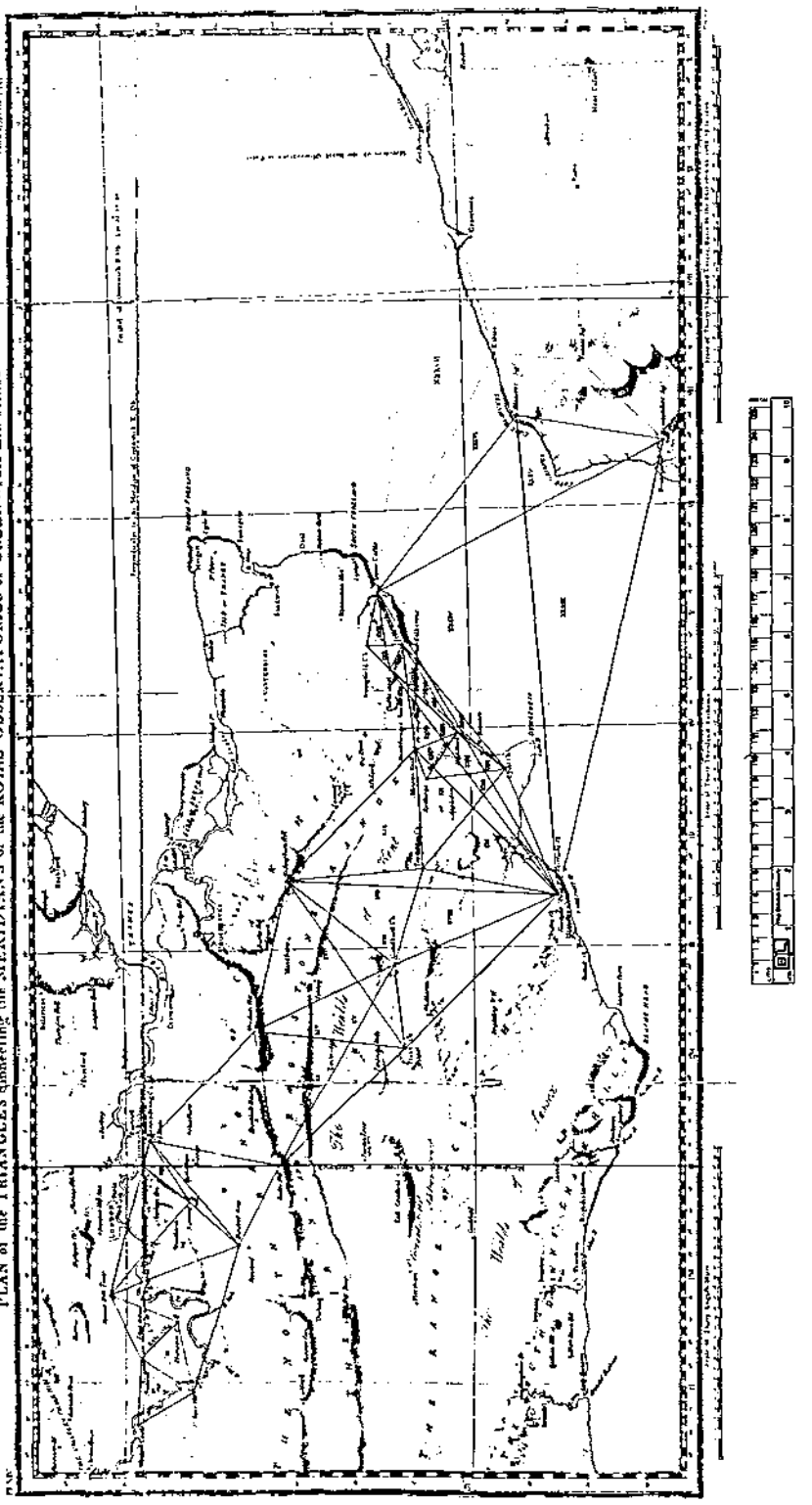
Measurement

George III, who had a keen interest in scientific matters, passed the responsibility for settling the French dispute over the juxta-position of Paris and London to Sir Joseph Banks, president of the Royal Society. He immediately thought of none other than Roy, who was by then a Fellow of the Royal Society, to whom he could safely entrust the project.

Roy saw in the Anglo-French triangulation at last the chance to set in motion his long held desire to triangulate the whole of Britain 'For the base on Hounslow Heath (he wrote at the time) is well suited for extending different series of triangles from thence in all directions to the remotest part of the Island'.

He was also wise enough not to have his scheming blocked by the accountants. His extremely low bid of £350 for 60 days was too good to refuse. In April 1784 he was told to proceed. The final cost was some £2,000 but Roy was away even before he had formal confirmation from the Royal Society. He had no faith in local labour so he immediately had a sergeant, corporal and 10 men of the 12th of Foot on the 'march from Windsor to Hounslow Heath where they encamped on 26 May, close by Hanworth summerhouse'.

The Heath in the summer of 1784 was the place to be — it was like a 'scientific carnival'. Sir Joseph Banks set up his tents and as Roy reported


PLAN of the TRIANGLES connecting the MERIDIANS of the ROYAL OBSERVATORIES of GREENWICH and PARIS

'his (Bank's) immediate guests and the numerous visitors whom curiosity drew to the spot, met with the most hospitable supply of every necessary and even elegant refreshment. It will be easily imagined, how greatly this tended to expedite the work, and how much more comfortable and pleasant it rendered the labour to all who obligingly took part'.

On Saturday 21 August 1784 Roy recorded 'about noon, his Majesty deigned to honour the operation by his presence, for the space of two hours, entering very minutely into the mode of conducting it, which met with his gracious approbation'.

For a very full and minutely detailed account of the actual measurement of the base line from near the Hampton Poor House to the water gardens of Kings Arbour behind the Magpies Inn one should recourse to Roy's own paper in *Philosophical Transactions* (Royal Society) for 1785 Vol LXXV. Or the slightly modified version based on Roy's paper and included in *An Account of the operations carried out for accomplishing A Trigonometrical Survey of England and Wales from the Commencement in the Year 1784 to the End of the Year 1796* by Captain William Mudge FRS and Mr Isaac Dalby, copies being held in British Museum Reading Room and Map Library respectively.

Suffice it here to say that Roy measured the distance three times — first with a specially made 100 foot steel chain supported in wooden coffers on trestles and uniformly tensioned. Secondly, using deal rods of Riga pine cut from a seasoned ship's mast, four rods in number each 20 feet 3 inches long and braced in wooden coffers to hold them rigid. The third and most accurate utilized 20 foot glass rods also in wood boxes. The ends of the rods were hollow to hold fixed and spring-loaded ivory studs arranged to read against a vernier scale.

Accuracy

The atmosphere caused the deal rods to swell and shrink to an extent which made Roy reject this measurement. The tally between the extreme accuracy of the glass rods and the steel chain led him to an average of the two measures after all corrections had been made.

The steel chain was so successful that Roy's able Lieutenant James Fiddes of his Royal Engineers survey company used it in 1787 to measure a base of verification on Romney Marsh prior to the cross Channel observations. These were completed on 17 October 1787 using night sightings on flares.

But even then the Greenwich-Paris link was incomplete. A gap in the triangulation existed between Wrotham Hill and the coast.

By November 1787 with all observed but two of the 14 ground stations and nine on tops of buildings, Roy noted of the worsening weather 'at length (it) became so tempestuous that it was utterly impossible to continue ... perched on the tops of high steeples such as Lydd and Tenterden ...'.

The work was completed in the next season of 1788, four years after Roy's work on Hounslow Heath. The effect on his health however was severe and in 1790 he died suddenly at his home in Argyll Street.

In 1790 the Royal Society posthumously published in its *Philosophical Transactions Vol LXXX*. Roy's last paper in which on page 262, he writes '... that the trigonometrical operation so successfully begun, should certainly be continued and gradually extended over the whole island ...The honour of the nation is concerned in having at least a good map of this as is of any other country.'

Roy was only too well aware that the colonies and other countries were better mapped than Britain at that time.

