



THE ROYAL ENGINEERS JOURNAL

Vol LXXXVIII SEPTEMBER 1974

No 3

Published Quarterly by

The Institution of Royal Engineers, Chatham, Kent ME4 4UG

Telephone: Medway (0634) 42669

Printers

W & J Mackay Limited Lordswood Chatham Kent ME5 8TD

Telephone: Medway (0634) 64381

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Editorial

SYSTEME INTERNATIONALE D'UNITES

"I would like some plywood, 3 ft \times 3 ft \times $\frac{1}{4}$ in thick"

"We are metric now, Sir. You want 915 mm \times 915 mm \times 7 mm"

"Do I? Right. How much will it cost?"

"Two bob a foot super"

For some years we have been moving towards "metrication". The first mistake was to associate "SI Units" with "metrication" as the latter is more often associated with the CGS system and they are not the same. This point is clearly made at the beginning of the Second Edition of the Royal Engineers Metrication Aide Memoire (Army Code 61166).

How are we doing?

Whenever the mass media discuss the question they conclude with a confused picture of old age pensioners trying to work out whether "X" gram of chicken soup (Brand A) is a better buy than "Y" ounce of baked beans (Brand B) since we gave up £ s d and moved to metric money. Children seem to be doing very well, in fairness they did not have to "unlearn". TV programmes for children use SI units. To them 1 bar = 10^5 newtons/square metre, to the parent it has something to do with the village pub and the chap who was hit on the head by an apple and invented gravity!!! Do you still convert from "SI" to "Imperial", and vice versa? If the answer is "Yes", you are doing badly, because you are immediately throwing away the advantage of the coherency of the new basic, supplementary and derived units. It is very difficult to think in SI units unless you work in them all the time. The child at school, some of the professional engineers, technicians, craftsmen and tradesmen do this. The casual-user is at a considerable disadvantage. This is particularly important in the field of symbols where upper- and lower-case letters have a specific meaning and are not interchangeable. MW and mW have a not insignificant difference of 10^9 —carelessness could be disastrous. The change is not just a question of attitude, it can also involve SI "hardware", instruments, gauges, tools and textbooks. Although lack of hardware can be important it must not be made the reason for resistance to change. Some time ago twenty minutes of TV time were devoted to the difficulties of changing over from "pint bottles of milk" to some unspecified SI unit size. It was argued that the difficulties would (naturally!) result in more expensive milk, therefore we should not go metric. The obvious solution that milk should be distributed in 568 ml bottles at no extra cost was not even mentioned!

How are others doing?

All countries in the EEC and many others agreed to change to SI units, one of the main advantages of any international system is common usage. Very few countries seem to have made much progress so far, indeed some appear to have made none at all. Are we to be the only people "in step" or merely "the first to be in step"?

Time will tell

"Twas pascal and the nano ampere
Did lux and tesla in the hertz;
All milli were the atto weber
And the femto lumen hurts."

With apologies to Lewis Carroll

1974 Corps' Annual General Meeting

ADDRESS BY ENGINEER-IN-CHIEF

At the Annual General Meeting of the Corps, held on 26 June 1974, the Engineer-in-Chief, Major-General M E Tickell, CBE, MC, spoke on the state of the Corps.

He said:

This is a Defence Review Year when the MOD is required to look even more closely and critically than usual on roles, capabilities and organizations. Even if I knew the direction in which the Review was moving I would not, of course, be allowed to talk about it today. What I will do instead is to try to illustrate from the work of the Corps this year some of the difficulties in analysing logically our particular roles and organizations.

VERSATILITY

The first difficulty stems from the very versatility of the Sapper. If, for example, a Sapper unit is in the order of battle for a particular purpose and that unit, as will normally be the case, has many other skills, those other capabilities tend to be used by grateful staffs who might otherwise be in a spot. The question which arises, therefore, is whether you should judge the requirement for that unit only on its prime purpose or whether you should take some notice of its other valuable capabilities as well. You will probably agree with me that the latter would be more sensible.

Let me illustrate this versatility by citing the case of the Royal Engineers in Rhine Army who number nearly 40 per cent of the Corps. Engineer regiments and independent squadrons there are directly concerned with the number one defence priority in support of NATO. They train with all Arms using an increasingly sophisticated range of equipment and have a vital front line role, particularly in the creation of obstacles to give a framework to the defence plan. They have, or are getting, the most modern equipment for bridging and so on. Yet these same Sappers continue to be used as infantry in Northern Ireland—two three-squadron regiments have been there from BAOR in the last twelve months: 25 Engineer Regiment who were in East Belfast and 32 Engineer Regiment who were spread between Fermanagh, Down and the Maze prison. Commanders in Northern Ireland generally admit to me that Sappers make quite good infantrymen. BAOR also provides a squadron on four month roulement in the sapper role—a very different form of sapping from their normal one. BAOR Sappers also do construction tasks for both the Army and the RAF within Germany itself, thus saving the taxpayer money and often speeding up the completion of important facilities—plant nearly pays for itself every year. I have thus listed three other roles over and above the prime purpose for which these 1st British Corps units exist.

DIVERSITY

I would now like to illustrate versatility in another sense—the wide diversity of different activities under one cap badge in one area of operations. I will do so by expanding on Northern Ireland. As I have already mentioned, at any one time you will generally find Sappers there acting as infantry. You will certainly find them in the Sapper role, one squadron in direct support of each of the three brigades. I spoke at some length last year on the kind of work this involved so will only mention one aspect; the further improvement in our search techniques which has led to many noted successes, not alas without casualties. Incidentally, you will be interested to know that 33 Field Squadron is just deploying as a resident accompanied unit with the main responsibility for the support of 39 Brigade in Belfast. I am sure that their reputation as a member of the permanent garrison will be in line with that which they gained on their three previous short tours, and their permanent deployment saves a tour for three other squadrons every year.

During the recent Ulster Workers' Council strike two further field squadrons and a large number of specialists were sent to Northern Ireland. The strike ended quickly, but under certain circumstances you might have found the Sapper Cap Badge in the more unlikely places.

I would next mention 325 Engineer Park which provides engineer defence stores for all units in Northern Ireland as well as the Ulster Defence Regiment and the Royal Ulster Constabulary. This organization has grown again in the last year—as a Corps we always seem to underestimate the amount of engineer support needed at the start of operations. The unit also acts as a support squadron to the field squadrons and provides an engineer workshops and plant repair facility. In 1973, some 6,000 tons of stores were issued and £1m was spent on local purchase.

Continuing the cap badge theme (although in this case the individuals concerned can work more safely out of uniform), we continue to give support to the DOE by providing officers and Clerks of Works on MES attachment. Their number is increasing to twenty this year as the DOE are finding it increasingly difficult to fill vacancies on their establishments with civilians. But they, DOE, have the prime responsibility and co-operation is excellent.

Survey, of course, are there. A small map section under the direction of a WO2 is the tip of the iceberg; the Survey Service as a whole provides innumerable maps at short notice and also does the amending and updating of large scale city maps to reflect a constantly changing pattern. Twenty new and fifty revised maps have been produced in the last year and new plastic laminated map sheets are on user trial in the Province.

Finally, a Sapper you meet in Northern Ireland may be a member of the Postal and Courier Service. The postal bomb has introduced a new dimension into the field of postal operations. The most sophisticated parcel searching X-ray equipment available is now in place in Northern Ireland as well as in the Home Postal Depot and other main British Forces Post Offices overseas. The postal Unit in Northern Ireland also provides a twice daily delivery of mail to all units in the Province and gives a greatly enhanced service at its nine post offices by dealing with family allowances and so on.

I will not have time to mention Engineer Support or Survey again but I would like to make some general points here. The modernization of Engineer Support generally and its extension into management areas other than stores provision is gathering momentum. Furthermore, its potential for technical innovation and advice to the rest of the Corps is far more widely known and used than hitherto. I would cite as examples metrication, the application of ADP and the use of microform.

As for Survey, its increasing sophistication and importance, like Postal in support of all three Services, is perhaps best indicated by the decision to upgrade the post of Director of Military Survey to Major-General.

OVERSEAS PROJECTS

The next question which a critical examiner of the size and shape of the Royal Engineers might ask is "what is the value in a harsh economic climate of the overseas work of the Corps?" The case for it is well known to you; in summary it rests on the essential needs of our training, the value to the developing countries concerned, the credit accruing to HMG's position in those countries, and the value to the world standing of British Forces who might otherwise not be so widely seen. I say "British Forces" advisedly—all the projects I visited this year involved six or more Army cap badges, as well as the RAF.

I am not going to answer the question posed but would like to illustrate our work from one continent only during the last twelve months.

In Africa, the last year has been rather exceptional even by Corps standards. Our involvement there started last November when twenty Landrovers and three trucks were delivered to Mali having been driven across the Sahara as part of a joint Army/Christian Aid venture. The soldiers came from 3 Division, with strong Sapper

representation from 22 Engineer Regiment. The party was led by Major Ken Rutherford, 2IC of the Regiment—a RNZE officer who has just completed a two year attachment to the British Army, and has now taken up the appointment of Chief Engineer of the New Zealand Army on promotion.

In response to a request from the Overseas Development Administration, a small Military Assistance Team left for Ethiopia in January. The OC of 524 STRE commanded an All-Arms team in Ethiopia, planning and supervising the road construction scheme in Wollo Province in support of the Ethiopian "Food for Work" programme. This work in the famine area is well described in an article from one of our National newspapers, as follows:

"Prosaic as it may seem, it is the roads project of a thirty-strong team of Royal Engineers under the command of Major Guy Edwards which is carrying out probably the most important work of all in the famine country. The team—with two helicopters, one RAF officer, members of the Army Air Corps, and other support units, along with Paddy, a splendid Irish Paratrooper as their cook—is engaged on building four roads which will open up the remote area of the mountains so that trucks may take food closer to the disaster areas. The Sappers have settled down as only the British Army can, making themselves at home in a strange atmosphere. Young Corporals accept tremendous responsibility with aplomb, directing hundreds of labourers in backbreaking work."

The Operation was certainly of value—work and food were provided for up to 10,000 local tribesmen and 110 km of stone pitched track were constructed.

32 Field Squadron deployed to the Sudan last December to reconstruct, in conjunction with Sudanese Engineers, two reinforced concrete bridges at Tonj and a Bailey Bridge at Ringasi. The aim of the project was to improve communications in the South which had been damaged during the protracted civil war. The two substantial bridges at Tonj were rebuilt under pressure during three very hot months to exacting engineer standards. The bridge opening ceremony was a cordial bi-national occasion.

Over the same period, 60 Field Squadron were in Kenya. Their tasks included a 9 km stretch of road, with thirty-five culverts and a substantial 12 m bridge, in the Mweiga Settlement, and a large welfare building in Kahawa Garrison. The projects were of a high engineering standard and kept the squadron at full stretch. 20 Field Squadron and a troop from 66 Plant Squadron are currently in Malawi undertaking road and bridge construction east of Lake Malawi, perhaps the largest of all our overseas projects this year.

Finally, the British Army Training Team in Zaire, which is entirely Sapper, has continued to work hard and sensibly under difficult conditions. Their achievements are considerable. The new engineer school is properly established and operating; the base organization has been rationalized; and there are now enough Zairian officers who know what to do to develop their engineer potential, when more money and equipment is available. The BATT is thus able to withdraw at the end of this month.

Time does not permit me to cover a number of important survey projects in Africa.

One indicator of the value of the work we do to the country concerned is the interest shown by its own leaders. Here I can only report that they have all been rather kind to us. The Emperor of Ethiopia personally received all the available members of our Team and presented a LSGCM to WO2 Walton. President Kenyatta laid the Foundation Stone of one of our projects and his Minister of Defence opened two of them. President Numeiry honoured 32 Field Squadron by awarding it the Sudanese "Order of Merit" and the project was opened by the Vice-President; and HE The Life President of Malawi, Dr Banda, has already indicated interest in a continuing project by granting me an audience. Of the other countries I mentioned, we have had the pleasure of entertaining the Minister of Defence of Mali at the RSME, and President Mobutu has given his blessing to the Sapper-led Zaire River Expedition of which more anon.

There were many other interesting Overseas Projects outside Africa but I have

probably said enough to indicate their continuing value. I have already talked about the multi-function role of individual units and the range of different activities covered by the cap badge. I would now like to expand a little on the latter.

RANGE OF SKILLS

Anyone concerned with the future size and shape of the Corps has to ask the question "what range of skills really need to be covered?" The theoretical answer is easy. We have the military responsibility on land to all three Services for every kind of engineering except that involved with communications and the maintenance of equipment. The Engineering profession is a wide one and it is getting wider and more sophisticated each year. Should we and can we try to keep pace? I will only comment now that whenever we are tempted to let any aspect of our professional skill slide a bit, sooner or later we seem to regret it. E and M capability is a case in point—I am not the only one who now thinks that it needs a fresh boost.

T & AVR

There is one part of the Corps about whose professional skill and ability over the full range of our engineering responsibility I have no doubts whatsoever. I refer of course to the T & AVR. So much happens in a year that it is bound to be individious to select examples—and you meet TA Sappers everywhere; for example, I have just met a detachment from 72 Engineer Regiment in Malawi.

In April this year 71 Engineer Regiment built a 310 m HFB across the River Rhine between Rees and Emmerich in seven hours as part of a Northern Army Group Exercise. This is one of the few occasions since 1945 when the lower reaches of the Rhine have been bridged by British Engineers. On this occasion there was close and friendly co-operation with the German Army who produced six tugs and crews. A good example of the versatility of the T & AVR Sapper is given by 73 Engineer Regiment who while at their annual camp:

- (a) Moved to Scotland by LSL.
- (b) Laid a 4,000 m barrier minefield inside twelve hours.
- (c) Demolished an old castle.
- (d) Renovated 8 miles of track in the highlands including the construction of twelve new culverts.
- (e) Erected three foot bridges for the Forestry Commission.
- (f) Erected a 24-foot Nissen hut.

The members of the Engineer Specialist Pool are, of course, our real technical experts. Their work has included geological work in Hong Kong, Nepal, Malta, Gibraltar, Dominica and Belize; heating and ventilating work in Gibraltar and Malta; advice on coral blasting in the Seychelles; advice on oil pollution in Gibraltar harbour; and architectural advice in Cyprus. 111 Engineer Regiment is currently in Gibraltar working on the Europa Promenade Project—a continuation of the Europa Road Project, which I mentioned last year.

SUMMARY

To sum up so far. It seems to me that anyone taking a hard and critical look at the order of battle of the Royal Engineers must take full account, *inter alia*, of the following factors:

- (a) The versatility of the Sapper—the ability of our units to undertake a wide range of tasks at short notice for which they are not specifically designed.
- (b) The diversity of different Sapper activities which are needed in an operational area.
- (c) The wide range of different engineering activities which HMG may suddenly and unexpectedly ask its uniformed engineers to undertake.
- (d) The fourfold benefit from our overseas activities.

Incidentally, I have never really understood why it is that Sappers have historically formed more than 10 per cent of the Army in war and yet always drop to about

8 per cent in "peace". I only know that our versatility—our ability to hop quickly from one role to another—does help to fill the gap.

