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Contents

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A Representation Not Amounting to a Complaint!!

RSME Open Day, Veterans Weekend and the Annual Memorial Service in Rochester Cathedral, 1983 were as successful as ever despite rather inclement weather. The "Chatham" Weekend is still a marvellous opportunity to meet both young and old. It produces a marvellous fund of stories:

"We always called the CO *February*, every time we were marched in front of him we got twenty-eight days"

"We were told to stop calling the Falkland Islanders *Bennies* [after the TV character in Crossroads who favours the same type of woolly hat as that worn by the Falklanders during the winter] so we called them *Stills*, as they were still Bennies to us"

This rather flippant opening is the result of a *Representation* that the RE Journal is getting too serious and too technical and less readable. The Editor was assured that this did not amount to a *Complaint* but that Members would welcome more readable articles of general interest! Being a delicately nurtured flower from the North and an extremely sensitive person (as all who know him are well aware!) he was a little miffed.

It is the Editor's belief that the problem lies not with the subjects of the articles but with the style of presentation. It may well be that some articles were not written for the journal—they may well have been written for another purpose, eg. a Trials Report, a Recce Report or a COs Winter Essay, and that the style was not aimed at readers looking for readability but was concerned more with dispassionately presented facts and opinions! It may be that some Authors are convinced that they are readable! It may be that some readers are not making sufficient effort to enjoy the articles! It may be that the Editor's judgement has been dulled over a period of reading dull articles! No matter what the cause we can only publish articles which are submitted.

There can be no doubt that an injection of articles from younger members would be of benefit to all.

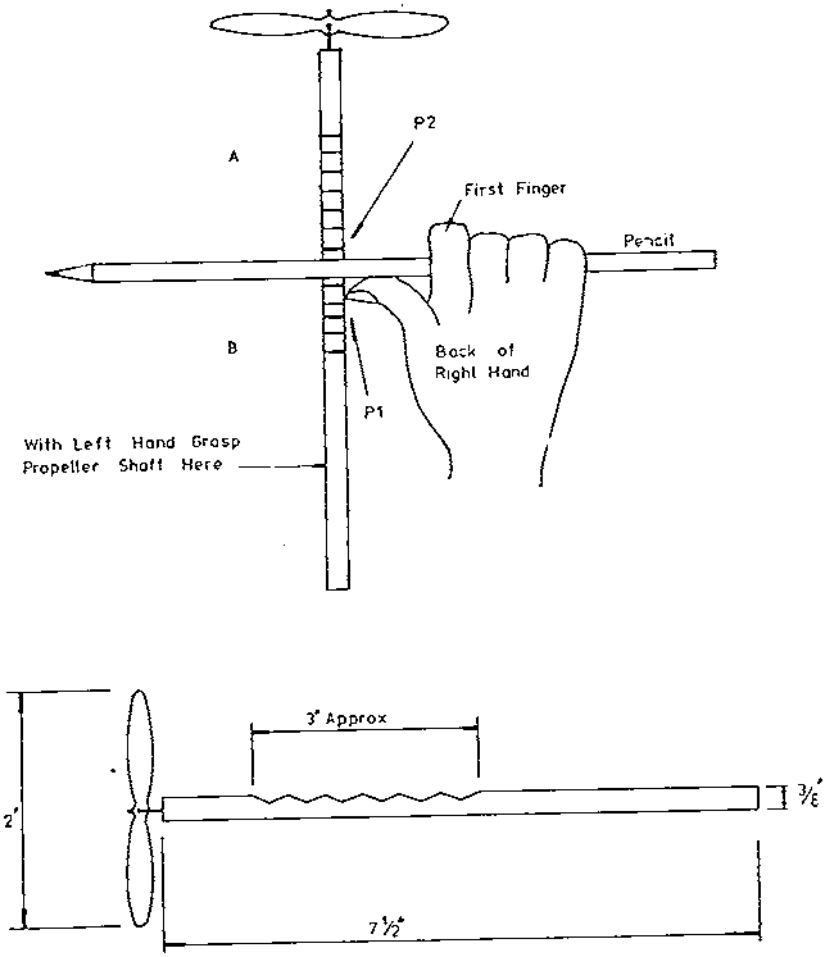
Curious Toys for Curious People

BRIGADIER SIR MARK HENNIKER Bt, CBE, DSO, MC, DL

I. The Magic Propeller

IF you have ever ridden a motorcycle or driven a motor mower, you cannot fail to have observed that a nut which is loose on its bolt will always tend to come unscrewed. The reason why it unscrews itself, rather than screwing itself up, we are most of us content to attribute to the natural cussedness of inanimate objects; but experiments with the *Magic Propeller* lead me to suspect that there may be more to it than meets the eye. Let me therefore begin by explaining the Magic Propeller.

The device was brought to my notice at an "old boys' day" by a man who was more or less a contemporary of mine at school. He called it a *Snorrewieltje*, which he claims can be interpreted by anyone who knows the Dutch language. He first saw it in Holland at the end of World War II. (He served as a temporary soldier in REME; and it was one of his NCOs who induced a Dutch child to swap it for some British sweets. He, the NCO, then kept his Officers happily contented, till demob carried all of them home). As I know no Dutch I prefer to call it the Magic Propeller; though a Dutch dictionary suggests that the words *vibration* and *spinning* may be relevant.



Sketch No 1. The Magic Propeller

Sketch No 1 shows the idea. The propeller is 2in in diameter, and I make them from pieces of sheet plastic, about ⅛in thick. (I have had to make so many that I had to persuade a retired tool-maker to make me a special stamp, enabling me to go into mass production). Research has revealed that the shape of the propeller is immaterial; anything will do, from a circular piece of flat tinplate, to a thin piece of aluminium shaped like a matchstick. That is presumably why any nut on the motor mower revolves so merrily. The only conditions appear to be that, first, the propeller must be correctly balanced; and secondly that the hole at its centre must be amply large for the pin that secures it; but not so large that the pin's head may allow the spinning propeller to come off.

The main propeller support is made from a piece of dowel wood, 7½in long, and the same diameter as a kitchen wooden spoon, or a washing-up mop handle—say ⅜in diameter. It must have anything from ten to fifteen notches cut in it between Points A and B as shown in Sketch No 1. It does not seem to make much difference what shape notches you cut. They may be regular "vees", with each side sloped; or you may cut one side of the notch vertically (as it were) with a saw, and slope the other side to meet the saw-cut with a knife. There must be three or four notches to

Photo 1. The Magic Propeller. A Pass Degree method!

the inch. To make the propeller spin, all you need do is to stroke it with a pencil. That is where the trick lies.

You must hold the propeller shaft horizontally; and you must lay the pencil horizontally across the notches and at right angles to the wooden shaft. You then stroke it gently, to and fro, from A to B. It makes no difference whether you start from A or from B; and it is no use getting cross and scratching harder. If you are looking for first class honours you must learn to hold the device correctly; though some, who are content with a pass degree, can get away with it even when the wooden shaft is held horizontally in a vice (Photo 1). When, however, I give lessons to Doctors of Philosophy—or to grandchildren—I always advise a grip similar to that shown in Sketch No 1. Suppose you are right-handed, you must hold the propeller shaft in the left hand, and the pencil in the other. Then—and here comes the magic—there are alternative grips for the right hand. Either you may hold the pencil, as illustrated; with the thumb in contact with the pencil and also touching the propeller shaft at Point P_1, or you may withdraw the thumb to a subordinate position, and advance the first or fore-finger, so that its first joint presses against the wooden shaft at Point P_2. This change of role by the thumb and the fore-finger is what causes the propeller to reverse its circular motion: clockwise for the thumb, and counter-clockwise for the joint of the fore-finger. This is what gets full marks.

For a suitable honorarium I would be prepared to give lessons in Magic to Fellows of the Royal Society. Not unnaturally, perhaps, there have been no takers so far.

II. The Cartesian Diver

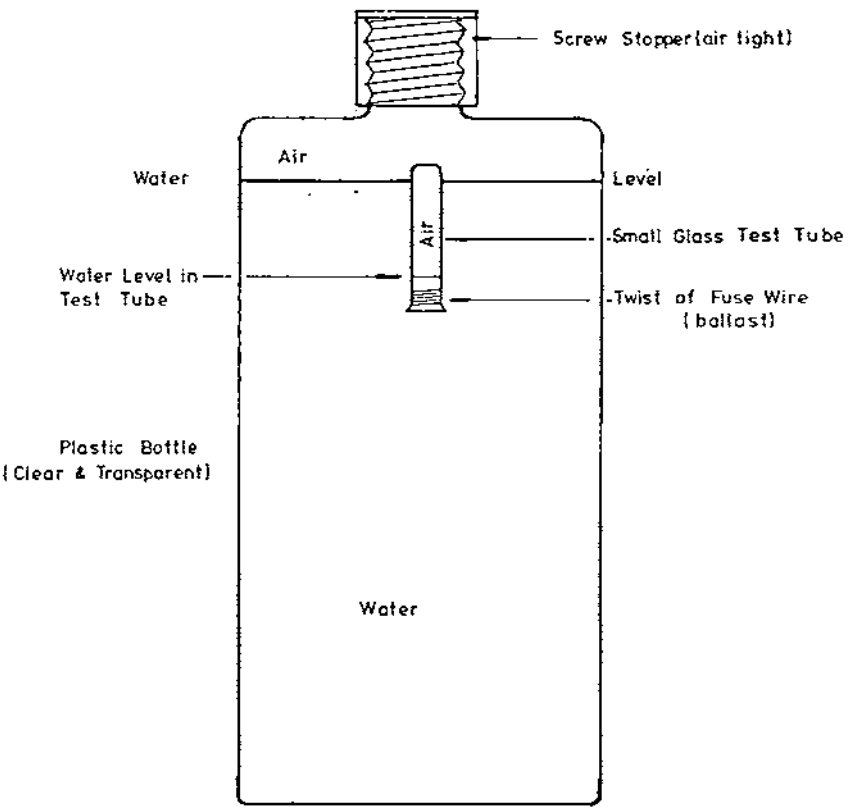
My next curious toy I really thought I had invented myself—till my wife told me that one of her brothers possessed one like it over sixty years ago. Then searching (but without success) for something quite different in an Engineering Dictionary, I stumbled on the fact that Descartes (born 1596) had been there before us both. According to the Dictionary, the device is termed a *Cartesian Diver*. But whereas it is difficult to blow a glass diver, such as is illustrated in Photo 2, there is no difficulty in making the whole device with everyday objects. I depict it in plain clothes in Sketch No 2. It illustrates principles attributed to Archimedes and codified in Boyle's Law, and possibly by Pascal too; though he seldom gets a mention in the labs as far as I know. Such are the vagaries of scientific research.

Curious Toys For Curious People 1

Now look at Sketch No 2. Here you see a small test tube, 3in long and ¼in diameter, floating, bottom uppermost, in a bottle of water. A twist or two of lead fuse wire acts as ballast to keep the test tube in a vertical posture. The pressure of the atmosphere forces a little water up the open end of the test tube, but mostly there is only air compressed within it. You might say, if the test tube were human, that it has its head only above water. But the outer bottle is made of clear, transparent, plastic material, and its orifice is closed by an air-tight, screwed cap. Being made of plastic, it is possible to compress the air in the space between the surface of the water and the cap of the bottle by squeezing the bottle with your fingers.

Those who know about Archimedes, Boyle and Pascal, will foresee at once that if you squeeze the plastic bottle, the increased pressure of the air in the bottle only transmits itself to the air in the test tube indirectly; that is, by forcing a little more water up into the lower, open, end of the test tube. The test tube, is now fuller of water than formerly, and it sinks to the bottom in consequence. When you release your pressure on the outside of the plastic bottle, the process is reversed. The air in the test tube expells a little water, and the test tube rises to the surface. *QED.*

It is, however, possible to find glass blowers who can still make glass divers, in more or less human shapes. (Most glass blowers do it for amusement when apprentices). The feet of the diver must be of thicker glass than the rest of the diver in order to ballast the body, so as to float vertically with only its head above water. It is customary to give the diver a diabolical (or mermaidenly) tail, of which the tip is open at the bottom. It thus has all the same responses as a test tube to the pressure



Sketch No 2. The Cartesian Diver

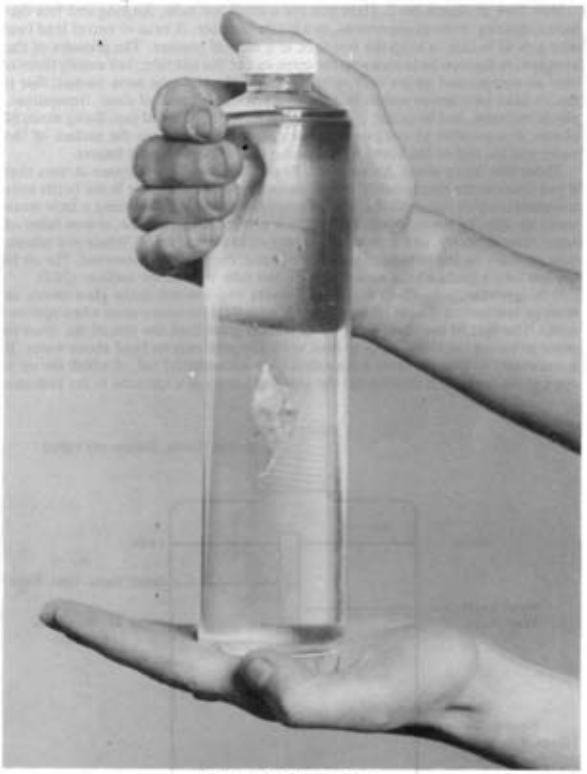


Photo 2. And down he goes!

of your fingers on the sides of the plastic bottle. Children and learned men, alike, are equally delighted.

POSTSCRIPT

It seems almost unbelievable, but I have found commercial outlets for both these toys. Specimens have even penetrated into America. I was sharing a taxi from my Club to Paddington with an interested Member; and I demonstrated both toys to him on the way. Leaving me his fare (he had to run for his train), the Cabby asked for a second demonstration on the pavement. He, too, was interested; and we settled for half the dual fare in exchange for the toys; but a third party was by then present—an American—wanting a taxi. He had also witnessed the tail end of the

Curious Toys For Curious People 2

demonstration and asked where, in the UK, could he purchase them? I told him to try the Cabby.

"I'll buy them from you," he said to the Cabby. "Will you sell?"

"What will you offer?" asked the Cabby.

"Twenty dollars," replied the American; and the deal was clinched. The Cabby winked at me as he pocketed the cash, and both Cabby and American drove away apparently delighted.

A New Design Course for Sappers at RMCS

J G HETHERINGTON MA; P D SMITH MA, M Sc, C Eng, MICE; *et al*

John Hetherington (left) and Peter Smith (right) have both been lecturers in the Civil Engineering Department at RMCS Shrivenham since 1976. They have been engaged on several topics of militarily relevant research including cross-country vehicle mobility and response of materials to blast and ballistic impact. Amongst their teaching responsibilities has been the development of a new Civil Engineering Design Course for Sapper undergraduates.

Foreword by Lieut Colonel M J Payne, RE, MA

Some readers may have seen the article by Professor Wood on the future of Civil Engineering at Shrivenham, in which he asked whether the Corps wanted to continue to send young officers for degree training at the Royal Military College of Science. Now that the Corps has given a hearteningly positive answer to that question, (and confirmed its previous position), I felt that it might be of interest to describe something of what those on the course do whilst at Shrivenham. The idea arose when I went round the design exhibition laid on by the third year Civil Engineer students who have recently graduated and have now been posted to squadrons and regiments around the world. The exhibition was an impressive display of engineering skills on the drawing board and in model form, eloquently expounded to the throng of military and academic visitors.

I decided to ask two members of the Civil Engineering Department, John Hetherington and Peter Smith, to explain the reasons behind the design element of the degree and two students to describe their designs. The projects undertaken were wide ranging and included a sports complex for the College, a commercial development at an adjacent disused barracks, and a battalion size camp for Northern Ireland. However, to illustrate the span of projects undertaken, we chose a

JG Hetherington MA, PD Smith MA M Sc C Eng MICE

multi-faith Chapel described by Lieutenant James Pennington and at the other extreme, Lieutenant Ian Sanderson's description of an Armco MILAN Emplacement.

Introduction by J G Hetherington and P D Smith

At its worst, Civil Engineering Design at undergraduate level can consist of a series of routine exercises which require the mechanical application of specified design code rules. Students can emerge from such an approach with little understanding of what they have been doing and with no appreciation of the interaction of one element with another. As a consequence they can end up being rather uninspired by the whole business of design.

When a restructuring of the RMCS Civil Engineering Degree undergraduate design course was proposed, it seemed that at every turn there was a constraint imposed by what may be termed the "need to know" criterion. As soon as some freedom and originality was mooted, some item had to be omitted and the quite legitimate criticism was raised that "you cannot let a Civil Engineering graduate loose on the world without his having designed a ———". The conclusion was that more time was needed and this would only come about by a new deal for design.

We considered that design needed to be recognised as both the core of and the inspiration behind a first degree course in Civil Engineering. Students should be encouraged to see design as the focus of their endeavours rather than a somewhat peripheral activity. Staff should see design as a joint responsibility and an opportunity to bind together their diverse inputs. We argued that since they could be asked to sacrifice about 15% of their current time allocation to create more room for design in the timetable, it should be in *their* interests to ensure they were adequately represented in the final design package.

The ground was prepared for the development of a new course in three important ways:

(1) The aims of the course were established:
   (a) to provide as complete an education as possible in the whole process of design
   (b) to inspire and motivate the student
   (c) to convey the complexity, interaction and coherence of real engineering design, and
   (d) to provide the unifying element in the CE Degree Course.

(2) A significant amount of time was allocated, particularly in the second and final years of the course, equivalent to one day per week throughout the year.

(3) Design was given a central role in the course and all members of staff were encouraged to contribute towards its success.

The New Course

Year 1

In this year students receive a total of just over fifty hours basic tuition in engineering drawing and graphic communication. There are also thirty hours of design work in which apart from designing simple elements subject to tensile, compressive, bending and shear loads, students also undertake two open-ended design exercises. The first of these is to design, build and test the lightest possible model bridge from balsa wood to carry a prescribed load. The second exercise involves the design of a grid of beams to support the first floor of a house. One valuable outcome of this task is that often the most economical design is unacceptable for other than engineering reasons: aesthetic considerations and construction problems may be the governing factors. Students are frequently shocked to realise that the final design choice must be moderated by personal judgement: a good lesson to learn early!

Year 2

In the second year about 180 hours are allocated to design in which mainstream design topics are covered by lectures, tutorials and design classes. Students become

familiar with design codes and individual lecturers seek to relate design code methods to the relevant theory met elsewhere in lectures.

Year 3

If the job has been done properly, students embarking on their final year are conversant with all aspects of individual element design. It is at this stage that the opportunity to launch students on an ambitious design project presents itself. It is a chance for the undergraduate Sapper officer to get to grips with a wide variety of problems some of which he will certainly have to tackle on his return to the Corps and some, while being outside the normal sphere of activity encountered in regimental duty, can provide a stiff test of the officer's ability to seek out, and apply effectively, new design techniques and construction methods.

Students are carefully paired and provided with a *scenario* conceived so as to provide scope for original conceptual design, engineering design of a range of elements and an appreciation of the problems of sequencing of construction, interaction of elements and costings. The projects are chosen such that students can visit, survey and if necessary make boreholes on the site. This aspect is important in creating an air of realism around the project and certainly provides a powerful motivation to students to optimise their designs and generally become involved with the whole process of design.

The first few weeks of the year are taken up with the students toying with general ideas of schemes for the project topic. This phase goes hand in hand with a series of lectures and tasks designed to ease both this conceptual phase of the design and provide further guidelines when the time comes for detailed designs to be formulated. At the end of this conceptual or architectural phase students present their ideas to a panel of two members of the academic staff. The role of this panel is twofold. Firstly, they behave as clients to whom the students convey their proposals and secondly they act as tutors throughout the year providing assistance where necessary. From the overall scheme the panel selects specific elements for detailed design chosen to be representative of the whole concept and to draw on a wide range of experience gained in Year 2.

Once this major element of the work is completed and presented in report form the students mount an exhibition of their designs where drawings and models of the schemes are displayed to an invited audience of both military and civil engineers, academics from universities and polytechnics as well as representatives from firms and local authorities (some of whom have been associated with particular projects). This has proved a most rewarding event where the young officers entertain their guests, enthusiastically describing and justifying their work.

Case Studies From 1983

To demonstrate how projects of both military and civilian relevance were conducted, students were invited to submit a brief résumé of their project, giving their impressions of the exercise. We have selected the following two.

"Chapel Royal" was a project to design a new multi-faith chapel complex for RMCS and was undertaken by Lieutenant J C Pennington RE and his partner, a civilian student Mr D J Barker.

"Static Defence", tackled by Lieutenants I A Sanderson RE and P J Shaw RE, was an exercise to design a rapidly-built hardened emplacement to cover an anti-tank obstacle.

(a) *Exercise "Chapel Royal". Lieutenant J C Pennington writes:*

"Having only just discovered that CP110 was not a telephone number, and that reinforcement was also a non-military term, I was perplexed, if not a little bemused, to discover that I, working with another student, was to design a "Multi-Faith Chapel". A brief *scenario* sheet—unusual if only for its lack of a Red Force with a propensity for Soviet tactics — laid down the conditions under which this ecclesiastical *pot-pourri* was to be constructed. It included the need to convert this place of worship into a Concert Hall when not otherwise occupied, and a need to

Photo 1. Chapel Royal—The Concept, by Lieutenant Pennington and Mr D J Barker. "Boring, badly drawn and barnlike"

ensure that the particular requirements of each faith's place of worship were met.

"The first part of the Design Exercise was the "Conceptual Phase". Although usually undertaken by a multi-talented architect, we were entrusted with this task, which involved deciding on the basic criteria to be satisfied (eg that all had access to toilets) and then "Brain Storming". This process involved three phases; (1) visualising possible shapes and their combination, (2) putting them down on paper, (3) deriding them, then starting again. When repeated frequently, indeed *ad nauseam*, this method finally produced a result which both withstood derision, and slipped past a feasibility test. We had two possible designs which were duly presented to our notional client, a thinly disguised member of the academic staff. Whilst he was not overwhelmed by the artistic merits of either concept—he dismissed one as "boring, badly drawn and barnlike"—he accepted the other, although pointing out one or two minor revisions necessary to avert a religious war!

"The first hurdle over, our scope was now limited, since there was only sufficient time to fully design certain areas. Both of us were allocated some aspect of the scheme to design, chosen to ensure we gained experience in both concrete and steel design. It was now that ideas dreamt up at the concept stage revealed their side effects, and a little design experience and ability had to go an extremely long way. However, after ten weeks or so of "number-crunching", drawing pens were sharpened and the drawing began. Since for many of us this was a first experience of ink-drawing, the results varied from the sublime to the illegible, but with practice (and deft use of the electric ink rubber) presentable drawings were soon flowing off the drawing board. Indeed, an iterative cycle developed between drawing and cal-

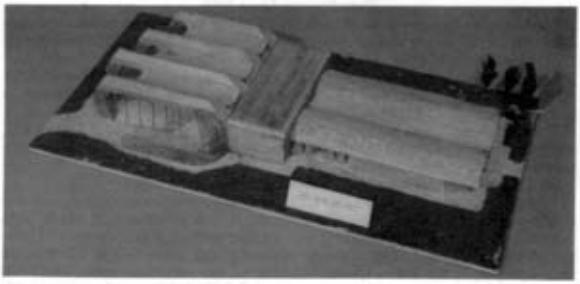


Photo 2. Chapel Royal—"The Hand of God"—a rival scheme, by Messrs K Bearder and C J Harding

A New Design Course For Sappers At RMCS 1,2

culations, with corrected errors revealing further blunders, until time finally called a halt. The big day had come: the Design Exhibition.