Theodolite

But why had there been such a delay in progressing from the measured base line of 1784? A theodolite of sufficient accuracy and power had been specially ordered by Roy from Jesse Ramsden, a famous instrument maker, whose main excuse for being some three years late was the cumulative improvement he had made to the design of the massive instrument. It was a three foot theodolite having a 36 inch diameter horizontal circle with which angles sighted over 70 miles could be read to within two seconds.

Ramsden, the perfectionist, lamented that he worked 'within a fixed price' and 'to the neglect of more lucrative business'.

Ramsden Theodolite.

The theodolite weighed 200 lbs and was conveyed in a specially sprung carriage. It was constantly hoisted to the tops of church towers and high points of observation. But the wait by Roy was vindicated by his successors to the National Survey in that Ramsden's instrument (known as the RS) was used for over 70 years. A second was produced for the Board of Ordnance to be used on its survey work up to 1853. It was regrettably destroyed in the bombing of Southampton during the Second World War.

Besides being an eminent surveyor, Roy was also a keen antiquary and 20 years before his work on Hounslow Heath he had spent ten years in Scotland collecting material and making sketches for his major work. This was *Military Antiquities of the Romans in North Britain* published in 1793, after his death, by the Society of Antiquaries.

Monument

Almost every second of every day someone somewhere will be using an Ordnance Survey Map — the latter day monument to the almost forgotten meticulous piece of mensuration 200 years ago by William Roy on Hounslow Heath and hard by Heathrow, as it is today.

The occasional academic or esoteric researcher will now and then shake the dust off the Philosophical Transactions of the Royal Society or plunge into the depths of the British Museum to view Roy's maps and work on antiquities and to most these will be the tangible legacy of this remarkable man.

But perhaps his real legacy is the example of the achievements of a man of lowly origin, product academically solely of the local Lanark grammar school, who through his consummate skill in cartography and meticulous attention to detail, reached general rank in the Army, became a noted Fellow of the Royal Society and numbered amongst his friends, kings, princes and dukes. He ranked high in a period with a full complement of eminent scientists.

Surely, this is a legacy of comment on today's meritocracy which demands higher and higher academic excellence and an abundance of paper qualifications. Surely the professional door must always be left open, no matter how slight, for the admittance of latter-day Roys, skilled but unqualified, on equal professional terms with the often well qualified but unskilled, academic.

(With acknowledgements to British Museum Map Library, Library of Institution of Royal Engineers and British Airports Services Limited of BAA plc).

The Shortest Distance (1)

The RE 200 Greenwich to Paris Measurement

MAJOR M C BREACH MA MSc FRAS ARICS RE
and MAJOR A R T WARDROP MSc ARICS RE

Major Breach was commissioned into the Corps in 1969 and served as a Field and Amphibious Engineer in Germany, UK, Cyprus and Kenya prior to joining Military Survey in 1976. Since then he has been "surveying" in Kenya, North Yemen, UK and USA in a variety of technical posts. His degree subjects include statistics, experimental psychology and geodesy and he is currently exercising the latter as senior instructor in field survey at the School of Military Survey at Hermitage.

Major Wardrop was commissioned into the Corps in 1969. He subsequently served in UK and BAOR, including with 22 Engineer Regiment, 3 Training Regiment and 26 Engineer Regiment. In 1978 he joined Military Survey and since has completed an attachment to the Ordnance Survey and an exchange posting to the Australian Survey Regiment. In 1983 he took an MSc in Design of Information Systems at RMCS Shrivenham and after a tour with the Systems and Techniques Unit RE he assumed command of 19 Topographic Squadron RE in August 1986.

Introduction

Between 6 - 9 September 1987, Military Survey contributed to the RE 200 Anniversary celebrations by remeasuring the longitude difference between the Old Royal Observatory at Greenwich and the Observatoire de Paris. The first measurement was made by one of the greatest of our predecessors, General William Roy FRS, using the latest technology and the best instrument of his time: this was Ramsden's Great Theodolite

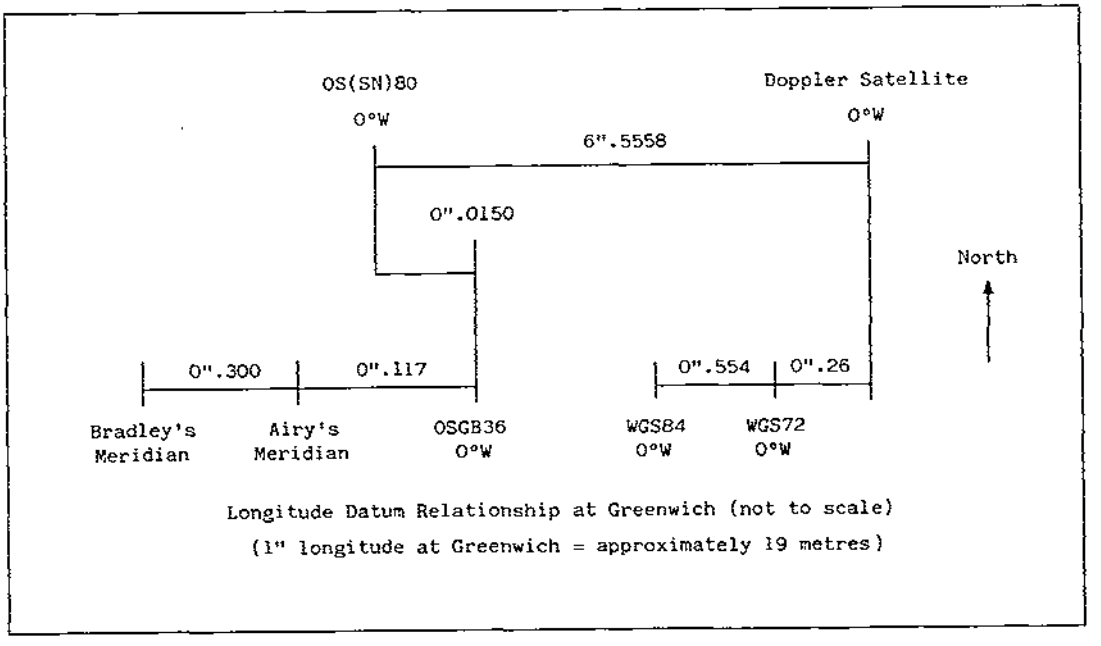
Major M C Breach Major A R T Wardrop
The RE 200 Greenwich to Paris Measurement

and the project took from 1784 to 1789 to finish. The RE 200 measurements were also made using the latest technology and the best instruments of their time - receivers for transmissions from earth satellites. Although the operators wore the uniforms of General Roy's era, the provisional result in 1987 was available at the end of the fourth day's work. The event was completed by the Corps Band Beating Retreat followed by a reception in the Greenwich Observatory.

Preparation

Our original intention for the 1987 measurement was to use only a single pair of satellite receivers with one at Greenwich and one at the Paris Observatory. This quickly developed into an interesting geodetic project using four different manufacturers' products and, by coincidence, this allowed us to compare the instruments under fairly rigorous test conditions and perhaps give us a pointer towards the type of receiver we might be looking for in the future. Sercel TR5S, Wild-Magnavox WM 101 and Trimble 4000SX receivers, all of which work to the new NAVSTAR Global Positioning System (GPS) navigation satellites, and the Magnavox 1502 receiver, which works to the well established US Navy Navigation (Transit) satellites, were used. The Institut Geographique National (IGN) in Paris became equally interested in the project and gave us magnificent support throughout.

One of the problems in relating Roy's determination to modern terrestrial or satellite determinations is that of referring the observations to a geodetic datum, and finding the interrelation between the respective datums. Roy's observations are related to Bradley's Meridian, which is represented by a brass strip in the floor running north-south at the Greenwich Observatory. Another definition, by Airy, is marked by a similar brass strip running right across the courtyard, some six metres to the east. The zero of longitude of the respective modern satellite datums are of course unmarked on the ground, but have been found from observations and experiment. For the Transit (Doppler) satellite system the zero of longitude is that of the US Navy Navigation satellite datum; for the GPS it is the zero of longitude of the World Geodetic System 1984 (WGS 84). As shown in the diagram, the rather complicated connection between all these different definitions of the international datum which have been adopted over the years, is made through two more: the zero of longitude of the GB national mapping datum (the Ordnance Survey's 1936 readjustment of the nation's survey data, defined as OSGB36), and a further scientific adjustment in 1980 (OS(SN)80).