I have already talked rather philosophically far too long and I am very conscious of the fact that there are older and wiser heads in the audience who understand my theme much better than I do. But there are one or two other Corps activities and problems which I must mention, however fleetingly.

OTHER ACTIVITIES

I will pass quickly and inexcusably over Gibraltar, Malta, Cyprus and the Far East, well aware of the fact that I will have to face, sooner or later, the fury of CsRE scorned. Rest assured that we continue to make our considerable mark in all those places. I will skip equally quickly over Red Berets and Green Berets and support for Blue Berets. Our support for the Royal Air Force is, of course, a main part of our role but it merits full treatment in its own right.

Another important issue which I have not time to expand on is the extent to which, in this harsh economic climate, we should undertake more tasks for PSA/DOE to save money and time on a diminishing Quartering vote. As examples we have been involved in the preparation of married quarter sites in the Shetlands and many projects for the RAF.

On the training side of the Corps—perhaps in the long view the most important of all—I will highlight only two points.

You may know that the Junior Leaders' Regiment at Dover was due to close and that our Junior Leader training was to be done with the apprentices at Chepstow. For various reasons, not least the increase in junior recruiting, this policy is being reconsidered in MOD and I am fairly confident that we will keep Dover. The second point is that we have at last given way to what has been a consistent and, in my view, fully justified demand from our RSMs and next year the RSME will start to run Senior NCOs Courses for all NCOs about to be promoted, or recently promoted, to Sergeant. I do not understand how my predecessors have been strong enough to withstand such unanimous RSM power.

I must mention recruiting again this year because our intake is our life-blood. Thanks to strenuous efforts by the Training Brigade and units, our wastage figures are now reasonably satisfactory (although what is known as "premature voluntary release" is not). However, our adult intake is tied to the Army's which was sadly down last year. This makes the junior entry all the more important to us.

I am still not entirely happy about officer recruiting, particularly direct into Sandhurst. The important point here is early contact with the boy in the school because it is then that his eyes must be turned in a Sapper direction. We need more Corps contacts in the schools. The Short Service Limited Commission, designed to fill the gap between school and university, is also a valuable way to sell the Corps.

ADVENTUROUS ACTIVITIES

I will end on a less military note. The Sapper needs his eyes on the horizon and his feet confronted with almost insurmountable obstacles to bring out the best in him. I am pleased therefore that our adventurous activities flourish. Last October Captain Clive Lee led a team which successfully completed the first intercontinental paraglide, in Turkey across the Dardanelles; last month Captain Michael Burgess led a British Army climbing team in the Himalayas and himself reached the summit of the 22,900 ft Lamjung Himal alone and without oxygen. A YO team from Shrivenham aims to climb Mount Kenya this summer, and later in the year the Zaire River Expedition, aiming to traverse the full 2,000 miles, will have a very strong Sapper element and will, of course, be led by Major John Blashford-Snell.

We were also well represented in the "Round the World" sailing race. Major Neil Carlier was the genius behind *British Soldier* as well as the skipper for the leg round the Horn. Major George Philp skippered the second leg to Sydney and four

other Sappers won crew vacancies. There were other noted activities of equal merit—long may this continue.

As forecast last year, the whole of my Headquarters is now together on the 2nd Floor of the Old War Office Building. We are much smaller but happier and I like to think more effective—long may this continue too.

New President—Institution of Royal Engineers

MAJOR-GENERAL J C WOOLLETT, CBE, MC

MAJOR-GENERAL J C WOOLLETT was elected President of the Institution of Royal Engineers on 16 May 1974, in succession to Major-General Sir Gerald Duke. He has had a varied career during which he has had experience of a great number of Sapper activities, as well as a full range of Staff appointments. He believes strongly that the military and professional sides of Corps duties, far from being mutually exclusive, are complementary, and that the Sapper Officer becomes a better soldier and staff officer because of his engineering background. He hopes to be able to continue the policy of joint meetings with other professional bodies, and to extend it by establishing relations with the professional bodies of the engineer corps of allied armies and the professional organizations of their countries.

Major-General J C Woollett CBE MC MA C Eng FICE was commissioned in 1935 and after YO's courses and taking a degree at Cambridge, he joined 1st Division Engineers at Aldershot in 1938. The following year he served with the BEF in France and Belgium and was initially concerned with concrete defence construction and, during the retreat, with demolitions and mining. Later in the war he served with No 6 Commando and subsequently commanded an Armoured Engineer Squadron during the campaign in NW Europe. Service on the staff in the Far East followed, until he returned to the UK in 1950 to command a Port Squadron, engaged in port operation and construction duties at Marchwood. After a tour as a DS at Camberley, he was concerned with flood relief operations in 1953 and the following year went to take command of 28 Field Engineer Regiment in Korea. During this period, in addition to operational duties, the regiment was constructing semi-permanent accommodation for the Commonwealth Division.

After returning to England, he took 28 Regiment out to Christmas Island and was in charge of the planning and construction of the thermonuclear trials base, including the Royal Navy and RAF elements of the Task Force. This was a considerable civil engineering task, involving airfield and port construction, water and power supply and fuel storage and the construction of specialist building as well as normal accommodation.

After relinquishing command, he served on the staff of Northern Army Group and then spent two years as the British Army Instructor at the US Army Command and General Staff College. A further period in Germany as DQMG (Movements) followed, during which the change over from sea to air trooping was established. He then became Commandant of the Transportation Centre RE at Longmoor, and was the first Commandant of the Army School of Transport after the formation of the Royal Corps of Transport.

In 1966 he became Deputy Engineer-in-Chief and the following year saw him back in Germany again as Chief Engineer, BAOR. During his tenure of this appointment, the Divisional Engineers were re-organized and the Amphibious Engineer Regiment was raised. He also extended the policy of promoting close friendly and professional relations with the Engineer Arms of allied armies. At the end of 1970, he retired and is now a Senior Planning Inspector with the Department of Environment.



Major-General J C Woollett CBE MC

The Indian Sappers and Miners

Some Aspects

PART TWO

COLONEL P A EASTON, OBE

IN the first part of this series it was seen how the main invasions of India were restricted generally to the Northern Plains, principally the basins of the Ganges and the Indus Rivers, and that the South, screened from the North by the physical obstacles of Central India, generally remained free from foreign invasion up to the arrival of the Portuguese in the fifteenth century; thus accounting for differences between statures, appearances, and creeds of the inhabitants of the continental and the peninsula portions of the sub-continent. However, as the Mogul Empire increased in power it slowly extended its influence through the savage country of Central India until it was established as far south as Madras and beyond.

But the Europeans had arrived and in 1510 the port of Goa was seized by the Portuguese, who, sixty years later, established a settlement as far North as the Hugli River. They were soon to be followed by the Dutch, the French and the British.

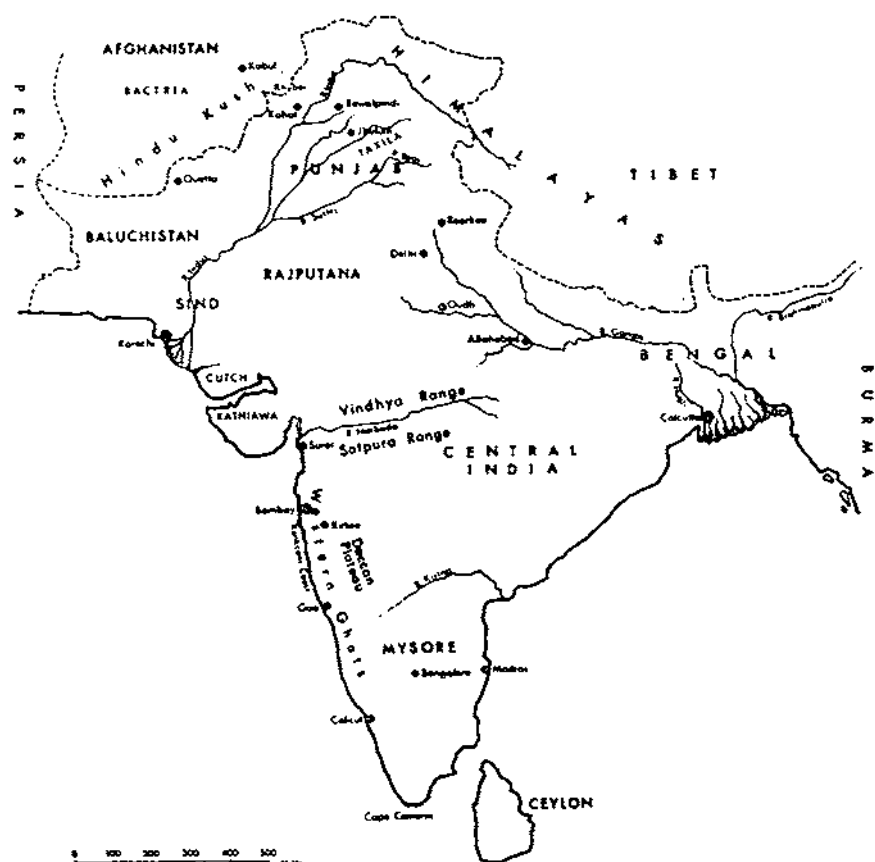
In 1600 Queen Elizabeth I had granted a charter to the "Merchants of London trading with the East Indies", which a century later amalgamated with a rival company to become "The United Company of Merchants trading with the East Indies". The "John Company" was virtually to become the sovereign power of India up to the India Act of 1858.

The first British arrival was Captain Hawkins, a merchant adventurer, who landed at Surat and found his way to the court of the Mogul Emperor with whom, if rumour be true, he became a drinking companion. However, he obtained his real objective which was a treaty enabling him to trade on the sub-continent. But at this time the Portuguese were at the height of their influence in India and soon the treaty was abrogated. Seven years later a properly sponsored envoy from Britain arrived in the person of Sir Thomas Roe, who obtained an agreement for the establishment of factories along the coast. Thirty years later the British obtained their first real footing in the country when the Emperor Shah Jahan granted a plot of land in Madras for trading purposes. Later in 1662 the island of Bombay was ceded to Britain by the Portuguese as part of the dowry of Catherine of Braganza. When in 1690 Calcutta was founded by Job Charnock, Britain seemed to be firmly established on the coasts of the country. In fact, there were now the beginnings of the three presidencies of Madras, Bengal and Bombay, which names are still retained in the titles of the three Groups of Indian Sappers, the successors of the three Corps of Sappers and Miners; the engineers of the three Presidency armies which were still to come into being.

In the early days of the "John" Company few troops were needed but owing to the disturbed nature of the country a sound measure of defence of factories was vital. Guns were needed and the sole source of supply was from the ships of the Company which were berthed near the factories. Walls, which were at first erected only to keep out marauding bands, had to be strengthened to take this borrowed artillery, and there were no sappers, officers or men, to advise or to do this work. Who was better to advise but the man who was responsible for the cannon on the ships? So from the necessity of the times the "Gunner with his crew" supervised the construction of defence works to take the artillery. Thus; the Gunner was recognized as the first British engineer in India. But this extempore measure could not last for ever and indeed the Gunner was used solely for defence. By 1685 the necessity for engineers was recognized by the directors of the Company. "The Duty of a Soldier in Intrenchment warfare . . . such work is only proper for Pioneers as you call Cooleys." But matters moved slowly and by the time of the Battle of Plassey, in June 1757, only a cadre of Engineer Officers and companies of European or Indian Pioneers had

been formed and then only on a temporary basis. Three years later the need for organized and permanent units had been recognized by the Madras Government which raised two companies of Pioneers, each consisting of two sergeants, two corporals, five havildars, five naiks and 100 pioneers. They were to be dressed in blue jackets and to be armed partly with light pistols and partly with pikes; their duties being; "to clear roads instead of mamooty-men" (the mamooty being the digging implement of the time). A year later these companies were present at the defeat of the Mysore Army; an event which was recorded in the battle honours of the Madras Sappers and Miners. The need for some form of engineer troops was also recognized by the Bombay Government and so was raised a company of "Pioneer Lascars" in 1777, consisting of one sarang, four tyndals and 100 "private men". This company was to work under the engineer corps, which consisted of officers only, and it is from this company of Pioneer Lascars that 18 Field Company of the Bombay Sappers always claimed its descent, although not officially recognized.

The situation regarding organized bodies or corps of engineers still remained unsettled. Each Presidency had its own army with an Engineer General, who also had Chief Command of the Artillery. But the necessity was increasing and in 1797 the Bombay Government expanded the company of Pioneer Lascars to a Pioneer Corps of four companies, each of 100 men, with officers from regiments of the Line. However the first Commandant was an officer of the Bombay Engineers. These companies were not to be armed although there is evidence that they assisted an attack on Bhore Ghat with flanking fire in 1781.



So far the word "Pioneer" had been applied to engineer troops in each of the three autonomous Presidencies. But they were the forerunners of both the three Corps of Sappers and Miners and also of the Corps of Pioneers; the latter being organized on a battalion basis and remaining on the Indian Army List until 1932. It may be difficult in early days to find the distinction between the two. However the history of the Bombay Pioneers makes this clearer: "In battle Pioneers being primarily fighting troops will be used as such". In the years leading up to 1932, when the disbandment of the Pioneer Corps took place, their officers were Indian Army Officers, who were given courses of Field Engineering at the Headquarters of the three Corps of Sappers and Miners.

The time is now approaching when the title "Sapper and Miner" was to become more commonly used. Initially the need for engineers was only in defence and for that purpose the "Gunner and his Crew" had been employed. But now the need for engineer troops in addition to the existing cadre of Engineer Officers was not only being recognized but becoming firmly implanted in the minds of the three Commanders-in-Chief, and in the first quarter of the nineteenth century the first units of Sappers and Miners were raised in each Presidency. Some units were new and some were the descendants of former companies of Pioneers.

To trace the early histories of each of the three Corps collectively may well lead to confusion. The three Corps were separated from each other by hundreds of miles and each was under the command of its own Presidency Army. Each, also, enlisted men of different races, creeds and customs. The late Lieut-Colonel E W C Sandes in his *Indian Sappers and Miners* examines in some detail the early days of each Corps and much of the later historical facts in this article are drawn from this important book.

The origin of the Madras Sappers, later "Queen Victoria's Own Madras Sappers and Miners", lies in the two companies, mentioned earlier. In 1790 the strength of the Corps was increased to five companies and more were added later. In 1803 the Corps was organized into two battalions, each of eight companies. In 1831 the first battalion was converted into a Corps of Sappers and Miners with engineer officers from the Madras Engineers. At the same time the battalion was awarded the honours and distinction won as Pioneers from the Battle of Seringapatam to the Burmese War of 1824 to 1826. The Headquarters of this Corps was not stationary and it was not until 1857 that it moved to Bangalore, its present location.