"If you can, imagine six months of endeavour crammed on to a 2 × 3 metre design board, albeit supplemented by a model, and you will appreciate the heartache that went into the planning of the layout. Several hours were spent writing captions and changing the arrangement, stepping back to admire then stepping forward in anguish. But, as the examiners examined in the morning and visitors visited in the afternoon we could confidently meet the gaze of enquirers, whilst reflecting on the lessons learnt.

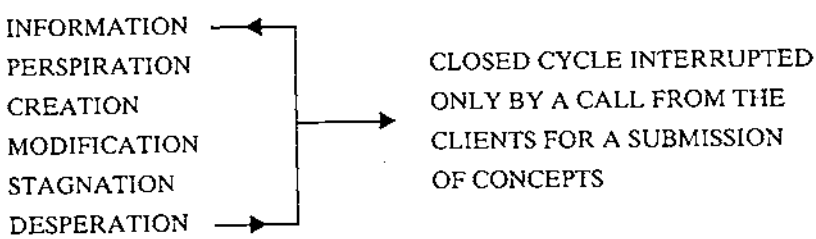
"Firstly, design is more complicated than a dogmatic following of the rules: a constant question and answer technique, whether vocal or merely internal musing, is the only way to achieve results. Secondly, to twist an old adage "If a job's not worth doing well, it's not worth doing". The project demanded a great deal of time, but to deny it sufficient effort would just have produced an embarrassing display. Thirdly, do not join a Civil Engineering Design Team! Just like beating your head against a brick wall, it was great to be able to stop. It does, however, seem strange not to be Chapel designing. Anybody want a Multi-Faith Chapel Designer?"

(b) *Exercise "Static Defence". Lieutenant I A Sanderson writes:*

"We came tripping gaily back from summer vacation last September, full of eager anticipation. After all, we were now Third Year Students, and we had a wonderful Design Project to look forward to. What wondrous, exotic structure would we be required to unleash our collective, creative genius upon? A multi-faith chapel? A leisure complex? A railway station? No. Not for us such castles in the air. Ours was to be a much more down-to-earth project entitled "Static Defence". Nary a hint of wit or amusement to be found in that title!

"Our brief was deceptively simple. "You are to design a hardened emplacement to cover an anti-tank obstacle and plan its construction during a period of warning before the outbreak of war." Consultation with our "clients" narrowed our options down by specifying the weapon as MILAN. Funnily enough, we had never considered using MILAN for a static emplacement before! Our first problem was in trying to obtain information on the characteristics of MILAN fired from enclosed spaces, and finally we were obliged to make some broad assumptions on back-blast and gas generation etc.

"The Conceptual Phase followed the path shown below:



"Towards the end of term, a date for a planning meeting was fixed by our clients, which spurred us to a short burst of creative activity. Several different variations on a theme of concrete bunkers were produced. As an afterthought, a version using Armco culvert sections was slipped in to thicken up the pile of suggestions. After Christmas vacation we received notification of our design tasks. Two concepts were chosen, both similar in that they comprised two firing posts connected by an accommodation/ammunition storage section. One was to be constructed of concrete by host nation contractors, and the other of Armco sections by Assault Pioneers.

"Since it was obvious that the concrete bunker involved much more work than the Armco one, we both designed parts of it, and then separately did the construction sequence and cascade planning. To increase speed of construction, high alu-

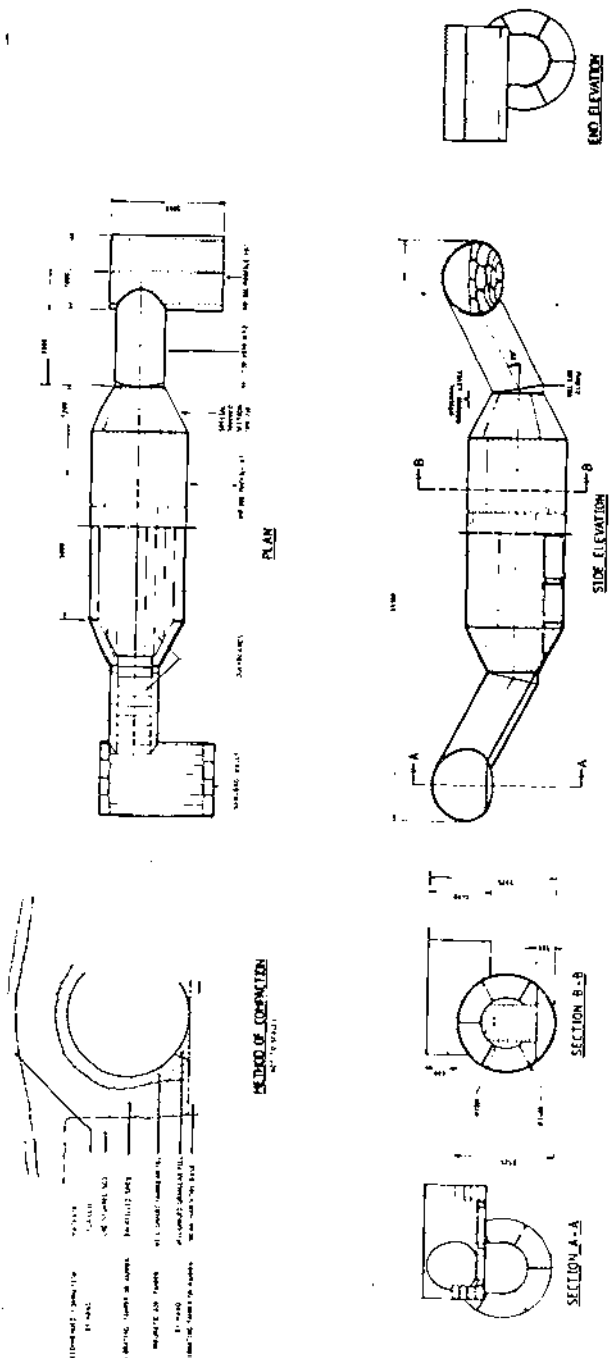


Photo 3. Static Defence—The Armco Structure, by Lieutenants I A Sanderson and P J Shaw

Photo 4. Tri-Service Sports Complex for the Shrivenham Campus, by Lieutenants M Foden and J Mitchell

mina cement concrete was specified throughout, and the internal shuttering was to be left *in-situ* to form anti-scab protection. The structure was designed to withstand an airburst of 152mm shell at a height of a few metres, and the same shell exploding at a depth of one metre, two metres from the emplacement. It was found that this could be built in a minimum of ninety-six hours, assuming non-stop working and with no allowances for bad weather etc.

"The Armco design was much simpler and straightforward, though in order to ease construction and maintain integrity throughout, a non-Armco tapered section was specified. This would have to be specially manufactured if production of the Armco structure is given the go-ahead. It was found that Armco is inherently very strong, and with sufficient overhead cover it seems ideal for buried defence-works. The final design could be built in under forty-eight hours by an Assault Pioneer section with plant assistance for excavation and compaction.

"Well, that was our Design Project. It was completely unlike any of the others, and just possibly a great deal more useful. If it is felt that the Army needs rapidly-built defence positions offering a high degree of protection, then look no further. Here they are!"

Some of the drawings and exhibition models from these two projects are shown in photos 1–3: the quality of these endeavours is self-evident.

An Overview

Inevitably the recasting of a design course for Sappers in this way is not achieved painlessly. Many had fears that such a move would leave the students less well educated than would a series of rigorous design exercises: however great the benefits in terms of motivation and integration, were the students learning how to *design*? The final year students had always previously sat a seven-hour design exam at the end of the year. We decided to keep the exam, whilst greatly reducing the contribution it made to their final assessment. To our surprise the students performed neither significantly better nor significantly worse than their predecessors. We felt happy to settle for that, for we knew they had gained many intangible and unexaminable benefits along the way. We are convinced that students who have followed this course have a "feel" for the subject that we could not give them any other way. Furthermore, we consider that such an approach has an even greater importance for Sappers given the sort of tasks that they will be faced with in the course of duty.

Suggested Further Reading

1. Can Design be Taught? A J Harris. *Proc Inst Civil Eng Pt 1 1980 Vol 68 Aug 409–416.*
2. A new approach to design teaching. J G Hetherington and P D Smith. *Proc Inst Civil Eng Paper 8562 Pt 2 Sept 1982.*
3. The Teaching of Civil Engineering Design—The Way Ahead? J G Hetherington and P D Smith. *Engineering Designer Sept/Oct 1982 pp 19–20.*

Signals—Establishing Communications

SIGNAL WING ROYAL SCHOOL OF MILITARY ENGINEERING

ONE of the earliest recorded military communication systems was that set up by the Persians in the 5th Century BC. They posted soldiers on hill tops as a message shouting chain. 450 miles could be covered in forty-eight hours by this system. Changes in wording of the message between origin and receipt is not recorded! For all practical purposes the only method of transmitting a message was by runner and horseman. By the time of the Napoleonic Wars the increased size of field armies, and the great sophistication of weapons led to more complex administrative toils and a need for faster communications. In the Peninsula, Wellington set up a scheduled despatch system using Dragoons detached from their regiments.

A number of visual telegraph systems were invented at this time. Based on semaphore arms or large shutters, they were large and fairly static, but once set up they were comparatively fast. Using an extensive code book a message could be transmitted from the Admiralty in London to Portsmouth in twenty minutes using a succession of telegraph stations.

Smaller and more mobile systems were needed for use in the field and one such was invented by the Chaplain-General who had previously been a mathematics don at Cambridge. Called the Radiated Telegraph, its five arms radiated from a single pivot. A complete station could be carried on a single cart. Its cost, including the cart and two telescopes, was forty-two guineas. Two arm semaphore telegraphs were used in India but the simple two flag semaphore system was not introduced into the Army until 1896. It was not popular due to its short range and the exposure demanded of the signaller! Another system was called the Military Anthropological Telegraph which had the added advantage, according to its inventor, of "requiring a dignified drill to deploy a single terminal of one Officer and six intelligent Sergeants."

The invention of the Morse Code in 1837 and the almost simultaneous perfection of the electric telegraph opened up a completely new field in both military and civil communications. Direct speedy communication was now possible between the home base and the Commander in the field. First used during the Crimean War it was not universally popular. Continually pestered with administrative queries from Whitehall, and without an adequate staff to deal with them, the C-in-C was forced to comment, "The confounded telegraph has ruined everything."

In the Crimea a detachment of one Royal Engineer Officer with twenty-five Sappers, two telegraph wagons, a plough and twenty-four miles of gutta-percha insulated copper wire, was provided to meet the field communications needs of the army. Mice ate the insulation, soldiers stole it to make pipe stems and even the conductor wire was found to make excellent pipe cleaners. Despite these difficulties, by the end of the war twenty-one miles of cable had been laid and eight telegraph offices were in use.

As the electric telegraph was a new innovation in the Army, it naturally became a responsibility of the Royal Engineers. In 1857 the telegraph detachment on a punitive expedition in China was provided by 10th Company RE. The equipment had

been shipped from London but when it was unpacked it was found that only one battery had been provided. The type of telegraph to be used needed a battery at each station, and none was obtainable in China, or indeed anywhere in the Far East. Nothing daunted the detachment Commander obtained sulphuric acid from the medical authorities, zinc from local purchase and with copper from the hoops of old gunpowder barrels made his own.

In the Abyssinian War of 1867, field telegraphy and visual signalling were extensively used. Signallers from Chatham, 10th Company RE and Indian Sappers and Miners took part in the campaign. An Officer of the Indian Telegraph Department recorded that the telegraph cable was not cut by the natives as they had been given to understand that its purpose was to guide the unwelcome invaders back to the coast.

The need for formal training in signalling techniques was recognised and in 1869 a Signal Wing was formed at Chatham. One of the main instigators was Field Marshal Sir John Fox Burgoyne who had long realised the need for good communications. The new Wing was to instruct Royal Engineers in the electric telegraph and all arms in visual telegraphy. This Wing later split when, in 1875, a school of visual signalling was opened in Aldershot, under the Infantry. Instruction in electrical signalling remained at Chatham. This split responsibility remained until 1908 when, in the light of experience gained in the South African War, all forms of signalling in rear of battalions or Artillery brigades became a Royal Engineer responsibility.

Although a Field Telegraph Train had existed at Chatham for some years there was still no suitable specialist unit available for deployment with the Field Army. Consequently in 1870 "C" Telegraph Troop RE was formed with an establishment of 5 officers, 246 men and 150 horses. Two years later Lieutenant H H Kitchener became Adjutant. The Troop first saw service in the Zulu War. They were deployed with only their peacetime scale of cable, about twenty miles, which was totally inadequate. Uninsulated fencing wire was obtained locally and laid directly on the dry ground. Telephones were used to amplify the clicks of the telegraph sets which were at their faintest in the early mornings when there was dew on the ground. Visual signalling reached a peak during this campaign. The heliostat was replaced by the heliograph which, with its oscillating mirror gave a much steadier signal. When the sun failed the necessary light was produced by arc lamps.

Alexander Graham Bell announced the invention of the telephone in 1876 and by the next year various designs of telephone were being discussed in the *RE Journal*. By the end of 1877 telephones, which had been made in regimental workshops, were in use on active service in India. At the siege of Sherpur in the Second Afghan War in 1879 there were more telephones in use than existed in the City of London at that time. There were seven in London!

C Troop was again at war in 1882, this time in Egypt. An expedition under Sir Garnet Wolseley was dealing with an insurgency and the telegraph kept pace with the advancing forces. In fact it was frequently ahead of the forces. On one occasion a detachment was ordered to erect two miles of poles out into no-man's land to guide the later advance of the infantry. (See Vol 96 pp 172 and p 249). No-man's land was dominated by enemy cavalry and the Corporal in charge was later thanked by the Commander for "A service of possible danger." During the subsequent advance cable was laid at a fast trot and communications established almost as soon as the battle was over. The Commander was able to report victory directly to Her Majesty The Queen at Balmoral, the first time such a message had been sent from the battlefield.

The civilian telegraph system had been developed piecemeal in the United Kingdom by private companies. They were disorganised and collectively inefficient. They were purchased by the Government in 1870 and the GPO Telegraph came into existence. As there was a shortage of trained staff, the Corps was asked to assist. Two Postal Telegraph Companies were raised to work with the GPO and to be available to reinforce C Troop in time of war. Amidst other tasks the companies

extended the system throughout the Highlands of Scotland and to some of the west coast islands. They became experts at erecting line in inhospitable terrain. Considerable tact was needed when working in a part of the country where soldiers in "red coats" and trousers were still not entirely acceptable.

In 1884 C Troop and the Postal Telegraph Companies were amalgamated into the Telegraph Battalion RE. The crest of this new unit was the figure of *Mercury* which is still found in the Royal Signals cap badge of today. Such was the development in communications that hundreds rather than tens of miles of line and cable were being considered necessary. On the expedition to relieve General Gordon in Khartoum, 600 miles of civilian network was taken over and refurbished. Civil traffic was accepted on the network on repayment. The Mudir of Dongola was a particularly good customer as his messages were always preceded by a chapter from the Koran!

The South African War saw another rapid expansion in the use of communications systems. Artillery fire was directed using telephones from balloons, line and cable were used on the actual battlefield. The numbers employed directly on communications rose from 12 officers and 331 soldiers in 1889 to 24 officers and 2424 soldiers by the end of the war. 18000 miles of cable were laid and, with the existing civil network, 28000 miles maintained. Altogether 13500000 messages were passed. The telegraph had come a long way since the twenty-one miles of cable and eight telegraph offices of the Crimea.

Marconi's experiments in 1895–96 had drawn attention to wireless. In 1899 a wireless system, complete with operators, was hired from the Marconi Company for use on active service in South Africa. The equipment was bulky and unreliable and could seldom be made to work in the field. It was not until a later campaign in Somaliland that field radio was made to work and then, surprisingly, the operators came from the Royal Navy!

As part of the major Army reorganisation in the early years of this century, it was decided that all forms of communications from regimental level upwards—telegraph, telephone, visual and wireless—should be grouped under a single organisation. Rather than form a new Corps the Royal Engineers Signal Service came into being. In 1910 the word "Telegraph" in the titles of units was changed to "Signal."

The Corps was therefore well placed to provide the Army with communication by the start of the Great War in August 1914. The Signal Service provided 75 officers and 2346 men with the original British Expeditionary Force. Some difficulty was experienced in adapting the French civil system to British military needs, as the French had called up all their telegraph staff, but an efficient network had been provided by the Battle of Mons. Even during the retreat from Mons contact was maintained between brigades using the civil network or, where this did not exist, by the continual laying of line, usually at the canter. It was at this time that the Motorcycle Dispatch Rider Service came into prominence. Originally formed in 1912 as part of the Reserve Army, DRs were given the rank of Corporal and provided their own machines. As motorcycling was still a hobby of the well-to-do the service attracted all sorts of people. While many still provided their own machines, some arrived in their own motor cars. One unit had a rich South American and another a Rajah from Central India, both "mounted" on Rolls-Royces!

The Signal Service had been organised to provide communications in mobile operations. When the war settled into static trench warfare, new techniques had to be learned and on a scale previously unheard of. Signals were given the additional responsibility of inter-unit communication within divisions as the forward trench system became an indescribable tangle of wires. Visual signalling came back into vogue as the lines were continually cut by shell fire. Carrier pigeons were used, as were message carrying and line laying dogs. The scope and importance of wireless increased. By 1915 armoured cable was being buried at a depth of six feet. This work was generally carried out by the Infantry under Signal Service supervision. Before the Somme offensive in 1916, 43000 miles of overhead line was erected and

7000 miles of cable buried. Before 1914 two pairs of cables or lines had been considered sufficient to support an attack. By 1917 the pamphlets were recommending at least forty pairs, buried and inter-connected. Throughout all this the pigeon remained important. At the Battle of Cambrai each Section of four fighting tanks was accompanied by a signals tank in wireless communication with Brigade Headquarters. Each fighting tank had two pigeons, the signals tank four.

Signallers served with distinction in all the other theatres of the war—in Gallipoli, Salonika, Palestine, East Africa and Russia. At Kut al Amara during the siege, out of a total strength of 279, 34th Company suffered 104 killed or dead of disease and over 50 wounded. In northern Russia the dispatch rider's motorcycle was replaced by the sleigh.

By 1918 the RE Signal Service in France alone had increased to 70 000 men and had become a Corps within a Corps. It was decided that the time had come to form a separate organisation and in June 1920 the formation of a Corps of Signals was authorised. Six weeks later His Majesty The King, in recognition of the fine service given by the RE Signal Service in the Great War, conferred on the new Corps the honour of the title "Royal", the Royal Corps of Signals taking precedence immediately after the Royal Engineers.

The Development of the Batri-trike

BRIGADIER H G W HAMILTON CBE, BA, FBIM, DL

The Author was educated at Wellington College, RMA Woolwich, and Cambridge University, and was commissioned into the Corps in 1938. During the War he served overseas with the BEF, BNAF, and BLA. After various staff and regimental appointments, including being a DS at the Staff College Camberley, he commanded 125 Engr Regt TA, attended the Imperial Defence College, and commanded 29 Engr Bde. He retired in 1968 and was General Manager of Corby New Town Development Corporation for 12 years. He is at present Chairman of the Forces Help Society and Lord Roberts Workshops.

For many years my wife has produced ideas for some new development, some of them revolutionary, and we have then found that someone else has had the same idea but has actually developed it. In 1979 it was "With the increasing cost of petrol and the lack of public transport, what about an electric tricycle for shopping?" So we bought a second hand tricycle from an old man of ninety who could no longer use it. But it was not until I had finally retired that I decided that this time I really would go ahead with the development and "electrify" the tricycle.

What type of motor, what horsepower, what speed to aim for, and what control system should I have? A considerable amount of "back of the envelope" work on weights, gradients, speeds, wheel diameters and so on was carried out. Thoughts turned back to earlier days at school and the "Shop" and formulae such as P = mf were resurrected from seemingly forgotten memories. A visit to the "Drive Electric" Exhibition clarified ideas and questions forming in my mind regarding the best

Brigadier H G W Hamilton CBE BA FBIM DL, The Development Of The Batri-Trike

control method to use, switches, batteries, motors and so on. I inspected in detail the invalid pavement vehicle, the *BATRICAR* which I had seen being driven by a disabled friend, as I felt that the power required for the slower and heavier Batricar was probably about the same as I would require for the lighter and faster electric tricycle.

A letter to the service manager of Batricar Ltd produced a very helpful reply, and the promise of a reconditioned motor and gearbox. On collecting it a good look round his store also produced other items that I thought that I might need, these included a reconditioned Variable Speed Control unit—a thyristor "chopper"—together with the necessary potentiometer, which I decided I could adapt with a thumb operated lever as the control accelerator on the handlebars. The next task was to work out how these "electrics" were to be connected together, and how the motor and gearbox should be fitted to the rear axle of the tricycle, as well as what final gearing would be required. The motor was a Lucas ½HP series wound, and the gearbox gave a 9 to 1 reduction. Calls to Lucas produced the relevant performance charts, from which the optimum reduction gearing could be worked out to give a maximum speed on the flat of about 8 to 10mph, and maximum power on hills at lower speeds. I took a 1 in 10 gradient without pedalling as my target initially. I decided on a sprocket and chain final drive to a freewheel on the rear axle, having toyed with the idea of a belt drive which could be tensioned to slip if the motor became overloaded. The total required reduction was calculated to be 14 to 1 with a 20-inch wheel of the Pashley tricycle, and so a 12-tooth sprocket driving an 18-tooth freewheel was used. Having two freewheels on the rear axle, one driven by the pedals the other by the motor, meant that the two forms of propulsion could be used either independently or together according to the riders inclinations and the gradients.

After considerable trial and error all parts were mounted slung beneath or in rear of the rear frame, with an old car battery, 12 volt, on top of the frame, and a rough thumb control on the handlebars, and—it worked! The next step was to improve the mounting so that the motor/gearbox unit could be attached to other makes of tricycle, including an American Columbia that I had bought which had 24-inch wheels. Improvements were made to the thumb control unit on the handlebars to include a key switch, warning light and battery condition meter, and to add safeguards to the thyristor "chopper" unit to include on/off and full speed by-pass contactors and a strong fuse (150 amps), as the currents on steep gradients were very high, and there was a danger of a stall in the hands of the uninitiated.

After discussion with the battery manufacturers, I finally decided on a Chloride 278 battery designed for caravans and motor boats which had deep cycling properties, and which with a 60 amp hour capacity would give at least a 10 mile range, which was my initial target for one charge.

For the Mark II prototype, a smart container with a detachable cover was made to go on the rear frame to contain the battery and the "electrics". This was made initially in aluminium, though it was always my intention to use fibreglass or vacuum formed plastic to avoid possible corrosion from spills. The skills learnt in the sheet metal workshops at the SME before the War came in useful!