Longitude Datum Relationship at Greenwich (not to scale)

(1" longitude at Greenwich = approximately 19 metres)

Observations

Our final plan was relatively simple and involved setting up the various antennae as near as possible to the original meridians at Paris and at Greenwich. Offsets in all three dimensions were recorded at Greenwich so that all antennae there could be referred to the "red band" electrical centre of the Magnavox 1502 receiver which was sited in the middle of the roof over Bradley's Meridian. Longitudinal offsets from the Meridienne Pilier Geodesique at the Paris Observatory were also recorded for the corresponding instruments there.

The line was then measured over a four-day period, and mean result computed for press release on the evening of day four. Like all good surveyors, however, we allowed for delays and flew the French observations back from Paris, by courier, on day three. The exercise was very successful and a provisional result of 2° 20' 17".14 was computed and released on site. Two hundred years earlier Roy's results were only available after prolonged office calculations.

Final Computations

The final processing of the data was completed after the event by the firms that lent and operated the various equipments. The post-processed corrected results were:

Satellites	Instruments		Longitude Difference	
Transit	Magnavox 1502 (Magnet Software - WGS 72)		2° 20' 17".000	
GPS	Sercel TR5S	WGS 84	2° 20' 17".143	Mean 2° 20' 17".147
GPS	Trimble 4000SX	WGS 84	2° 20' 17".143	Mean 2° 20' 17".147
GPS	WM 101	WGS 84	2° 20' 17".155	Mean 2° 20' 17".147

The GPS results show a range of longitude of 0".012, which represents 230mm on the ground, or 1.4 parts per million of the longitude component of the line. The arithmetic mean of longitude difference between London and Paris derived from these GPS determinations changes the provisional results announced at Greenwich by only 130mm. The difference between the Transit and GPS results of 0".147 or 2.81 metres was larger than expected. No satisfactory explanation for this has been found to date and further studies are needed to determine the reason.

General Roy's initial answer of 2° 19' 51" was too short by about 500 metres, when compared with the 1987 results, but after some extra observations in 1851, and a more rigorous adjustment, a value for the longitude difference of 2° 20' 17".730 was obtained based on Bradley's Meridian which improved the results to within 0".583 or 11.17 metres of the final GPS determination.

Conclusions

The 1987 RE 200 observations gave a value of 2° 20' 17".147 for the longitude difference between Bradley's Meridian at Greenwich and the Meridienne Pilier Geodesique at Paris using the GPS satellite system and the WGS 84 datum. This compares with 2° 19' 51" from Roy's original 1787 observations and 2° 20' 17".73 achieved from additional observations and adjustment in the mid 19th century. It is impressive testament to our predecessors' distance measuring techniques to see an agreement of 25 parts per million with their work, especially when one considers the difficulties they faced.

We are most grateful to the Survey and General Instrument Company Limited for the use of the Sercel TR5S receivers, to GPS Survey Services

The 1987 team, dressed for 1787, using the modern equipment. Compare Ramsden's theodolite in the previous article

Limited for the use of the Trimble 4000SX receivers, and to Global Surveys Limited for the Wild/Magnavox WM 01 GPS and Magnavox 1502 Transit receivers, and to each of the companies for their own post-processing of their respective results. Our thanks also go to IGN in Paris for all their support at the "other end of the line", and to the Director of the Royal Observatory, Greenwich for the interest and support which he and his staff gave in support of this project.

The RE 200 Greenwich to Paris Measurement

Lessons Learnt By The Royal Engineers In The South African War

COLONEL W G A LAWRIE

The late Colonel W G Lawrie passed out from the Shop in 1883 having won the Sword of Honour and the Pollock Medal. After postings to Jamaica, Malta, and Khartoum he took part in the Boer War and remained in South Africa after the hostilities to assist with rehabilitation works. He retired in 1912 on medical grounds but was recalled in 1914 and spent the war years as CRE Woolwich. He then transferred to the RAF as a Group Captain and was employed on airfield construction in southern England and Malta until his final retirement in 1924. This account of a lecture given by the then Major Lawrie, CRE Natal, in January 1905 in the Garrison Theatre Harrismith, was first published in the Harrismith Weekly Chronicle.

We are indebted to his son, Colonel W G A Lawrie, for sending us the article found amongst his father's papers.

Manpower

At the beginning of the war the Royal Engineers numbered some 8000 officers and men distributed all over the Empire, of whom no less than 7000 were sent to South Africa. To enable us to do that we called up about 3000 reservists, 360 RE militia and 1200 volunteers and recruited widely in the UK. The present strength worldwide is about 1000 officers and 10,000 men.

Organisation

Three field companies accompanied each division with a field troop to each cavalry brigade. Corps troops consisted of four field companies, one bridging battalion, one telegraph battalion, railway companies, balloon sections and a survey section.

Bridging

The pontoon troop in the bridging battalion carries 85 yards of medium bridge and the Corps field companies each carry 15 yards, giving a total in Corps troops of 145 yards. But modern artillery requires a heavy bridge and Corps troops can provide only 95 yards of this. As the war progressed every pontoon in England was sent out, but many of these were unserviceable and sank. A 266 yard medium pontoon bridge was required at Norval's Pont for a divisional crossing, the longest bridge made by the British Army since the Peninsular War. Since many of the pontoons had sunk an improvised bridge was built using casks and the division crossed without delay. Our shortage of serviceable pontoons is a very old problem dating from the time of Wellington.

Field Telegraph

At the start of the war there were 10,000 miles in existence and we constructed a further 18,000 miles, making 28,000 miles to be worked. Some thirteen and a half million messages were recorded. A novel feature in this war was light cable laid on the ground. One mile of cable weighed only 100lbs. This was used for mobile operations. When a column became stationary the cable was picked up and replaced with an air line fixed on posts. At first there was a shortage of cable but the reserve has been increased and the design of cable cart improved.

Colonel W G A Lawrie
Lessons Learnt By The RE In The South African War

Boer pontoon bridge near Hlangwani.

All telegraph lines in the south of England have been built, maintained and repaired by the RE for the last 30 years, so our men get plenty of practice. Many employees of the Post are taken on one day and transferred to the RE Reserve the next day. War correspondents have stated that our telegraph system is the best and fastest in the world.

At Ladysmith on Wagon Hill day for the first time in history the battle was directed by telephone over a large area. It had been suggested that its use at Spion Kop would have been a great advantage.

When marching on Bloemfontein and Pretoria Lord Roberts had kept in touch with his units up to 40 miles on each flank by means of the light cable and also 100 miles to the rear and had been in communication with Sir Ian Hamilton until they reached Kroonstad. When crossing roads the cable had been buried a few inches to protect it from damage.

We brought out apparatus for wireless telegraphy and men from Marconi's firm. We also captured Kruger's equipment which was acknowledged to be better than ours, but both failed. This was thought to be due to the altitude, dryness of the air or iron ore in the hills. At sealevel, however, it worked perfectly. Further experiments are being carried out.

Railways

We have a good system similar to that for the telegraph battalion. Civilians are nominated by the railway companies, enlisted as reservists and called up when required. This was the system recommended by Lord Wolseley. It is being extended to include station masters, traffic managers, etc in the same way.

Road Transport

Steam tractors have been a great success. The advantages being safety against attack; tractors can be armour plated and can carry their own fuel and water if necessary. It is recommended that they should be used for hauling guns instead of horses, avoiding confusion when attacked. The great thing is to have roads inspected by an RE officer who can advise on suitability. Tractors had proved very useful at the Cape but had been a failure in Natal.

Motor cars were found very useful for transporting officers, light loads and searchlights, which could be concentrated very quickly for lighting up an area 100 miles from their base.