The origins of "King George V's Own Bengal Sappers and Miners" appear to lie in four companies of Artificers, that were raised in 1776. Four years later two of these companies were officered by engineer officers of the Bengal Army. These, however, appear to have been garrison troops. In 1803 a Corps of Pioneers with infantry officers was raised in Cawnpore and existed as a separate arm until 1835 when it became Sappers and Miners, but frequently appearing in Orders as "Pioneers" or "Sappers". In 1808 a company of Miners was raised for Field Service and merged with the Sappers and Miners eleven years later. In 1818 the formation of a Corps of Sappers and Miners was decided by the Bengal Government and a draft of "European Sappers", trained at Chatham, arrived in India for service. Formed in Allahabad the uniform was that of the Pioneers of 1803 but in 1819 it was changed to that of the Royal Sappers and Miners of the British Army. The Headquarters of this Corps was also subjected to many moves. After settling in Delhi in 1834 for some years, where the Corps received a number of its Indian ranks from disbanded units of Pioneers, the Headquarters of the Bengal Sappers finally established itself in Roorkee in 1859.

Brief mention must here be made of an irregular company of sappers, raised by Captain George Broadfoot for the army of Shah Shuja, to proceed to Kabul. With a stiffening of Indian Officers and NCOs from the Bengal Sappers he filled his ranks with a motley collection of men from Oudh, Gurkhas, Pathans and Afghans, eventually arriving in Kabul in 1841. Later this small "private army" expanded into one of six companies. But when in 1842 the army of Shah Shuja was distributed among

units of the Bengal Army, the Bengal Sappers received two companies of this force.

As has been mentioned earlier the Royal Bombay Sappers and Miners unofficially claim their descent from the company of Pioneer Lascars that have been mentioned earlier. These Pioneer Lascars, commanded by Engineer Officers, took part in both the Mysore and the Mahratta Wars and in 1797 were raised to a strength of four companies. In 1820 the Engineer Lascars were reorganized as a company of Sappers and Miners, under the command of Engineer Officers of the Bombay Army and one company proceeded overseas to the attack on Beni Boo Ali on the Arabian Coast a year later. In 1830 the Sappers and Miners were merged with Pioneers and the combined force was designated "Engineer Corps", although frequently referred to as the Corps of Bombay Sappers and Miners. This title was not confirmed until 1840. As in the case of the other two Corps the Headquarters of the Bombay Sappers was not stationary, moving from Ahmednagar to Sirur, where the ruins of its old barracks could still be seen a hundred years later, to Poona in 1837 and to Karachi in 1843. It was not until 1868 that the Headquarters of this Corps finally came to rest at its present location of Kirkee, three miles from Poona.

Undoubtedly each of the three Corps had its own individuality, which in many respects remains to this day. Not only was this caused by the fact that each was raised by a different Presidency Government and under different circumstances but also by the different races, with their different habits and customs, and by their uniforms. In early days the Madras Sapper would wear a red tunic with blue facings, blue trousers with a red stripe and on his head a "doopta" or species of shako, which is still worn by the quarter guard of the Madras Engineer Group. By contrast the Bengal Sapper wore a short tight red coat with tight white shorts. His legs were bare and on his feet he wore sandals. His head dress consisted of a "tall black hat" built on a bamboo frame. In 1851 this uniform was changed to red with blue facings. Due to the dislike of paper work by a zealous subaltern, who used many valuable papers to paste up the backs of targets, early records of the Bombay Sappers are scarce but the Bombay Sapper wore a red jacket with black facings with white drawers and shirt.

Having been raised in regions so far apart, each of the three Corps drew on different races, classes, castes and creeds in their own neighbourhood for recruits. Again the three Presidency Armies had their own Corps of Engineer Officers. Although there must have been some form of liaison between the engineer officers of the three Presidencies (and hence of the three Corps), each Corps slowly built up its own individuality, tradition and esprit that were to be of such value. Indeed a family spirit was born; one that is most noticeable to a visitor to any of the three Corps of today.

In their early days the Bengal Sappers drew their men primarily from Oudh and from the Punjab. Consisting of Mohammedan, Sikh, high caste Hindus as well as Rajputs and Jats it would seem that these men were of higher caste than those of the other two Corps. They were soldiers first and artisans second. The earlier Madras Sappers were of lowlier origin and there were no special caste observances. All ate out of the same dish, a custom that prevails to the present day. Men were prominently from ancient Dravidian races; Hindus, Mohammedans and Indian Christians. There is an interesting direction by the adjutant of this Corps regarding recruiting in the early years. "The tall, smart and showy men get coughs and pneumonia, when serving in a severe climate. . . . No man should be taken, weighing less than 120 pounds. Continued hard work by sappers makes it essential to have some reserve of weight." Despite the efforts of the paper-hating subaltern it would seem that the Bombay Corps first drew largely from the Mahrattas of the Konkani coast, who with the roving corsair spirit of their forbears were not averse to serving overseas. Indeed history reveals that in the peninsula portion of the sub-continent there had been trade by sea with distant countries. Other sappers of the Bombay Corps included Mohammedans from the Deccan, Tamils and Telegus.

It is not the intention in this article to make a play of such words as Class or Caste; indeed at the present time in India every effort is being made to eliminate

caste and its resulting habits and customs. Generally; the term "Class" has been used to describe different races, eg Sikh, Mahratta and so on, while "Caste" as its name implies refers to social and religious status. Thus there will be Brahmin and Rajput Hindus; Rajput and tribes of lower status among the Mussulmans of the Punjab: Jat and Mazhbi Sikhs. Despite their social differences each class has its own history, customs and habits, of which every British officer had to have knowledge if he was to understand "what made each man tick". The Southern Indian, enlisted by the Madras Corps presented no difficulties in the matter of caste or social status, in fact this has been pointed out in an earlier article when it was shown that originally the Southern races of the peninsula did not have caste. Caste did however have effect on domestic administration elsewhere and it was not so long ago that the author noticed that for sixty men, eight separate cooking places were required. The Madras Corps fortunately had no shiboleths in the matter of caste. On enrolment all men partook of food from a common cooking pot. Indeed; when a Madras Sapper was once asked what was his caste, he proudly drew himself up and gave the simple answer "Sapper".

To give an account of all the campaigns in which the three Corps took part would require many volumes. Much detail has been given to the exploits of each Corps in *Indian Sappers and Miners* and, in addition each Corps has its own history. To give such accounts is outside the scope of this article, which is to focus attention on the individualities of each of the three Corps. Later, it is true, there was one Corps of Royal Indian Engineers and, still later, the Corps of Engineers in India after 1947. Even so, the three Corps still retain their own individuality and family spirit.

At first enrolled solely for the purposes of defence of the Company's factories the scope of the three Corps rapidly enlarged, even as far as expeditions outside Indian territories. The Madras Corps was the first to send a unit across the seas when in 1795 they took part in operations against the Dutch as far away as Malacca. Six years later they were the first of the three Corps to operate outside Asia when they were present in Egypt. Again in 1841 two companies of the Madras Corps took part in the First China War. A major event in the First Afghan War is recalled by both the Bengal and Bombay Corps when a mixed party of British, Bengal and Bombay sappers blew up the Kabul Gate at the siege of Ghazni. And, as has already been recounted, a unit of the Bombay Corps operated at Beni Boo Ali on the Arabian coast.

The first half of the nineteenth century witnessed many changes in titles and in organization. Except for a brief reappearance from 1847 until 1851 the name "Pioneer" disappeared from the Bengal Corps. During that brief period this Corps was organized with three "Sapper" companies, officered by Presidency Engineers, and with seven "Pioneer" companies with officers from the infantry: the Sapper companies being the more highly paid. There was a difference in the uniforms in that the "Sappers" were clad in a red uniform while the "Pioneers" wore green uniforms. The title too was changed to "Sappers and Pioneers". However, in 1851 there was another reorganization of the Bengal Corps. The original title of "Sappers and Miners" was restored and the strength was increased to twelve companies with officers drawn from the Engineers of the Bengal Presidency Army. Uniforms were changed to red with blue facings and the Headquarters of the Corps moved to Roorkee.

Operations by the three Corps were not always entirely warlike and in 1837 the Madras Corps, having expanded to six companies, employed four of these on Civil Engineering works, thus obtaining a high degree of technical skill for which the Corps has always been notable. Having further expanded in 1854 and 1857 a uniform, similar to those of the other two Corps, was adopted being red with blue facings, with blue trousers with a red stripe, and retaining their "doopta" as a head-dress in blue, resembling a shako without a peak. This head-dress, although in khaki, persisted until World War II.

About the second half of the nineteenth century doubts were raised about the

proficiency of the three Corps in musketry. Until 1854, when he was re-armed with the Sapper carbine, the sapper of the Bengal Corps had been armed with a fusil and bayonet. In 1844 the Bombay Corps was armed with the Brunswick rifle while the Madras Corps were equipped with the Sapper carbine in 1846.

By the end of the first half of the nineteenth century the three Corps of Sappers and Miners, originally raised for engineering purposes in defence and later having played their part as fighting troops, had become integral parts of the three Presidency Armies. Each Corps had a reasonably settled organization and a Headquarters, which occasionally moved albeit after long intervals. Each Corps still retained its own recruiting areas but nevertheless wore similar uniforms. Tradition and *esprit de corps* was being built and a strong family spirit was emerging; a spirit that would be essential for the stormy days ahead.

Some Experiments on the Stirling Cycle Engine

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

IN order to reduce pollution of the air when motoring, I used to drive an electric motor car; and in order to get a longer journey from each battery, I sought to build a Stirling engine to carry in the boot, with the object of running a generator to top-up the batteries. I never expected to generate as much energy as the battery gave out; but I thought that if I kept a Stirling engine, which is silent in operation and can be made pollution free, and kept it running all the time, in traffic blocks and when otherwise halted, I should contrive to make a charge last longer than formerly. Though I have not yet succeeded, the search has led me to design and build a family of Stirling engines, culminating with Mark III; and some account of these experiments may be of interest.

Most engineers have vaguely heard of Stirling engines and the Stirling cycle—so called after the Reverend Robert Stirling, who flourished about the time of Waterloo, and gave his name to the discovery. But most engineers have forgotten how the thing worked; so perhaps I may be pardoned for producing Figure 1 which illustrates the general principle. The name is, of course, a grand title for what is otherwise called a "hot air" engine, for air is the working fluid. In the early part of the last century the steam engine was in bad odour because of the propensity of the boiler to burst with fatal results; and even when no such catastrophe occurred, jets of escaping steam were none too pleasant. There were many accidents and Stirling thought he could do better with hot air; and he might have succeeded but for the invention of the steam turbine and then the diesel engine. These reduced the hot air engine to the status of an also-ran. None the less a few were built for use in out of the way places, where oil was hard to come by, as they could be run by burning dead leaves or wood or other solid fuel. When I first went to India in 1928, a few of the older men I met had table fans worked by hot air engines burning kerosene. They ran silently all night, and were better than all but the most stout-hearted *punkahwallahs*; and I have an old catalogue from which it is evident that hot air engines were made up to about 1940 for pumping water in country houses, being stoked with hedge trimmings by the gardener's boy. Since then, the Philips Company in Eindhoven has done much research into Stirling engines; and I have, myself, been for a ride in a motor bus powered by one of their engines. It was a highly sophisticated machine, using hydrogen or helium (I forget which) as the working fluid, all raised to an ambient pressure of many atmospheres.

I never sought to emulate that sort of thing, but I thought that by using modern materials and modern engineering practices I might be able to improve on the magnificent museum pieces that are to be found here and there, up and down the country.

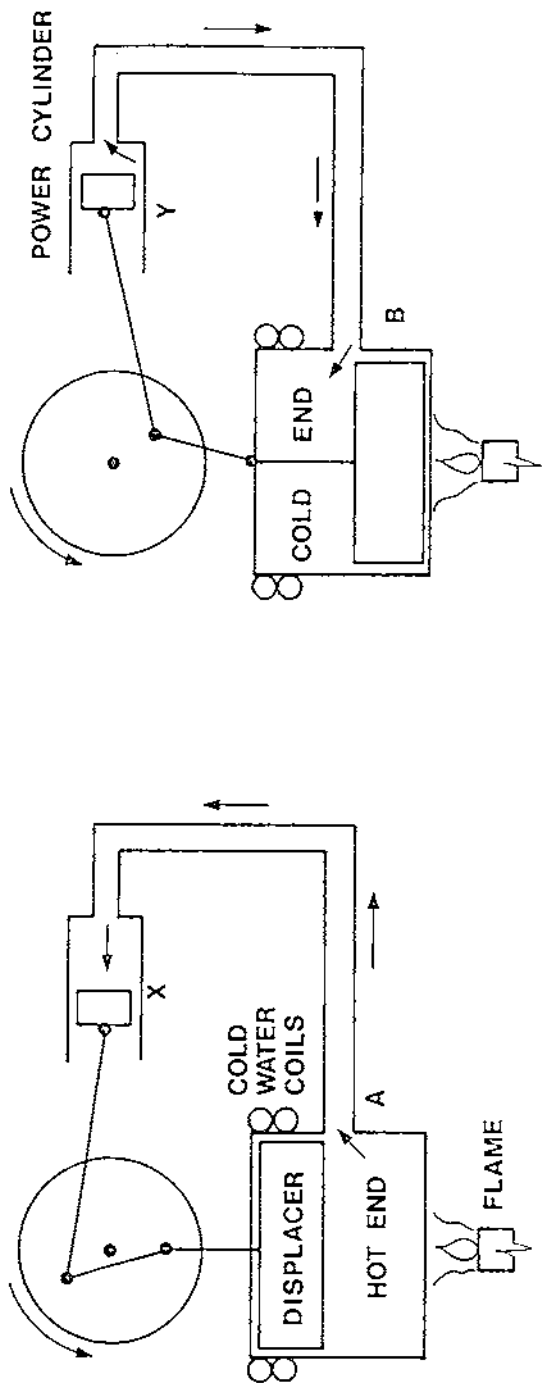


FIG 1 THE STIRLING CYCLE

AT 'A' MOST OF THE AIR IS HOT AND EXPANDING
 AT 'B' MOST OF THE AIR IS COLD AND CONTRACTING
 AT 'X' THE PISTON IS BEING FORCED TO THE LEFT
 AT 'Y' THE ATMOSPHERE IS FORCING THE PISTON TO THE RIGHT

Perhaps it is worth speculating who it is who actually *builds* an engine? Is it the man who sketches it out on the back of an envelope? Or is it the man who turns that sketch into a working drawing, altering what is impracticable and substituting better devices? Or is it the foundryman who casts the cylinder block? Or the fitter who makes the crank-shaft? Or the man who, by wielding the power of the cheque book, decides whether anything shall happen at all? The fact is that there is room for argument; and all I claim is that I performed a fair proportion of these roles. But in the same breath that I make this claim I readily assert that but for my friend, Felix Cunuder, not a single one of my Stirling engines would ever have been built. Felix is an engineer of the old school—strictly speaking he is an Old Age Pensioner—who learnt his engineering the hard way, and became as cunning with his hands as he is ingenious in his mind. It was with him that I discussed every step; and it was in his workshop that each of the first engines worked.

The first of the series, Mark I, was really no more than a toy. I found it necessary to convince a lot of people—including myself—that the thing would work, in order to get co-operation. Showing it in action was better than showing them diagrams; but Figure 1 is the next best thing. From this I hope that the reader who is not familiar with the Stirling cycle, or who has forgotten it, will be able to see the principle. It is certainly extraordinarily simple; and because it is external combustion, as opposed to internal combustion, it is possible to regulate the heating source so that there is little or no pollution. Mark I had no power to speak of; and one could stop it with one's little finger on the 3 in flywheel. But it did about 1,500 rpm without making more noise than a manually operated sewing machine.