At about this time my disabled friend with the Batricar came over to see me as he felt that the electric tricycle might have possibilities for partially disabled people who had arthritis or a similar disability. After some discussion I designed an adaption consisting of a running board or footrest which replaced a pedal on one side, and attaching a "stirrup" to the remaining pedal so that the rider could still use that pedal with an up and down or pumping action. Thus the "Disabled Batri-trike" was born, later to be called the Uni-pedal Batri-trike for obvious commercial reasons, and designed particularly for those who have a disability in one or other leg, such as a stiff knee joint or artificial leg, or for those whose leg power is getting weak.

By now I had two prototypes with identical motor and control units, one on the Pashley Tricycle, the other on the American Columbia, and I had also fitted a com-

plete Conversion Unit to a tricycle belonging to Letty Hamilton-Baillie, who is the wife of a Sapper Brigadier and has very limited mobility. I am glad to say that she is still very satisfied with her Batri-trike as it gives her a new freedom to get about the village. The American tricycle was no longer being imported, so I decided to concentrate on the Pashley. Pashleys had also being dabbling with an electric tricycle, using a front wheel mounted motor, but they now decided that the "Hamilton Batri-trike" was better and so pulled out of further development.

At an early stage I started to do the costings to see whether the Batri-trike was commercially viable, and found that the price of the gearbox, as reported by Batricar Ltd was too high. So I designed and developed my own gearbox making it of sprockets and chains using two series of 12-tooth to 36-tooth sprockets and a final drive of a 12-tooth sprocket to an 18-tooth freewheel. For bearings I adapted old bicycle front wheel bearings, and made the gearbox casing of some sheet metal I found in the garden. It worked well but was noisy and getting the correct chain tension was difficult, however the firm of T D Cross, the main manufacturer of industrial sprockets and gears, were interested and started to design a similar but more efficient gearbox as a project for one of their apprentices. My information on the cost of a totally enclosed gearbox proved to be wrong, and I had two specially made 14 to 1 gearboxes designed and made at a reasonable cost, and this gave me a greater latitude in the final drive gearing according to the wheel diameter of the tricycle and its use.

After considerable thought I decided that to set up a complete manufacturing and marketing unit was too much trouble what with problems of VAT, product liability, guarantees and so on. So after some very useful advice from the managing

Photo 1. The Uni-pedal Batri-trike negotiating a steep hill

Photo 2. The Uni-pedal Batri-trike fitted with a special seat for a Disabled Person whose balance is impaired. Note the "stirrup" fitted on the right pedal. Production models now all have a luggage carrier fitted

director of Plessey Connectors, an approach was made to the Chairman of Batricar Ltd, to see if they would be interested in the project, particularly from the "Disabled" point of view, of which they had extensive knowledge. They were very interested in some form of association, particularly in making the conversion unit of the motor/gearbox and the controls, since they were already considering making a similar "power egg" which could drive small hand trucks, mowers etc and this fitted in with their development plans. Initially the idea was for them to produce the conversion unit, which I would purchase from them and fit to tricycles purchased from Pashley, or to tricycles already in customers possession. This would still leave me with some problems, but it would mean that I would be able to do special adaptations for people with a particular disability which was, and still is, my main interest.

Batricar Ltd then suggested that they should take over the whole project including assembly, marketing etc and give me a royalty on each one sold, which was more satisfactory provided that the royalty was right, and that I still retained some form of consultancy interest. They decided to make an initial ten models which I would endeavour to sell as I already had a number of enquiries and semi-firm orders as a result of a press article and a television programme on BBC "Look East". We could not go into full production however as we were awaiting the new Regulations concerning "Electrically Assisted Pedal Cycles", and thereby hangs a tale of frustration and bureaucratic ineptitude which nearly caused me to give up the whole project.

As soon as I started on the project back in January 1981, I asked the police what the legal status of an electric tricycle on the road would be and whether there were any construction and use regulations with which I would have to comply, and what "type testing" would be necessary, before the Batri-trike could be sold commercially. They passed me to the local office of the Department of Transport and eventually I got in touch with a variety of civil servants in London. After finding that the Batri-trike could probably be considered as an "electric three-wheeled moped" which would pay no tax, since all electric vehicles pay no road fund tax although they have to be licenced, the Department informed me that under Sec 24 of the Transport Act 1981 Electrically Assisted Pedal Cycles would be exempt from

having to be licenced, for the rider to have to hold a driving licence and from all the other rules normally applying to motor cycles, provided that they conformed to a set of regulations which had yet to be defined. This was excellent news as it would mean that the Batri-trike would have a much wider market particularly amongst the elderly and the disabled. Nine months later and after repeated enquiries, a meeting was arranged at the Department when I found that not only had they not written the first draft of the regulations for consultation with interested parties, but that they had not realised that there was a difference between bicycles and tricycles. They were proposing a clause which would state that the motor could only be switched on whilst the pedals were rotating "as a result of the exertion of the rider". This of course was nonsense and would in effect put paid to the Batri-trike for the Disabled.

After enlisting the support of my MP Reg Prentice, the Minister for the Disabled Hugh Rossi, and others and after much correspondence, the draft regulations were amended and the final Electrically Assisted Pedal Cycle Regulations 1983 were issued in a form which was acceptable, but they still required Parliamentary approval before they could become law. After a further five months delay they were due to be placed before Parliament early in June, but the election stopped that! By the time this article is published the Batri-trike should be legally on the

Photo 3. The Standard Batri-trike for the housewife fitted with baskets for shopping

road, but if it takes a Government Department over two years to define a comparatively simple matter like an electrically assisted tricycle, it is no wonder that businessmen get frustrated and put off when trying to get a new idea off the ground.

We have now sold a number of Batri-trikes, and are gearing ourselves up for full production once the regulations have been approved by Parliament. Batricar Ltd have kindly presented a Batri-trike to the British Limbless Ex-Servicemens Association who are delighted with it and are hoping to get a grant from the South Atlantic Fund to purchase more. The whole project has been the greatest fun and has given me a real interest on retirement.

Details of the Batri-trike and its possible uses are set out in the Appendix:

Appendix

THE "HAMILTON BATRI-TRIKE"

The STANDARD BATRI-TRIKE, which has the normal two pedals, is designed particularly for:—

–the Housewife, as a shopping vehicle with its large carrier on the rear and the front basket, or with one or two childs seats fitted on the carrier to take young children to playschool.

–the Elderly or Retired to give mobility particularly where a bicycle is difficult to manage.

–the Public Service Employee in urban areas to save on transport costs particularly where a bag or small equipment has to be carried, eg postmen, visiting nurses.

The UNI-PEDAL BATRI-TRIKE, which has one pedal (with a "stirrup") and an interchangeable footrest, is designed for:—

–the Partially Disabled and those who are not sufficiently disabled to warrant an invalid car or Batricar.

–those who have a disability in one or other leg, eg a stiff knee joint or artificial leg.

–those whose balance is impaired and cannot ride a normal bicycle or who have arthritis and find walking any distance difficult.

PERFORMANCE

Range Up to 18 miles on one charge, depending on the amount of pedal assistance given and the gradients.

Speed Variable Speed up to 10mph on flat without pedalling.

Gradients Will climb a 1 in 6 gradient without pedalling. (Short distances only)

Running Costs Less than 2 Pence for a 10 mile journey.

TECHNICAL DETAILS

Tricycle Pashley Single Speed Picador with 20" wheels. Fitted with front basket and rear carrier.

Control Twist Grip on handlebars actuating an electronic variable speed control unit (Thyristor "chopper"). Separate cut-out switch on handlebars.

Brakes Front Hub, Rear Calliper, and Front Rim Parking Brakes.

Motor 12 Volt ½HP (250 watts continuous rated output)

Battery 60 amp hour in fibreglass "Boot" with battery meter, light switch and isolating switch with key, and charging socket.

Charger Separate 12 Volt Charger 50 cycle automatic cut off.

Things Left To Chance Often Go Better

MAJOR J R HARRISON MBE, RE, B Sc

The Author was commissioned from RMA in 1968 and joined a YO course at RSME where his engineering knowledge was established as nearly negligible and rapidly deteriorating. A non-engineering degree read at the RMCS did much to reinforce this decline. As a Tp Comd in 59 Indep Cdo Sqn, he discovered mental acuity was not everything. However, as an Adjt in 26 Engr Regt and Ops/Trg Maj in 21 Engr Regt, he found it was. This awkward differentiation he resolved in his mind at Naval Staff College, before it became scrambled again on Div 1 ASC at RMCS and even more muddled over the period he was the GSO 2 RE in Corps HQ. Now at the School of Infantry, having relinquished command of 50 Fd Sqn (Const) in September, the author often wonders . . .

PART ONE

RAF Laarbruch, February 1982 and the flag fluttering above the sign proclaimed 50 Squadron was in residence. First day as OC, ho-ho, by now confident ADR stood for Airfield Damage Repair and that a Construction Squadron rarely did any real construction work (odd name though, almost perverse?); still I did feel there were odd gaps in my knowledge. Stick to tangible things, something to impress with, ensure one is getting a grip. A room inspection, good idea, please the SSM as well (who obviously enjoys them), having mentioned the idea to me at least four times already, safe. Right . . .

"Hello, second-in-command? we need to organise the EFHE training do we? the what?"

"E–F–H–E training!"

"I can hear!" Careful good leaders do not lose their tempers over trivia—is EFHE trivia?

"OK what of this EFHE".

"Well the bunds need lining."

"Probably do; I remember when I had to lay a minefield in . . ."

"The B–U–N–D–S . . ."

"OK, OK, I surrender what is an EFHE?"

Then followed a ten minute explanation about an aspect of the Corps I knew little about. By the end, my enlightenment was such that thoughts of the room inspection had evaporated from my mind. This EFHE (Emergency Fuel Handling Equipment) stuff was important and needed to be grabbed.

Enter a Clerk of Works. Hands up those of us who didn't know we had different types of these chaps—"C", "E" or "M". Come on, be honest, how many of us? Well, I am telling you, get one of these fellows and your problems over EFHE are over with. That is if he comes complete with a suffix "E" or "M". Show a Clerk of Works "C" an EFHE and he will look just disappointed, but an "E" or "M" laps it up.

"Bunds?"

Major J R Harrison MBE RE B Sc Things Left to Chance Often Go Better

"No problem, Sir"

"Training programme?"

"Done"

"Kit?" I worried over this question, a vital thingummy, the size "no bigger than an agate stone on the forefinger of a burgomaster" could be missing, then what do I do?

"In hand" Then reassuringly "everything has been checked". Hurray, next problem; ah yes, the room inspection. Two hours into the job—easy. The next day's room inspection was a huge success, much twinkling in the SSM's eyes and tears, I think, in the QM's—"I cannot get anymore . . . cleaning materials". Replies from me, based on a somewhat stubborn and rhetorical theme of "Oh yes you can!" eventually elicited "I will see what I can do", ie, "OK, I will get more cleaning materials."

Problems being an OC? Not a chance just challenges for others to face.

Next sport, fitness training, bicycle race, orienteering, march and shoot competition; it was the bicycles that nearly did it. Firstly, it was impossible to get "bikes" and even if they could be acquired the airfield would have to close and . . . Anyhow the boys enjoyed the "Tour de Laarbruch" and the RAF police assisted us. By early April and our exercise almost at an end a curious telephone call was had between myself and a member of RHQ in UK. As I understood little of what was being said I passed the regimental spokesman over to the second-in-command. Apparently there was some trouble in Scotland and whilst the chief clerk checked in the *AA Book* (essential in every Command Vehicle I find) as to the exact location of the Falkland Islands, I mused or to be honest, in the absence of a *Men Only*, I let my mind go pear shaped.

It was two days later before I was clear in my mind why the Upland Goose, Port Stanley, would never receive a star rating in the AA UK motoring guide. Anyhow by now it had been confirmed that on return to UK the Squadron would go on leave as planned and if, a big if, this Scotland-sorry-Falklands affair did blow up (some chance I said), we would remain behind as the rear party. No problems, OK, fine; two days after departing on leave we were recalled.

Part Two

"Things get worse under pressure" (Murphy's Second Law of Thermodynamics).

It is now Act One as a drama opens, in a muddle. An extraordinarily well co-ordinated muddle which took the author and a few of the Squadron to America, some all around UK, and all to the once found, never forgotten Falkland Islands. Of paper there was little. Cynics might suggest the less paper the better the operation; but they were proved wrong over this point with *Exercise Spearpoint 80*, weren't they? However, with no paper, tit-bits of information were offered by signal or telephone:

Tantalising—"You might be going on the QE2". We did not.

Incomprehensible—"You could be cross-decked from one ship to another, say, during a RAS". In fact we most definitely did not, I think?

Fearsome—"You will be building an airfield". Now on my YO course the airfield project, *Landings East*, is the only time I have dealt with this engineering discipline, and it filled six days of my life with misery, ending in a personal interview with the CI PR & A Wing, who like me marvelled at my work. Actually he did not marvel, this is merely artistic licence gone a wee bit daft. D minus, the grade if I remember correctly, quite hurt me at the time. The chap whose paper I had borrowed largely from (the wrong ideas as it turned out) received a C plus and hoots of praise.

Deflationary—"You will not be going". We did.

Inflationary—"You, plus another Squadron, diving teams, RE Band, the cat, all the plant you can name (name ONE!), loads of vehicles and stores are going". Almost right but forget the cat. Oh, and we left the band behind on the docks at

Southampton, careless I thought. Subsequently I thought "thats planning for you". As we sailed into the sunset I gave up thinking and just reacted to events instead.

During the build up to departure, the need to remain calm was evident, so inertia could have set in easily and some really neat planning done. Instead on my advice and example we all slipped into a panic. Some of us ran around organising and reorganising training, based on the latest information on likely move date and tasks. Others concerned themselves with equipment which frequently nobody had seen before and required someone to find, grab the relevant literature and examine the spares pack. Civilian manufacturers were good over last minute modifications to their machinery and Central Engineer Park did a magnificent job preparing, packing and collating a huge pile of plant, ECP and resources. Most importantly we managed to get the usual cryptic hieroglyphics painted on the exterior of boxes, bearing a legend such as X1–32–45–81–961874 CARB expanded upon with the more prosaic but somehow more useful detail such as "red bit affix to black bit on conveyor Goodwin Barsby". Even better, Central Engineer Park marked the boxes associated with each arrestor gear set with a distinctive colour code and the simple statement one of sixteen etc. Such a seemingly trivial point made location and unloading of each arrestor gear set from the ships relatively quick and once ashore, lost in the morass of peat and mud, it was a straightforward business bringing the correct boxes together at the right site.

Picture, if you can, The Pentagon, I was there. Yes I thought, I have made it, sitting behind a mini Union Jack as part of the UK team my mind . . . "what, sorry, er could you repeat that?". The American panel across the oak table sitting behind their mini version of the Stars and Stripes were questioning me, wait for it, questioning me on airfield DESIGN, gulp! This is when staff training comes in useful. Making noises like a slide projector and pointing to an imaginary Vu-foil, I gave a first class demonstration of how to give a presentation. Also I spoke up and pointed vigorously at a light green wall, an unfortunate colour really as it was not as descriptive of snow and ice as the new Ultra White Dulux paint. Small point perhaps but it is the omission of the fine detail, I find, that often causes DS red ink to flow all over one's papers. Fortunately there was help at hand and members of the British team who understood such terms as LCN etc, rescued one and apologizing for my colour blindness (nice touch that, subtle) cast all doubts from the assembled American minds over our abilities as airfield engineers by their learned comments. Thank heavens for experts, my mind once again at rest I was relegated to a job I do well. Namely, passing around the coffee and making the odd *ad lib.* Basically I think this is how the runway matting expedient, AM-2, and accessories were purchased.

This LCN (Load Classification Number) worried me, as back on the YO course previously mentioned it had featured a great deal. So, I admit it, I went to the PR & A School and drew out from the library four books, one blue, two green and a yellow pamphlet. I opened one the other day and what they contain has to be seen to be believed. I have not read them yet but the SD and layout is quite superb. Of course, the greatest value of going to the PR & A School was to talk to the professionals and what I understood them to mean over airfield construction I reiterate below, as we do not want another *Operation Crown* again do we? So for posterity let one's cranium work overtime, here it is, sitting comfortably? right:

(a) The airfield must be flat.

(b) The runway should be strong enough to allow the aircraft to land on the surface rather than on the subgrade beneath the surface material.

(c) Provided the first two criteria are obeyed the surface pavement must be sufficiently long to allow the aircraft to come to a halt without the pilot having to use all his brakes (including the handbrake) or lose over much of his shoe leather.

Armed with this useful information, which was and is the sum total of my knowledge of airfield construction, we sailed on *Rangatira* on 19 June from Southampton with two stores-carrying merchant ships following behind. I was elected to be OC Embarked Military Forces (EMF) in which capacity I earned various nicknames, all

rude. The First Lieutenant started by "hassling" the Army as we never had sufficient tea and said so. Before he could form a definite dislike his attention was drawn more and more to the four hundred or so RAF personnel on board and his budding disatisfaction with the Army was delayed, in the event cancelled, in lieu of a more serious and protracted campaign with the Air Force. Certainly this campaign, like all such affairs had its ups and downs but as OC EMF I feel I maintained a dignified and aloof position, only putting "the boot in" when it looked as if the Army might be losing favour with the Navy. In no sense was I biased. But, I did take a firm position which brooked no argument, the RAF were wrong, OK, fine. So it was a jolly cruise occasionally punctuated by squeals from the RAF which I found rather disconcerting as it tended to give the impression that the harmony between the Services was breaking down. I could never understand it?

And so we arrived. What a dump, "look at all that **it, its everywhere!"

One's first impression of Port Stanley led me to suppose it had slipped down the side of the hill into an enormous sewage farm and the villagers finding themselves in the "proverbial" and, not being able to get out, had temporarily flung up some shanties. That memory lingers along with one other, etched in my mind as indelibly as the black figures on a Lowry canvas. Those we came to relieve were tired, not physically but mentally drained. Perhaps relief in-the-line means more to me now than it did. But it was good to meet up with the Regiment again. Everyone was in high spirits and scenes on *Rangatira* were reminiscent of an Old Boys gathering.

Prodigious efforts had already been made including the temporary repair of the airfield. But, the amount of work outstanding was almost overwhelming. Every Sapper skill was being called upon to the full and everything was in short supply or in the wrong place, half buried in the peat and mud. Endless haggling was needed to get a helicopter to move the stuff. One of our first jobs on the airfield was the building of a DTL (Deep Trench Latrine)! Perhaps in the debris of war this task appears odd, but the lack of just such a basic facility contributed in the early days, to nearly 30% sickness in the Squadron. Human excreta lay all around Stanley and the airfield. Clearly, at last we had found what the "Argies" excelled at, but the clearing up was revolting and due to the lack of any laundry facilities or dry, clean, warm accommodation and ablutions, sickness soon became rife. Accommodation, certain foods, and ablutions were a continual problem and only by putting pressure on anyone who would listen could beds, blankets, heaters, tentage, fresh (frozen) dairy produce be obtained.

The QM on one foraging expedition to the ships discovered and borrowed a torpedo shaped heater which improved the quality of life for many of the lads, a hundred times.

This work was vital and occupied a lot of my time initially along with establishing a stores area, getting the G1098 organised ashore and acquiring a B vehicle fleet, part Argie part Brit, all in a state of collapse. Feeding was always difficult and the cooks worked much longer hours than most, frequently up to sixteen hours a day. Again the husbanding of kitchen resources, tables and chairs took time and effort but, as ever, success could only be achieved if regular, good hot meals in a reasonably dry place were made available. We were never totally dry. The mundane took hours to solve. But after a couple of weeks things began to take shape–the DTL was finished!

To assume there was a plan which unfolded in beautifully well orchestrated stages is to miss the point quite wonderfully. There were lots of bits of plans, some good ideas and to start with no clear mission. Were we to build an expeditionary airfield? Rule One, the golden rule, establish the aim. Once I had an unequivocable statement that we were to build an expeditionary airfield I was able to direct the planning effort accordingly. Dear Reader, "planning effort" reads well, implies an ordered array of like minds working in a common direction with one aim in view. Well, it was not really like that. As I have hinted at already I had only the vaguest notion of what was wanted and I could not carry out some diversionary tactic to dis-

tance everyone from the engineering problems, like a room inspection—no rooms!

Recces, daily briefings and conferences all helped to occupy the day and night but the real problems, mail deliveries, families, feeding arrangements—I spent hours, the QM days, getting hold of cooking oil for—CHIPS! Monitoring sanitary conditions, weapons and suchlike were the daily stuff of life. The airfield, well that just went along . . .

WHOOSH

"Built by the end of the month"

"Yes Sir"

"No problems, must be achieved"

WHOOSH

The second-in-command still rigidly to attention, handset in left hand, pipe ash down his front on account of his pipe having been hurriedly clamped teethwards as he braced himself to attention, the pipe bowl in the upside down mode.

"Who was that?" said the Sapper radio operator.

"That, that was the CRE".

Enter myself calm, assured, unhurried, the visitation explained, the personal qualities mentioned in the previous sentence hardly deserve a mention in this one, as they had been supplanted almost entirely by a twitching sensation in the lower regions.

WHOOSH

"Ah, the OC".

"Who said that! Who me? Right I admit it but in my defence I . . ."

"End of the month, earlier if you can make it"

"Fine, but . . ."

"Good. Not much activity in the quarry" said through clenched teeth so the word "much" sounded uncomfortably accusing.

"Well, equipment faulty, quite a puzzle really, drills just go snap, crumble, plop".

"Need more drills".

"Yes please".

"I will get them, cannot afford to be delayed, making Corps History".

WHOOSH. Silence

"Second-in-command, surely the pipe bowl goes heavenwards". The one thing I felt I had some control over was quickly put right. After that "Tea", a decision was about to be made "no sugar, just milk".

Grimacing over a hot brew and gazing over a bleak landscape upon which Sappers were industriously working on a diverse number of activities I was forced frequently into feeling things could not be worse for the lads. The urgent need for the airfield to be completed meant twelve hour shifts as a minimum, but, I wondered regularly, what are the limits of endurance in these circumstances and what can be done to alleviate the pressures of work and the discomfort. Clearly, the work load could not be reduced but by ensuring a clear aim was given for each task a readily identifiable goal was set which could become a competition in itself or allow a reward to be given at the end. In addition regular orders passed down the chain of command did breed a confidence in the troops that their efforts were being employed in the best way possible to achieve the ultimate aim in graduated, logical steps. The giving of orders, use of aids and models plus confirmatory orders which troop commanders always received well, indicates the excellence of the basic training given at Sandhurst. Prior to orders detailed briefings were given, if necessary by troop commanders down to Sapper, cook and REME fitter level. All this, not surprisingly, ensured everyone was informed and knew the likely pitfalls we would encounter. Having said this the greatest calamity occurred when orders down the command chain failed to coincide with the technical advice being given by the Squadron Project Cell and as a result two or more vital days work were lost. I would like to think we made up for those lost days later on.

But, if ever I needed the message it was this—do not forget to follow up orders to make sure everyone understands fully what is required and that they are best organised on the ground to achieve success speedily. A basic mistake perhaps, but it is the neglect of the fundamental principles taught at Sandhurst which I find I do overlook most easily. In this case I assumed too much, as there was no failure in comprehending the technical input, merely the technical advisors and commanders were working in opposition to each other in order to "get on". Probably I was over confident at the time and so I neglected to notice this and ill fortune resulted.