Survey

Complaints had been made about the lack of maps and topographical information before war broke out. It had been found impossible to get any information about the country when the farmers were hostile. RE officers had even been ordered off farms in the vicinity of Ladysmith.

Balloons

They had been of great use to the British at Ladysmith, Colenso and Modder River, enabling us to fix the position of enemy batteries which would otherwise have been very difficult when smokeless powder was used. It was essential to have telegraphic communications from the balloon to the ground and from there to the General conducting the operations. The Boers had everything that we had except balloons and regarded us with envy on that account. They wasted a lot of ammunition firing at our balloons but rarely got a hit.

Sapper Mobility

One very important lesson was the need for sappers to be mounted or at least mobile. Foreign attaches were astonished to see our sappers marching, working and then marching on again. They should always be the first to reach a camp site to see to water supply, defences, etc. We do have mounted field troops who carry explosives, pumps, tools for mending telegraph lines and a

Lessons Learnt By The RE
In The South African War (1)

small amount of bridging material. Our mounted infantry called out for more field troops and the Australians formed their own mounted troop which they called the Australian Mounted Pioneers. Even the natives who worked with the RE had to be mounted.

At present only 40 men per field company were mounted and it has been recommended that nearly all field company personnel should be mounted or at least carried in wagons, as had become customary in this war.

Entrenching

There is only one field company of about 200 men allotted to an infantry division of 10,000 men. Some people still imagined that the sappers should do all the entrenching work for the division, but that was never intended and is obviously impossible. Some units always did this work for themselves as soon as they got into camp. It had been found that an ordinary infantry soldier could entrench himself in ten minutes and experiments had been carried out to show the great protection afforded by this.

At the battle of Liau-Yang in 1904 both the Russians and Japanese had used a new form of trench which they had picked up from the Boers and found it worked very well. This was a snake-like trench about 5ft deep and 2ft wide. The Russians had also used two tiers of trenches — when the fighting in the front line got too hot, they retired to the second line.

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101 (London) Engineer Regiment (Explosive Ordnance Disposal) (Volunteers)

On 1 June 1988, a new Territorial Army Regiment was formed with the title '101 (London) Engineer Regiment', which traces its history back to the 1st Middlesex Volunteer Engineers.

The following article is a reprint, with a postscript added to bring the history up to date, of one published in the Journal *in 1959. The article was written by Lord Mais, one time Commanding Officer and then Honorary Colonel of the Regiment, to celebrate its centenary.*

The 1st Middlesex Volunteer Engineers, founders of the present Regiment, were raised in January 1860, and their descendants are thus the senior Territorial Regiment of the Royal Engineers†. The first member to be enrolled was Colonel The McLeod of McLeod on 6 February 1860.

The original headquarters were at Whiteheads Grove and Kensington Museum. Later, in December 1865, the unit moved to a new headquarters in College Street, Fulham Road, Chelsea. Volunteers served in the Egyptian war of 1882. Two sections of the Middlesex Volunteers Royal Engineers, made up of volunteers, served in the South African War. In December 1910 the unit moved to the Duke of York's Headquarters to become the divisional engineers of the 2nd London Division formed under the Territorial Act of 1908, viz Headquarters Royal Engineers, and the 3rd and 4th London Field Companies, with a Telegraph Company which in 1913 was renamed 2nd London Division Signal Company, Royal Engineers.

On the outbreak of war in 1914 a third Field Company was raised and named 2/3rd London Field Company, Royal Engineers; the unit then became the divisional engineers of the 47th Division, as the original 2nd London Division was then renamed. In the early part of 1915 a second line was raised, consisting of Headquarters Royal Engineers, 2/4th, 3/3rd and 1/6th London Field companies, Royal Engineers, which formed divisional engineers of the 60th Division. Later a third line was raised, but only formed reserve units which were stationed at Esher, partly for reinforcement purposes.

The 3rd London Field Company, Royal Engineers, proceeded overseas in January 1915 and served with 28th Division, British Expeditionary Force. This company was one of the first Territorial Army units to proceed overseas. In January 1915 the 2/3rd Field

†However, if militia units are included, the Royal Monmouthshire Royal Engineers (Militia) claim seniority since they derive from the Royal Monmouthshire Light Infantry, converted to militia engineers in 1871.

Company left 47th Division to join the 60th Division. The 4th London Field Company and the Divisional Signal Company, Royal Engineers, proceeded to France with the division in March 1915, and were rejoined by the 3rd Field Company, Royal Engineers, and 2/3rd Field Company, Royal Engineers, between April and June 1915.

On 1st February 1917, units were renumbered as follows:

3rd Fd Coy—517th Fd Coy
4th Fd Coy—518th Fd Coy
2/3rd Fd Coy—520th Fd Coy
Signal Coy—17th Div Signal Coy

The 47th Divisional Engineers served throughout the war in France and took part in the battles of Festubert, Loos, Vimy Ridge, Somme, Messines, Ypres, Cambrai, Ancre, and advanced into Artois. The units of the 60th Division served overseas in Palestine and the Middle East. 177 men lost their lives. In June 1919 the units returned to cadres and were brought home and disembodied, the men being placed into "Z" Reserve.

On the reconstitution of the Territorial Army in 1920, only two London divisions were formed 47th and 56th. Originally it was decided to form a Royal Engineer battalion, but after one camp, in 1921, this was abandoned and a normal divisional engineers of the 47th Division was formed to include Headquarters Royal Engineers and two field companies. Later a third company Royal Engineers was raised, the companies being renamed 220th Field Company, 221st Field Company, 222nd Field Company, Royal Engineers. The Signals Company had left on the formation of the Royal Corps of Signals.

In 1935 the two London divisions, 56th (1st London) Division and 47th (2nd London) Division were broken up. Selected units were taken to form the London Infantry Division, and the unit then became the divisional engineers of this new division.

Following the Munich crisis the London Division formed a second line, and the two divisions then became known as the 1st London Infantry Division and the 2nd London Infantry Division, and these two divisions were rapidly brought up to full war strength. 220th, 221st, 222nd Field Companies and the 223rd Field Park Company provided the key personnel for the following duplicate units, 501st, 502nd, 503rd Field Companies and 504th Field Park Company. These latter companies became the divisional engineers of the 2nd London Infantry Division.

The present Commanding Officer Lt Col J P Marsh BSc(Eng), C Eng, MICE.

Immediately after mobilization the 221st and 222nd Field Companies left the 1st London Division to join regular formations with the British Expeditionary Force in France; the former joined the 1 Corps and the latter the II Corps, and later came under command of the 3rd Division. Shortly afterwards they were joined by 223rd Field Park Company, which became part of X Force in France. Upon 221st and 222nd Field Companies proceeding to France with the British Expeditionary Force, 501st Company was transferred from the 2nd London Division to the 1st London Division. Early in 1940 the designation of the 1st London Division was changed to the following: 56th (London) and 47th (London) Infantry Divisions. Following the evacuation from Dunkirk, 221st Field Company returned to the 56th Division and 222nd Field Company to the 47th Division.

101 London Engineer Regiment Explosive Ordnance Disposal Volunteers

In 1942 56th Division proceeded overseas and saw service in Persia, Iraq, North Africa, Sicily and Italy, and were at the landings at Salerno, where they suffered heavy casualties. The 47th (London) Division did not serve overseas as a formation, but 502nd Field Company joined the 78th Light Assault Division, and 222nd Field Company became a squadron of the 79th Armoured Division.

During May 1947 the Regiment was re-formed under its new name, and the 101st Field Engineer Regiment became the divisional engineer regiment of the 56th (London) Armoured Division. It re-formed at its old station at the Duke of York's Headquarters, Chelsea, and was composed of RHQ 220th, 221st, 222nd Field Squadrons and 223rd Field Park Squadron. In 1954 the title of the Regiment changed to include "London" Field Engineer Regiment. Later, in 1957, the role of the division was changed from an armoured to an infantry division and considerable reorganisation took place, but the Regiment remained as the engineer regiment of the division in its new role.

The 101st (London) Field Engineer Regiment was disbanded on 31 March 1967 upon the reorganisation of the Territorial Army.