There is an immense satisfaction in seeing one's brain-child moving before one's eyes; and I have frequently bored my friends, playing with it on the dinner table when the ladies have withdrawn. They ask me which is the boiler, and I have to explain that it is hot air and not hot water that does the trick. It is well worth another glass of port wine.

However, when Mark I succeeded, Felix and I embarked on Mark II. This was to have the 5 in diameter liner from a diesel lorry engine as the power cylinder; and we tried to calculate the proper size for the displacer cylinder. This is not easy, but I happened at this time to meet a man called Bradley, who lived in Coventry. He had done a lot of private research on hot air engines; and had, in fact, not only made some of the parts I had bought for Mark I, but had patented a displacer. He was of the opinion that if I cared to use his patent displacer, the correct diameter for the displacer cylinder would be one and a half times the diameter of the power cylinder. That fixed the displacer cylinder at $7\frac{1}{2}$ in diameter; and then many of the variables began to resolve themselves.

Bradley's patent is illustrated in Figure 2. It consists of two separate ideas. The first concerns the design of the displacer, the second concerns the manner of assisting the transference of heat from the flames to the inside of the cylinder, and from hot air back again to the cooling water.

The design for the displacer consisted of two metal discs, each with a "skirted" periphery, and mounted back to back, with a small air space between them. This acts like the safety curtain in a theatre. The safety curtain prevents the heat of a fire on the stage from incinerating the audience; and Bradley's two discs with an air space between them tend to control the movement of heat from one end of the displacer cylinder to the other. The air remains more or less in the same place throughout, and is either exposed to, or shielded from, the heat according to the position of the two discs. Whether this arrangement is more or less efficient than Stirling's original system is a matter of opinion; but there is no doubt that it enables the designer to make the displacer cylinder much shorter in length than is possible with Stirling's displacer.

Bradley's design for transferring heat through the top and bottom of the displacer cylinder depends on a number of "pins" through the end of the cylinder as shown in Figure 2; and it is these pins that necessitate the skirting on the discs.

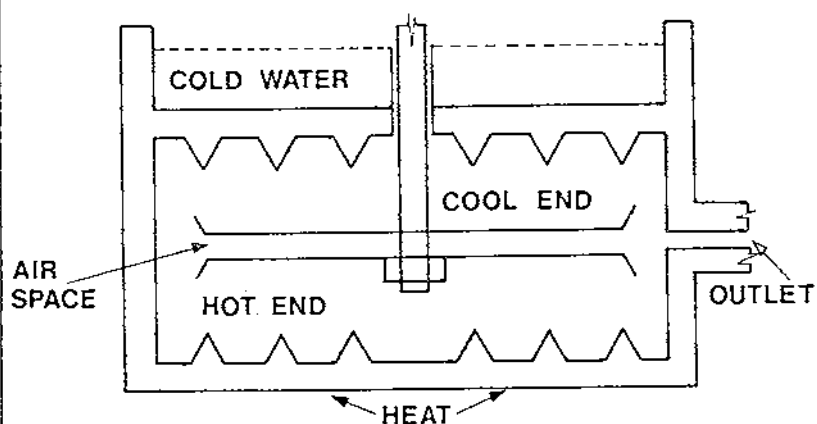


FIG 2 BRADLEY'S PATENT

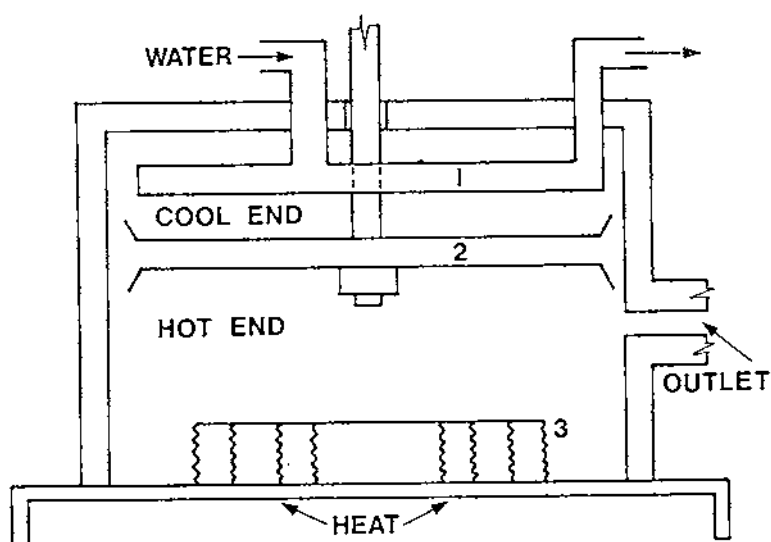


FIG 3 DISPLACER CYLINDER MK II

- 1 PANCAKE COIL FOR COOLING WATER
- 2 SKIRTED DISPLACER DISCS WITH AIR SPACE
- 3 CIRCULAR WALLS OF COPPER GAUZE

In Mark II we tried to improve on the second part of Mr Bradley's patent. We dispensed with his pins to transfer heat through the ends of the displacer cylinder and put a pancake coil of copper tube, carrying cooling water, inside the cool end of the cylinder. At the bottom, on the hot end, we had a plate of copper with rings of copper gauze rivetted to it like circular walls $\frac{3}{4}$ in high. (Figure 3.) The displacer itself, was made according to the patent, with an annular clearance between it and the cylinder wall of about $\frac{1}{8}$ in. I say *about* $\frac{1}{8}$ in because the tinsmith who made the two skirted discs was a bit dubious of achieving an accurate result, and only agreed to take the job in hand on the understanding that the size would be *about* right. As it turned out, the clearance was *about* $\frac{1}{8}$ in and was apparently *about* right.

The arrangement of copper gauze at the hot end was a great success; but the pancake coil at the other end was not so good. Thermally it was good enough; but it was not easy, due to the differing expansion of the two metals, to get a good seal where the copper tube emerged from the top of the cylinder.

We had some debate on where to fit the connecting pipe from the displacer cylinder to the power cylinder. We could lead it out from the waist of the displacer cylinder, as in Figure 3, or we could take it from the top. We settled for taking it from the waist, partly because it would then be well clear of the pancake coil at the top, and partly because we could have a shorter pipe that way and so have less dead air. On reflection, however, we later concluded that this was not the best way to do it; and in Mark III we took the air from the top.

(I must say in parenthesis that we were much in Mr Bradley's debt; and it is sad to recall that he died very suddenly in 1973; but I hope to help his widow to dispose profitably of his patent.)

When Mark II was running nicely, we laid on a demonstration, and invited a few people who had helped us, and a few others whom we thought might be interested for academic reasons. One of these, a real live PhD, was so thrilled that he persuaded his university to buy it. This not only put me in funds for Mark III, but it raised Felix and me to that rarefied stratum wherein dwell only those who have not only designed and built engines but have also sold them. This I believe to be unusual in the present age. Many men have designed engines; still more have sold engines designed by others; and the numbers of men and women who are making engines on the shop floors of the civilized world are legion. But few, I think, have combined all three offices. However, Sappers are expected to be versatile; and Felix, without being a Sapper, is certainly that.

That set us off on Mark III, which was to have a double-acting power piston. There were to be two displacer cylinders, each servicing a different end of the power piston. Figure 4 shows the lay-out in a schematic manner. In the posture shown, the power piston is in the middle of its stroke, travelling from left to right. The air in the left-hand displacer cylinder is mostly below the two metal discs, being heated and therefore expanding. The pressure is being transmitted past the discs in the annular space between them and the cylinder wall and into the power cylinder, *forcing* the piston to the right. Conversely, the air in the right-hand displacer cylinder is mostly above the two discs and is being cooled. It is therefore contracting and, so to speak, "sucking" the power piston to the right also. Both displacer cylinders are thus acting in a common endeavour. The linkage between the displacers and the power piston is such that when the power piston is at either end of its travel and on a dead centre, both pairs of discs are centrally situated in their respective cylinders. The air within the displacer cylinders is then equally divided between the hot and the cold ends, and so not exerting pressure either way. As the power piston returns to the central position, moving from right to left, the two sets of discs are in exactly reverse positions to those shown in Figure 4, so that the power piston is being *forced* to the left. It is really very simple.

The heat for Mark III is supplied from a Calor Gas bottle to two gas rings. The heat is transferred to the cylinders as in Mark II, and the lower of the two discs that form the displacer is dished in the manner Bradley prescribed. At the top of the

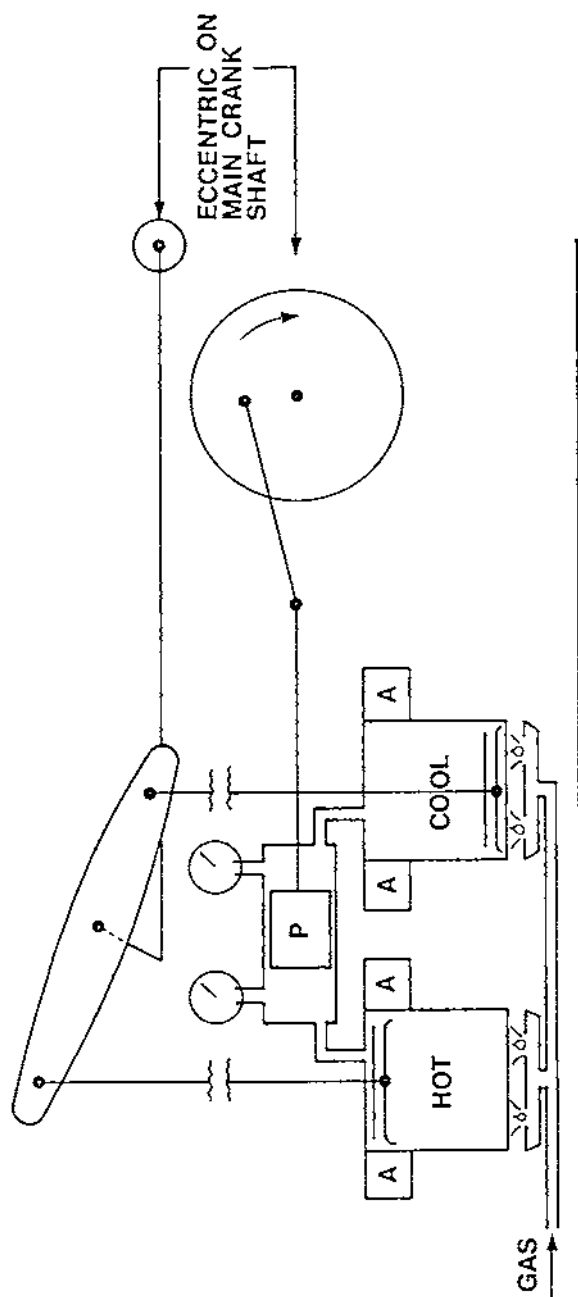


FIG 4 MK III SCHEMATIC DIAGRAM: SHOWING HOW IT WORKS

'p': POWER PISTON A - A : WATER JACKET

displacer cylinders there are water jackets and no protrusions or pins within, so we made the upper discs flat. When we came to assemble the machine we found that the air could not get past the discs fast enough; and retarding pressures were set up; so we bored a number of holes through the discs. This seemed to be contrary to the "theatre safety curtain" principle, because there would no longer be a wafer of still air to act as a heat insulator. We got over this by putting a thin strip of asbestos between the two discs and piercing it with holes that registered with those in the discs. In this manner some of the hot air passing through the holes tended to give up heat to the asbestos, and to recover that same heat on the way down again. This is what The Reverend Robert Stirling called "regeneration", a word that may have been prompted by the Greek of St John III, verse 7, which reads:

Δει ὕμιν γεννηθῆναι ἀνωθεν.

The displacer cylinders are aluminium-alloy castings; and to minimize the amount of heat that was conducted along the cylinder walls, we made each in two pieces, an upper and a lower, separated by an asbestos gasket.

The metal discs that form the displacers are raised and lowered by two rods attached to a sort of see-saw, which is operated by an eccentric rod from the main crank-shaft. The displacers have a "lead" over the power piston of 90°. (We experimented a good deal with this angle; and 90° seems to be the best that can be found.)

We assembled the machine and heated it. We then turned it by hand before connecting the power piston rod to the crank shaft. In this way we established the natural travel of the power piston. Having established that, we were able to cut the length of the power piston and its cylinder to eliminate dead space at either end. The weight of Mark III is about 100 lb.

In our first practical trial of Mark III we had it driving a dynamo to light a bulb. This was disappointing owing to the many conversions. First, Calor Gas was turned to heat; then heat was turned into motion; that in turn was turned into electricity, which was then turned into light. More light would have been shed if the Calor Gas had been burned directly in a properly designed lamp.

However, about this time there were a number of power cuts in the electricity supply; with the result that many people found their central heating fail, although allegedly oil or gas-fired. The reason was that the hot water in such systems is usually circulated by an electric pump which relies on the mains.¹ It then occurred to me that if the circulating pump were run by a hot air engine, using the heat that normally goes up the chimney, we might get somewhere. We therefore started to rotate a circulating pump by a belt off the flywheel of the engine; and as a start we made it circulate the cooling water through a domestic radiator. Although it was not exactly as intended, the result was interesting. We were not using all the power available, and we were at the same time warming the room through the domestic radiator. In fact, by extending the pipes from the engine to the radiator there was no reason why we should not heat the next room as well. We had a wholly gas-fired system. It was on this basis that we demonstrated Mark III to various interested parties. (See photo I.)

At our demonstration a number of academics were present, and the instructional potential of Mark III was appreciated. By weighing the Calor Gas bottle from time to time it is possible to measure the consumption of gas, and calculate its calorific value. With a strap over the flywheel and a spring balance, it is possible to measure the bhp of the engine. (My guess is about $\frac{1}{4}$ hp.) By observation of the pressure gauges at either end of the power cylinder, or by fitting indicators in place of them, it would be possible to calculate the value of PLAN and divide by 33,000, which engineers find irresistible. It would also not defeat the wit of man to measure the heat rejected into the domestic radiator. In this way one might even be able to reason out that mysterious property known as Entropy. In most students' minds this lurks like some evil monster in a sulphurous cave; but by playing with Mark III it can be tamed. Moreover, while playing, the enquirer after truth is neither making an

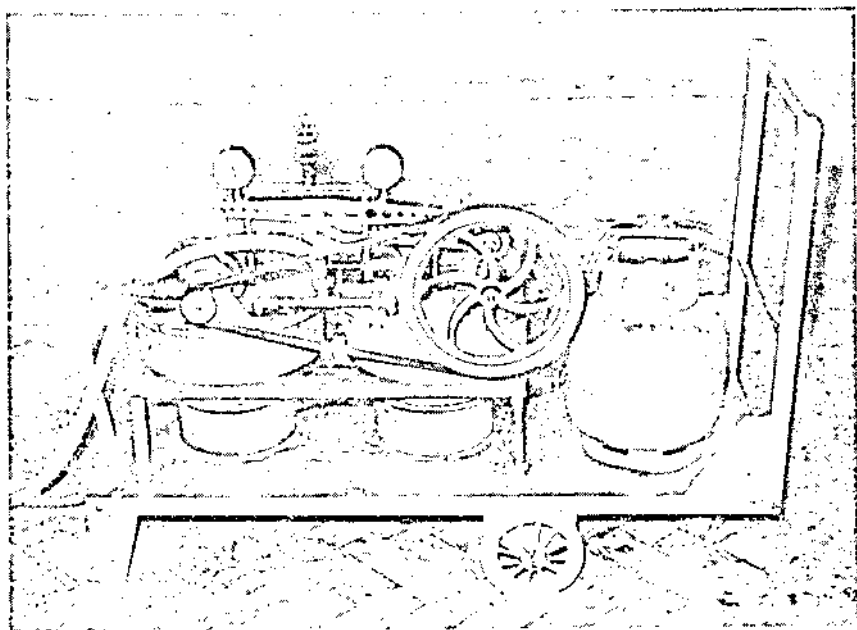


Photo 1. Hot air engine mounted on a trolley and turning a water circulating pump.

obnoxious smell nor an insufferable din. Mark III runs very silently, and of course the Calo Gas rings give off negligible stink.