Secondly, the discomfort we had to live with grew less as time progressed, or did we just get used to the conditions? A firm administrative base everyone had faith in, continual improvements in feeding, accommodation and ablutions all helped to foster the belief that things were getting better. Towards the end, with the longer days we managed to play quite a lot of sport which hugely improved morale. The one notable failure was in personal equipment and clothing. Considering the money we spend on equipment, it is ridiculous we do not get the man correctly kitted out first. Get him right and, surely, everything else follows? After that homily I should make it clear we did receive extra clothing prior to deployment and during the tour. Suffice to say most of the cold weather clothing was outdated being cumbersome and difficult to impossible to dry out.

On 12 October a Phantom landed at Stanley but to my surprise the perishing aircraft did not appear to require the additional 2000ft of runway we had built, using much crushed rock, over a period of six weeks. Tears almost came to my eyes when the name of "Goodwin Barsby" is mentioned. The tonnages of rock, the sweat and effort to get the extension built was incredible. The promised drills did arrive in late August and almost simultaneously with their arrival two things happened. I was sacked from the job of running the quarry, another luckless Squadron Commander got this task and soon it was discovered once the drilling and blasting was successful, the crushing plant (Goodwin Barsby) was suspect. No amount of kicking, abuse or tantrum throwing could ever get those machines to work effectively for any length of time. As we could see the quarry and crushers from the CV, the relief of no longer having to concern ourselves with producing crushed rock so essential to success with the airfield, made life bearable. Well, almost . . .

WHOOSH

"Erk!" Second-in-command, pipe in teeth, to attention rises. OC diving for cover.

"How is it . . ."

"Sir, the crushers aren't working!" Quipped the quick-witted radio operator (they usually are when they want to be).

WHOOSH

Some Sappers deserve instant praise, this radio operator received one of the OC's personal biscuits from the hands of the OC. Many people helped themselves to my biscuits, this was one of the few occasions when actually I awarded one myself to a deserving person. The pilfering of my biscuits became so severe for a time that I thought of changing my name to *Peak Frean*, in order to catch the culprits snaffling the "family" food.

Then, of course, there were these piles of AM-2. Day One of the big lay (nudge, nudge!!), a cold night Gurkhas everywhere working hard. The AM-2 panel has a green wearing surface on one side with a silver underside. Which side do you think goes uppermost? Day One, night build, Corps History being made, Major Harrison (not too loud) in charge. Two Gurkhas on the first row to be laid, struggling with a panel silver side up.

"Oi!" I stepped in. "Look it is green side up".

Gurkhas keep struggling "GREEN SIDE UP, UP, UP!"

No reaction, just more sweat, incredible determination, they had got the thing almost in! Dreadful, Corps History records "initially one side of Stanley airfield was built upside down". PR & A experts never mentioned this could happen. Into

the gloom walks a Gurkha officer, after a quick explanation to him and a translation to the over-heated Gurkhas the panel was turned over and slipped in. Smiles and much gabbling in the dark and all was well. I had never worked with Gurkhas before, but their energy and resolution is quite fantastic. Coupled with their smartness under all conditions they must be the most unique soldiers in the world. AM-2 laying almost, I repeat almost, became a sport with parties being provided from most Squadrons, infantry, RAF, RN and merchant seamen. A few hours training and, with the necessary supervision and stores support, a successful build was possible.

Eventually we were allowed to leave and we slipped anchor one morning in late November comfortably ensconced on the luxurious *Cunard Countess*. A fitting end and an incidental forced rest before arrival back in Albion and a round of Christmas parties and the "I was there" stories.

PART THREE

"You are not drunk if you can lie on the floor without holding on" (Dean Martin)

The thing which struck me most on return was what the Falkland Islands failed to do, but regimental employment, postings out, courses, sports did succeed in doing—no men. *Operation Keelman* created spasms of activity although the never-to-happen firemen's strike meant a major interruption to a bridge camp exercise for hose pipe drill and water squirting by numbers. This happened when one troop was already detached, conducting an emergency trial for the RAF. But, this is all old hat and visits to Cyprus to see friends, sorry exercises, were compensation. The best news of all was having to visit Germany regularly, which meant access to cheap booze. In fact, so regular were my visits that I started to take the empty beer bottles back; so I have been able to remain "raver sholly, reesonably sheeply" in Maidstone which I am sure is a great comfort to the readers of this article!

FINALE

I will end this amazing literary accomplishment with the words Oscar Wilde delightfully and so aptly, as far as I am concerned, chose to place in the mouths of two of his characters in Lady Windermere's Fan:

Dumby: Experience is the name everyone gives to their mistakes.

Cecil Graham: One shouldn't commit any.

Dumby: Life would be very dull without them.

Well, I have not been bored over the past eighteen months and it must be impossible not to make some mistakes? Well little one's, very small one's . . . chaps, surely, at least one mistake, a really good one of course, but ONE . . . chaps . . .

La Place des Royal Engineers

MAJOR GENERAL A E YOUNGER DSO OBE

IT is always a special occasion when a foreign street or square is named after a person or an organization. It was consequently a particular pleasure for a group of World War II Sappers to be invited to such a ceremony near their old landing beach in Normandy on Sunday 29 August 1982.

It has primarily been the continuing connection established by 85 Field Company that caused this honour to be bestowed on the Corps of Royal Engineers. This Company, which was disbanded once the war ended, had been part of the Beach Group responsible for the stretch of Normandy coastline that included the community of Graye-sur-Mer. The Company has passed its silver jubilee of reunions in England since disbandment and has maintained its links with Graye by inviting French friends to these and by paying visits.

Graye was in the Canadian Sector for the D Day landings and, consequently, it is much more difficult for ex-members of Armoured or Infantry units who landed there in 1944 to return for a visit, although it is not unknown. However, it happened that another British unit, again from the Royal Engineers, landed there on D Day. This was 26 Assault Squadron, which came in at H Hour to clear lanes through the obstacle belts established by the German defenders. After the hectic first few hours, 26 Squadron passed through Graye heading south, leaving behind only their casualties. However, they did leave one of their tanks, codename *One Charlie*, in the middle of a sixty-five foot crater in the main beach exit, where it acted as a pier under a hair-raising bridge over which all traffic had to pass to leave

Photo 1. The plaque after the unveiling

La Place Des RE 1

Photo 2. General scene on beach with French Memorial to D Day on the left

the beach. This provided the first link between these two Sapper units, as it was 85 Company that eventually removed the improvised structure built by 26 Squadron under fire, and replaced it with something more permanent.

The next link occurred thirty-one years later when 26, reorganized as a modern Armoured Engineer Squadron, planned to lift out their old tank as a training exercise. The veterans of 85 soon heard about this through their links with French local inhabitants, and representatives of the two units met again at the bridge site. Since that day, ex-D Day members of 26 have been invited to join all visits of 85 to Graye, and indeed to attend their UK reunions as well.

Photo 3. Laying wreaths on the Churchill AVRE which acts as a Memorial to those killed on the beach

La Place Des RE 3,4

So, primarily because of 85 Company's initiative, Graye-sur-Mer has had a double link with the Corps. The climax of this occurred when a combined group from both units were invited to pay another visit to the now historic site. On this occasion six members of the Corps, including the only two survivors of *One Charlie*, were honoured by being given the Freedom of Graye. Then, in the presence of a French military band and what appeared to be the entire population of Graye, a plaque was unveiled at the newly designated "Place des Royal Engineers".

Monsieur Maurice Schumann, Vice-President of the Senate in Paris, ex-member of General de Gaulle's staff in wartime London and himself a recipient of the honour of the Freedom of Graye, spoke during the festivities. After a powerful and warmly applauded speech in French, he switched to equally forceful English to emphasise the importance of continuing links between the two countries. "I have never ceased to be in favour of British membership of the Common Market" he said, "not for economic but for political reasons. The greater the contacts between two nations, the more ridiculous and unthinkable does war become".

The patient un-ending work done by the Mayor of Graye-sur-Mer and the veterans of 85 Field Company, Royal Engineers, to prove the correctness of this dictum deserve the thanks and support of us all.

3 Field Squadron Do It Again

LIEUTENANT C D S INCE RE B Sc

The Author joined the Army in 1977 on an O-Type engagement and after passing RCB was briefly attached to 28 Amph Engr Regt prior to spending 3 years at Aston University on a Cadetship to read Civil Engineering. After completing 73 YO Course he joined 3 Fd Sqn RE as a Fd Tp Comd. While with the Sqn he has been involved in a great variety of different jobs including deploying with the Sqn on Op Corporate *and taking part in the RE Demonstration to the Army's Staff College.*

3 FIELD SQUADRON of 22 Engineer Regiment have achieved yet another first. This year while involved with the RE Demonstration to the Army's Staff College, 1 Troop constructed a class 60 triple-span Medium Girder Bridge (MGB) with two piers over Finger Lake. The triple-span MGB with two independently erected piers was the first such bridge to be constructed by a field unit outside of the training establishment or trials environment.

The construction of such a bridge should normally only be considered if a raft support for the bridge cannot be used; such supports on MGB pontoon rafts can be placed in eight minutes. These therefore do not come on the critical path for the construction of the bridge. In this particular case the MGB pontoon rafts were not available in sufficient quantity to produce a raft support for the bridge. As a result, it was decided that for the purpose of the demonstration a triple-span MGB with two piers would be constructed.

Lieutenant C D S Ince RE B Sc

The gap to be spanned was a 61m wet gap over Finger Lake. Design for the bridge was based on the *Provisional User Handbook for MGB, Chapter 11, Multi-Span Bridges*. Initially, when it was decided to build the bridge, advice on its construction was sought from the RSME, this however was unforthcoming as at that time RSME had no specific experience of Multi-Span construction; and without this they were not prepared to offer any advice. Advice on the construction was eventually obtained from Lieut Colonel Fitzgerald Smith of MVEE, the Project Officer for the MGB Multi-Span Trials, the advice proving to be invaluable.

Multi-Span MGB bridges can be constructed by one of two methods:

(a) Shuttle Method.

(b) Independently Erected Piers Method.

Construction of Multi-Span Bridges by the shuttle method requires additional stores to those provided with the standard MGB equipment. The most important of these being a "guy steel wire rope". The guy rope used needs to be within a 19–22mm diameter range, the rope being used as a guy system to position and shuttle the piers into place. This rope is attached to the piers by means of the guy clamps, which incorporate carpenters stops. As the guy ropes required for construction by the shuttle method are not on the normal scale of issue, and in this case could not be obtained from local resources in sufficient time for the demonstration, the alternative method of construction, the independently erected piers method, was used.

Construction by the independently erected piers method can be be split into two main parts, the construction of the bridge and the erection and placing of the piers. The bridge is built in a normal fashion on a series of roller frames, span junctions being incorporated in their appropriate positions; while the piers are concurrently constructed and placed using the MGB pontoon raft. Once this has been done the bridge is then boomed over the pre-positioned piers.

Looking firstly at the construction of the bridge, this follows a standard MGB construction sequence with one or two minor differences. Amongst others, the span junctions are incorporated next to the final portable pier positions, anchorage pins being pre-positioned during construction on either side of the span junctions. These pins being used so that diagonal bracing can be incorporated to prevent torsion of the bridge.

The piers are constructed in the following sequence:

(a) Construction of Raft.

(b) Assembly of Pier on Raft.

(c) Positioning of Raft on Bridge Centre Line.

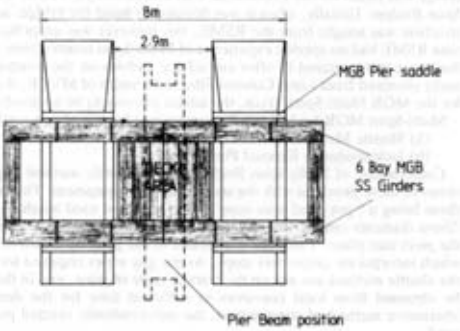
(d) Stabilization of Pier and Raft Removal.

To construct the raft, two MGB pontoons were placed side by side in the water and a six-bay SS (single storey) MGB platform was craned on to them and attached to the pontoons by means of the pier saddles—see Figure 1. The MGB platform being attached to the pontoons at 2pO and 6pO. (2pO and 6pO refer to points on the MGB Bays—these points are numbered 0 to 7 and are generally used as reference points for Centre of Gravity calculations when booming the bridge).

Pier beams were then assembled on the bank and housings attached with articulators in position. This was then placed by crane on timber packing on the raft and strapped to it to prevent it rolling on its longitudinal axis. The base and first pier leg section was then placed through the housing using the crane. The raft was then rotated through 180 degrees and the other sections were placed in their housing. The puller frame was fitted and X and Y pullers attached (X and Y pullers refer to the Tirfor Jacks used to raise the pier up its legs—the X puller is a horizontal pull and the Y a vertical pull). The legs were then lowered one at a time and connected to the pier grillage beam, which had been pre-positioned athwartships on the gunwales of assault boats located under the leg housings.

Having assembled the pier on the raft it was towed on to its position on the bridge centre line using assault boats with Outward Motors (OBMs) fitted. Four Anchors

Figure 1 (taken from PUH for MGB chpt 11)



Improvised MGB Pontoon construction raft

Earth Holdfast (AEH) sets with pullers were located on the banks, these being attached by puller cables to the corners of the raft. The pier was then brought into its final position by adjusting the puller cables. The positioning of the first pier proved to be comparatively straightforward, the second pier in relation to the first had to be quite accurate so that the piers and span junctions coincided and the bridge locked on to the piers. Once in position the piers were secured by means of the puller cables attached to the AEH sets on the banks.

After positioning the first pier, its legs were lowered and once firmly in place, the retainer straps released and the raft removed. The second pier was then positioned. The bridge was boomed over the first pier and locked on, then the piers were anchored to AEH sets on the banks by means of pullers and puller cables. Once

Photo 1. View of undecked bridge supported on two piers

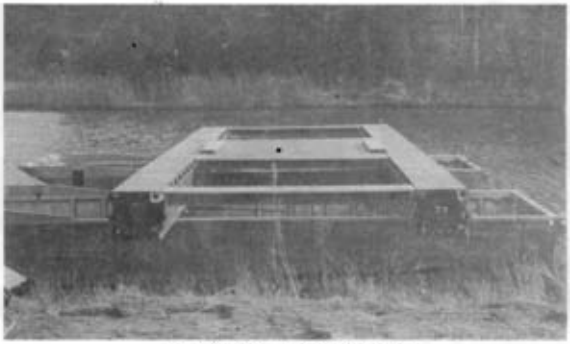


Photo 2. MGB Pontoon construction raft

secured the legs of the second pier were lowered and the raft removed.

Once the piers were in position the bridge was boomed over them. The bridge was then anchored, and decking was completed. The bridge itself was used as a foundation for a spectator stand for Part II of the demonstration—"The Reserved Demolition".

The hardest part of the construction turned out to be the positioning of the second pier relative to the first. In this particular case despite great care in its positioning, it turned out to be 150mm out of place laterally and 50mm longitudinally.

Photo 3. Raft with assembled pier on it

3 Field Squadron Do It Again 2,3

Photo 4. Pre-positioning of piers

However, the lateral error was corrected by adjusting the position of the pier beams on both piers, by using the articulators connecting the beam and the pier housing; and the longitudinal difference was overcome by connecting the first pier on to the bridge and then shunting it on to position on the second pier. The sheer fact that this could be done shows that there is a fair amount of leeway in constructional accuracy when using the independently erected piers method. As a result, it would be quite acceptable to build a multi-span bridge by either of the two methods given in Chapter 11 although, in fast flowing water, positioning of the piers by the independently erected piers method might prove to be very tricky.

The bridge could be constructed by a well trained team in a period of six to eight

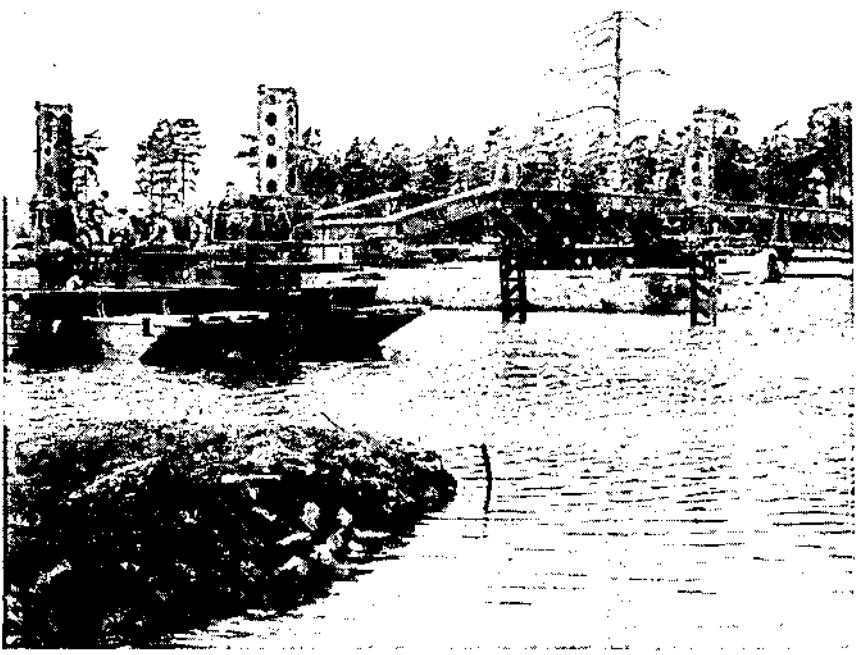


Photo 5. Piers in position ready to support bridge once boomed

hours. However, I would not recommend it as a Combat bridge for a number of reasons. The chief of these is that not only does it take a long time to construct, but it also ties up a very substantial quantity of MGB equipment. To justify the use of such quantities of equipment, the gap to be bridged would have to be of great tactical importance. Such a bridge might be justified however as a Supply Bridge in rear areas if the Army ever reached the stage where it had as much MGB in war reserve stocks as it does Bailey Bridge.

Finally to close, as a one-off, the bridge was not only a challenge to construct but was of great training and interest value. I recommend that for future years the bridge be kept as a part of the RE Demonstration, if only to show foreign buyers the sheer versatility of the MGB equipment.

The Value of Adventurous Training in Today's Army

LIEUTENANT J D W COOPER RE, BA

The Author joined the Corps on a Short Service Limited Commission (he wrote on this experience page 130 Vol 92/2 in June Journal *1978). He went to Oxford on a University Cadetship and after his YO Course was posted to command a Fd Tp in 35 Engr Regt. He is now a Tp Comd in 3 Trg Regt. His interest in the subject of this article arises from several traumatic experiences skiing and sailing.*

THE value of adventurous training is not always immediately obvious, as it is in the case of training involving purely military skills such as shooting. Therefore some thought is required to determine the value of adventurous training. This is especially important at a time when resources are spread thinly to facilitate the many varied commitments of today's Army. Adventurous training provides the soldier with the experience of adventure, an experience supposedly lacking elsewhere in peacetime military life. This assumption must be examined, as must its consequences if true. In the final analysis, the value of adventurous training must be compared with that of other types of training for war.

The trained soldier should know certain skills and how to apply them to solve a problem (for example to remove enemy from a position). Therefore training should teach skills and how to apply them. But certain personal qualities such as leadership, determination, confidence, team spirit, initiative and the ability to communicate undoubtedly aid the soldier in his task and training should also develop these qualities. Skills are best learned whilst based in barracks. The application of skills is best consolidated through a sequence of field exercises each more difficult than the last. Development of character may occur as a by-product of such training. Adventurous training, however, may do this in a way that other training cannot.

Lieutenant J D W Cooper RE BA

By participating in adventurous training soldiers can teach themselves to conquer fear of physical danger. Some adventurous training occurs in conditions of obvious physical danger (for example mountaineering), some not so obvious (for example hill walking). Such danger is rarely apparent in military exercises. Soldiers must learn to work in the presence of danger for obvious reasons. Inherent in the experience of physical danger is the fear of the relevant consequences (death or disablement). The fear itself can be an incapacitating emotion if not controlled, and succumbing to it can precipitate the feared consequences. It is possible that this fear is different to other types of fear such as the fear of failure. Therefore some training for war for soldiers must contain the specific ingredient of fear of physical danger.

The learning process involved in adventurous training is of particular value to the soldier. To start with it is similar to that experienced in other training, in that he learns basic skills. These are then applied in situations which are not too difficult, but where there is an element of danger. The student conquers the small amount of fear he has through his faith in his recently acquired skills and in his instructor. By succeeding in such a situation the student now has increased faith in his abilities. He may even begin to associate the small amount of fear experienced with his success, so that, in future, the fear may act as a stimulant. The student then acquires more skills and, through practice, applies them in increasingly difficult situations, in which he objectively perceives more and more danger, but in which he does not experience a dramatic increase in fear. This is because he is learning to control it. The soldier rapidly learns that the ability to control fear is a vital aid to his success. This is an essential aspect of character development.

In acquiring knowledge and skills of adventurous training the soldier can also develop his abilities to teach, organize and lead other people in arduous conditions. In barracks and on exercise he may be one of many junior soldiers with much the same knowledge, skills and experience as his colleagues. But once he becomes proficient at an adventurous activity he can teach, organize and lead others new to the activity. This will develop his personal qualities and will give him greater confidence. Such a soldier will then be better motivated to take on a more active role in other forms of training as he will realise that he has latent potential to develop.

Becoming aware that one is a member of a team is another part of character training promoted by adventurous training. Without teamwork individuals would be more likely to fall foul of any physical dangers present. It is not always easy in barracks to feel part of a team; especially when members of sections are employed on many separate duties and small administrative tasks. On exercise there is more scope for working as a team since sections are employed as such. But there may not be the same incentive for teamwork as on adventurous training, which may have the excitement of physical danger.

Initiative is another personal quality well developed through adventurous training. For some soldiers it may be difficult to show initiative on other sorts of training. On exercise tasks involve the pursuit of rehearsed drills and set procedures and thus there may not be much scope for initiative from the private soldier. But this personal quality must be allowed to develop for the potential junior non-commissioned officer. Also in war more demands will be made on personal initiative for all soldiers. This will especially be the case where the established leaders become casualties and junior soldiers must step in to lead.

Inherent in the qualities described, and also developed by adventurous training, is the ability to communicate. Any act of initiative may fail if the initiator does not successfully communicate his intentions to others. These abilities develop together. On exercise whilst practicing standard operating procedures communication is mostly downwards. Certainly there is little communication upwards from the private soldier.

The value of adventurous training in developing desirable personal qualities is clear. Because of the stressful nature of warfare some character training for soldiers is required. Adventurous training will aid the soldier to withstand the fear of

physical danger whilst exercising the qualities of leadership, determination, confidence, team spirit, initiative and effective communication. Adventurous training provides an opportunity for any soldier, regardless of his role in uniform, to develop his personal qualities. This is essential training for war which is a time when every soldier may be required to exercise these qualities. The training is also of great value to the Army as a whole since it develops the Army's most important resource—the soldier.

The Korean War: Between June 1951 and August 1952

BRIGADIER E C W MYERS CBE, DSO, BA, C Eng, MICE

EVER since my fifteen months in Korea, I have found it difficult to give a balanced overall picture of the country as it was in 1951. One military wit described it then not only as the bottom of the world, but Pusan, the Army's port of disembarkation on the south coast, as its "arsehole" and all other places further north as in an unprintable position in relation to it. It wasn't quite as bad as that!

Korea once led civilisation in that part of the Far East. But until comparatively recently it had been the local underdog for many generations. As a result, thirty years ago, it was a backward country. The country folk were living at bare subsistence levels and because much of Seoul, its capital and only modern city, had been badly damaged by the war, it had little to offer soldiers when out of the line, who, as a result, spent their few days off every few months in Japan.