On 1 June 1988, 101 (London) Engineer Regiment, (Explosive Ordnance Disposal) (Volunteers), was formed. The Regiment took under command from 33 Engineer Regiment (Explosive Ordnance Disposal) (Volunteers), the following squadrons:

579 Explosive Ordnance Disposal Squadron
583 Explosive Ordnance Disposal Squadron
590 Explosive Ordnance Disposal Squadron
591 Explosive Ordnance Disposal Squadron

August 1988 Journal Awards

THE Publications Committee announces the following awards for articles of special merit published in the August 1988 *Journal*:

TO SPLIT OR NOT TO SPLIT by Major D W Taylor, **£75**
IMPACT MOLING: AN INTRODUCTION by Second Lieutenant R A C Stephens, **£40**
ENGINEER OPERATIONS OUT OF AREA by Lieut Colonel I D T McGill, **£25**
2001 — AN ENGINEER SUPPORT ODYSSEY by Major A D Thompson, **£25**

The Royal Engineers Specialist Advisory Team (V)

COLONEL E P F ROSE TD, MA, DPHIL, FGS, MIWEM

Dr Ted Rose joined the Engineer Specialist Pool (ESP) in 1969, after service in the Oxford University Officer Training Contingent (Pool of Subalterns), Q Battery 299 Field Regiment Royal Artillery (Territorial Army) (The Queen's Own Oxfordshire Hussars), and the Oxfordshire Territorials (Oxfordshire Rifles). He became Commander ESP in 1987, and was retitled Commander RESAT in 1988. He is a Senior Lecturer in Geology at Royal Holloway and Bedford New College (University of London).

ON 1 March 1988 the Engineer Specialist Pool of Officers effectively acquired a new name and status. It became the Royal Engineers Specialist Advisory Team and potentially able to mobilize as a formed unit. RESAT is part of the Territorial Army, one of the Specialist Units RE under command of Central Volunteer Headquarters RE at Minley Manor, near Camberley. Those familiar with the Territorial Army will know that the TA contains units of two types:

- Independent Units, which are based on local training centres, recruit locally, and have a training commitment which includes weekly evening training;
- Specialist Units (called Sponsored Units until renamed in 1987), which are based on a central headquarters, recruit nationally, and have no week-night training commitment.

Since the RE Specialist Advisory Team is one of the Specialist Units, its members consider themselves to be very "special" indeed.

The role of the Team in peace and war is to provide highly qualified specialists in a wide range of engineering or engineering-related skills, principally those skills which do not exist at all, or exist only in small numbers, in the Regular Army. The Team provides individual specialists to fill war appointments in Germany; it also provides specialists to support operational tasks world-wide for the Army, Royal Air Force, and even the Royal Navy, normally in close association with officers from the Military Works Force at Chilwell.

To reflect the necessary high level of expertise and experience, the Team is rank-heavy: one colonel, four lieutenant-colonels, five majors, six captains. Their range of expertise varies with officers actually in post but broadly groups into four categories: building and civil engineering (but with emphasis on the disciplines which are outside the mainstream sapper officer career pattern, such as railway engineering, water engineering and quantity surveying); mechanical engineering (including petroleum and port engineering); electrical engineering (including power systems, transmission and distribution); and engineering geology. All officers are appointed to the Team because of their ability to utilize their civilian engineering expertise in a military context. In

Colonel E P F Rose TD
The RE specialist Advisory Team

consequence, their minimum annual TA training commitment is low: to average only 15 days' service (continuous or otherwise), with two or three military training weekends, and the obligation to pass annual proficiency tests in first aid and NBC, a basic fitness test, and an annual personal weapon test. However, in practice, officers appointed to RESAT either have STRE experience or have served with other TA or Regular Army units, often extensively, and have the enthusiasm to more than meet their basic commitments. A high standard of military as well as technical competence is required.

The RE *Journal* has already been used to advertise the availability of geologists (see articles by Rose, 1978a,b; 1980a,b; Rosenbaum 1985). The success of this publicity is evidenced by cryptic references to work of RE geologists in other sapper publications (such as the Falkland Islands Briefing Map) and by requests for geological assistance annually received from a wide variety of service agencies, to undertake tasks widely located in UK and overseas. The purpose of this note is to emphasize that RESAT contains many specialist skills in addition to geology.

Two current RESAT officers run their own consulting engineering companies; one is managing director of a major contracting company; several are employed as senior engineers by UK local government or by major engineering companies; one is a petroleum company geophysicist; others include academic staff in major university departments. All provide expertise that would normally command substantial fees from civilian clients.

RESAT officers, as individuals of senior consultant status, provide expertise complementary to that of the Specialist Teams Royal Engineers (both Regular and Territorial Army) who provide all-ranks expertise in building and construction works, bulk petroleum engineering, railway construction, and well-drilling/water development. As officers on the TA Active List, they are available (through tasking by CVHQRE, MWF or Engr 5) to provide expertise on site to an extent not normally expected of specialists in the Engineer & Transport Staff Corps (V). For specialist engineering consultancy advice, RESAT is therefore a new name worth remembering.

Rose, EPF 1978a Engineering Geology and the Royal Engineers. *Journal*, 92, p38-44.

Rose, EPF 1978b Geology in War. *Journal*, 92, p182-190.

Rose, EPF 1980a German Military Geologists in the Second World War. *Journal*, 94, p14-16.

Rose, EPF 1980b Military Engineering Geology. *The British Geologist*, 6, p10-13.

Rosenbaum, MS 1985 Engineering Geology related to Military Quarrying at Stanley. *Journal*, 99, p26-33.

Memoirs

BRIGADIER W M INGLIS CBE

Born 20 January 1915, died 22 April 1988 aged 73

'JOE' INGLIS, whose real Christian name was Murray, was a truly great and admirable character of whom the Corps has every reason to be proud. He was born in Scotland but spent his early youth in Johannesburg where his father was working as an engineer and it was because of his time there that he acquired the nickname which was to stay with him all his life. In 1928 he came back to school at Rugby where he distinguished himself as an all-rounder, doing well academically and becoming head of his house and captain of the rugger and swimming teams. In 1933 he passed second into the RMA Woolwich. His strong character and his natural presence and authority, allied to his personal popularity (among his many talents he played the piano well) made him the undisputed choice for SUO and the Sword of Honour in 1934. Commissioned into the Royal Engineers in 1935 he went up to Clare College, Cambridge, where he got his rugger blue, being selected to play for Scotland in 1937 and again in 1938, the famous year when Scotland won the Grand Slam. In 1939 he married and shortly afterwards joined the BEF as a subaltern, being mentioned in dispatches for distinguished service during the retreat to Dunkirk. Like many others he spent the next three years in a variety of training jobs, tasks for which his intelligence and enthusiasm particularly suited him, and it was not until late 1944 that he again saw active service as a Sapper major in NW Europe, being wounded at the Rhine crossing in 1945.

There followed the Staff College, a spell in the Middle East and then four years as an instructor and company commander at the RMA Sandhurst. Staff jobs in Washington, Northag and the MOD followed before a very happy time with his wife for two and a half years as Military Attaché in Rome where, with his fine presence and his fluency in German, French and Italian, he made a notable impression. After this came three years as CE Northern Command and finally three years as Commandant of the RSME. His very successful tour in this job, for which he was admirably suited, included a well arranged Royal visit and earned him the CBE.

So much for the bones of his career but the flesh on the bones was that of a very remarkable man. Joe was wonderfully good company, widely read and with an acute sense of humour, always full of stimulating ideas and ready to argue and burst into roars of laughter on almost any subject. Although blessed with many talents and a natural gift for leadership he was fundamentally a modest, sensitive and warm-hearted person who had a deep and genuine interest in people of all kinds. His friends can recall many examples of his kindness and the trouble he took all his life to help and encourage not only those he knew well but anyone he came across who was in difficulty. A large and very athletic man, he played many games well but his great love was rugger and the game, and those who played it, were a lifelong interest to him. Had not the war intervened he himself might have reached even greater heights; as it was he enjoyed coaching and encouraging younger players.