It might also be possible with an air bottle to pressurize both sides of the system, which should theoretically vastly increase the output. So, although Mark III has failed to achieve its main purpose of charging the battery of the electric car, it seems to be capable of opening the gates of knowledge to students of thermo-dynamics. And, after all, is that not something in these utilitarian days?

¹ Editor's Note: There is in addition the problem that the valve controlling the gas supply, or the pump delivering the oil fuel to the boiler, also normally rely on an electric supply; therefore whilst the electricity is off, the boiler itself cannot operate.

Odd Ode

*Composed and recited by a member of the Senior Officers' War Course
at the conclusion of their day at RSME*

We like the way you fix the roads with concrete and macadam,
And extended runways at Masirah and El Adem.
And using PSP for airstrips with a pretty good strong mesh,
And also homes for Puddies in the buildings at Long Kesh.
And as for building airfields you must have needed urgin'
To go and build an airstrip on those islands known as Virgin.

I was also glad you're keen on supporting our new Harriers,
Though the sailors are convinced that they will never replace carriers.
From all we've heard, both overt and also under wrappers,
Makes us quite sincerely say—Here's hats off to the Sappers!
And if the DS is angry—I hope he won't be very,
Please excuse my little ode by blaming it on sherry.

KC

Holdfast Foxhounds II

LIEUT-COLONEL J R ALFORD, RE, BA

INTRODUCTION

THE first of two articles about sappers as Infantry in Ulster (see June 1974 issue) described some of the problems encountered in training and preparation for a tour in the Province. This, the second, covers the tour itself. Whereas the first was to some extent prescriptive, tried to give our answers to some of the problems we met and to set down solutions which seemed to us to work and make for better training, this article is almost entirely descriptive—that is it is a kind of muddled narrative of what actually happened and what it felt like to be there. It would be quite wrong in any case to attempt to lay down general rules by extrapolating from a unique area at a particular time. I shall also try to avoid political judgements except where this is unavoidable and I shall not attempt to unravel the complex of initials (which in any case largely defy analysis) which went to make up the Protestant extremists who lived and operated in East Belfast. What I will try to do is to describe some of the sorts of actions and reactions, the pressures and constraints, the feeling that one gets and the more universal antagonisms which exist between the tribes themselves and between the tribes and the security forces. I do this by first describing the area, then by making some general points and finally by a blow by blow account of an Evening in the Life of CO 25 Engineer Regiment.

East Belfast

The River Lagan is not simply a geographical fact, it is also a symbolic divide between two quite different parts of Belfast. In terms of population it divides the City in two more or less equal parts but, whereas to the West Catholic and Protestants are roughly balanced, to the East the area is almost exclusively Protestant and tends not only to speak with one voice but to consider that that voice represents the one true voice of the Ulster Protestants. It is not without significance that the Reverend Ian Paisley has his living in East Belfast and that Mr William Craig is currently the sitting member for the area in the Westminster Parliament. There is much less of the feeling of immediate threat which exists, say, in the Shankill (lying as it does between the Ardoyne and the Falls) for there is no immediate threat to the security of the East Belfast Protestants except in the immediate vicinity of the very small Catholic enclave of Ballymacarrett. It is therefore a good area for testing the temperature of Protestant feelings in general about law and order and Protestant attitudes to the security forces.

To give a rough idea of numbers, some 200,000 Protestants live in East Belfast. A mere 2,500 Catholics live in Ballymacarrett and many fewer—perhaps 700—live in Willowfield. There is in addition an indeterminate (and dwindling) number of what we called "scattered Catholics" who lived throughout the area and were, inevitably, subject to intimidation of various kinds and differing beastliness. This is a subject I shall touch on again later.

Broadly speaking the area consisted, if such a thing can be imagined, of three concentric half-circles. The innermost half-circle consisted almost entirely of mid-Victorian working class back-to-back slum housing of the worst kind—overcrowded, totally lacking in open spaces (except where houses had been blown up or cleared for redevelopment) and very depressing at any time. Many houses (over a 1,000) were derelict. There were virtually no green things. All was uniformly grey except for Union Jacks. There is little here to lift the spirits. The next half-circle was rather later Victorian and Edwardian development along more spacious lines interspersed with new estates—altogether greener and less depressing and much like the outskirts of any industrial city built between 1880 and 1910. Finally the outer ring was often very smart indeed with a large number of post-war detached houses nicely set where lived many of the prosperous (but no less extreme) Protestants who were

largely untouched by and, one is bound to say, largely unaware of what was going on in the poorer parts of the City. This is also a point to which I may return. In this very large outer ring were further redevelopment areas.

I think such a general description is worth making for it indicated that the centre of gravity of our deployment was well to the West—that is near the middle of the innermost circle and the hardest area—but with an eye frequently and anxiously turned towards the redevelopment areas where now lived a large number of the tougher members of the tribe. The great belt of middle and upper class housing required only a cursory glance from time to time, and in general they needed only to be reassured that the Army wasn't far away.

Atmosphere

This is a marvellously vague group heading and if I pursued it vigorously I would be led not, as Churchill said "into the muddy byways of Tyrone and Fermanagh", but so far back in Irish history that the article would not be at all what I intended. Yet while I am concerned with the "here and now"—or rather "the there and then"—it is impossible to spend four months in Belfast without being constantly reminded of the extent and potency of tribal myth. So much falls into place if one analyses Ulster today not in terms of politics (for the term as I understand it is meaningless in Ulster) but in terms which an ethnologist would use in studying a primitive tribe in New Guinea. I may call down a storm of protest on my head by saying this but I am absolutely convinced of the strength of the tribal imperatives which affect every day life in Ulster.

I read in an Open University publication the following:

"The point about the influence of tribal life is that it is all-pervasive and enters into the whole consciousness of the individual." In fact the author was talking about tribes of the most primitive kind but it describes with remarkable accuracy the extent to which the Ulster man identifies himself with his tribe. I make the point because we were dealing with tribalism. A number of things follow, the most significant of which is that if an act tends to promote the coherence and strength of the tribe it is justified in the eyes of the doer and no other justification is needed. The walls surrounding the tribe must be strengthened, marriage outside the tribe weakens the tribe, myths and



Photo 1. "The influence of tribal life,"

ritual strengthen the tribe, symbols identify a member of the tribe and render him safe from other members of the tribe in battle, legends are perpetuated to strengthen the consciousness and separateness of the tribe—be they legends of the heroes of the Easter Rising or King Billy or Carson or Parnell or Wolfe Tone or Cuchulain or the I.R.B. So deeply rooted are these legends that you will never convince a Protestant that King William did not in fact ride a white horse at all but a bay? Nor will you easily convince a Catholic that Wolfe Tone was a Protestant.

I make these points for unless one starts with a basic understanding of the depth of tribal feeling and lack of apparent rationality that pervades the Ulster scene one will be in danger of missing the point altogether. It is easy to be misled into attempting to reason with people who are deaf to reason and to apply logic where no logical solution can be applied. The need to compromise is fundamental. Sadly I am bound to say that you can't reconcile the irreconcilable except occasionally on immediate and essentially short term issues. This may seem an unduly pessimistic view but I am still waiting to be proved wrong.

Missions

Nothing is ever simple and I had a mixed bag of missions, none of which I quarrelled with. The first related to the Catholic areas: to maintain selective but relentless pressure against the Provisional IRA—but even that wasn't simple for I had also to keep a careful watch on the Official IRA and, in that area, do what the police would not do. My second was to assist the RUC in maintaining Law and Order in the Protestant areas for the RUC were—and still are—subjected to overstretch in East Belfast generally. I also had a long term aim which was to prepare East Belfast, except for the Catholic area, for a return to normal policing. To jump straight to the end of the story, we did at least appear by the end of our tour to have achieved our long term aim for when we pulled out of East Belfast, we were not replaced and, at the time of writing, the policy seems to have worked. A significant number of RMP were drafted in to reinforce the RUC but no unit as such took over our role.

Deployment

With three Squadrons at my disposal and my assorted bag of missions, there was an obvious case for deploying one exclusively in the Catholic area of Ballymacarrett. It was not large—approximately a quarter of a mile each way—and there were many advantages in giving one Squadron the job of policing it. There was an additional reason for redrawing the boundaries I inherited (which divided the Catholic area in two). This was that the long term plan, if the rest of East Belfast stayed fairly quiet, was to place the Ballymacarrett "company" under the City Centre Battalion. It was therefore far better to start considering Ballymacarrett a sub-unit task from the beginning in order to simplify the subsequent handover. Integrity of Catholic Intelligence was another good reason for considering the area as a whole and finally the whole question of command and control was made vastly more difficult by having a sub-unit boundary in the centre of the area. We had this confirmed very early on (and before we had redeployed) during the anniversary of internment on 9 August 1973, when we had some quite angry scenes in the street which formed the boundary. Squadrons eyed each other suspiciously across the street pretending hard that what was going on in the street itself was not their business. Lesson One in deployment is never to make an important thoroughfare a sub-unit boundary but always give a sub-unit "hunting rights" at least a tactical bound beyond that thoroughfare.

For the rest of the area, it lent itself to division in two along police boundaries for this greatly eased liaison with the RUC. I therefore redrew these boundaries also to conform with Belfast E and F Divisions which is Lesson Two in deployment for it greatly simplified not only operations but also representation on Divisional Action Committees which met weekly.

I did not maintain much of a reserve under my own hand. Before there is a sharp

in-drawing of breath at such a heretical statement, I should perhaps explain myself. In an Internal Security situation—that is a continuing and static “framework” operation—any soldier not on the streets is wasted. Provided a sub-unit has enough men to meet its day-to-day commitments in maintaining law and order (and these commitments must be most carefully assessed) it will only need more in a crisis. Experience proved that crises don’t occur all that often and when they did they were fairly predictable. Moreover a crisis was relatively unlikely to occur in more than one area and then a reserve could be found from sub-units not “in contact”. When what I could spare from other areas had been used up, I had call on the services of the City Reserve Battalion. I did keep a number of search teams under my own hand and these could be lent as the Squadrons demanded. That was all the Reserve I had.

Command

Exercising direct command in this kind of Internal Security situation is difficult and the ability of myself, as Commanding Officer, to influence events directly when they were happening was severely limited. I thought much about this while preparing to go and I came to the conclusion that, in an area the size of East Belfast, I could not and should not interfere with the day-to-day running of Squadron Areas. When I came to add up what I could do to exercise command, the list was small. I could plan and order set-piece operations such as “lifts” and searches; I could re-direct my very meagre Reserve or earmark or redeploy sub-units but had to place these under command of the Squadron that needed them; I could arrange assistance of various kinds for the Squadrons; I could monitor performance and ensure the highest standards in day-to-day affairs. I could not take command on the streets, command had to devolve. I could not control the pattern of patrolling so long as it fell within my broad directive. I could not, without the fullest knowledge of local facts, personalities and geography, tell a Squadron how to conduct a particular operation although, at least in the early days, I asked to be briefed by OCs on how they planned to do things.

It follows that my day was spent co-ordinating, filtering, directing and planning. During times of tension I found it best to be in the operations room with its superb communications where I was well placed to take decisions and pass out instructions. At quieter moments I would visit all squadron bases and static posts and guards but it would have been asking for trouble to have stopped and talked to patrols. I would sit for quite long periods in squadron operations rooms with antennae wagging, asking questions and just listening to the way the Squadron was conducting its routine business. You could learn a lot from this.

Command from above was exercised in much the same way. Three times a week, all the COs of the Belfast Brigade would meet in conference to report matters of interest and receive direction from the Commander but generally I was, to a very considerable extent, allowed to get on with things in my own way. There was no other way of controlling the city.

Most of day-to-day business was covered by clear rules which circumscribed one’s freedom of action and, in the nature of things, these rules changed little over the period of the tour. Many derived directly from the Special Powers Act and the Emergency Powers Act and their application to the particular circumstances of Belfast. One came to know very quickly what could be negotiated and what could not, SOPs were essential and continuously in use, only requiring amendment from time to time. For once in my life I became totally convinced of the need for really good and comprehensive SOPs and much care and thought went into their preparation.

Standards

I suppose in some ways the most difficult thing for myself (and Commanders at all levels) was to ensure that standards of performance and standards of self-preservation did not fall off during quiet periods. Analysing one’s attitude to events showed the curious ambivalence that in quiet times when, presumably, the Regiment was doing its job well, boredom set in and one longed for a bit of action. When all hell

was being let loose and everyone stretched beyond the limit one longed for peace and quiet. From this I evolved my theory of the "controlled disaster" for there is no doubt at all that after weeks of comparative peace, the average soldier does allow his instinct to preserve himself to slip. Most lack the imagination to realize the danger that is always present and when the hairs on the back of the neck cease to bristle, that is the point when mistakes are made and people get hurt. If skins are to be retained intact, a weekly near miss is essential. Unless every man develops his sixth sense and keeps it finely tuned people will get hurt. If people get hurt through being stupid and breaking the rules, one has to be somewhat brutal in advertising widely through the Regiment exactly what the soldier did wrong and what rules he broke. We had one very near miss and a soldier was critically ill for two weeks (he subsequently fully recovered) but he had broken every rule in the book and one had to say so as loudly and as long as possible. It made us all think much harder about a number of security arrangements and made every man sit up and think about his skin.