Korea is a country of extremes, which need to be experienced to be believed. Although our work as Sappers, in the first ever British Commonwealth Division to be formed as such, was exceptionally, perhaps uniquely, varied, challenging and interesting, the country could hardly have been called a Sapper's paradise. For in paradise one should not have needed to eat salt pills in summer to avoid heat exhaustion. On roads through paradise one should not have been travelling through thick clouds of finely powdered dust on one summers' day and churning through deep mud on the next. In late summer one should not have expected to experience ten inches of rain in as many days, with flood waters on the main rivers at speeds up to eighteen feet per second, breaking up one's bridges; nor, in winter, almost unbearable cold, unless adequately clothed; followed in spring by a thaw with broken ice up to ten inches thick coming downstream liable to pierce and sink the pontoons of floating bridges.

The Korean countryside follows a similar patter of extremes. In winter it is a monotonous and barren looking brown, except when covered by snow. But in spring it can suddenly become incredibly beautiful with colourful outcrops of tiny purple iris and other wild flowers, grain and vegetable crops, surrounding the lower lying expanses of swamped paddy fields; with, in the higher valleys, occasional wild fruit trees bearing blossoms of delicate pastel shades, intermingled with bright yellow forsythia; sandy foothills, often covered with mauve azalea as well as chestnut, with a distant background of fir trees and rugged blue-tinted mountains up to 10 000 feet high.

The Korean people are in general ugly. They are also callous. Because of this, during World War II, the Japanese had frequently put Korean Warrant Officers in charge of their most severe prisoner-of-war camps. But I found them to have quite a lively sense of humour which made them easy to deal with. Throughout my time in Korea we employed up to a 1000 of them, who, when trained as Service Corps Pioneers, greatly assisted our Sappers on many of the more simple types of field engineering, thus considerably increasing our output of work.

The full Commonwealth Division came into existence as part of the United Nations Force in South Korea on 28 July 1951. By then the war against the Chinese and North Koreans had been going on for several months and the initial British contingent, 29th Infantry Brigade Group, had already experienced an extremely uncomfortable winter of mobile warfare, not overwell protected against the elements, bravely helping the original United Nations force to withstand attacks by an enemy which heavily outnumbered them. But by the summer of 1951 this Force had become probably one of the best equipped, best clothed and best fed Army there has ever been and our front had become more stabilised, largely due to our increased strength on the ground and our air supremacy.

Our Division was made up of the 29th Infantry Brigade, which was entirely British; 25th Canadian Infantry Brigade, entirely Canadian and 28th Commonwealth Brigade, composed of British and Australian Battalions. We had a British RAC Regiment of Centurian tanks and the Divisional Gunners consisted of New Zealand and British Regiments RA.

The Divisional Sappers consisted of my small prototype HQ RE, with, as my Senior Staff Officer, a Canadian, Major A J Abbott RCE; and 28 Field Engineer Regiment, under command of Lieut Colonel (later Brigadier) Peter Moore who, already with two bars to his DSO and an MC, was one of the most courageous and resourceful Sapper Officers of his era in the Corps. His Regiment consisted of RHQ, three Field Squadrons and one supporting Field Park Squadron. One of the Field Squadrons had been sent out to Korea the year before from 32 Assault Engineer Regiment, which I was then commanding on Salisbury Plain, to support 29th Brigade. Another, also a British one, included a detachment of New Zealand Sappers. The third Field Squadron was entirely Canadian. The Field Park Squadron was a composite British and Canadian unit.

It can readily be seen that we were a truly Commonwealth formation, with all its elements vying with each other in performance. During my time as CRE, the Sappers received a number of well earned awards, which included an OBE, four MC's, one BEM, two MM's and no less than ten Mentions in Despatches. Sadly, during the same period two officers and eight other ranks were killed and double that number wounded.

Our Division initially took over what seemed to many of us an exceptionally long section of the front, some five miles in overall width. It comprised a series of mutually supported localities in depth, each capable of all round defence and normally of Company strength, in foothills about a mile to the south of a huge river called the Imjin, which, up to 800 feet wide, flowed roughly from east to west across our front. Here, to begin with, we were mainly concerned with improving the strength of our positions to prevent penetration by the Chinese. But, as the summer wore on, we became more confident of our strength and began active patrolling across the Imjin into what was then a "no-man's-land", some four or five miles in depth, between the river and the Chinese main positions further north.

After a partial side-step to the east and then back again early in October, immediately after the worst of the summer rainy season was over, the Division put in a large scale and successful attack against the Chinese in their main hill-top positions, where they were busily digging themselves deeply in, in preparation for the winter. As a result, our front line of defended localities was re-established between five and eight miles north of the Imjin.

In the spring of 1952, peace talks between the United Nations and the Chinese began at a place called Pan Mun Jong, in North Korea. These talks dragged on and on and were still in progress when I left Korea in August. Meanwhile the Chinese dug deeper and deeper into their new hilltop positions and long communication trenches to their almost equally deep support positions, which made it difficult for us to dislodge them. At the same time, they brought up an increasing quantity of medium range artillery, which they used to harass our troops in their forward positions and occasionally to support quite vicious but limited attacks of up to Battalion

strength. This made it necessary for us to dig in to a greater extent than before.

During my time in Korea, our main Sapper activities were due firstly to the necessity to strengthen our defences, both at the beginning and towards the end of this period; secondly to compete against the ever changing and challenging behaviour of the river Imjin; and lastly to the necessity to overcome the lack of roads essential for our day-to-day maintenance and mobility. Continuously superimposed on these were the extremes of climate, especially winter temperatures which affected most of our work; and the cunning, persistence and courage of our main enemy, the Chinese.

To strengthen our defences in our early positions south of the Imjin, we were called upon to assist the Infantry in the laying of a large number of anti-personnel minefields between defended localities. (Photo 1). Thanks to the ingenuity of Captain Nevill Smith, a Royal Australian Engineer on loan to us from the RAE Regiment stationed at Kure in Japan, on Allied post World War II occupational duties, we devised a means of setting the surface of the Imjin alight, should the enemy attack across it in strength. This was done by anchoring, below the surface, a number of oil drums filled with a mixture of napalm and petrol, bringing them to the

Photo 1. Peter Moore, CO 28 Fd Engr Regt and Nevill Smith RAE. It can readily be understood how anti-personnel mines laid with trip wires when this sort of ground was bare, were prematurely detonated on a large scale by the thick summer undergrowth. One of the many lessons learnt the hard way!

surface and setting them alight by means of small explosive charges by remote control. We never had to use these devices operationally because, before we had gone into full production, we advanced across the Imjin and drove the Chinese well back from the river. During our trials, however, we had some anxious moments when an experimental drum, fully alight, accidently broke loose from its anchor and started sailing down the river, towards a bridge across the Imjin on the front of our neighbouring American Division. Fortunately it was successfully sunk by rifle fire in time.

Another device which we installed in quite large numbers before our advance across the Imjin was a flame or illuminating *fougasse*. This basically consisted of a container filled with napalm, which could be propelled some fifty yards, to light up areas or deny their use to the enemy. This was particularly useful owing to the wide front for which we were responsible and the distances between our all-round defended localities.

Small parties of Chinese were always liable to penetrate by night between our forward positions and make a nuisance of themselves in the rear areas. They usually wore rubber soled shoes; sometimes they were barefooted. We decided to take advantage of this custom by getting the Field Park Squadron to manufacture welded steel tetrahedrons with two-inch long spikes. But again, before we had gone into mass production, we moved forward and by the time our lines were more or less re-established, the Chinese had become more interested in strengthening their new hill-top positions by digging deep defences and lines of communication trenches on a World War I Western Front scale, than in marauding by night behind our lines.

Whilst on the defensive our Regiment of tanks was often used in twos and threes, in hull-down positions, to strengthen forward positions. The supply of ammunition to them became a problem, due to lack of tracks suitable for two-wheel drive supply vehicles. This problem was solved by the manufacture, by our enterprising Field Park Squadron, of heavily timbered sledges, strong enough to be towed by tanks across all but the roughest country. One was once seen being dragged through the Imjin, reportedly at 20mph, with no ill effects to sledge or load!

The revetment of trenches and the construction of mortar and shell splinter-proof roofs to hillside shelters and dug-outs, in our new positions north of the Imjin, called for a large quantity of timber logs of all sizes. Some thirty miles to the south, we developed a large lumber camp near a huge fir forest. Here, some of our Canadian Sappers were in their element. We brought forward some hundreds of tons of timber from this source for our forward defences. (Photo 2).

Now for the behaviour of the river Imjin. In the spring and early summer it flowed peacefully and harmlessly between 650 to 800 feet wide banks, being less than three feet deep at two crossing places on our front. It was fordable there by both men on foot and tracked vehicles. As a result, in the early days of the Division, we soon started patrolling actively across the river into "No-man's-land", probing the enemy's defences. Sappers almost invariably accompanied these patrols, mainly to identify and clear scattered enemy mines.

Between mid-July and September, however, during the period of heavy rainfall, the river could and often did rise at the fantastic rate of two feet per hour to a depth of thirty feet or more, developing speeds of between 14 and 18 feet per second. During this period it seldom subsided to its gentle early summer trickle and it remained in the order of at least ten feet deep, even at the fords. As our General, Jim Cassels, wished patrolling to continue, we were called upon to establish a number of ferries. Unfortunately, as none of either our or the Americans' various types of floating equipment were designed to operate in currents in excess of an absolute maximum of 8 feet per second, we were frequently unable to use them. As a result of the additional hazard of debris, we lost some of the cables on which a number of our ferries operated and later on, when we had built two floating bridges across the river, on many occasions they had to be temporarily swung into the bank.

Photo 2. Korean Service Corps Pioneers at work at our RCE Logging Camp

These excessive floods resulted in the use of aerial ropeways, to help supply our forward troops permanently north of the river, pending the construction of more substantial fixed bridges on piled foundations, built by American Corps of Engineers. Before the completion of the first of these bridges, we found what was in those days a comparatively new item of Field Engineer equipment, a rocket propelled holdfast, extremely useful. This was used on more than one occasion quickly to re-establish ferry cables across the river after they had been broken by debris or had been let go at one end to avoid being broken.

As soon as the really cold weather arrived in December and large sections of the river began to freeze, the vertical movement of pontoons of floating bridges, espe-

Photo 3. An amphibious vehicle breaking up the ice above one of our bridges across the Imjin

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cially when under load, was liable to cause them to be punctered by the ice. This necessitated permanent maintenance gangs to keep the ice clear, until we obtained some amphibious "buffaloes" to break it up. (Photo 3).

By the early summer of 1952, we had two lovely looking fixed span bridges across the Imjin on our front, built remarkably quickly and efficiently by American Corps Sappers. So we were no longer dependent upon floating bridges or ferries, except in an emergency. But, not totally unexpectedly, the Imjin had the last word; for during a flash flood in July 1952, in spite of all our attempts to save our two bridges, for one of which we had already built robust "shear-waters", I witnessed a pier with two adjacent ninety feet spans being swept away downstream, just as if they had been made of matchwood. Fortunately we suffered no loss of life in this incident. (Photo 4).

When the Korean war began there were few roads strong enough to stand up to heavy military traffic and nothing like enough of them to meet our requirements, particularly in the forward areas. Most of the roads which existed in 1951 were of earth or earth and a little stone, consolidated over many years. Although when crossing paddy field plains they often stood on four to six feet high embankments, those which had any foundations at all were too thinly laid for our purposes. After a little rain they soon collapsed beyond repair and had to be completely reconstructed.

During my fifteen months in Korea some 70% of our Divisional RE effort was devoted to roadwork. We built over fifty miles of main supply and subsidiary stone-based roadways on properly shaped and drained formations; and many more miles of all-weather tracks to forward units, nearly all of them with gravel and therefore gradeable wearing surfaces. No bitumen and virtually no cement were available. All our stone and gravel had to be won locally from quarries and gravel pits, which we had to develop from scratch. We soon had on loan from our delightful American Corps Chief Engineer, Colonel Itchener, some thirty pieces of heavy earth-moving and stone-crushing plant and it was noticeable how quickly we learnt how to become "plant conscious" and to make full use of it.

Most of our road problems were caused by the elements; by the fantastically heavy rain storms in July and August; the extremes of cold in winter, when all

Photo 4. Early stage of the Imjin in spate. In spite of the "shear-waters" we lost a pier and two spans of this bridge a few days later

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except low-lying, sheltered, ground was deeply frozen down to two feet on northern faces; by rapidly freezing snowfalls, tending to make the roads like ice rinks before the snow could be cleared; by "heaving" or "boiling" and collapse of road surfaces, often in the most unexpected places, during the spring thaw; and last but not least, by the problem of dust suppression in the early summer and autumn, especially in the forward areas, to distract enemy shelling of our supply routes, for which our Corps Engineers managed to produce for us large quantities of salt.

For effective road construction during the heavy rains, especially across low-lying ground, we quickly learnt the lesson that to achieve rapid progress it was essential to install adequate intercepting and site drainage before any earth-moving plant, leave alone any foundation building, was allowed on site. When our calculations of the necessary size of waterways under roads would have called for an impracticable quantity of culverting we freely resorted to the use of stock span bridges, using Japanese rolled steel joists, with stone faced abutments to prevent scour, or to "Irish" bridges or longer lengths of low causeway with well cambered stonework foundations to take floodwater over rather than under the road.

We were properly into the winter weather, with nightly temperatures registering between 30 and 40°F of frost at Division HQ, more on the hills, when we were ordered to build a new main supply route at the utmost speed up a steep moraine filled valley on to a high plateau with now deeply frozen ground and on to a mountain pass, where some American Engineers were to meet us after constructing an almost equal length of new road from the other end. Until deeply embedded boulders and the ground beneath them had been broken up by explosives, it was impossible to use even the heaviest earth-moving machinery. For several weeks we expended explosives on this roadway at the rate of nearly a ton a day.

The spring thaw gave us surprises, as well as problems. We expected some low-lying sections of our roads across wide paddy fields to give us trouble. In many cases they gave us none. On the other hand some sections on high embankments at times looked more like ploughed fields than roads, the stone base and wearing surface literally changing places with the sub-grade. This we thought was sometimes caused by the sub-grade having been frozen after the summer rains still with a high water content, due to inadequately sealed stone courses above. On thawing out in the spring from the top downwards, the upper layer of sub-grade under pressure of traffic had only one outlet, upwards through the stone base. Many of us witnessed road "heaving" or "boiling" for the first time. One senior officer, returning one evening from visiting a near-by Mess, thought he really had taken "one over the odds" when, in the headlights of his jeep, he thought he saw a foot high mound of road surface, stone base and all, suddenly rise up from the rest of the road a few yards in front of him. It took a bit of explaining that in all probability he had actually seen this happen, having been caused by lenses of sub-grade being unable to expand in any direction but upwards.

A short while before our attack across the Imjin early in October, I succumbed to an attack of acute sinusitis. This was due to the many hours I spent most days travelling on heavily dust blanketed roads, visiting widely scattered Sapper detachments. I was evacuated to a British General Hospital at our base in Kure, Japan, where I was operated on by a most competent ENT Specialist in the RAMC. After about a fortnight in hospital, I spent a week in a British run Convalescent Home on the shores of the beautiful Island of Miya Jima, regaining my strength before returning to Korea.

This period in Japan gave me not only an opportunity to see a little of the way of life of this strangely reserved people in their lovely countryside, but it also enabled me to make close friends with the Australian Base Engineer Regiment at Kure. This RAE Regiment became of great help to us in Korea in many ways, such as undertaking base repairs to our heavy plant from the UK, and assisting in the acclimatisation and jungle training of our battle reinforcements. Lieut Colonel Peter Jackson, its commander, who later became Chief Engineer of the Australian

Army, and his charming wife, Joan, became life-long friends. And my two, all too short, trips far into the country with his second-in-command, Don Cooper, living in native fashion in small rural hotels, are unforgettable.

In the middle of November the Engineer-in-Chief, General Pat Campbell, came out from England to visit us. He spent three lovely sunny days in the forward area and was able to see practically every Sapper and all our main activities. The morale effect of his interest in everyone and everything and his cheerful disposition, was tremendous. When he got home he kindly telephoned my wife to report on my good health and on the luxury of my private lavatory, another delightfully human and indelible incident, which my wife still greatly enjoys recounting.

With increasingly low overnight temperatures we learnt to pay attention to a number of necessary precautions. For instance, to ensure that our heavy plant and vehicles would start up in the mornings, after work we re-filled fuel tanks to the brim, to prevent water condensation and then ice formation in the fuel systems. We never parked overnight on soft ground. We cleaned off all mud from tracks and rollers of plant and fully greased them to push water out of track lubricating systems. At waterpoints all our storage tanks and filters had to be housed in heated tents or shelters, where our pumps and emptied hoses had to be placed before nightfall.

The knowledge that at the end of a hard day's work, all Sappers not on night work, such as accompanying patrols into "no-man's land", mine-laying, booby-trapping or strengthening our forward defences, had a warm and reasonably comfortable hole to go to, was a great morale raiser. It was equally important to officers, who often had to think and write late into the night after an active day in the open.

The Korean way of installing central heating, was to build broad flues under the floors of their homes. In Seoul there were some elaborate such systems. Even in the "mud and lath" walled and thatched shacks in the poorest villages the principle was the same. They built a fireplace outside at a lower level than the floor. The flue from this led straight into one or more broad flues under and right across the floor of the living room, coming out at the far end into a normal vertical flue or chimney. Many of our locally enlisted Korean Service Corps built for themselves this form of under-floor heating in their hillside shelters and even in their tents. A large number of our troops not in the forward areas copied them. "Space heaters" were widely used for heating our shelters, tented offices, messes and caravans. Petrol, of which there was no apparent shortage, was their main fuel. Although more dangerous, it was cleaner to use than paraffin or diesel. As there was always a shortage of factory made "space heaters", all sorts of improvised adaptations could be seen in the Divisional area, mostly made out of used 25-pounder gun charge containers, a little copper wire, a 4-gallon petrol tin and, if refined a tap; if most refined, with a "space heater" type of home made carburettor. The fire hazard from these heaters in British made tents was considerable as, unlike American tents, they were not impregnated with any fire proofing mixture.

Shortly before the end of my tour of duty in Korea we were sent out from UK a detachment of about a dozen dogs, reputedly trained to detect and "mark" buried mines, by sitting down when locating one. They arrived with their handlers. Some of the dogs turned out to be distinctly "gun shy". Up to the time I left we had found them to be more useful on silent night patrolling, in alerting our troops to the presence of Chinamen, especially dead ones, rather than to the presence of mines!

Before the beginning of my tour I had been flown out from the UK with other senior officers of the new Division via Singapore and Hong Kong. When, in August 1952, it ended, I was able to complete my encirclement of the globe, thanks to a kind invitation by the Royal Canadian Engineers to be their guest on my way home via the RCSME at Chilliwack, their Yukon outpost at Whitehorse, Toronto and the RMC Kingston.

And so ended a memorable year.

An Attachment to the US Corps of Engineers

MAJOR P M ARMSTRONG RE, B Sc (Eng)

The Author was commissioned from RMA Sandhurst in July 1969. He attended No 26 Degree Course at RMCS Shrivenham between tours as a Tp Comd in 53 Fd Sqn (Airfds) in the Trucial States and 12 Fd Sqn in BAOR. He was 21C of 33 Indep Fd Sqn RE in Antrim and then GS03 Engr 1A in Whitehall. He has just completed No 28 PET(C) during which he was attached to the US Corps of Engineers.

Organization

For readers unfamiliar with the organization of the United States Corps of Engineers (USCE) I should explain that it has much wider responsibilities than the Corps of Royal Engineers. In addition to the uniformed units forming an integral part of the US Army orbat, the USCE has a 37 000 strong civil and military works organization commanded by military personnel but with about 98% civilian staff. The latter organization is responsible for a civil works programme within the USA and a military works programme in support of the US Army and USAF worldwide.

The civil works programme is aimed at developing water and land resources, planning and executing national programmes for navigation, flood control, water supply, hydro-electric power, pollution control and recreation areas. The military works programme provides for the construction and maintenance of almost all permanent facilities used by the Army and the Air Force. The budget for both programmes and for the running of the Corps itself is voted annually by Congress.

Role of the Works Organization

The Corps acts as the promoter and consultant engineer for the projects in its civil and military works programmes. As the promoter, the Corps defines the requirement, obtains legal authority and funds for the project. As the consultant, the Corps may either produce an in-house design or award a design contract to a consultant, in the latter case the design is vetted by the Corps. Once the design is complete and the project approved the Corps invites tenders from civilian contractors and a construction contract may be awarded. On most civil and all military works the Resident Engineer and inspectors appointed to supervise construction are Corps employees.

The Savannah District

My attachment was to the Savannah District of the Corps, one of thirty-six Corps Districts nationwide. The District employs over 1000 staff of whom 700 work in the District Office in Savannah. The District Engineer, a full Colonel, is responsible for civil works in 70% of the river basins of Georgia and for military works throughout Georgia and the two Carolinas. The military bases within this area would comfortably house half of the British Army and the entire Royal Air Force, complete with equipment. The annual construction budgets are currently about $120M for civil works and $160M for military works.

On the civil works side the District's major construction project is the $500M Richard B Russell Dam and Lake situated on the Savannah River, 160 miles north west of Savannah. This was the project to which I was assigned for my site attachment.

An Introduction to Georgia

My wife and I arrived in the nearby City of Elberton, Georgia, (population 8000) at the end of April 1981. Our journey had been broken for a one day briefing by the British Defence Staff in Washington and two days at the Savannah District Office where we received a warm welcome from the District Engineer and his staff. The transition from blizzards in England to a temperature of over 30°C in Savannah and

90% humidity was just the first of our adjustments. On arrival in Elberton we took up temporary residence in the best of the two motels and set about solving two important problems, where to live for the next ten months and how to get about.

Elberton is a good example of the thousands of small towns found throughout the USA and in which about half of the population must live. The city proclaims itself "Granite Capital of the World" and boasts several granite quarries, over ninety granite sheds mainly producing monuments, and a granite museum. The city's principal features are ribbon development along the railway line and main roads leading into town, a central square surrounded by a few ailing shops and a courthouse, two motels, three supermarkets and four automobile dealerships (each with dozens of new cars on their lots). It is claimed that the town has the highest number of millionaires per head of population in the country. The presence of twenty-seven practising attorneys in the town and some fine neo-colonial mansions set in the woods, lends weight to this claim. The nearest large towns (population 40 000) are thirty miles in opposite directions and the nearest "real" city, Atlanta, is 100 miles away. The country for fifty miles around is undulating covered by a mixture of fine forest and poor farmland, offering only tree covered horizons.

By the end of our first week in Elberton we had signed a lease on a "modest" 3-bedroom house, spent a fortune on furniture and 110V electrical goods, and were negotiating to buy a new car. The last a 5-seat, air conditioned, 2.8 litre automatic, was locally termed "a compact"!

The Richard B Russell Project

Planning for the Russell project had started back in 1968, with work on site starting in 1976 and a planned completion date in 1985. The project consists of the following main elements:

(a) Construction of a 1640 feet long concrete gravity dam of up to 195 feet in height, flanked by earth embankments totalling 3000 feet in length.

(b) Construction of a powerhouse containing 8×75MW turbines, four of which will be reversible for pump storage.