He loved music, a taste he shared with his first wife Moira Macintyre, whom he married when

Brigadier W M Ingles

he was twenty-four. 'Early' marriages were officially frowned on in the Army in those days but Joe was always one to do what he thought sensible however great the opposition. Moira died in 1972 bringing to an end a very happy marriage. To the delight of his friends Joe then married as his second wife Lola Lumb, whose family had been close friends for many years, and was again fortunate to make a splendid match. He kept up with his many friends to the end and bore with great courage a painful and disfiguring illness, only made bearable by the devotion of his wife. He leaves two sons and a daughter by his first wife.

JHSB WBJA DLGB RJA FRB IHLG

LIEUT COLONEL R E BLACK DSO BA

Born 3 November 1906, died 13 May 1988 aged 81

Lieut Colonel R E Black DSO BA

RICHARD BLACK's life was one of Service to his Country and to his Fellow Men. He was a great sportsman and a keen countryman, who made the most of life in every way, and was respected and loved by everyone with whom he came in contact.

Born in Calcutta, where his father was in the Indian Medical Service, his original ambition was to serve his Country in the Navy, and so he started his education at Osborne and Dartmouth where he was, as one would expect of a popular cadet, well above average both educationally and at games. However it was found that his eyesight was not up to the very high standards required, so the Navy lost — and the Army gained — a first class officer and he continued his training at the RMA Woolwich, was commissioned into the Royal Engineers and then took an honours degree in Engineering. The Army also gained a Rugby player of distinction.

As a young sapper officer he then saw pre-war service in Malaya and in England, and went to France at the very outset of the war with the BEF. He returned via Dunkirk, being Mentioned in Despatches for his efforts in helping other men into the many small boats during the evacuation without regard for his own safety. He was back in France again on D + 1 commanding the equivalent of an engineer regiment, and having again been Mentioned in Despatches for his work in Normandy, he was awarded the DSO for his part in the Arnhem campaign and in building one of the first bridges over the Rhine. The Belgians also awarded him their Croix de Guerre and made him a Chevalier of the Order of Leopold, for his part in the liberation of their country. After the war ended, he spent some time in Germany running a vocational training scheme and as the Chief Instructor of the Engineer Training Establishment, which of course fulfilled his great interest in training and educating young people.

Although he was obviously destined for higher appointments he retired in 1950 in order to take over the management of the family property in Milstead, Kent. In 1954 he joined the staff at Welbeck College, in Nottinghamshire, as an assistant master teaching mainly applied mathematics. At that stage Welbeck was only a year old and he contributed strongly to its early development. His practical approach and full involvement in the life of the College enabled him to inspire many young men, while his modesty left them oblivious of his distinguished war record. He returned to his home in 1960 and will be particularly remembered there for his interest in the welfare of ex-servicemen. Richard was a staunch supporter of the local branch of the Royal Engineers Association, and in 1961 joined the Committee of the Forces Help Society and Lord Robert's Workshops, becoming its enthusiastic and dedicated chairman for a number of years. The

Society has a countrywide organisation for giving help and assistance to ex-servicemen in need, homes and cottages for single and married ex-servicemen, and also a number of workshops for the training and employment of disabled ex-servicemen; Richard was tireless in seeing that our ex-servicemen were well and properly looked after. As HGWH commented "I should know, having served with him in France and seen him often after he retired, he invited me to follow in his footsteps on the committee and later as Chairman of the Society."

It is probably as a countryman and sportsman that he would, like to be remembered. He was an active member of the Country Landowners' Association and the Royal Forestry Society to whose journal he contributed his interest in and profound knowledge of trees. He was a keen horseman and his proudest achievement in this field was to be Master of Foxhounds with the Tickham Hunt. He was a good shot, a keen fisherman and an enthusiastic skier and golfer. He was always amusing and cheerful, a great sporting companion to his many friends and a man who made the most of the life that God gave him. We should all be grateful for that life.

HGWH NHT JEW

Memoirs in Brief

Brief Memoirs are published below on a number of distinguished men whose deaths have been notified recently in the national press and who served in the Royal Engineers at some stage in their careers.

SIR WILLIAM KININMONTH, died in August 1988, aged 83; distinguished architect whose work was regarded as "firmly rooted in the Scottish tradition"; past President of the Royal Scottish Academy. Served in the Corps in World War II as a captain.

HUBERT JOHN KING, CBE, died in June 1988, aged 73; Emeritus Professor of Mining, Nottingham University. Began working life aged 15 as assistant to collier down a Welsh mine and became academic by way of evening classes. Served Royal Artillery and Royal Engineers during 1939-45 War.

LEONARD KENT, died in July 1988, aged 78; served in 1939-45 War designing and commanding anti-gas laboratories in many different theatres. After the War he played a crucial role setting up the Microbiological Research Establishment at Porton rising to be its Deputy Director.

BERNARD ASHWELL MC, died in August 1988, aged 79; served in the Corps in World War II. He won the MC for actions destroying petrol dumps behind enemy lines and the American Legion of Merit for carrying out hazardous air surveys of airfields after DDay. He was Architect to Gloucester Cathedral from 1960 to 1985 and was a recognised expert on cathedral architecture.

TWO FORCES TO BE RECKONED WITH.

AWD

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Correspondence

Irregular Thoughts

From Brig J H Hooper OBE

Sir, — The letter in the August issue of The *Journal* from the trio of extremely well qualified TA officers concerning technical expertise in the Territorial Army has stirred me into action — no mean feat. I am now serving my fourth tour with the TA (Adjt of 131 Para Engr Regt, BM of 44 Para Bde, Deputy Commander Wales and thus responsible for TA units in Wales and now Joint Honorary Colonel of R Mon RE (Militia)).

In 131 Regiment we had a strength of over 800 in 1956/58. The Brigade units were nearly all recruited to around at least 80% of establishment in my time in 44 Brigade. The usual cry from non-airborne units was "It's alright for you — the red beret recruits automatically" or words to that effect. It was, of course, a reasonable observation. The real point is that although the red beret might have attracted the potential recruit in the first place it was the activity once in the unit that kept him in.

It seemed to me then that the harder we drove and the more we demanded in terms of effort and guts the happier everyone was. If recruiting or attendances dropped off we turned up the burners and demanded more effort and that along with dismissing the worst attenders on regular periodic weed-outs seemed to do the trick.

The rules and requirements have changed since the fifties and sixties; the Regular Army support to units is vastly increased; but I doubt if volunteers have changed. They were, and still are, wonderful people looking for a challenging, demanding and worthwhile addition to their normal life. I rather wonder, as do my erudite friends in 71 (Scottish) Engineer Regiment (Volunteers), whether we make the best use of the wealth of talent available to the general defence effort or appreciate what a valuable resource we have. One thing I do know is that the average hero I have bumped into in my years in the TA is not looking for a "busman's holiday". There's not much joy in welding for 50 weeks of the year and then doing another two weeks welding at camp. Of course, there are exceptions. A REME unit for example usually has a large number of volunteers in it who do in fact get a "busman's holiday" at camp. Many other units, medical and indeed ourselves necessarily recruit to a trade requirement.

We once took the whole TA Parachute Brigade to Cyprus for camp one year. We ran Company Test Exercises for sixteen all arms company groups over a period of four weeks (two battalions + half the Gunners and half the Sappers for two weeks and the other two battalions for the next two weeks). We used about half of each of the logistic units to activate the Cyprus stock-pile and half to reconstitute it and to administer the whole two months of activity, (two weeks build up, four weeks exercises, two weeks clear up).

The "busman's holiday" of the logisticians made the whole thing possible but we did not keep volunteers in REME and other logistic units by too much of that sort of thing — there had to be other attractions and we provided them.

In the Regular Army I believe one can achieve wonders with soldiers who are happy, fit, well disciplined and complete masters of the absolutely basic skills. Many problems derive from the fact that soldiers (and indeed officers) have not mastered the basic skills. There seems to be no shortage of young officers prepared to discuss divisional level tactics but far fewer who show the same enthusiasm for discussing the problems of section and platoon activities.