The point I am making is that it is in setting and maintaining standards of alertness and preparedness that a Commander really earns his money. It isn't terribly difficult to apply common sense to the solution of most of the tactical problems encountered but it is quite difficult to achieve and maintain the appropriate standards of alertness. I use the word "appropriate" with care because each area at different times of day and night demanded certain protective measures which had to be a nice balance between the over-careful (indeed, alarmist) tactics of moving every man from fire position to fire position at a run and the over-casual tactics of walking or driving without a look-out, without being covered and without a sense of being under threat. The former would have been quite wrong on a busy afternoon in a shopping street in a Protestant area where the critical things are to induce a sense of security and to make contact with the population. The latter would have been equally wrong at night in a Catholic ghetto. Only an intelligent, observant patrol commander with all his senses active can really know what is best to do in a particular place at a particular time but we laid down general rules when "hard-line" and "soft-line" should be used



Photo 2. "Alertness and preparedness."

and when to change. The moment a shooting incident was reported, all patrols automatically went "hard-line" but it was all too easy for a casual young man, not in contact, to say "it won't happen to me". Nevertheless we never had to go anything like as hard (for the threat was never as great) as in the Lower Falls or Andersonstown and it came as a mild shock to one of my Squadrons when, near the end of our tour, it had to do a stint in the Ballymurphy. It had to move a lot faster than it had ever had to move in East Belfast.

It certainly is not easy for many people—particularly for soldiers but also for NCOs and Junior Officers—to gauge the right line to take and we came in for some criticism from the Northern Ireland Training Team on one occasion because we were accused of being far too casual for safety. In fact we knew our area and we knew that dashing about on a Saturday morning in East Belfast would merely excite trouble; we also knew that this was the least likely time to expect any kind of serious incident. Basically it seemed to me that even quite experienced infantry NCO instructors had failed to appreciate the need to analyse very carefully the response appropriate to every set of circumstances.

It is not enough to say that if you always adopt "hard-line" tactics you won't lose soldiers. You may also be failing to do your job because you can't talk to somebody lying flat on your face in the gutter and you can't give a law-abiding citizen a sense of security by waving your gun at his stomach as you sprint past him for the next street corner.

Intelligence

I would be much in error if I failed to include a section on Intelligence. Nevertheless it is a little difficult to know what to say without letting too many cats out of too many bags (I do not intend a pun). Without good intelligence one is fighting blind. That is a truism but one which has to be said again and again in a situation of this kind. I never added up the successes gained by chance and compared them in quantity with the successes gained as a result of good intelligence or good deduction. I am sure that the ratio would have been not less than 1 : 10. Hardly ever did we find things by luck unless the opposition had already lost interest in what was found—for example discarded mortar bombs and a discarded mortar. The latter was presumably discarded because it would have been more lethal to the firer than to those fired at. As it appeared to have been designed to be fired also from the shoulder, we did spend some days looking for a man with a broken collar bone for such surely would have been the effect of attempting that feat. I do not say that one can ever afford to neglect continuous routine and random searching as a policy. It is a way of keeping pressure on wrong-doers and forces the frequent movement of munitions and it will undoubtedly uncover a certain amount of stuff. The fact remains that it is the hot tip and the intelligent guess that is going to make real inroads and damage the enemy.

In a similar way, it is extremely important to compile statistics and maintain reliable up-to-date records in such a way that the information is readily available. The logging of significant detail in intelligence files appears humdrum but is of tremendous importance. In hard areas everything that can be recorded about people, about houses and about cars is potentially useful. You never know when a person, a house or a car will suddenly assume importance—in the same way that a new face, a new car or a new occupant in a house can be of interest just because they are new. Very often the matter of significant change will crop up—particularly in an area which could be used as a haven from tougher parts of Belfast west of the Lagan. Which houses are "safe" houses? Which cars may be stolen? Who might have moved in temporarily from The Markets or the New Lodge? These are important questions and one relies upon the sharp eyes and quick wits of the individual soldier to spot the odd man out, the new car in the street, the extra milk bottles on the step.

I believe that we ran a very comprehensive set of records, inherited in large measure from our predecessors and from theirs. Everything that might be important

was recorded, became part of local history and might be used later. Who might have been behind the bomb attack on the church at —? X and Y have bombing traces and live at —? Z has too but he's on holiday in The Isle of Man—or so his sister says. Is he? He often stays with his uncle at —. Send a patrol to check. What about Q? He is known to do a trade in safety fuse. Cross check with Special Branch. Cross check with the battalion in — because that is where his brother lives. Have they seen him around? Cross check with —. The story can go on and on but it is all based on painstaking work and on records built up over years. An arrest and conviction may follow. We may save some lives. We may deter another would-be bomber.

I leant heavily on my IO and his very strong team. They never get much of a rest and much of their work is unpleasant at best and dangerous at worst. Local contacts must be made. Only part of what you want can come from the soldier on the street. The rest will require courage, cunning and the confidence of some insignificant Irish rogue who just happens to like your Intelligence Corporal and will happily take a pint or two off him in exchange for a little snippet of information or for the local reaction to the arrest of Mr L. Selection of the right people to do this job is very important.

I can say very little more on this subject. I did begin to notice a real danger in the inter-relationships between the various intelligence cells. It manifest itself in what I call the "that-may-be-your-deduction-but-this-is-mine" syndrome. In real terms a Squadron cell could be giving advice on how to act which differed quite markedly from the advice given to me by my own cell. This could take a good deal of resolution at times and some clashes are, I fear, inevitable so long as one is forced by the sheer size of the problem to maintain separate and to some extent autonomous intelligence organizations. Central records would have made sense if I had been able to control operations directly throughout East Belfast but, as I have already explained, command had to devolve for very good reasons. I offer no solution to the problem but underscore its existence as a problem. There is a natural tendency for all intelligence people to be secretive and possessive and to consider that they and they alone are the possessors of the Philosopher's Stone.

An evening in Belfast

I now come to the difficult part and confess to being at something of a loss over the best way to convey as vividly as I can my own feelings and impressions. A straight chronology of what happened would make dull reading and I suspect that I would not be allowed to describe those incidents in the chronology which would prove most entertaining. It would also take too long. Equally unsatisfactory would be a kind of edited highlights. I therefore adopted what might be termed "The Atmospheric Approach" using a sort of sub-Hemingway shorthand. I have tried to set down my thoughts as a transcript from a tape-recorder. I cover my evening rounds during a typical day in a typical week in a typical month. Much has not been said. Much can be read between the lines of my shorthand. There has been no undue compression of events. At times the incidents crowded more densely onto the canvas than on this day. At other times an unearthly quiet would descend for days and even weeks. I think this is typical:

2100. All fairly quiet. Decide to go on rounds. Warn the crew that I am going out. Tell Watchkeeper. Find my Pocketphone. Check all radios—mine and vehicle sets. Load up. Mount up. Gate guards open Mt Pottinger gates. Move out keeping good look out on Madrid St. Shotguns watch rooftops and upper windows. I watch alley opposite. Check that VCP is in position at the far end. It is. Girls are big problem with that one and locals complain of immorality! They want the VCP—not me. May give me an excuse to pull it out. Swing right, over the sleeping policeman, and right again into Mt Pottinger Rd. All quiet. Usual bunch outside Lavery's Bar. Recognize most of the faces. No smiles. Pass foot patrol moving right into Harper St. Security lights are out so can't see much. Never use lights here anyway. Speed up a

little only to slow down again for more bumps. Do wish that bumps weren't always opposite street ends—you feel terribly naked doing no miles-an-hour. Slow down again to check chains across end of Vulcan and Chemical Streets—what charming names! That was a silly story if ever there was one. Open up streets by making chicane of concrete blocks instead of barrier. Seems good idea. Residents then complain that Protestant car-bombers will get at them. Seems highly unlikely but they stay convinced. If we close streets again, fire engines can't get in. Nor can RUC. And anyway aren't we trying to get things back to some kind of normality? Assemblyman called in to arbitrate. That at least is a good thing because its the first time that anyone here has even acknowledged that such a being exists. After a lot of chat we try chains with hooks. Chains stolen within twenty-four hours. Next try padlocks. Chains and padlocks stolen within forty-eight hours. One more try with bigger padlocks and if that doesn't work it will be either back to the drawing board or close the roads off again which I think will be a pity. All right at the moment.

Passing East Sirocco Works at same time. Lights are on so overtime again to-night. A bore for the Squadron. All workers have to be guarded in and out because they are Protestants and this is Catholic territory—even overtime and late shifts. Had fearful row over car headlights which workers would not turn off even though they made targets of all my men. I'm afraid that harsh words were exchanged and a stone might just have been thrown to bring the point home to the drivers. All seemed most unreasonable but then Ulster Protestants are not always noted for being reasonable. A strike loomed. Compromise reached as in all good Union matters. Whatever happens mustn't let the Cats have another go at Port workers. More than my life is worth. A very hot potato at Stormont. (Afternote: it's happened again.)

Now passing the smart CGI of Blair's Yard Base. Pity my own Squadron will never use it but some lucky company will get a very comfortable berth. No comparison with the old Bus Station. Noisy, dirty, smelly and crowded. The Squadron have done a lot to it and call it "Home" but its as bad as anything that I've seen in Belfast, even if they don't actually have to sleep in the buses any more. Searching them as they come in is bad enough and a drain on manpower. Wonder if that new sangar is exactly right. Probably OK but we've had over thirty rounds of miscellaneous small-arms fire from the general area of the bypass and we can't take chances. At least they won't hurt the gate sentries that way. Security lights? Must remember to check with DQ. Is that fence really high enough to keep out blast bombs? Doubtful but we haven't been much troubled except for the one that went off against the Ops Room wall! That gave us a scare and a dusting. Wish we could get some of those awful derelicts down. On cosmetic grounds? That is the "in" word at City Hall. Little success so far in that direction but we have over a thousand in our area alone, most unbricked—and anyway the kids knock the bricks out in no time. No response from the Public Health people either and they're a breeding ground for rats and everything else you can think of. What a place to bring up children!

Round the roundabout and down Bridgend. The old railway bridge with the arch stones picked out in red, white and blue always makes me smile. There's patriotism for you—although it is a rather special sort of patriotism. Over the Lagan bridges, skirting City Centre, into the Dockyard. Bit worried over Dockyard Police. Do they really stop enough vehicles and search? It isn't really my business but the Dockyard is. Somehow or other enough explosives were got in to have a couple of attempts at the Goliath crane. Luckily it isn't all that easy to shift 1,500 tons of German crane. Every bomb scare stops all work in the yards and that isn't good for business when there are Heaven knows how many millions tied up in Harland and Wolff. What a place to be responsible for. It's enormous! Fortunately actual damage to date is nil. Touch wood—what wood? There isn't anything except steel and stone for miles. Second super tanker this year already on the stocks and growing fast; had to move *Maidstone* for the first floating out. Always thought that you *launched* ships—but not in Ireland. These are too big. Story is that the yard lost a million or two on the last one, but what the hell! It's the taxpayers money if you lose and yours if you make a



Photo 3. "An evening in Belfast" on "The anniversary of internment."

profit. A nice comforting thought for a winter's evening. Down Dockyard to visit the Power Station. UDR alert. All well. Funny thing about it is the bullets. Keep on picking them up. Where do they come from? Why are they so obviously put where we are meant to find them? A practical joker? Distinctly sick sort of joke. Is somebody trying to write messages in the sand for us? If he is, he is not getting through. Perhaps he is sitting there muttering to himself like JFK over Cuba—"there is always some bum who doesn't get the message". We certainly haven't. The Squadron have combed the place several times and it's not easy to search a power station. Whenever they search, they find very little but the stuff is still being dropped. Maybe we have a genuine nut case on our hands. Purely out of a spirit of intellectual curiosity it would be nice to know. (Afternote: we never did know.)

Maidstone looks all quiet on the other side of the Musgrave Channel. Wonder how safe she is. James Bryson's escape made it all seem rather less safe than people thought. UDR guard in good heart. Chat them up for ten minutes, talking about this and that. Drive out past Administrative Building. My poor RSM spent five days in the lift shaft trying to get his man but he never did. Never mind. He enjoyed playing detective. Getting the ladder in had not been easy. Ladders don't fit into Landrovers. Drive out of the gate and visit Goliath guard as well for good measure. Yard is working tonight. Very easy to spend too long just sitting and watching. Can't afford to. Leave Dockyard and head North up the Sydenham Bypass.

Under Dee St Bridge. That CGI screening has stopped the kids throwing stones at cars that whizz underneath which is a relief but someone is using a gun from the end of Dee St itself which is a bit unsettling although he hasn't hit anything yet. Another cowboy? "Must be a f . . . Taig" said the six-year old when I asked him at 0130. Hardly likely—not from Dee St of all places. Forgot to ask boy if he was first shift bedder just got up or second shift bedder not yet gone.

Drive on up the Bypass, traffic very light. No real worries over the aircraft yard although I am bound to ask whether the RAF know that there is a war on. Go on as far as Hollywood. Not many worries here except the big RC church. It's been threatened several times. The curate is very worried (as who wouldn't be!!) and is becoming thorn in my side for all sorts of good reasons but he simply won't take "no" for an answer. He thinks my whole Regiment ought to be standing round his church

holding hands. I tell him we can't. He says he will tell his Bishop (and does). The Bishop tells Stormant who tell Lisburn who tell Brigade who tell me. I still say we can't—but have to anyway till the dust of the last demolition job dies down. Overstretch is a constant nagging problem in an area so large. All quiet tonight. Take quick look at Knocknagoney (strong UDA area). One of our earliest searches was here. No weapons but the usual haul of UDA uniforms and military bits and pieces. Wonder what a UDA uniform costs. Next tour prefabs. Very scruffy and sad. No intimidation here as all Prot, but Abbey Rings, just up the road, has had its share. Virtually impossible to stop where Cats are isolated. Vile. Usual tricks—stones through windows, scratched cars, painted slogans, telephone calls, bullets dropped in the handbag while shopping. No actual shots yet. Not like the Cregagh. They've had the lot there. Still a bad business. Half trouble is that they—the Cats—are too scared to tell us that they are Cats and so we just don't know who is being intimidated until they have moved out. I suppose its not surprising.

Turn back towards City. Are shotguns cold? No. Nor, for a change, is it raining. Head down Holywood Road towards Newtownards Road. We had a good arms haul out of that house—a big Victorian semi. Not at all the usual place to find stuff. Curious story. Catholic arms—in a Protestant area. That took a bit of puzzling out. A very useful armoury of thoroughly lethal kit. Looked good on statistics however they got there. All because someone was behind with the rent. Check on church of Christ the King—or what's left of it. Still not rebuilt after the last explosion. Sitting duck. No wire, no lights, no defences of any kind. What else can one expect? They will still rebuild it as a matter of pride. It will be like raising two fingers to a Prot crowd! Last bang took the end wall clean off and bowed the side walls. Beer keg—over 100 lb. I bet someone was proud of that. Isolated Catholic churches in Prot areas are a hostage to fortune. Pompous phrase but very true. Even re-builders are being intimidated—by schoolchildren—and we have to keep a presence while they hold services in the house. What a crazy situation.

Nearly down to the Arches. Silly name. Arches are no more. On the left, still only patched up, is the evidence of nastiest case of intimidation so far. Nice old man, never harmed anyone. "CATS GET OUT" on back gate one week. Took no notice and decided to brave it out. Bomb through front door the next. Poor man took full blast and was blown to pieces. Three men seen legging it towards Sydenham. Seems likely but, of course, "they got away". What a clever thing to do—and so brave! Ugh! How can one possibly prevent that kind of thing with my numbers? It is really quite difficult to keep one's cool with so much determined bloody-mindedness about. One incident like that and it takes a very brave Catholic to stay put under threat.