(c) Relocation of existing road and railway lines affected by the formation of a lake twenty-five miles in length covering forty-two square miles. The three roads and the single track rail line which cross the Savannah River are retained by realignment and construction of embankments and new bridges. About fifteen new bridges are required to carry roads, tracks and railroads across several small valleys which are to be submerged.

The Resident Engineer's task is to administer all the contracts associated with the project. When I arrived on site at the beginning of May 1981 the Resident Engineer staff consisted of about fifty personnel including five civil, two electrical and two mechanical PQE's, two geologists, four contract administrators, about thirty construction inspectors including graduates, undergradutes, technicians and tradesmen, and five secretarial staff. About 900 000 out of the one million cubic yards of concrete required to complete the concrete dam were in place. The dam was far from complete however as much of the more complicated work remained and work on the earth embankment was still at an early stage. The powerhouse contract was not due to be let for another five months and several relocation contracts had not yet been awarded.

The Resident Engineer informed me that I was to work as his Project Engineer on the relocation of a road which crossed the Savannah River about twenty miles upstream of the dam. The contract was due to be let in early June but protests over the two lowest bids delayed the award. The postponment gave me time to work with the engineers and inspectors on all the main contracts, and provided me with valuable experience in contract procedures, construction practice and the use of plans and specifications.

Work as a Project Engineer

As a Project Engineer I was the Resident Engineer's site representative. My duties were to interpret the contract plans and specifications to ensure by inspection

that the construction complied with them, and to administer the contract. Administration included everything from drafting letters to measuring up completed work, submitting progress reports, and in conjunction with the Design Section in the District Office, approving: temporary works designs; amendments to the plans; additional works and payment requests. I was fortunate enough to have assigned to me one of the Corps inspectors who had worked on the much larger road bridge, recently completed, downstream. His practical experience and local knowledge were invaluable.

The Savannah River contract required the construction of a 914 feet long, six-span bridge, together with half a mile of approach road on each bank. The bridge deck was to be of composite construction continuous except over the centre pier, and supported on five reinforced concrete piers of up to one hundred feet in height. The contract was awarded in mid July at a price of $3.8M. The deadline for completion was 23 January 1983 with a $200/day penalty if the contract was completed late.

In late August I was allocated a second road relocation contract close to the Savannah crossing. This contract required the construction of a permanent 220 feet long bridge and half a mile of approach road across a small river valley called Coldwater Creek. The new bridge was to be on the existing alignment so a temporary diversion and bridge were also required to keep the route open. The permanent bridge was to consist of three spans with reinforced concrete piers carrying pre-cast beams and a cast-in-situ deck. The design of the temporary bridge was unspecified except for its position, size and load capacity. The bid price for the temporary and perment works was $0.8M and contract duration was one year starting in early September 1981.

Both contracts were reserved for small firms under the terms of a Federal Government programme, and both were awarded to local firms specialising in bridge construction. Each firm subcontracted the earth moving and road construction work; however, they retained overall responsibility for completion under the terms of their contracts.

Photo 1. View of the Savannah River Crossing site from the Georgia bank taken early in November 1981, showing construction of the first two cofferdams in progress. The "Old" bridge, dating from 1926, is on the left, 200 feet upstream of the new alignment

Photo 2. View of the Savannah River Crossing site from the South Carolina bank taken in April 1982 shortly after my site attachment finished. The foundations of four of the five piers were complete and the columns of three piers well advanced

During my tour of duty as Project Engineer, which lasted until early March 1982, the majority of the foundation work was completed on both contracts. I had heard previously that the majority of a contractor's problems occurred during the preparation and construction of foundations, however I had never seen this at first hand. The Coldwater Creek contract produced no major problems, but the Savannah crossing produced a series of setbacks for the contractor which could have been very costly. He hit trouble on the first river pier on which he started work, as the *single borehole record for the pier was not representative of the underlying strata.* It took him three months to cast the footing for this pier, against his planned time of one month. The first month was wasted drilling underwater for a blast of what was later found to be badly decomposed rock. The second and third months were spent building a cofferdam, using twenty-five feet long sheet piles. The piles were eventually driven to below the winter season daily high water level—release of water for power generation at the dam upstream would raise the river level as much as eight feet in height for several hours each week day. At one stage work was only possible on the cofferdam over weekends.

At the same time as work on the first river pier was falling behind schedule, work was just starting on the first of the two piers on the banks. To save money the contractor planned to improvise a cofferdam for this pier using a framework of steel joists to hold a timber lining in place. One corner of the cofferdam was less than six

feet from the river bank and one day when excavation was almost complete the cell flooded and a ten feet length of river bank disappeared. The improvised design was abandoned and all available lengths of sheet pile were driven to form a wall around the cell. The cell failed once more when the river rose unexpectedly one day, however the foundation was eventually completed two months late.

By the time the contractor started on the next pier he had decided to mend his ways. The task was completed in the four weeks allotted, however this still left him two months behind schedule with no cheap and easy way of catching up. Luck was on his side however, as when he started work on the centre pier in mid river, he discovered that the ground conditions were completely different from those given in the borehole record for the site. At this point I had to depart from my design attachment, but I heard later that the contractor had successfully claimed time and money for the change.

Design Work

To undertake the design phase of my attachment I transferred to the District Office in Savannah, since no design work was undertaken at the Dam. In early March 1982 my wife and I moved to an apartment in Savannah which was to be our home for the remainder of the tour, and I began work in the Structural Section.

The Section establishment was twelve engineers and a secretary, and its task was to provide design support for both the military and civil works programmes. I was assigned to the military works programme since it was felt that this would provide the best experience for me. After a couple of days of introduction to the computer facilities I was given my first project. The task was to design a roof system for a $6M helicopter hangar to house up to six Chinook helicopters. The proposed dimensions were 245ft × 170ft in plan with the 170ft dimension being a clear span. Two bridge cranes, each with a 2½ ton lift capacity, were required to cover the whole hangar area. My brief was to produce a design using steel trusses.

Several weeks later, having tried various layouts, using different truss spacings, depths, and types of sections, I submitted my design. My next task was to design the columns required to support the trusses and a bracing system to carry the wind and seismic loads. Having completed this work the inevitable signal arrived—"Stop all work on the Chinook hangar, priority has changed, hangar now required for Blackhawk helicopters". There being no similarity in the proposed layout of the hangars my work was shelved.

Whilst decisions were made about the revised hangar concept I produced a set of footing designs for a vehicle workshop and a structural report on an equipment failure in a sewage treatment plant. The item which had failed was a simply supported box steel shaft, 27ft in length, formed by welding together two U-shaped sections of inch-thick steel plate. The main axis of the shaft was horizontal and central to a set of cylindrical polyethylene packs, the complete assembly was called a rotating biological contractor unit. The unit was partially immersed in waste water and slowly rotated so that active biological growths occurred on the unit which treated the water.

My structural analysis led me to the conclusion that the effects of fatigue had been ignored by the designer and manufacturer of the equipment. The weights of the shaft, pack and biological growth were well within the allowable static limits for the section, but grossly below those required for a welded structure with an expected ten million loading cycles over twenty-five years. It appeared that the other fifteen units at the plant were also likely to fail prematurely, so the lawyers were called in. At the time of my departure the matter had not been resolved and a protracted dispute seemed likely.

Agreement on the revised helicopter hangar layout was finally reached a month before my departure, so I was able to spend the last few weeks designing the roof of the structure. All too soon I had to hand over the project to another engineer and pack up to return to Chatham. The preceding eighteen months had provided me with a wealth of engineering challenges and experience.

Lest I give the impression that my stay in the USA was spent entirely at work. I should admit that I did take some leave. The first summer we were almost washed into the Atlantic when six inches of rain fell on our campsite in Charleston, South Carolina in one day. At Christmas we discovered that Vermont has an even colder climate than Scotland, but the skiing is better. In March 1982 we visited some of the attractions in Florida, and during the summer we drove to the West Coast and back and decided that we could have done with an eighteen month extension to our tour!

The Edinburgh and Heriot-Watt Universities OTC. Who?—What?

WOI (RSM) J B MIDDLEMASS RE

The Author joined AAC Chepstow in Jan 1960 and left as A/T RSM some 3 years later. After a tour with 8 (Rly) Sqn at Longmoor he was posted to Aden on formation of 63 MELF Pk Sqn. With 38 Engr Regt he was with 32 Sqn, was promoted to Sgt and then with 73 Fd Sqn with whom he served a tour in Bahrain. Having broken a leg, which cost him a tour in Singapore with Comb Svcs Soccer Team, he returned to Ripon and was posted to Jnr Ldrs Regt Dover. From 1973 to 1981 he did 3 tours in NI, in 1974 became QMSI and in 1978 SSM 16 Fd Sqn. In 1981 it was back to Dover as QMSI Skill-at-Arms before taking up his present appointment in April 1982. An all-rounder, he has played soccer and still plays cricket and squash and is keen on shooting (full bore, musket and game) as well as painting in water colour and acrylics and making terrrariums.

"Before I came here I didn't know what an academic was, now I is one!"

University Officer Training Corps are probably as unfamiliar to most readers as they were to me when I arrived as RSM at Edinburgh and Heriot-Watt UOTC. This UOTC is one of nineteen, of which three have RSMs from the Royal Engineers and four are commanded by Royal Engineer Lieut Colonels—three Regular, one TA. At present about 40% of newly-commissioned Officers into the Regular Army come from the Universities, indeed in 1981 some 50% of new Royal Engineer Officers were awarded Universtity Cadetships and Bursaries or were University Graduate entrants. Thus OTCs can play a significant part in the Training Organisation and greatly affect commissions within the Corps.

I arrived in Edinburgh to find myself initially accommodated in the historic Castle, which dominates the skyline. The University of Edinburgh is the *newest* of the *old* Scottish Universities and celebrates its 400th Anniversary in 1983. The origins of the OTC go back to 1859. On 24 May 1859 Professor Robert Christison convened a meeting of students in the Old Chemistry Classroom. Such was the enthusiasm that about 500 turned up and the meeting was transferred elsewhere. There was, as is usual among students, a hostile faction, but he is reported to have dealt with them with great tact. Afterwards 110 members were enrolled, the first enrol-

WO1 J B Middlemass RE

Photo 1. Demolition

ment of any volunteers in Scotland and they became the "Rifle Volunteer Force" later known as No 4 Company, The Queens City of Edinburgh Rifle Volunteer Brigade. The University of Edinburgh OTC came into being in 1908 as part of the Haldane Reforms, out of which the Territorial Army grew. The unit title was modified in the present form, shortly after the formation of Heriot-Watt University in 1967. Both Universities have property in the centre of the city and the OTC is nearby in the Old Edinburgh Rifle Volunteer building, so preserving our link with our founders. On entering through the stone archway, it can be seen from the partly worn stonework, that the HQ was rebuilt in 1905 and opened by *FIELD MARSHAL: HRH THE DUKE OF CONNAUGHT KT* and *COLONEL SIR ROBERT CRANSTON VD* (Colonel Commandant of the Brigade and Lord Provost of Edinburgh). The building is also shared by other departments of Edinburgh University. The Commanding Officer, Lieut Colonel W D Cooper TD, B Sc, Ph D, MRIC, REME(V), commands a Regular Staff of two Officers; an RSM, and four Sergeant-Majors; other posts within the units are filled by TA personnel.

It may be that the much publicised image of University life is often dominated by the vocal left wing, which is anti-military. However we have no problem in recruiting as the OTC provides an opportunity to develop leadership skills through partaking in a wide variety of activities. Some students also find that the pay supplements their grants, others are clear in their aim to achieve a Commission. The Officer Cadets join one of the following sub-units: Royal Artillery, Royal Engineers, Infantry, Royal Electrical Mechanical Engineers, Royal Signals. Up to 30% of cadets may be women, who take an equal part in all activities, this includes without exception digging trenches and building the Medium Girder Bridge (MGB). The young ladies put on the "cam" cream like veterans—once they are told it is made by Max Factor—but after bridge construction, the girls are prone to Arm Stretch! Walking around grazing their trailing knuckles on the ground is not a pretty sight, they do, never-the-less, keep up well with their male counterparts!

It is hoped that interest in the OTC will foster an understanding of the Army and

The Edinburgh And Heriot Watt Universities OTC. Who What 1

its part in Defence Policy. The importance of good military training has been emphasised by the recent Falklands Campaign. For many potential Officers whose careers may start in the UOTC, the basic training consists of military skills, leading to a Certificate of Military Training (CMT). Following this is a Special-to-Arm stage, after which those who have demonstrated qualities of leadership are given tuition as Junior Officers.

As a group of young people, the students are of above average fitness. This was brought home to me after seeing them perform on weekends; when I likened them to greyhounds. Not to be outdone by these budding athletes and having recently passed my Basic Fitness Test (BFT), I secretly loaded my 10-speed cycle, in preparation for the big day, the UOTC BFT! Although Claro Barracks, home of 38 Engineer Regiment, was sadly almost empty, due to their many commitments, including the Falklands, the sight of forty or so scantily clad female Officer Cadets straining at the starting line, suddenly turned the barracks circuit into an Olympic Stadium. From a birdseye view the start would have looked like the London Marathon! 5-4-3-2-1-*GO*—like a flash out of nowhere the RSM leapt into the lead on his flashy green racing cycle much to the dismay of the super-male cadets who all wanted to lead! With this cycle I managed to eventually push—by pacing—the greyhounds, and to coax—by dismounting and pushing—the tail enders around the course. For the past two years—including the former episode—the unit, including all Regular and TA Staff, have won the Tickle Basic Fitness Test in Scotland.

The three-year training programme reflects the "academic year" and is divided into three terms. Officer Cadets join the unit in October in their first University term. In each term there is basic training alternating with Specialist Training, relating to Corps or Regimental affiliation.

The two-week Summer Camp, the highlight of the year, takes place during the Summer Vacation and is an annual event. It is the Cadets' first opportunity to practice their individual and group skills in a realistic environment. It is in this situation that Officer Cadets learn the functions and qualities required of a leader. It is necessary to strengthen confidence by a supportive approach to training, rather

Photo 2. Improvised Rafting

The Edinburgh And Heriot Watt Universities OTC. Who What 2

Photo 3. "Brig O' Glen Dui" nears completion. Parts of works team in foreground. *(Photo from local Aberdeen newspaper)*

than being completely driven. The choice of one of the two methods is obviously determined by circumstances and the individual.

In the second year emphasis is on the Certificate of Military Training (CMT) with examinations in the Easter Vacation. In the third year Special-to-Arm training is available, but it is in this year that military training takes second place to academic pressure as students take their final exams.

RE tasks are undertaken on Weekend Exercises in the form of Bridging, Demolitions, Minewarefare, Field Defences and other Basic Combat Engineering practices. An annual RE sub-unit project is usually a task similar to the one undertaken last year, which was to build an improvised three-span timber footbridge. The Nature Conservancy Council were the sponsors and the site was within the estate of the picturesque Forest of Glen Tanar. All timbers for the bridge were supplied from the estate and three 150-year old larch trees were used. The Factor (Estate Manager) kindly consented to open the bridge, and after the tape cutting ceremony all who built the *Brig O' Glen Dui* walked across to be greeted with a sip of champagne.

On this type of project the Cadets enjoyed the opportunity to carry out some practical building on a permanent task which gives them a chance to use their initiative by planning the works programme and learning at first hand from their mistakes and successes.

The flourishing Pipes and Drums Band with Highland dancers also publicise Edinburgh and Heriot-Watt Universities OTC and by sponsoring those musicians it again fosters the link between the Army and the Community.

It is stimulating working with the enthusiastic and interested students. The Permanent Staff need to match their enthusiasm with drive and efficiency, for the UOTC is only as good as its staff. Should the staff not measure up to these qualities then there is a tradition at the end of the annual camp of a "Review" in which the Officers and Staff are satirised. This is done aptly and amusingly in the best University tradition.

The Edinburgh And Heriot Watt Universities OTC. Who What 3

Early Days

MLC

As with the Falklands in 1983, the *RE Journals* in 1883 were much concerned with the happenings of the Tel el Kebir campaign. Technically the main problem had been to move the maximum tonnage by rail (roads across the desert were non-existent) from Ismailia westwards. This was done by a hastily prepared 8 (Railway) Company RE with commendable skill.

On 6 July 1882, Major W A J Wallace, on leave from India (presumably from the Indian Railways) was briefed by the Inspector General of Fortifications and Works, and told that he would be in charge of a Military Railway Corps then about to be formed as part of the Egyptian task force. The "Corps" was to consist of a small HQ and 8 (Railway) Company—a total of seven Officers, one WO, ninety-seven NCOs and men and two buglers. 8 Company was immediately given three weeks practical training. The London, Chatham and Dover together with the South Eastern and South Western Railway Companies gave the troops the "run of their lines", particularly as regards plate laying, engine driving, traffic control and in general railway working. These few days "giving intelligent men the opportunity to see how work should be done, were of great use to us afterwards", to quote from Major Wallace's report. By 23 August, Wallace had completed his "shopping list" in the UK (four small tank locomotives, ten passenger coaches and forty cattle trucks, plus brake vans, travelling cranes, breakdown vans and five miles of track), the whole had been loaded on board ship and the "Military Railway Corps" itself had arrived in Alexandria.

Many of the locomotives and other heavier stores (there had been more local purchase from the Railway Administration in Egypt) were loaded onto barges for towing down the canal to Ismailia. The locomotives had to go on to Suez, as there were no proper heavy landing facilities at Ismailia. One barge was "towed under", the minimum steerage way being too much for the heavily laden tow! As Major Wallace stated in his final report "All hands worked willingly and well, and when it is borne in mind that they had little or no previous experience of railway business, the results achieved were creditable".

The Army itself certainly seemed to have basked in the reflected glory of the Egyptian Campaign. A large RE contingent took part in a "Royal Review of Troops from Egypt" on 18 November 1882. This took the form of a march past the Queen on the Horse Guards Parade—the Sappers, according to the *Journal*, going past in "most perfect lines"—followed by a march through the streets.

Other events included a large dinner in the HQ Mess for Officers returned from Egypt. The large number of eulogistic speeches at functions such as this, and reported in the *Journal*, at least gave the Editor plenty of gratifying material! Lord Wolseley, the C-in-C in Egypt, remarked in one after dinner speech "in the Crimea there was not a single Officer of either the Artillery or Engineers employed in command of a Division or Brigade. But how different was the case in the Egyptian expedition. On the HQ Staff there were twenty-five competent Officers and out of these twelve were either Engineers or Artillerymen". General Sir Lintorn Simmonds praised the way in which units of the Corps had been able to deal with "Whatever came along". For instance, "the telegraph line was repaired and made to work . . . by material and with instruments found in Ismailia, by officers and men not belonging to the Telegraph Troop (which had yet to disembark), most of them with a very imperfect knowledge of the subject, and with very indifferent instruments". Water supply was another RE activity, and mention of 17 Field Company's use of Norton Tube Wells, brings to mind the many generations of Sappers which that equipment must have served!

This need for, and virtues of, versatility were frequently stressed in the 1883

Journals. When presenting Afghan War medals to men of the Queen's Own Sappers and Miners at Bangalore, the C-in-C of the Madras Army stressed the importance of "more intimately connecting the spade and the shovel with the gun and the rifle", and how in future campaigns the demand for Sappers and Pioneers would be even greater.

There was a long obituary of General H D Harness in the April 1883 *Journal*. Harness was another example of the remarkable ability of Sapper Officers of those days, to combine a distinguished military career with high government service in other capacities. In 1860, as Commandant, Harness was instrumental in instituting a major reorganisation of the SME, which had continued in much the same way ever since its foundation by Paisley. "The School had not kept pace with the changes in military science, and it was time to effect a rearrangement of the whole establishment." Harness insisted that the education of the officers and men in military science was as much a Corps duty as military drill and should be done from within its own resources. His ambition for the Corps was that the Officers should be acquainted with the principles of all physical sciences. He was concerned that it would be wrong for the Corps to be "subdivided with the object of greater perfection of detail and then losing sight of the infinite variety of conditions under which the Corps had to serve, and for which nothing should qualify them except thorough soundness in principles".

Again on the theme of versatility and application of principles, there is the example of that remarkable officer Major General H Y D Scott, a long obituary of whom was published in the July 1883 *Journal*. Scott was commissioned in 1840. He was an instructor at the SME during the Harness period (for which, incidentally, Scott "ever felt grateful"). In 1865 he was seconded to the "Commissioners of the Great Exhibition of 1851" as part of the Board of Works.

It is not the intention to give a resumé of Scott's career here, except to note that amongst other notable architectural achievements, he "successfully accomplished the problem put before him of constructing a covered building in which ten thousand persons could satisfactorily enjoy a musical performance". In producing the Albert Hall, although taking over some preliminary ideas from Captain Fowke RE, the technical problems of design, construction, materials and acoustics were immense. In their solution, Scott had behind him solely that education and training which he had received as an Officer in the Royal Engineers.

After eighteen years service with the Board of Works, Scott was summarily dismissed when the Treasury was conducting a cost-cutting exercise. He died shortly afterwards, leaving a widow with eight of their fifteen children still dependent on her. A joint Corps and Departmental initiative later established a memorial fund for her benefit.

Despite all the achievements of that period—the height of Empire as it was—there was an undercurrent of unease, which was reflected in various articles in the 1883 *Journals* and *Professional Papers*.

For instance, there was a letter in the January issue about the famed linked battalion system, which operated as a result of the Cardwell reforms. The writer pointed out that the home battalion had become a mere supplier of men and a training organisation for the battalion abroad. Furthermore, on mobilistion the home battalion would have to rely to a very great extent on reservists, and there was much wishful thinking in supposing that such men were the equivalent of men serving with the Colours. The writer acknowledged that the Germans also relied heavily on reservists, but "the training of a German soldier is of a harder and more severe nature than in our service. Conscription removed the necessity for considering the prejudices or inclinations of the recruit. All ranks worked twice as hard and submit to a discipline twice as strict, as with us. In short, our battalions on a war footing would be inferior to those of the German Army."

Then there was an article reprinted from the *Hanover Courier*, published in the August 1883 *Journal*, entitled "England and a Foreign Invasion". Understandably,

this seems to have had the sole purpose of highlighting "English" weaknesses, but it does seem to make some telling points.

"The time when English gold, English ships and English soldiers decided the course of events is long gone by . . . Indeed, even Albion's very core cannot defend itself against invasion." The article alleged that the Fleet, though demonstrably strong, was so spread that European Powers would have no difficulty in defeating it in detail. The coast defences were quite insufficient—particularly from Plymouth to the Wash. The Army at home was weak, with too much reliance on reserves of doubtful quality. It was "well known that the tactics of the English infantry are unwieldy and its training in loose order, in shooting and in outpost and advanced guard duties deficient." The Militia, it seems, were unfit for a modern campaign and they "simply could not be opposed to regulars." The worth of the Volunteers was summarily dismissed. "The Englishman watches them with pride on parade, when they are really no better than a collection of shooting guilds." And so on!

The article makes much of the fact that only the introduction of universal service could put things to rights. However "this was impossible for social reasons. England, with its aristocratic constitution, does not recognise equality of rights and therefore does not demand equality of duties."

Whether true or false in 1883, one might add that in 1918 it was the British Army that had stood the test. When compared with the French and German armies, there was no doubt which had emerged from those four fearsome years in best shape.