However in the TA unit there is so much knowledge available to resolve the more complex matters that you can afford to have a very good time keeping fit and well disciplined and banging home the basics. There's a wealth of really high level technical expertise available for the relatively few occasions that it is needed. So let's keep it simple.

I have seen training directives from pretty senior officers (who should know better) which are mind-boggling in their complexity and if it were possible to carry them out in their entirety (which I doubt in most cases) it would prohibit any fun at all. And TA must be fun!! There seems to be a lack of appreciation that even two TA battalions of the same Regiment can differ widely in temperament, background and enthusiasm. A brigade training

directive will not necessarily have the required effect if applied without allowing for this.

Now to return to our erudite trio. It may well be that there are a lot of highly qualified officers who are so enthusiastic about their disciplines that it is sheer bliss for them to apply their specialist knowledge to related problems in the defence sphere. It seems silly not to cash in on this — the problem lies in finding tasks which can be addressed almost in isolation, which are capable of resolution in two weeks or can be rendered into two week chunks to be dealt with by a series of like minded soldier-citizens. Doubtless such problems exist and hopefully someone will tumble to the virtually untapped reservoir of expertise in the TA. However I suggest that in general TA officers render the greatest value to the defence effort by forming a vital part of a happy, fit and well disciplined team ready to tackle just about any task that may come its way. The crucial requirement is to get these well qualified chaps into the unit and keep them there and one must never lose sight of that.

In many ways a TA unit is better prepared to cope with a future conflict than a regular unit. How do you train for an unknown form of conflict? Let's not train for the last war! There is this huge reservoir of diverse talent that a regular unit lacks. Having heard many tales from an uncle of mine who went from subaltern troop commander to company commander with the same RE TA company in the early part of World War II it seems his and the company's bacon was saved time and time again by just happening to have one man in the unit who had the requisite skill or knowledge from his civilian job — even a coffin maker! It saddened me when National Service ceased as we lost the leavening of other disciplines in our units. The cross-fertilisation of ideas from people who were not "military" never intended to be "military" but were certainly going to enjoy their military tour was invaluable in my view. The TA officer can still provide this invaluable "other way of seeing things" and the Regular officer would be well advised to take full advantage of it. Whatever the problem, provided one person in the unit has a good idea of how to deal with it, the well disciplined, fit, basically well trained unit can resolve it.

To sum up all this rambling, my advice would be "get them in, keep them in by keeping them happy and listen to what they have to say no matter how outrageous it may seem at first". The greatest joy I had as a young regular officer serving alongside TA was to watch senior TA officers throwing the book away when it made little sense. One of the saddest things I have seen happening is the TA becoming too concerned with the book!

Let's hope we never stifle our "irregulars" by leading them to believe that "better brains" have the best answers. We should create and maintain an environment in which the wealth of diverse TA talent can be exploited to the full.—Yours faithfully, J H Hooper. *Great Osbaston, Monmouth, Gwent, NP5 4BB.*

TUNNELLERS

From: Mr Harry S Raymond (Ex Mechanist Electrician)

Sir, — I enjoyed reading the article (*Journal* Aug 88) about the mining and demolitions in 1916-17 on the Western Front. The account does not match up with that shown in ME Vol IV *Mining and Demolition* for there is no mention of gun cotton being used.

I think it was in 1916 that the top of Hill 60 was blown off.

In 1916 there was a system of tunnels excavated at Darland Banks and this exercise was supposed to be a mock-up of what was going to happen at Hill 60.

Three of us sappers had finished our Fieldwork course and were employed on general duties. We were electricians and were given the job of wiring up for telephone communication among the tunnels.

As far as I remember there was a control telephone which could connect with two other points in the system. To arrange this we required an intermediate switch (the type illustrated in Vol I *Telegraphy and Telephony*). So I approached the field works instructor and asked for an intermediate switch.

He blew up somewhat and said "you get no expensive switches for that job, the whole lot will be blown up. You must use your wits and improvise". Well we did improvise with some nails for contacts and a cleaned up strip of hoof iron for a switch arm, we rigged up a switch that did the job, so the use of an expensive switch was not needed.

And I shall always remember the FWIs instruction "improvise, use your wits". This I

think makes the Corps a Technical Corps as there must have been many situations where problems had to be solved by improvisation. — Yours faithfully, Harry S Raymond, *55 Limbury Road, Luton, LU3 2PJ.*

Military Trains

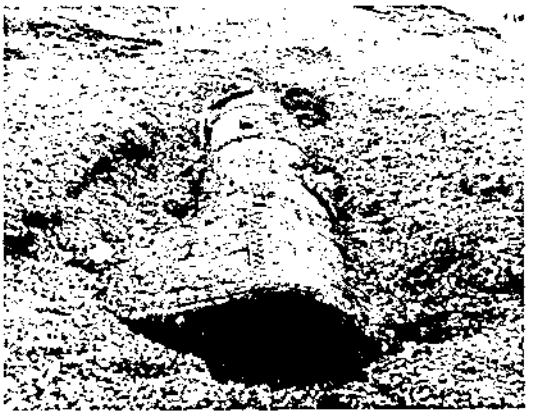
From William E J Parker Esq

Sir, — I am trying to research the old military train which ran from Fort Blockhouse along the Haslar seawall to Fort Monkton, then down the road to Fort Gilkicker and along the beach to Stokes Bay pier.

The railway line was built in the 1880s by the Royal Engineers who were stationed at Fort Blockhouse. Later the Royal Navy took over the railway which was abandoned around 1920.

The photograph depicted is of a locomotive which used the railway line. It was excavated by the Royal Corps of Transport in 1960 and I took the photograph at that time.

I would be very grateful for any information about the train or the use of the line, documents or photographs or any contact with individuals who might have personal recollections. — Yours sincerely, William Parker, *Flat 42, Hamble Road, Gosport, Hampshire, PO12 3RJ.*



Reviews

THE DAY THOU GAVEST!
A E TAPLIN

(Published by Merlin Books Ltd — Price £5.95 ISBN 0 86303 379 2)

THE author of this set of reminiscences was commissioned with the Regular Army as an ordnance mechanical engineer but appears to have served in the Corps, at some stage as well, before taking up a successful post-war civilian career as an engineer in South America and the West Indies. He had an adventurous war having been at Dunkirk, the Western Desert (including Tobruk and Alamein), elsewhere in the Middle East and in Germany. The stories are short, colourful, personal tales which should appeal particularly to anybody who has lived through the times or knows the area he describes.

GWAN

CABLE-STAYED BRIDGES
M S Troitsky

(Published by Blackwell Scientific Publications Ltd — Price £45.00 ISBN 0 632 02041 5)

DR M S Troitsky, Professor of Engineering at Concordia University, Montreal, Canada, is one of the world's leading authorities on cable-stayed bridges and as Chief Bridge Engineer with one of the leading Canadian firms of Consulting Engineers, has been responsible for directing and supervising the design of a number of major steel bridges in Canada. He is the author of a number of books and articles on structural engineering subjects and in this second edition of his book, which was first published in 1977, he has taken the opportunity to include details of a number of the latest bridges built in North America and Europe.

In the first chapter he reviews the cable-stayed bridge system and then follows with chapters on typical steel, concrete and composite bridges. These well written chapters are very readable and excellently illustrated with photographs and line drawings of many famous bridges throughout the world. A chapter dealing with structural details follows and then the second half of the book deals with structural analysis, using approximate and exact methods, including two computerised design methods. The book finishes with chapters on model analysis and aerodynamic stability. The book is author- and subject-indexed and each chapter includes an extensive list of references.

The book will serve as an up-to-date handbook for structural and bridge engineers but the second half, dealing with methods of analysis, is not for the faint-hearted.

JHJ

HOLDING THE LINE
KEN HECHLER

(For sale by the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 — Price $4.50, Stock number 008-022-00247-2)

HOLDING the Line is a military publication written as a teaching tool to show how a unit which keeps its nerve can bring some order to the confusion of an enemy breakthrough.