Turn back into Newtownards to see Squadron in Paulette Avenue. Pass UDA HQ, as forbidding as ever. Closed tonight but a fair crowd outside The Farmer's Rest and The Vulcan. You can always spot the tip-off man. Wonder what he earns. The protection racket seems to have stopped anyway. Contemplate thought of a bottling session tonight. We are getting distinctly tired of this particular activity. Two Landrover patrols pass in opposite direction. Nothing thrown at them or me. Whole business of identifying stone and bottle throwers very difficult. Need really effective flash photography, but not much progress in this direction but Squadron have developed quite telling tactics. Its a sort of slightly vicious game with clear rules and touchlines.

Cross other end of Dec St. The great Arch is down now but that really did symbolize rampant Protestantism. All the emotive bits and pieces stuck on it—including HM's portrait! Turn down Templemore Avenue where all the marches come. They really are a bore. We have to man all the interfaces just in case. We have to do it for two boys and a band on a rainy Sunday afternoon. The "skippers" are the worst—12 and under. They will get up to all kinds of mischief and it only needs one stone thrown from cover by the Cats to start a riot. The way they always play "The Sash" when they get opposite St Matthews' Church makes me feel slightly sick. Deliberate provocation. Never mind—nothing like as frightening as Tommy Heron's funeral.



Photo 4. "It only needs one stone from a skipper."

That really could have gone wrong. They—the procession of uniformed UDA—halted for what seemed like six hours opposite Ballymacarretti. 3,000? 4,000? An awful lot anyway. Who killed Heron? Still don't know. Can only guess. For three nights the Newtownards Road was really humming. All the East Belfast UDA there, even were hanging about outside UDA HQ waiting to be told what to do. "We'll sack Ballymacarretti" they said. They didn't. It was exactly as the Israelites must have looked waiting for Moses to bring the tablets from the mountain. Anyway the marching season is over—thank goodness.

Drive past the end of Beechfield St where we tried a CGI screen to stop the kids throwing stones at each other. Didn't work so took it down again. Just like football anywhere else. Turn right on Albertbridge Rd. "Hullo 3. This is 9. Lights out. Over". Lights go out. Turn into Paulette Avenue Base. Even money whether this is worse than the Bus Station or RHQ worse than either. Very cramped. Incredible display of erotica wall-to-wall. Take cup of coffee in Ops Room and chat about this and that with one ear on the Squadron net. Fairly quiet still but one Landrover was bottled outside Templemore Arms just after I passed. Are we in for another round? OC thinks we may be and starts to redeploy callsigns to meet it. I impress on him need to

make arrests. He needs no impression. No other problems except for R and R flights which are being delayed. Rotten luck if you only have three days anyway. Never seems to be any really good reasons for delays. Must remember to tell Brigade Staff in the morning. Dig crew—as always—from in front of TV and leave, security lights going out again. Head for country.

Down Lord St. Looks as if UDA club we raided for illegal booze is in business again. Hi-jacked stuff mostly. Report of contact over radio. Callsign One. Two shots not very close to patrol. FUNTR—shorthand for nothing found at the scene of the crime." Sounded like M1 carbine. Favourite Catholic cowboy weapon. After one such they were so scared they tossed the thing into a baker's yard as they ran where we found it when we followed up. Thank the Lord they can't shoot straight and are far too frightened to get close enough—except the real professional and we don't have many of them. Turn left and pass site of our first (Prot) bomb factory. Ordinary garage. Five large bombs. Two kegs, three cylinders and lot of co-op sugar. All primed and ready to go. Obviously due to be moved the day after. Luck? Or good information? We've had three more since then but never been able to pin it on anyone. There never is anyone. Its all around you in East Belfast but its such an enormous place that you never knew where to start. You can't turn the whole place upside down at once. We did all the lock-up garages in one day and that was a major operation—found nothing! Major logistic problem providing replacement padlocks as PR exercise. 21C's job to sort that one out—poor chap.

Head down mean little streets between Cregagh Rd and Woodstock. All quiet. Check guard on Willowfield Church. No way of shedding this particular commitment—I've tried hard enough and been told to shut up. This one was sacked in February. It is all political but once again it ties soldiers down to dreary guards. I calculate that over 40 per cent of my available strength is tied down in this way. NOT cost-effective whatever that may mean. Can't take on any more or all flexibility and capacity to react will have gone. Its only 40 yards from a police station anyway! Feel very sorry for Father Courtney whose flock are rapidly disappearing. Girls feel very sorry for soldiers—and show it!

See a mobile patrol and wonder if Cregagh is behaving itself. Will look later. Drive on to the Forensic Science Laboratories (DIFS). No sort of trouble on Saintfield Rd. Belvoir Arch is down as well. DIFS is classic case of bolting stable door after departure of horse—in this case a lot of weapons which were removed with deceptive ease. New defences very impressive but we guard while being built. The guard is UDR by night. All dedicated if rather disillusioned. Who wouldn't be if all they are allowed to do is mount guards!

Head over the Cregagh Hills with marvellous view of Belfast by night. Drop down to Cregagh. Who polices the Cregagh? Answer: we do—but only after major confrontation with UDA over intimidation cases. We are not much liked here but must not allow unlawful policing by UDA or anyone else for that matter. Vigilantes must be resisted at all costs. Estate very dark (no lights last long down here) and impersonal. Started as multi-tribal. Not any more. Who would dare to be a Catholic on the Cregagh? Stop off at mobile patrol checking a group of yobboes in standard uniform of jeans and bover boots. No problems. A troop commander is there in charge. He will stand no nonsense. Just turning into next Base at Castlereagh Police Station when hear of bomb (scare?) in Woodstock Rd. ATO has been called, an RV given and the RUC and the Squadron are already on the ground, therefore nothing I can do but decide to get in the way all the same. Hairdressers. What looks like an Army haversack pushed deep into recessed doorway. All residents cleared by the time I arrive. They stand disconsolately in small groups in their nightclothes. They don't seem angry. It starts to rain. Some get taken in by neighbours. Others go on waiting patiently on the wet streets. ATO arrives. Doesn't like it and uses robot tank. I order check in Ballymacarrett because warning call is traced to that area. Might find something to narrow the field. Why this hairdressers? Why any hairdressers? Who owns it? Who is the key-holder? Or is it just a drop and run job? I

call Acorn to set and talk about it. He has ideas and will follow up at his end. After what seems like an age ATO does remote controlled explosion. We stand behind cover waiting for bang. Nothing happens and after a little we emerge. Satchel has been blown to bits and ATO collects the bits. Irish blasting gelignite smelling very high. Clock stopped without setting off detonator. Plenty there to take front off the shop. Party disperses. People go home to bed and almost seem disappointed that there were no fireworks. I say thank-you to ATO. Now 0100 but he has two more jobs "cooking" elsewhere so it is a busy night still for him. However those are not in my patch. About time for bed but decide to hear first-hand about the earlier shooting incident. There was nothing more on the bottling and stoning.

Move slowly through Beersbridge Triangle—a very "strategic" intersection of roads that is invariably chosen by the doughty women of East Belfast when they want to demonstrate about this and that and the other—usually about Loyalist internees at the moment. The sight of ten or a dozen such wheeling their perambulators in a circle is enough to put the fear of God into braver men than I. It certainly stops the traffic but who it impresses, I don't know. It never lasts long and it isn't very difficult for the RUC and ourselves to arrange diversions! I pass the Bunch of Grapes from which we hauled a very respectable quantity of ammunition. We thought that the reaction to this would be a lot stronger than it was. UDA going off the boil? Too early to say for sure. This time we only had one bus burnt and the bag was three yobboes who were caught in the act by an alert patrol. A year ago there would have been a lot more fuss. Have to test my hypothesis a good deal further yet.

Turn right off Albertbridge Rd into dark of Ballymacarrett. Pass VCP packing up for the night. Have to keep one outside the Bridge Bar for the Cats demand it. Never like permanent VCPs as terribly vulnerable. We keep it moving as much as we can. Been shot at twice now—or was it at the revellers coming out of The Bridge? Certainly VCPs do deter the hit-and-run merchant. This was a bad corner a year ago but it has cooled down a lot since then. Are things really getting better? Perhaps.

Swing into Bus Station. Gates open as if by magic. All buses have been put to bed by now. Squadron has very little to say about earlier shooting. Bullet strike found on parked car and 2 MI cases found. Corner of alleyway off Harper St. Drink fourth cup of coffee and chat about life in general with watchkeeper. Say good night and drive back in darkness to Mt Pottinger. Station yard far too full again but shifts are changing or having their mid-shift coffee break or something. Finally find place for Rover as my slot is full. Get RSM to sort out parking and go in having warned crew for 0830 start. Unload. Go into Ops room and run through log with duty watchkeepers. Nothing very exciting. All hot news has already gone to Brigade. NIREP has been started. Nothing for me to do. Have fifth cup of coffee and chat to IO and 2IC about bomb in Woodstock. Put forward various ideas and hear what other have to say. Why? Who? First check has shortened list to four likely lads who are known to be around. Decide to bring them in and so issue orders. Seriously doubt if we can make anything stick—never can unless we get them red-handed which does happen sometimes. Go over tomorrow's activities. Say good night and turn in leaving instructions to be told results of lifts and for an early call. Now 0230. A bit later than usual but not much. A pretty typical evening. Odd about that bomb though. Funny place to put it.

Conclusion

By 30 November 1973 all except a small Rear Party had left Belfast. All the bases had been handed back to their owners—bus company, church and RUC. We were all in one piece. We had learnt a great deal and many young men had grown up fast. Almost all responded very well; a few failed to meet the new challenge. We had done what we set out to do for, when we left, East Belfast was quiet and no battalion took our place. No one can really say that they enjoy being totally involved in a situation so tragic and, arguably, unnecessary but I would not have missed the opportunity of commanding a battalion in Belfast for all the tea in China.

The Second Month of World War I

(Cont)

Parts I and II took the reader up to 19 September 1914 and the first part of the battle around Missy, Part III covers the arrival at Abbeville and Belancourt ready for the First Battle of Ypres. This is the period covered in Corps History, Volume V, pages 200 and 201.

PERSONAL NOTES JOTTED DOWN BY THE WAYSIDE (Part 3)

K B GODSELL 17 FIELD COMPANY

Sunday, September 20th, 1914.

We spent a very quiet night expecting Black Maria to start at any moment. The Germans are quite close and we get an average daily bag of three. Fairly quiet up to about 11 o'clock today, but they have brought up a field gun which fires at us point blank. Major Singer came up and we walked round the position. Tonight I am going to improve a barricade and loophole a wall and put up a small entanglement. We spent the afternoon collecting wood and making the framework for a box barricade. We got half of it up but they made such a noise filling it with shingle that the Bosch turned his searchlight on so we had to stop. The men got rather jumpy as the Bosch shooting was good. A furious hoorush broke out on the left on the front of the Manchesters and in front of ST MARGUERITE where Pottinger was.

We got trip wires down in the front of the village and hope to get barbed wire out tomorrow. With any luck we may get relieved from this "nasty" place soon.

Monday, September 21st, 1914.

Still a lot of work to be done on wall and communications which we kept pegging along at. Got my razor and small kit up from HQ and had a good shave and wash, the first for five days. Smythe and his section are going back tonight to HQ. Byrne got a bullet through the wrist when attempting to do some work in daylight on a trench along the road leading north of the village. There was a heavy bombardment in the afternoon during which they dropped a shell into the "boulangerie", No 1's cookhouse, and killed Steadman the cook and set the place on fire thereby destroying most of our rations. These were replaced from the raft. All our stores now came up by the raft near the broken bridge as it was nearer and safer. During the bombardment we retired to our cellar but I got separated in the first rush. At night we finished off the barricade and the wire entanglement. One shot was fired. I got another parcel of tobacco and matches and spent a comfortable night. Our infantry officer in the outskirts of the village had the fright of his life when he stepped on a tame rabbit. Smythe and Payne and No 1 Section just as they were starting off had a narrow escape from a shell. We had to spend four hours in the cellar. There is a considerable amount of local produce to call on in the village in the shape of wine and food—both alive and dead. All the inhabitants have now left and most of the houses are in ruins.

Tuesday, September 22nd, 1914.

Got up at 6.0 am and had a good breakfast, a lot of shelling going on. I nearly got a blighty from our own shrapnel which was bursting short but luckily high.

Germans were shelling ST MARGUERITE and the valley heavily. Waiting to see about a forward position, and at the moment have no work for the men and am quite sick of MISSY. I had a narrow shave when looking for some bags but fortunately the shell fell on the far side of the wall and only covered me with dust, etc. We were confined to the cellar for two hours. Captain Taylor came out yesterday just in time for the bombardment. The section is now getting very small. I have lost Byrne, Biggs and O'Connell since we came to the village. Col Longley is CO of the East Surreys and Major Todd 2nd in Command, East Surrey Regt. The West Ridings did an excellent piece of trench work without asking me for any assistance

quite a change from the rest who haul me out for every hole in any wall and are quite incapable of the simplest aids to comfort, etc.

There was a lot of bombardment with CP Shell and we spent a lot of time in the cellar. They were very considerate and always started after a meal. As the Bosch blew down the houses where our forward position was to be the idea was given up. They also blew down a lot of the wall we had been to such trouble in putting up so it all had to be done again at night. At night the West Riding Regt wanted a wire entanglement put up so I sent out the usual four. Just as they set out a report was received that the Germans were advancing in force, so they all came back again. I went round the position with Col Longley in the evening but made no alterations, had some tea and went to bed. We have been very well off for rations and have had plenty to eat, drink and smoke. I managed to get hold of some soap, candles and sugar for the Section, all of which were much appreciated. At night the usual jobs were carried out and we got to bed about midnight. This night I got up about 2.30, and went out into the street, it was very dark. Suddenly from my left, "Halt who goes there" and without a moments pause for any answer, "Bang!" He was not a good shot. After a few terse remarks I left him. He was only a new and nervous sentry. Life seems full of little incidents. We heard rumours of a probable advance. I hope to goodness we soon get away from this damned village.

Wednesday, September 23rd, 1914.

A very misty morning and I got turned out at 5.30 by Major Tew, East Surrey Regt, who wanted a trench along the road traversed and more loop holes in the walls. The position is quite strong but the field of fire is not too good. Our artillery positions are better than the enemy's. I do not consider the traverses will do any good. We completed the wiring job under the cover of the mist. I sent out Corpl Geraghty and party to finish off the wall. Corpl Taylor was killed, shot through the head by a sniper, very sad and most unfortunate. Intermittent shell fire has been going on all the morning. I and the Section are heartily sick of it and this place and we shall be very glad to be relieved by No 4 tomorrow. The Dorsets are relieving the East Surreys tonight and there is still talk of forward movement. A heavy battery is in action close by and the noise is very trying. We buried poor Taylor beside Steadman and erected a simple cross, the shame of it was that it was so unnecessary. He would persist in looking over the top of the parapet in spite of repeated warnings. We had great trouble in getting dinner owing to shells but finally succeeded about 3.15. The men spent the morning washing themselves and their clothing. The West Kents are being dosed with Lyddite but I hear they have not suffered many casualties. I heard the 1st Army were attacked 22 times in 24 hours and beat them off every time. The East Surreys were relieved by the Dorsets at 8.0 pm and all went off well. We put up four box traverses on the road which were filled with shingle by the Infantry. We also loopholed a wall and finished repairing the old one in the West Riding's position. Got to bed at 11.30 and had a good night's rest.