But for all that, there were grounds for criticism. Lieutenant R de C Porter (the son of Major General Porter, the author of the first two volumes of the Corps History) in a long article on "The System of Field Training best suited to our Army", published in the 1883 *Professional Papers*, enlarges on the points made in the January letter referred to above. He underlines the fact that training in the British Army compared unfavourably to other armies. Voluntary recruiting, and the alleged need for a comparatively easy life were among the reasons for this. Fundamentally, he suggested, both officers and men must be called upon to make "greater exertions than is at present demanded. But to this it is usually objected that half the charm of military life, for the class from which the greater part of our recruits is drawn, lies in its comparative indolence in time of peace . . . If we were to work our men in any degree like the Germans, we should find our recruiting sources dried up." He also quoted an article by the then Adjutant General, in which the British Officer is accused of caring little for the hard work of his profession.

Porter did not ask for a more thorough system of selection, but a rather moderate one of rejection and a few more compulsory retirements!

The unease was thus there. Perhaps some of the criticisms were not always far from the mark. In the "Early Days" article published in the December 1981 *Journal*, mention was made of the tactical disaster at Majuba Hill. Extracts from a German military publication were published in the October 1883 *Journal*, which commented on the Majuba Hill defeat. "English" tactical failures were put down to want of a regular and sufficient supply of fit recruits, and deficient instruction of officers and men in the theory and practice of field service. "The English have in their Army a highly impractical war machine." The *Journal*'s only comment was that the remarks "were not uninteresting"!

The Duke of Cambridge in his address to those being commissioned from the RMA in July 1883, warned the Cadets that their careers would be demanding. "New inventions and new fancies were brought forward every week . . . and many of them, unfortunately, adopted." "Unfortunate" because of the "hindrance which these changes effected in the instruction of the Army and the difficulties which they entailed in the cultivation of efficiency . . ."! It is only fair to add that the Duke did concede that modern requirements and the march of the intellect went on continually, and the Army must keep up with these advances!

One wonders what the readers of the *Journal* in 1883 made of all this. The laudatory speeches about the Egyptian Campaign; the frequent obituaries reflecting the

tremendous careers offered by the Corps to those of ability and drive; these criticisms of Army life apd standards of training. One suspects that daily life was busy enough, for people not to think too deeply about things which did not immediately affect them. There were plenty of the other matters absorbing the Editor's attention, and which were of immediate concern. The fundamental reorganisation of the administration in India, which was reported at length in the *Journal*. Whether someone wanting an engineering career in India, be it on railways, irrigation, roads or public works in general, would do better to go out as a Royal Engineer or as a civilian engineer. New regulations about pay and pensions—a matter frequently referred to. Were not these the sort of things that really mattered?

At the 1883 AGM it was announced that the pension offered by the RE Widows Society was to be £30 per annum, with an annual bonus of £25. If the value of the pound was at least thirty times more than it is now (the present RE Museum's Appeal assumes that money subscribed in 1908, let alone in 1883, had that value) today's financial benefits to Widows seem to contrast rather startlingly!

The Underwater Concrete Base at REDW, Kiel

CAPTAIN J S KINGHAN RE, B Sc

On leaving the Royal Belfast Academical Institution in 1975, the Author spent 3 years at the University of Newcastle-Upon-Tyne studying for and obtaining an Honours Degree in Mechanical Engineering. He entered RMAS in 1978 on a Short Service Commission. On completion of his YO training he served as both a Fd Tp and a Sp Tp Comd with 5 Fd Sqn RE in BAOR. Before assuming his present appointment as OC RE Diving Wing Kiel in Dec 1982, he spent a short tour with 1 Trg Regt RE as a Sqn Officer. He is now serving on a Regular Commission.

Introduction

On taking Command of the Royal Engineers Diving Wing (REDW) at Kiel, I was informed I was the proud owner of an engineer task, the result of which would probably go down in history as the only one never to be inspected by a CRE or any other Senior Officer.

The role of the Royal Engineers Diving Wing is primarily to train BAOR diving teams. This is an ongoing exercise with teams visiting Kiel twice a year for a fortnights concentrated team training. All BAOR potential divers must successfully complete a two day aptitude course at the Wing, prior to attending the Army Compressed Air Diver Course at the Royal Engineers Diving Establishment at Marchwood. The aptitude course is for many Sappers their first introduction to diving and for most it is an extremely worrying and challenging experience. For two years the initial course safety training was carried out in an open, glass windowed, display tank. Despite taking all natural precautions it became a breeding ground for thick algae growth, which turned the water into something akin to pea soup, reducing the supervision of students to a dangerous and unacceptable level. The alternative was to throw the students literally in at the deep end by putting them into the open sea.

The Underwater Concrete Base At REDW,Kiel Captain J S Kinghan RE B Sc

within the port training area. Here the water is 5m deep and the sea bed is mud and sand. This, when disturbed, goes into thick suspension reducing visibility again to a dangerous level when working with students. Therefore a solution was sought which would allow students to be thoroughly assessed in a realistic but controllable environment.

The problem was discussed by the then QMSI L M Rutherford RE with SSgt J H Falinski RE, AIOB, a Clerk of Works based with the PSA at Detmold, whilst the latter was attending Kiel on a diver continuation period. "Straight forward" says they, "What we need is a concrete base laid on the bottom". And so the invisible Royal Engineers Diving Wing Concrete Base was conceived.

Aim

The aim of this paper is to summarise the work carried out and to emphasize the lessons learnt in building the concrete base on the sea bed at REDW, Kiel.

The Project

The initial recce was carried out in May 1982 and the Preliminary and Detailed Recce Reports were produced very shortly afterwards by SSgt Falinski who also supervised the majority of the later works.

Once convinced of the need for the base and of the training value to be obtained, Engr Branch HQ BAOR agreed to the project and allocated DM 4700 from training funds to cover the estimated cost of the materials. Obtaining the planning authority to pour concrete onto the sea floor was a straight-forward affair, with it quickly being given by the Wasser und Schiffahrtsamt Lübeck.

Not wishing to break with tradition, there were a number of changes to the design during the early stages of construction! These included an increase in size from 4m by 3m to 5m by 4m of the pad and the complete resiting of the base to make maximum use of access available from the surface. The increased size of 5m by 4m incidentally was thought to be the maximum area possible to lay in one pour if cracking and subsidence were to be avoided, once the concrete had set.

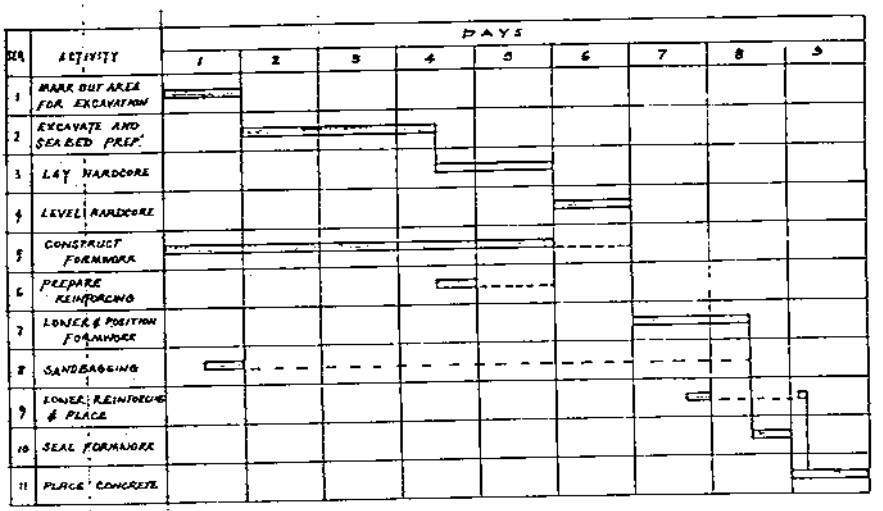
In order that the project once started could be finished in the planned time scale (see Figure 1) and yet cause minimum disturbance to the team training programme, a period was sought where two visiting teams overlapped. This decision was to prove slightly detrimental as continuity was lost. The project work was carried out by 25 and 26 Engr Regt and 28 Amph Engr Regt diving teams.

Work began in mid July, with the area of sea bed excavation being marked out, prior to air-lifting, by use of a tubular scaffolding frame. This frame consisted of four legs positioned at the four corners of the proposed area of excavation and driven vertically into the sea bed and connected by four horizontal poles. A complete day was required to install the frame. The time spent laboriously obtaining the correct horizontal level paid dividends later when the hard-core and formwork were lowered into position and had to be levelled. Due to the new site being chosen for the concrete base, which had not been surveyed, silt and mud clearance was considerably more than expected. An average depth of 1·5m of mud was excavated with an airlift pump using a 180mm diameter hose. A full 2½ days were required to complete this part of the activity. The airlift pump was of simple design and produced by the Workshops out of armoured hose pipe. The Diving Wing's Bristol Pneumatic Towed Air Compressor was used to provide an on-site high pressure air supply. Both combined to give an extremely efficient yet controllable lift when working. When idle the pump was difficult to manhandle due to the rigidity and weight of the exhaust pipe.

Once rock-bottom, or in this case heavy clay, was reached across the whole area, the decision to lay the necessary hard-core was taken. Delivering it as close as possible to the site provided problems as a very steep bank and 15m of water had to be crossed before the site was reached. The solution took two forms. The area immediately next to the pontoons was reached by full wheelbarrows being wheeled

Fig 2

WORKS PROGRAMME



to the edge of the pontoons and being tipped over into the marked area between marker buoys. This proved wasteful as accuracy could not be guaranteed. An assault boat was used to transport the hard-core to the area furthest away from the pontoons. This was filled from a stockpile and then carefully moved into the position, before being emptied by shovel power into the marked area. A total of eight men worked for 1½ days on this somewhat amusing but back breaking and exhausting part of the task. A further day was required to level the hard-core on the bottom. This was achieved by raking and using a long pole in a screeding action. As mentioned previously, the time spent achieving a perfectly horizontal scaffold frame paid off as this greatly assisted obtaining a level top to the hard-core. A slightly smaller size hard-core (16–32mm) was used than planned (20–50mm) due to availability at the time. This proved an asset as less voids were present, increased self compaction was obtained and it flowed easier when screeded level. A total of 19·2m^3 of hard-core was moved to site, dumped into position and finally levelled before the required base was obtained.

Due to insufficient lead time being given to Engineer Resources, the designed road forms for the formwork did not arrive on time. Using engineer initiative, an alternative system was fabricated out of RSJ's belonging to the REDW for use as underwater demoliton targets. The framework was constructed on the British Kiel Yacht Club roll-on-roll-off slipway to permit ease of launching into the water. Once welded together the bottom layer of reinforcing mesh was welded within the frame. The large number of pre-drilled holes in the beams all had to be welded over or plugged with dowelling rods to prevent seepage of concrete during pouring, once on the sea bed. The increase in weight as work proceeded did lead to handling problems even though the framework was on wheels. With the use of oil drums as buoyancy aids, the frame was "launched" and towed the 200m to site by a CSB. Once in position the frame was lowered to the bottom with oil drums attached. The partially air filled drums assisted final positioning of the frame on the bottom before being released and recovered. At this stage the original scaffolding frame was recovered. Before concreting could commence the formwork was finally levelled by excavation of hard-core or by filling where required. Sealing of the formwork was achieved by laying sandbags in a course of stretchers laid tight up against the web of the "I" beam formwork. This method of sealing proved adequate as there was no

visible fines losses during the concrete pouring phase of the operation. The sandbags were sand filled and left in position to prevent erosion of the hard-core base. In future, if a wet or dry concrete mix were to be used, this would allow a better bond between bags to develop regardless of the hessian bags rotting away. The sandbags used were a mixture of German and British make. The German type proving more efficient as they are made of plastic and non rottable, whereas the British hessian bags had began to rot by the six month inspection.

The concrete was placed by means of a pump. The pump pipe was attached to a floating oil drum at its point of entry into the water. This greatly assisted the movement of the lower end of the pipe when concreting was in operation. Unfortunately the pipe was just not long enough to reach one corner of the frame. The concrete did not self level as expected and the offending area of 0·6m^2 was later found to be devoid of concrete to a depth of 80mm. The exposed reinforcement was cut off and the concrete inspected for damage at three and six months after completion of the task. No damage could be found. During concreting the top layer of reinforcing was laid in position. The concrete was laid by two divers over a period of 1½ hours bottom time. One diver laid flat on the reinforcing, positioning the concrete with the aid of a toggle attached to the pipe. This ensured that the pipe remained below the surface of the concrete, thereby preventing any water filled voids appearing. The second diver stood over him with the pipe over his shoulder. This prevented the pipe from snaking whilst the concrete was being pumped. This proved to be an efficient and controllable method of pouring concrete. It was, however, extremely tiring on the two divers and an uneven finish was obtained. Therefore it is imperative that the two divers are replaced after a maximum of thirty minutes underwater, as placing pumped concrete underwater is a very exhausting activity.

The original plan of screeding the complete area once all the concrete had been placed was not a successful one. This was due mainly to the large area involved and the fact that the initial load of concrete was reaching its "final set". The combination made screeding very difficult. Although the final surface of finished concrete is of an acceptable level for the required purposes it was designed for, it is recommended that a second set of divers screed the concrete as placing proceeds.

Curing of the concrete was achieved by natural means, ie completely in an underwater environment. Inspections at three and six months after construction showed that curing had been achieved at a good rate as there were no visible signs of thermal stresses including cracks. It was decided to leave the RSJ formwork in position as it would add stability to the structure.

The concrete base has now been in use for over twelve months and has proven to be an asset during both aptitude testing and team training. The concrete base has provided a solid horizontal base for an underwater work bench as well as a safe platform on which to introduce aptitude students to diver training. With no silt being kicked up by the diver, good visibility is maintained, thereby making the divers bottom time more efficient in training terms when using underwater tools such as the Vixen Cutting Torch, or when carrying out safety drills.

The project, although a small scale task, did produce many problems to be overcome and lessons to be learnt. These were mainly:

(a) Where possible it is desirable to maintain the same construction team throughout if continuity is to be maintained.

(b) Full back up of Engineer Resources is necessary as is the confirmation of lead times at the earliest opportunity once construction start time is known.

(c) When pumping concrete underwater, frequent change-over of divers is needed to prevent fatigue. Each concreting team should also, where possible, be given time and concrete to practise pouring techniques.

(d) Pre-project underwater concrete training is essential before attempting this size or a larger task.

(e) When tendering for pre-mix concrete, the contractor chosen should provide both pump and concrete. This acts as an insurance in case either the pump fails to

function or the concrete fails to turn up on the correct day. One firm was contracted for this particular task and no problems were encountered.

(f) The problem of obtaining a horizontal level over a large area of poured concrete is difficult on the surface. It was complicated in 5m of water by the fact that the two divers could not see each other and also that the initial pour was already setting. Therefore it is recommended that for future tasks the area of concrete to be levelled is split into a number of smaller areas. This is dependent on visibility and the setting time for the concrete.

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"Whither the Corps in the Corps?"

Sir,—Lieut Colonel Peter Sheppard refers in his article (*RE Journal* June 83) to "our present difficulties" and invokes Prince Philip in urging us to adopt new ideas. I do not feel that the situation is as bad as he suggests. He implies that we do not get round to making our minds up on these matters. In fact, the blueprint that he calls for was produced not so long ago; the "Mercury" organisation. That has not been attainable because of the constraints of current equipment and manpower. We now have therefore what Colonel Sheppard calls an *ad hoc* arrangement but what I call a realistic and workable one. All that is needed is an updating of "Mercury" and sensible evolution towards the ideal.

In defining that ideal I agree with the basic contention that the field section can do little without more machine power. I also note and agree with the suggestion that the extra machines needed must meet the Army's countermobility requirements as well as the needs of mobility. Mobility is the "in" fashion in BAOR at present and there are suggestions that what is required is a greater proportion of armoured to field engineers and specifically more AVREs. I do not believe that AVRE provides the answer. More armoured engineers are required; there is a particular need for more AVLBs. In addition, we need a well protected vehicle with powered tools and equipment to help with countermobility tasks (eg, earth auger, hydraulic hoist/crane, blade, saws). It could perhaps tow a mine dispensing trailer. Organisations should be designed so that regrouping at troop level is simple, so enabling specialist kit and expertise to be concentrated in peace.

But the main matter I would like to address is Colonel Sheppard's salvo at that popular Aunt Sally, the full Colonel CRE. I would agree that the decision to have one or not should not be based on MS considerations. Indeed I believe there is no MS case for their retention and would concentrate on the operational arguments.

Principally, I do not agree with the independent brigade squadron concept, an idea which served the army well in intervention and peacekeeping operations but has otherwise been found wanting. At the least, brigade squadrons will need coordination (eg, over priorities for resources), I believe they will need actually to be commanded by an engineer commander (eg, to achieve the regrouping of troops between brigades). This cannot be done by the one Lieut Colonel with his five or six field squadrons, a support squadron and various specialists in his area as well. A Lieut Colonel Commander is required for both the brigade and divisional level Sappers. One of those Lieut Colonels could possibly be designated CRE, donning his red hat perhaps on going to war.

However, the argument for a full-time CRE at divisional headquarters in peace is so overriding that it makes sense to carry him forward to war.

This argument is essentially that the Commanding Officer of the divisional regiment could not cover the full range of responsibilities he must in divisional headquarters without detriment to his regiment. "They always managed before" I hear you say (especially those of you who have done it). Well, firstly they did not have a regiment to command as well as three brigade field squadrons. Secondly they did not all manage it. Some regiments suffered; alternatively some divisional headquarters suffered—especially those with the weaker GSO2s RE. More importantly, times have changed. Regiments are bigger, they are more complex administratively since mechanisation, their activities are more widespread and, dare I say it, higher standards of training are now demanded.

Furthermore, in peace, the Lieut Colonel CRE would inevitably have substantial responsibilities towards the brigade squadrons as well as his own regiment. He would have to co-ordinate training, the allocation of resources, tasking (I cannot visualise Corps HQ operating direct to eight independent field squadrons as well as the regiments) and manning (REMRO would not take kindly to such a plot, nor would squadron manning be beneficial to soldiers' careers or the Corps career structure). The CRE's position would be analogous to that of the commanding officer of the divisional signal regiment now, but much worse in view of the diversity of Sapper life. Even without the problems of being a station commander, as some of our commanding officers are, I would maintain that the job Colonel Sheppard proposes would be impossible.

Lastly, armoured engineers thrive better when they are concentrated in peace. Concentration means better equipment management, better training, both individual and collective, and better use of expertise. I am sure it would be worth accepting a measure of regrouping of troops into mixed armoured and field brigade squadrons on deployment. This would also give the CRE the flexibility to match squadrons to roles which is not possible in the Sheppard solution. I would go for two armoured and four field squadrons in each forward division. They would be organised for peace into two regiments. The brigade regiment would have the armoured and one field squadron and would regroup on deployment. In this reply I have not covered Corps engineers or the requirements of the third division but I believe the arrangements I propose would cater for both and leave a sufficient degree of flexibility.—Yours faithfully, G W A Napier

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THE FALKLANDS 1982—JULY TO SEPTEMBER, THE BEGINNING OF REHABILITATION

Sir,—I read the series of articles in the June issue of the *RE Journal* on the Falklands with interest. In particular, having been OC of the STRE(Airfields) from June to October 1982, my attention was drawn to Lieut Colonel P R Ievers' comprehensive article on the construction of the airfield at Stanley. To complement his article I would like to add, through these columns, a few particular points on the background and on some planning and technical aspects.

As Colonel Ievers states in his article, planning started in April 1982 when HQ E-in-C with, the then, CRE(Airfields) began examining methods of meeting the criteria required by the RAF to take sustained operations by heavily laden transport aircraft and fast jets. The background information for the planning was provided by Rendel, Palmer and Tritton, the Consulting Engineers who designed and supervised the construction of the airfield between 1974 and 1976, as well as from

Royal Engineer reconnaissances carried out in the early 1970s. As no ground reconnaissance was possible at this stage, intelligent guesses of the ground conditions and terrain were made and the plan was devised by Engr 2(A) and CRE(Airfields) over a long weekend to meet the necessary criteria. The plan was, in essence, to provide a stronger and longer runway without extensive civil engineering effort as time was of critical importance. The upgrading was to be achieved by overslabbing the existing runway with American heavy duty expedient aluminium matting (AM2). The matting had been used extensively in Vietnam and provides a very flexibile and complete expeditionary airfield system including its own integral airfield lighting. To lengthen the runway the plan was again to use AM2 but this time on a suitably compacted base material. The options for the base were to use either a beach won gravel, cement stabilisation or crushed rock. All systems were to be enhanced by the use of appropriate geotextiles, *Terram* for the retention of fine materials, *Netlon/Tensar* to increase the shear strength and *Trevira* to provide a waterproof membrane.

Planning for this project went ahead in the United Kingdom to produce an airfield package of 155 000yds^2 of AM2 matting and about 250 major items of plant and equipment. As the mat laying would be a very labour intensive activity, it was estimated that, at a peak, 1000 men including infantry would be required for the task. In all, the equipment and materials scaled out at 9000 tonnes.

Meanwhile, many major decisions were necessary, including the release and purchase of AM2 matting from the Americans and this produced a remarkable feat of cooperation and fast action. From 14 to 18 May 1982 an exploratory technical visit to the United States was authorised for a team of five officers who were given excellent briefings on the use and capability of the AM2 system. Thus, when that team left the United States, they were able to leave behind the complete stores list for the AM2 matting and accessories. On 23 May 1982, the United States Government was asked formally for the AM2. The next day, this request was approved and seven days later the 5000 tonnes of stores were at the dockside for loading, including some items which were brought in from Okinowa. It is worth noting that only three months elapsed from conception to the stores, men and equipment arriving in the Falklands. While these preparations were being finalised in the United Kingdom, the advance party of CRE(Works) Falkland Islands (formed mainly from CRE(Airfield)) went south with the Task Force so that they were on hand when Stanley was recaptured. Once in Stanley, the initial priority was to effect repairs to the existing runway and details of this are contained in the March *Journal*. Once this work was underway and the updated drawings and plans had been received from the United Kingdom the final designs could be produced, based on confirmed ground information.

The briefings that had been given in the United Kingdom by the consulting engineers and the information provided by the original contractors proved very accurate and the airfield and its surroundings proved very familiar and offered few surprises. All the promised problems of bad ground and bad weather were there in full measure but the basic layout that had been selected in the United Kingdom fitted the ground very well. Nevertheless, detailed surveys and ground investigation had to be carried out, but only after bomb and explosive clearance had been first completed. The surveyors had a very difficult time. There were three teams each of a surveyor and a staffman working in high winds, bad weather and with a shortage of daylight. At least two of their levels were blown over by the winds and damaged beyond immediate repair. The ground survey was also hindered by limited facilities, a shortage of plant to dig trial pits and, of course, the bad ground which meant that we could not get plant to where we needed it. Nevertheless, by working long hours, they produced sufficient detail for the construction force to start work on time. No doubt the construction force would say we produced the information too late but that is the prerogative of construction forces the world over! Our limited resources meant that we could not do trial mixes but had to rely on textbook solu-

tions together with our judgement and of course everything had to be modified in the light of experience.