The 51st Engineer Combat Battalion was a unit of the US Army in Northern Europe in 1944. Most of its members had been together for some two and a half years and overseas for one year. At the start of the Battle of the Bulge in December 1944, the 51st was operating sawmills in the Ardennes forests. Although short of front line experience, one company (having collected a stray anti-tank gun detachment and other stragglers) held off the enemy from a communications centre called Trois Ponts for three days, while the rest of the battalion established a 25 mile obstacle line and defended an important bridge over the River Ourthe. The battalion was awarded the Presidential Unit Citation and the French Croix de Guerre with Silver Star. A good illustration of its high morale was the greeting at Trois Ponts to a reinforcing Parachute Infantry Regiment "I'll bet you fellows are glad we're here".

As a military publication, the print is in typescript; sketch maps are clear but the reprints of military mapping are difficult to read. The text gives much detail of individual actions, it includes perhaps too many individual names for most readers. However for the military student, it is a

good example of what can be achieved with sound leadership in a well established unit to restore confidence and to stabilise defence. It also reflects well on the tradition of military engineers as versatile fighting sappers.

ITCW

THE BATTLE FOR CASSINO

(Video cassette produced by GMH Entertainments, 22 Monasty Road, Orton, Southgate, Peterborough, PE2 0UP, colour: Sepia, duration: 50 minutes, price £9.00, from the Publishers).

THIS tape was produced from authentic Allied and Axis sources. Interviews with a number of officers, including Field Marshal Lord Harding, illuminate the factual commentary covering the Italian campaign from the Gustav Line to Rome, in particular the four Cassino battles and Anzio. It covers the controversial bombing of the Monastery, ('D-Day dodgers' at the sharp end knew that the 'All Seeing Eye' must be blinded or destroyed).

The tape shows how uncoordinated air and ground attacks were a deciding factor during the early battles but the lack of battle maps leaves the viewer confused. The planned pincer movement by II Polish Corps (north) and XIII Corps (south) to pinch out the Monastery and town has not been mentioned; nor that the full fruits of the breakout from Anzio were lost due to General Clarke's disobedience of orders. (As Churchill wrote to Alexander "It is the cop which counts".) Some mistakes are quoted and insufficient credit given to the way the Allies locked up 20% of the German war effort in the south when it was sorely needed elsewhere. Nevertheless the tape is well worth viewing and good value.

TMJOR

WAR IN THE DESERT - TUNISIAN VICTORY

(Video cassette produced by GMH Entertainments, 22 Monasty Road, Orton, Southgate, Peterborough, PE2 0UP, colour: black and white, duration: 90 minutes, price £9.00, from the Publishers).

THE tape shows how the decision to mount Operation TORCH (not ACROBAT as stated in the tape) was taken on 18 June 1942 by the Allied leaders at a time when our fortunes were at their lowest ebb. Clear precise maps illustrate Allied and Axis movements and intentions as the plan and campaign unfolds. All aspects are portrayed in scene flashes of training, production of material and troop movements over immense distances by land, sea and air to the landing points; the invasion, the bold bid to capture Tunis and Rommel's reaction; the battles of the Mareth Line and Wadi Akarit and the final battle. The dual commentary interspersed with comments by soldiers George Metcalfe a greengrocer, and Joe Macadam from Kansas City is well done. Scenes of the Axis surrender which were unbelievable at the time compensate for the sparing use of formation titles. The tape is well worth a view and good value to buy.

TMJOR

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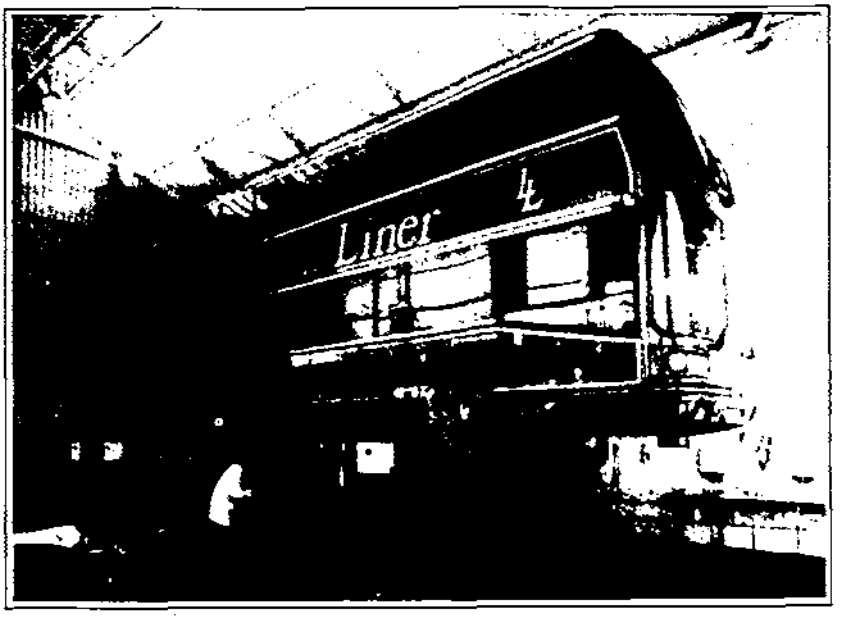

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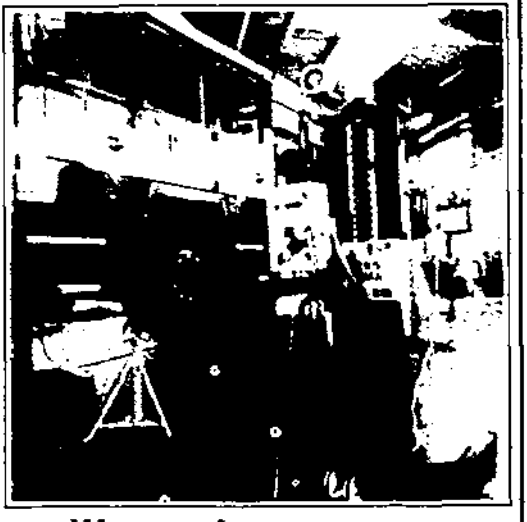

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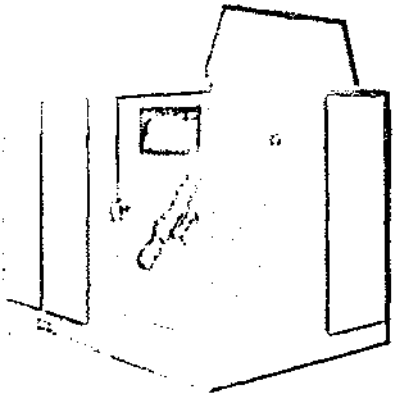

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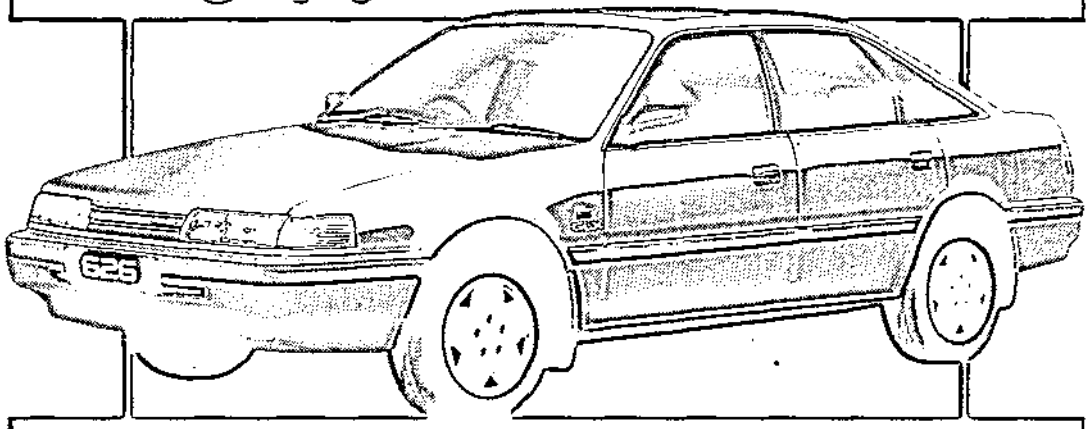

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