Turning now to the base for the runway extension, it will be recalled that three possible options were under consideration at the planning stage. The first of these, that is using "beach won gravel", had to be ruled out immediately because the beaches from which the gravel would have been obtained had been mined. The second solution of using cement stabilisation was eliminated when a short trial was done and found to be unsuccessful. Although this seemed to be the solution favoured by those in the United Kingdom, it did not work in the Falkland Islands because, we believe, the temperature at the time of the trial was too low for the cement to achieve a chemical reaction and thus did not set. We, therefore, fell back on the option of using crushed rock on sandfill as described in Colonel Ievers' article even though this, in some respects, posed enormous problems in winning the rock with the crushing operations that his article described so well in detail. The design specification for the extension was at no time evaluated in trials. It was in effect an intelligent *guestimate* based on experience of what would *work*. With no time for refinement or trials, we adopted a solution that would work and although, with hindsight, some changes—for example the omission of the Terram between the existing ground and the sandfill—might have been acceptable, it must be remembered that failure of the construction was not operationally acceptable even if this risk was low.

The design of the arrester gear foundations was based on the standard expeditionary RHAG designs. However the arrester gears were required to be the regular means of stopping all aircraft on landing and thus sturdy foundations that would stand up to frequent and repeated use were required. Also, the predominant subsoil type was of a fine uniform peaty sand in a waterlogged condition, rather like thick soup. A suitably conservative design was established for the buried concrete anchorages and in fact the volume of concrete required for each anchorage was four times the normal for an expeditionary RHAG. Fortunately in the airfield package there was sophisticated de-watering well pointing equipment and this allowed excavation to 7ft below the normal ground water level in dry conditions.

Finally, may I point out an error on the first full paragraph of Colonel Ievers' article on page 82. Here Trevira and Terram have become transposed. The waste material having been dug out, the sand was placed on Terram while the finished surface of the runway base material was capped with Trevira to prevent the ingress of water through the joints in the AM2 surfacing.—Yours sincerely, D I Reid

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Transition to Peace

Sir,—I was delighted to read Sam Hesketh's first class article on 60 Fd Sp Sqn's Falklands tour. As a fully paid up, card carrying member of the Sp Sqn OC's Union, how nice it is to see my very own thoughts, misgivings and fears laid out in black and white, and how sad it is to see once again a Sp Sqn having to suffer from low priorities and the deficiencies in its orbat.

There must be many causes. As OC Sp Sqn it was rather like being Cinderella. The Fd Sqns had their independent overseas tours. No such luck for the poor Sp Sqn. It was far too valuable in Barracks to be allowed such luxuries. "Projects," quoth HQ UKLF, "are simply not made for Sp Sqns. A Sp Sqn would never be deployed away from its parent Regiment. Stay at home, let your sisters go to the ball."

The BAOR Syndrome did not help either. Plt Tp could not be used in BAOR

FTX's nor could Wksp Tp, so all too often the Plant Operators and tradesmen were turned into reorganisers of mines and MGB, checkers of angle iron pickets and dummy explosives. To point out these failings was fruitless, because at the end of the day the Squadron achieved its objectives. There was thus never a case for additional manpower in the Resources empire.

Perhaps the biggest cause is that the Sp Sqn Establishment over the last fifteen years has suffered too many changes, mostly to suit "peacetime in barracks" soldiering, to allow it to be sensibly organised. (My own *bete-noire* was that I held four more trailers yet four less drivers than prime movers!) The time must be nigh for these potentially very powerful organisations to be properly organised and used.

What are the solutions? The Sp Sqn's have been the poor relations for a long time (is it that there are no ex Sp Sqn OC's in high places?) Can I suggest the two points below would go a long way towards resolving the problem:

(a) To thoroughly examine the Sp Sqn establishment and adapt it to suit its roles by giving it the men and equipment to do its job and disposing of all the useless G1098 it holds.

(b) Allow the Sp Sqn personnel to exercise in their trades, particularly in Wksp Tp, and to exercise *as a unit*. (I did manage to find a month's exercise for the whole Squadron in Scotland in 1981, and invaluable it was too).

A Sapper, it is said, is twice the soldier, he is both combat engineer and infantryman. A Sapper in the Sp Sqn is three times a soldier. As can be proved, a Sp Sqn can produce the best Infantry Company in the Division, can combat engineer as well as the rest, and also do what the others cannot, excel as tradesmen.

The Falklands experience will have gone a long way to stir the minds of those in high places, and they will have many important points to ponder. Let me plead that the Engineer Support Organisation at Regt/Sqn level should be very high on the list. It should not be relegated to bottom place because some excellent officers and soldiers have once again "hacked it" despite all the problems they have encountered.

Finally, I hesitate to contradict the E-in-C, but to put the record straight I would like to point out that the missing seals for the repair of the Stanley water supply system were recovered without any "finesse" with a helicopter. They were located on a foot recce by myself and Sgt Willoughby, the PCS Sgt. They were recovered simply by landing alongside them and loading the box on the chopper. Only *afterwards* did we learn that we had "trespassed" into one of the EOD's designated mined areas! All this after the PCS det had been patrolling the area for a week in search of lost air letters! I think this small point serves to illustrate one thing very clearly, particularly to those who were not in Stanley in the post surrender days: that the fog of war was run a very close second by the fog of peace!—Yours sincerely, R A Nicholas

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Aerial Mines

Sir,—Lieut Colonel Streeten's interesting article in the September *Journal* recalled a proposal in an American Magazine (*Army*, September 1982) for the introduction of aerial mines. This visualised a mine consisting of a helium filled balloon, a fragmentation munition with a proximity fuze and a cable to tether the system to the ground. A minefield would consist of several aerial mines at varying heights to give coverage across the desired area.

Such a device could reduce the difficulty, raised by Colonel Streeten, of making mine and aircraft meet. The vertical spacing of the mines, the activation distance of the fuze and the killing range of the munition will influence the effectiveness. In

addition, if the cable is made of *Kevlar*, or similar material, it, in itself, would be an obstacle, and a forward moving aircraft would tend to drag the munition onto itself.

There are several potential problems, however, which are not addressed in the article. Sympathetic detonation might be a difficulty, depending largely on the area of influence of munition. This could be overcome by separation of the mines into rows, as with conventional surface minefields, with each being at a different height from those adjacent. The chance of cables becoming tangled would also be reduced as mine separation would be greater than with a single row.

I cannot claim to know whether such a device is technically feasible particularly in respect of the dimensions and weight of munition required. These would determine the size of balloon which would be needed and, hence, the vulnerability of the system to attack.

A further advantage of the concept, however, is that the obstacle can be emplaced early but need not be erected until required. Activation could be manual or remote. The latter would allow the possibility of surprise: a forward observer could activate the minefield on identification of an imminent air attack. This factor is also important because those of our defences which rely on wire guided missiles would not be impeded until the obstacle was required. This consideration may restrict the use of the type of permanent obstacle suggested by Colonel Streeten particularly in forward areas.

This too may be a flight of fancy but if successful would fulfil at least two of Colonel Streeten's criteria, those of killing and concealment, though the third, of rapid positioning, is more doubtful.—Yours sincerely, T J Blad

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A Woman's Role?

Sir,—May I congratulate both Pankhurst and the *Journal* for their publishing "A Woman's Role?" They have highlighted an Army-wide problem in need of considered ventilation.

I understand why Pankhurst adopted a *nom de plume*; her story is too painfully personal to risk identification. But I am not so sympathetic towards "Uncle" Asquith for two reasons. Firstly, had he identified himself, his somewhat patronizing advice could have been assessed more clearly. His choice of an avunucular pseudonym reinforced my concern. Secondly and more important I believe his advice to be irrelevant—not wrong, just irrelevant: that is to say that it addresses the wrong problem.

Officers and soldiers experience a range of pressures affecting their personal lives which arise from their unlimited liability to serve, such as uncertainty, separation, turbulence, work overload and a degree of social isolation. These pressures are arguably at their greatest when applied to a commanding officer and, if accompanied, to his wife. Pankhurst's article shows clearly the stress induced in her relationship with her husband by the use of some telling cameos.

We recognize battlefield stress now and the disorders that arise from it. But battlefield stress is at one end of a wide spectrum of stress in need of formal acceptance and alleviation. Industry knows this as "Executive Stress" but some of us are as slow to accept behavioural science as some of our grandfathers were to accept the tank.

Rather than exhorting her to greater military efficiency, would not a more constructive and enlightened response to Pankhurst have been: to thank her for twelve years valuable help, sympathizing with her and her husband's problems and trusting that time and reflection might help: secondly, to acknowledge the stress to

which some are exposed by reason of their or their husband's profession; and finally to resolve to do whatever can be done to reduce that stress, recognizing that any approach will mean the deployment of resources and, therefore, money.—Yours faithfully, Eric Tait

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Should Civil Engineering Die at RMCS?

Sir,—I would like to add support to the idea of a new "PQE" post graduate course at RMCS suggested by Brigadier E G Willmott OBE in his letter published in the September issue. Irrespective of the place of origin of the first degree, it seems that an RMCS based professional engineering training ("PET") course could be a solution to the problem of the "PQE" career.

The present two-year RSME "PET" course could be extended to about two and a half years with the addition of a ten or eleven month staff training and streamlining of the present RSME content. It should be possible to preserve the entry requirements of the Engineering Institutions and achieve a much better base for "PQE" officers to compete fairly with their Army Staff course trained brother officers in their future careers. PQE officers should not be looked upon as specialists as they have been for the past thirty years or so. They are professional military engineers and their training and employment should be directed to this end as it is for all officers of the Corps.

Many details would need to be investigated. As a possible solution, or part solution, to both the abolition of the necessity for a "PQE" career stream and the loss of the civil engineering department at RMCS, I believe the ideas proposed by Brigadier Willmott for the Military Engineering Course First Degree and the post graduate "PET" training at RMCS merit further consideration.—Yours faithfully, J T Stokes

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What's in a Name?

Sir,—In his Editorial in the June 1982 issue of the *RE Journal* (Volume 91 No 2) our Editor forecast certain rotational action by "Mr Stevens" and "Notchy Night" caused by the introduction of the new NATO Staff Titles. Readers may also have noted another change that took place later in the same year that causes as much confusion. HQ Engineer Support Group was disbanded at Barton Stacey; 12 Engineer Brigade (ADR) raised its flag again, this time at Waterbeach; Engineer Branch UKLF was rusticated from Wilton and became HQ Engineer Support in Tidworth, taking under command Engineer Resources and the Engineer Parks, and 33 EOD Regiment. The Chief Engineer UKLF became the Commander Engineer Support.

Although the abbreviation "Comd Engrs" does not flow off the tongue as readily as CRE, CCRE, or even CE, everyone has accepted that our leaders are Commanders Engineer, but what about the Comd Engr Sp?! Over the past six months I have been introduced as the Chief Engineer Stores, Commander Engineer Resources (an honourable title already filled by an efficient Officer at Long Marston) and

Comd ESG. I am constantly being asked "what do you do?", or even more directly "what do you do for us?" The questioners come in all styles; senior serving Officers, fresh faced Staff Officers from Camberley, Warrant Officers and Senior NCOs, and Retired Officers, Gunners and Parsons. When I say that I am, in all but name, "Chief Engineer UKLF", but work at Tidworth, all are satisfied.

Why should there be confusion? After all we have been supporting the Army, and the other Defence Services for years. Our armoured and infantry colleagues talk about their "supporting" Sappers and we put Squadrons, Regiments "in support" or "in direct support". However, when we "capitalise" and talk about "Engineer Support" eyes glaze.

The Editor rightly said that all changes bring in attendant difficulties. We seem to have swallowed the anomalies of having an O and D (Organisation and Deployment) branch to deal with our SD problems, can we hope that the Commander Engineer Support is understood and accepted as the new title of CE UKLF, with added command responsibility?!—Yours sincerely, D H Bowen

Memoir

MAJOR GENERAL R LLEWELLYN BROWN CB CBE MA FRICS

Born 23 July 1895, died 17 July 1983, aged 87

REGINALD LLEWELLYN BROWN (widely known as "Bruno" in the Army) died, within a week of his 88th birthday, after an operation from which he had seemed at first to make a good recovery. He served almost exclusively in the Survey Branch of the Corps, and had continued his deep involvement in national and international activities and affairs of the survey profession well into retirement.

He was the youngest child of Colonel F D M Brown VC, who won his award in the Indian Mutiny. He was educated at Wellington and RMA. In 1914, while still a cadet, Bruno happened to be in Germany at the outbreak of war and, being unable to cross the frontier, was interned in the civilian internment camp at Ruhleben for the duration; an inauspicious introduction to his military career. His time in Ruhleben however gave him the opportunity to read and study widely. He had a keen interest in philosophy, literature, art, music, and many scientific subjects, to an extent perhaps unusual in a regular Army officer. In the camp he did much acting, and his role as Charles Surface in "The School for Scandal" was one of his best. He also began a lifelong interest in Freemasonry which led to membership of three Lodges, and to the most eminent positions. Having had the "advantage" of playing Rugby Football throughout his captivity, Bruno became a first class forward, playing for the Army against the Navy in 1921 before King George V and later that year against the RAF. He retained his interest in Rugby and was for many years an Honorary Vice President of the Army Rugby Union.

After the war, while conducting survey operations in the Gold Coast in 1921–26, he met with a shooting accident which led to the loss of his right arm. The rough surgery and crude care at the time left him with a legacy of recurring pain which he suffered for the rest of his life. But his courage and indomitable nature enabled him

Major General R Llewellyn Brown CB CBE MA FRICS

to come to terms with these handicaps, and to reach a pinnacle of achievement in the many spheres in which he became interested.

On returning to England, Bruno acted as if the loss of his arm had never happened. He got straight away into the car he had left behind (an old Standard) and drove it away, operating the right-hand "crash" gear-change lever with his left hand under his legs while leaning on the steering wheel. Later, during the very early days of the last war, when he was commanding 19 Army Field Survey Company then assembling at Fort Southwick for service with the BEF, he was observed by at least one astounded Second Lieutenant to be making a very passable attempt at press-ups with his men during a PT session on the square. An excellent golfer, he invented a hand-grip, moulded to the shape of his palm in aluminium, to clamp to the club handles to prevent the shaft from turning in one hand. With its help he came to play to a low handicap and continued with the game until well into his seventies.

In the years directly before World War II, Bruno spent a considerable time in Palestine where he pioneered methods of survey by aerial photography. He thus became an early and foremost expert in a subject which was soon to assume great importance. He took the opportunity to learn to fly, being taught by Squadron-Leader Atcherley, the RAF pilot of "Schneider Trophy" fame.

From the outbreak of war in 1939, Bruno played a vital role as the head of survey and mapping in the Middle East and then through the whole North African campaign, and on into Italy. During the latter two campaigns he first met and worked with the Americans at Allied Force Headquarters in Algiers. His ability to meld together the efforts of such diverse staffs and units made an important contribution to the support given by "Survey" to the fighting formations. He became close to Wavell and to Alexander, particularly. He did not speak much about the war in later years; but his great acumen, powers of observation, and sense of humour, caused him to develop a clear opinion on all the leading command figures . . . for good or ill. Mostly, however, he kept his own counsel. It never occurred to him to write his memoirs, an unfortunate loss to all of us. He was awarded the CBE in 1941 and the US Legion of Honour in 1945.

In 1946 he became Director of Military Survey in the War Office in succession to Brigadier Martin Hotine. His most important task was to plan and carry out the inevitable reduction of survey units, while maintaining the essential structure for the future. The present healthy nature of RE Survey still owes something to the wisdom of his handling in those days. He also set up a pattern of periodical Commonwealth Military Survey conferences, attended by representatives from the USA.

In 1949 he was appointed Director General of the Ordnance Survey. It was a critical time, for the Department was fully stretched in carrying out the recommendations of the pre-war Davidson Committee; in particular, to continue the resurvey of the country, then still far from complete, and at the same time to set up an ever growing permanent structure of Continuous Revision Groups to ensure the perpetual maintenance of the basic survey of the country. The latter, essential though it be, has always been vulnerable to Government cuts. In his retirement address, Bruno warned the staff that if they ever allowed this task to slip, he would return to haunt them. He created a series of Ordnance Survey Policy Statements, designed to ensure that for every major activity of the Department there was a clear unambiguous statement of policy governing it. Here his insistence upon meticulous exactitude in the use of language came into play, for he was a perfectionist in this as in other things. A particularly happy occupation for him was the part he played in the design of a new one inch map, the Seventh Series, which received wide acclaim. Another matter of importance was the selection of the most suitable new optical and electronic equipment coming on the market both for field and air survey. Though Bruno was an early advocate for the latter, at the same time his caution in exhaustive testing of something new coupled with the OS' traditional preference for

its own simple methods, delayed the adoption by the OS of new ideas which had proved their worth in other countries, and which were later adopted by the Department with enthusiasm and success.

During his last appointment and since his retirement in 1953 Bruno became increasingly engaged in a number of learned institutions; he was Councillor, Hon Vice-President and Foreign Secretary of the Royal Geographical Society; one of his most treasured awards was the Founder's Gold Medal of the Society, presented to him in 1978. He served on the Council of the Royal Institution of Chartered Surveys at a difficult time when severe differences of opinion about educational and professional independence led to a number of senior survey officers resigning from the Institution. He was Chairman of the newly formed Land Survey Committee in 1951–53 and President of the Photogrammetric Society in 1957–59. In 1960, he was President of the International Society for Photogrammetry and supervised its 4-yearly Congress in London that year, culminating in a grand Banquet in Guildhall, the tables adorned with Mess plate kindly lent by Chatham (Cleopatra, by order, placed opposite the President), and a section of the RE Band playing in the minstrels' gallery. Bruno concluded his Presidential address with the words "Not to us, Lord, not to us but to Thee be the Glory" spoken in Latin. He was made an Honorary Member of the Society, a rare distinction. He was made MA (Oxon) by decree.

His connections with the Services continued during the fifties when he became Honorary Colonel to 135 Field Survey Regiment (TA) in 1954, a post he finally retired from in 1960. During the sixties and early seventies, when a Director of Meridian Air Maps Ltd, he served as an elected member of the RICS Land Surveying Council. With a highly distinguished career behind him, he might have been expected to have been a staunch supporter of the establishment viewpoint. But he kept a very open mind on matters affecting the well-being of the profession, and was as likely as not to support a radical proposal if it appealed to him. His mind remained as sharp as ever, and he continued to speak it, freely—and usually with a light and humorous touch. In consequence, his views were most widely respected, and his contribution to the profession were as great then as they had been in earlier times. Apart from golf, his main recreation in later years was philately. He soon decided to specialise in Dutch stamps and had a fine and valuable collection.

Bruno was a man blessed with abundant energy and a sharp mind with which to direct it. He did not suffer fools gladly, if at all, and his subordinates stood in some awe of him—as indeed some of his equals did as well, did one but know it. He knew what he wanted, and he usually got it. But for all that he was capable of great kindness, and had a sense of humour which at times bordered on the puckish. He was essentially kind and considerate but with undoubted firmness of standard, and words of congratulations from him were treasured. He was widely respected and loved; he had a charm of manner that made him friends for life in many places.

At his home, Yately, Bruno was a Churchwarden, serving his church faithfully, and he took endless pains to see that his readings of the Lessons were clear as they could possibly be.

He leaves a widow, one son and three grandsons to whom we extend our deepest sympathy.

EWB, ANC, AHD, BStGI and others

COLONEL P D MACFEAT CBE MC B Sc C ENG FICE

Corrigendum: RE Journal, June 1983 (97/2) page 135 line 20

It has been brought to the Editors notice that Colonel MacFeat was not the CO of the Bush Warfare School at Maymu. The only two Commandants of that School were Phillip Meade and Michael Calvert.

JCG who researched and wrote the Memoir writes: "I would not wish to challenge this correction of fact though I defend my interpretation of the source, *Some Memories* by Peter D MacFeat pp 148 *et seq*".

50 Middle East Commando at Castelorizzo

EARLY in 1983 Volume VI of the Winston Churchill biography by Doctor Martin Gilbert was published. It covers the period 1939–1941 and is called *Finest Hour*. On pages 1014 and 1104 with Footnote 2, this book contains allegations about 50 Middle East Commando at Castelorizzo which are totally untrue. These allegations were strongly challenged, in that what had been written was a serious deviation from historical fact. Dr Martin Gilbert has apologized by writing to *The Times* and has promised that there will be an amendment in any reprint of this book.

With Dr Gilberts permission extracts from his letter of apology are published below:

"Sir,—May I use the courtesy of your correspondence column to right a wrong? In a letter to his son in June, 1941, Winston Churchill wrote of 60 British soldiers who surrendered (as he expressed it) 'in droves, and came out of caves with their hands up like a lot of ridiculous loons.'

"This comment was published in Volume VI of the Churchill biography, together with a footnote, for which I alone am responsible, identifying these troops as those involved in the attack on the Italian Dodecanese island of Castelorizzo four months earlier. Evidence which I have now seen (and ought to have sought earlier) makes it clear that no such surrender took place on Castelorizzo, and that the bravery of the unit involved, 50 Middle East Commando, was considerable.

"Whichever episode Churchill was in fact describing, he could not have been referring to the Castelorizzo attack, and I should like to apologize unreservedly to all those who took part in it, for the distress caused to them by an inaccurate identification.—Yours sincerely, Martin Gilbert"

ARTICLES AND CORRESPONDENCE FOR THE JOURNAL

YOUR Journal depends for its existence on articles and correspondence submitted for publication on historical, professional, technical and, indeed, on any subject of interest to Military Engineers.

ARTICLES

Articles may be of any length, but preferably not more than 6000 words. They should be typed in duplicate on one side of the paper only, double spaced with a one-inch margin. A third copy should be retained by the author for checking with the proofs.

Articles should be accompanied by a photograph of the author, suitable for reduction to two inches width, and a pen picture of his career to introduce the author to our readers.

Photographs to illustrate an article should be black and white prints on glossy paper. The size of the photograph does not matter as the size can be adjusted. Line drawings, maps etc must be in black ink and all lines, lettering etc must be bold and clear to allow for reduction in size when reproduced. Scales must be drawn and not worded.

The copyright of all articles published in the *RE Journal* is assigned to the Council of the Institution of Royal Engineers.

Payments for articles is at a rate decided by the Publications and Library Committee. An additional award of £20 is made at the discretion of the Committee for articles of particular merit published in each issue of the *RE Journal*.

Three further awards are made each year:—

The Best Article of the Year Prize (£50) open to all authors;

The Montgomerie Prize (a book to value of £25) for the best article on a professional subject by a Serving Regular RE Officer not above rank of Lieut Colonel;

The Arthur ffolliott Garrett Prize (to purchase or help purchase a piece of silver, value £25) for the best article on the technical aspects of logistic engineering or survey by a Serving Regular RE Officer not above rank of Lieut Colonel.

Articles may be submitted at any time but the following dates are *normally* the latest for inclusion in the issues shewn:

MARCH ISSUE	1 DECEMBER	SEPTEMBER ISSUE	1 JUNE
JUNE ISSUE	1 MARCH	DECEMBER ISSUE	1 SEPTEMBER

For articles requiring clearance attention is drawn to Military Security Instructions Part 1 Army Code No 60723 Appendix B to Chapter 5.

CORRESPONDENCE

Correspondence is the life blood of the *RE Journal*. Correspondence on published articles is particularly interesting as it provokes further thought and widens the discussions on controversial topics. It is important however that the initial reactions to articles published should be in the NEXT Journal to maintain the interest in the subject. For this reason the submission date for correspondence *referring to articles* is five weeks later than that for articles. On average this will give correspondents about one month to react.

The submission dates for Correspondence on published articles are therefore:

MARCH ISSUE	7 JANUARY	SEPTEMBER ISSUE	7 JULY
JUNE ISSUE	7 APRIL	DECEMBER ISSUE	7 OCTOBER