Thursday, September 24th, 1914.

Got up at 5.30 am and had a look round, very little doing and had a quiet night. A West Riding sentry was terribly frightened at seeing an object with long horns approach the barricade across the road where he was on guard. He challenged it twice and getting no answer fired and killed it, in the morning it was discovered he had slain an ass. Another sentry shot a cat on the top of the wall thinking it was a German peeping over at him. A Company Order was then issued that the next animal shot should be eaten by the slayer! I met a Tommy today carrying a bundle under his arm and awfully pleased with himself, he said he had discovered some brass and silver German Helmets, but they turned out to belong to the local fire brigade. Four men are knocking two holes in a wall for the Dorsets. Black Maria started on the West Kents. I saw Colonel Bowles but nothing important to do. Major Singer and Smythe came over in the evening and we went round the position, Smythe with No 4 Section relieved us as Porter had gone to the base. All sections have been strongly reinforced and we are now 42 strong. We marched along the river in the dark

all very glad to leave MISSY, the cellars and territorial artillery. I lunched with the West Ridings and had tea with the Dorsets. Adams was at the farm, (HQ) with part of the bridging train.

Friday, September 25th, 1914.

Got up at 6.30 and brushed my hair—first time for 8 days—received parcel of chocolates, etc and "The People". Went out with full section and dug trenches all day on the hill. A beautiful spot and a lovely day but I feel very slack and sleepy—too much food. We knocked off at three and came back to tea. My horse's hind legs have both filled very badly but I think it is only the result of standing about after so much work. There were a lot of aeroplanes working over here all day and the Germans were making quite pretty shooting at them but they did not bring any down. They have been doing very good work both in reconnaissance and directing fire. There is a battery of heavy howitzers (firing a 120 lb shell) in position just behind our farm. It is very quiet here after MISSY and very comfortable. We hear rumours about internal troubles in Germany and bits about no firing after Sunday but do not believe any of them. The new part of my Section are not at present very bright and require some licking into shape which I hope they will get. The weather seems set fine again but there is an autumn bite in the air and lovely moonlight nights. The inhabitants are getting very sick of us and it is very difficult to get food stuffs, potatoes, eggs, etc. It is a great strain on them as we have been here now for 12 days. After an excellent dinner I feel quite ready for bed.

Saturday, September 26th, 1914.

Got up at 5.0 am not feeling very fit, little Mary wrong and throat and head. It is a very cold, damp and misty morning, but cleared into a lovely day. We worked on the road from 6 to 12 on the trenches and clearing the field of fire. We came back to the farm for lunch. More good shooting at aeroplanes but no harm visible. Guns were very quiet all day. The 6th Divisional Artillery came up. We continued on the same job from 1 to 4 pm. We had some difficulty about rations—an inter section wrangle—which should not recur. Glad to say my horse is better.

Sunday, September 27th, 1914.

We were aroused at 5.0 am by a report that the Germans were crossing CONDE BRIDGE in large numbers, but no such luck, only an Intelligence Officer. We stood by till 7.30 and then went to our usual work at 7.45. Lunch at 1.0 pm and had a quiet afternoon's rest. Rean was here to lunch taking Adam's place in the bridging train just for the day. I hear of B K Young being in the neighbourhood and hope to come across him soon, it has been very quiet up to now but I expect the guns will begin again as the aeroplanes are just going up (4.30). Went with Captain Lees and prepared a foot bridge for swinging under heavy fire.

Monday, September 28th, 1914.

Reveille 5.30, breakfast 6.0, started work 6.45 to noon, worked in afternoon 1 to 4.0 pm. No 2 Section were on clearing foreground and finishing off trenches by hospital. We started making overhead cover with a party under Corpl Geraghty. One Regiment of the 3rd Division, on being attacked, let the Germans get to within 60 yards then fired a volley and chased them home with the bayonet. Germans reported to have left 1,000 (!) men on the field. The Section is now working better and will soon settle down. Infantry fatigue party of 100 men were employed under me from 7 to 10 and from 10 to 1 clearing a wood but the only tools we had were picks, shovels, jack knives (?). Capt Kelly came in to lunch. Chicken Fowle has been ordered to join the Company. The Major and Capt Lees went off to inspect some barges with a view to using them for bridging purposes. The Artillery had a quiet day. The Major has a bad cold. The evenings are drawing in and the mornings are getting dark. No sign of a move.

Tuesday, September 29th, 1914.

Started work at 7.0 am and was ordered to provide overhead cover for the trench in the meadow on the hill. Went on a foraging expedition with 3 sappers and a

trestle wagon along the river bank and had a fruitful search especially in the factory where I found a lot of boarding and square timber. In my absence preparations were made for cutting up the overhead cover and we made excellent progress on getting the materials. I think this is the first time any such thing has been attempted in this campaign. The loopholes were shaded by a curtain of split sandbags. It has been a quiet day on the whole with a few spasms of shell fire. Received a letter from Auntie Kate. The Chicken arrived with some cigarettes and tobacco. I heard that Miller had been killed and Renny-Tailour wounded. Most of the batch are employed on the Lines of Communication and having a rotten time. Half the Company are on night work under Captain Lees. There was a lot of firing down by the bridge last night but I have not heard of the cause.

Wednesday, September 30th, 1914.

Reveille 5.30 am and breakfast 6.0 am, started work at 7.0 am. We continued till 12.30 and from 1.30 to 4.0 pm. We were employed on the overhead cover trench and had many visits from the admiring General Staff who gazed on it open mouthed! Received a letter but still no parcel which I cannot understand. It was a quiet day on the whole. Most of the Company are on night-digging under Captain Lees constructing trenches to cover the bridge head below MISSY. These trenches have not been occupied but the Bosch shells them with great persistency. Pottinger and Smythe are returning tomorrow. MISSY had an awful doing yesterday and was shelled for over an hour.

At 5.30 pm Captain Herring and I left RAPREUX and came to a "Shalley" to look out for a fresh billet. Our success was far greater than we could have hoped for; we discovered a delightful spot with three sitting rooms and a bedroom apiece for the Officers. We stayed the night and had dinner and turned in. A beautiful room with a big bay window, roses on the wall paper, and pink side curtains round the bed. I only hope we shall stop here for some time. The house is on a hill with a fine view over the river and is much better than RAPREUX which is damp and low lying. I hope to get most of my "toy" finished tomorrow.

Thursday, October 1st, 1914.

Pheasant shooting begins. Had a topping night's rest on a real bed in our top rate little "Shalley". Woke up and looked at my watch and saw it was 7.15. This caused fearful consternation as the working parade at RAPREUX 3 miles away was at 7.0 am. I went out and cursed the guard and then woke Herring who also went out and cursed the guard. We had a very hurried snack of half fried bacon, mounted our steeds and "hied" off to RAPREUX. We trotted the whole way down and arrived in an excited condition to find it was only 6.45! I spent another day finishing my masterpiece which is quite fine now. I watched the 4th Division on the far hill through my glasses but could not make out what they were playing at. A man of No 1 Section was wounded by shrapnel while working on a trench between the road and river. We returned at 12 noon and spent a quiet afternoon in the "shalley" which was quite delightful. Reconnoitred for rabbits and saw a lot, and intend to try and trap some tomorrow night. The whole Company moved up during the afternoon and all were very pleased with our new home. We had a grand dinner and a good wood fire and were thoroughly comfortable. A game of bridge—a mail, a letter from home—and a comfy bed—joy.

Friday, October 2nd, 1914.

Reveille 5.0 am. We had that uncomfortable feeling that the present enjoyable conditions would not last. We went off at 6.30 to work. I was not allowed to continue my masterpiece which I had to hand over to Fowle. My Section were employed on draining trenches and clearing the field of fire. We worked 6.30 to 12.0 am and 6.30 pm to 1.30 am if on night work. General Sandback came along and questioned me about pontoons and trestles concerning which I was delightfully vague. Orders were received at 10.30 to return to billets. I got back with my Section at 12.30 and was ordered to stand by to move. We do not expect to move until dark when we go to NANTEUIL. It was bound to be too good to last and after MISSY where we

lived like a rabbit in a boro' too. We were busy preparing for the winter and getting the men refitted with clothes, etc. It is already very cold at night and in the early morning with a lot of mist. We paraded at 6.10 and started off by going cross-country up a steep grassy slope. As it was dry this was practicable and we saved a long circuitous road march by so doing. The march was not very well organized and there were many halts. After about 12 midnight everyone got very tired, I twice went to sleep and woke up to find my gee had taken me into the middle of my Section. At 2.0 am we arrived in the middle of a wood and when we crossed the railway bridge which was guarded by two "ancients" we were told to bivouac. Then the question rose, where and how? It was a very good night for marching with a bright moon and light frost. Our line of march was crossed at one point by the 27th Brigade, RFA—good staff work. At the beginning of the march we got on splendidly and did nearly 4 miles an hour, but when we caught up the rest of the column we were slowed up and experienced those short and frequent halts that are so annoying. We all wept bitter tears to leave our billet and no one knows what we are doing although everyone has at least three theories. The march was 15 miles.

Saturday, October 3rd, 1914.

We bivouacked in the wood close to the road at 2.0 am. It was very difficult getting the horses and wagons into the wood especially as there was a steep slope. It took a long time to get the horse lines for our 78 horses fixed up. We turned-in as soon as the horses and men were settled. We had breakfast at 8.30 and after breakfast Lees Pottinger and I went on a foraging expedition and had some success getting a cockerel for 3 francs 50, we also got potatoes, onions, carrots, damsons, apples and walnuts. The dripping of the trees was rather a nuisance as it made one's kit wet and kept one awake. Lunch 1.0 pm and Dinner 5.30 pm. We spent the whole day lounging about in a Sylvan glade and hiding from aeroplanes. The name of the village was LONGPONT. I saw some French Infantry this morning and there has been a heavy artillery engagement going on all day apparently round the neighbourhood of SOISSON. It has been a most restful and comfortable day. I managed to recover some of my lost tools from No 4 Section. In the afternoon I walked into LONGPONT which has a delightful ruin and charming modern chateau. The country round has been eaten up of eggs, poultry and butter but I managed to get some mustard in LONGPONT. I foresee some difficulty in turning our limbers round as they are standing in a lane in the wood with trees close up on either side. Delightful story about waiter! in the "CHEERY OPTIMIST" which we get issued about twice a week. I saw the Paris Daily Mail of the 2nd today. Our march was continued at 6.0 pm and we waited for half an hour by the Chateau Gate in LONGPONT. The march was bad to start with, there being many halts. After a bit things improved as we got away from the Infantry and went our own pace behind the ammunition column. We arrived at ROCUIGNY west of FRESNOI where we went into billets at 2.30. The men seemed very tired and footsore.

Sunday, October 4th, 1914.

Got up and had breakfast at 9.15 am. Had a grand wash and went to bed again from 10.0 till 1.0 pm. We had a big lunch and sat and smoked in a dirty garden. After tea we went and looked for nuts with no luck. Our issue of rum coincided with church this evening—most unfortunate. Orders not to move at present so are spending a very quiet Sunday. Heard a lot of firing in the distance. Several French Ammunition columns passed through all well horsed. We had a quiet game of bridge in the evening and ended up all square.

Monday, October 5th, 1914.

We had an excellent night's rest and breakfast at 8.0 am but the bacon was bad. We always get plum jam but I have not yet seen any stones or skin. Batgers jam is rotten but Maconochie's is better. Spent another very quiet day. Sleep—eat—sleep—our main programme. We played bridge again this afternoon and probably tonight. I had a letter from Aunt Evy who says I am a Lieut. We received a big mail with supplies from the Army and Navy Stores.

Tuesday, October 6th, 1914.

Breakfast at 8.30 am. After a quiet day we moved off at 2.15 pm to VERBERCE. The Company was broken up into five portions in order to entrain to proceed to an unknown destination. One section was attached each to a battalion of the Brigade and the HQ and transport came with the ASC. I was detailed to entrain with the Manchesters from LONGUEIL, the other Sections entrained at various stations. I reported to the CO Manchesters who was in a chateau. The men bivouacked in the chateau grounds and I had some dinner with the Battalion, a very uninteresting show. It took us two hours to eat a very thin soup, some bully and biscuits. We left the Chateau at 10.30 and went to the station crossing a bridge made from barges on the way. We did not start entraining until 2.0 am and completed it by 6.0 am. I had no difficulty in getting my wagons on and drew my rations and stores and saw the men settled in. I joined the subalterns of the Manchester Regiment and had a most uncomfortable journey, 8 of us in a first class carriage.

Wednesday, October 7th, 1914.

We arrived at ABBEVILLE at 5.0 pm and detrained. We then marched to BELANCOURT where we billeted. It was a rotten railway journey and I was glad when it was over. I felt like a lost sheep away from the rest of the Company. We managed to do very well in the food line which was a redeeming feature. The entraining of the infantry transport left much to be desired. It took them from 1.30 to 6.0 am to get their stuff on board and they wasted a lot of time over their wagons. The trucks were very awkward being too deep and there was only one ramp. There were three ramps for horses but they were only used one at a time. We got our stuff on board very quickly. I had some excellent tea and rum on the ramp having made love to the Quartermaster of the Manchesters. I travelled with four other 2nd Lieuts and learnt something of the running of the Manchesters which did not improve on acquaintance. We travelled at a good speed but stops were unofficial and uncertain. Managed to get horses watered at 10.30 and got some beer for lunch, it was bad beer but still it was beer. We got detrained quite quickly and marched off independently of the Manchesters. ABBEVILLE is quite a big town and Sapper Ludlow showed us the way, having been sent on as advance party under Herring two days before. The population seemed quite pleased to see us. We marched through and got on to the AMIENS road, we took the wrong turning but finally fetched up at BELANCOURT where I met Smythe and went into billets. The remainder of the Company less two tool carts which were left behind did not reach billets till 1.30 am. My room was a most disgusting mess being a mass of torpid flies and one bat. I eventually slept on the floor of Herring's room.

A HISTORY OF RE CRICKET 1862-1924

THERE can be little doubt that the deeds of our forerunners are well worthy of study and this book recalls happy memories and should enlist the interest of present day cricketers if not all Sappers.

The 100-page book not only gives match results, individual records, averages and notable performances, but also gives the History of the Cricket Club, the story of the Ground and of the Pavilion, and some wonderful pen pictures of distinguished players. The pen pictures include Corporal Bayfield (the first Other Rank to play for the Corps against the Gunners), A E J Collins (628 not out at Clifton, still the highest ever "recorded" innings), J Fellowes (who made 22 runs off four balls with W G Grace bowling), W C Hedley (probably the best all-round cricketer the Corps has ever had and son-in-law of J Fellowes) and H W Renny-Tailyour (who represented Scotland at both Association and Rugby Football and played in the FA Cup Winning Side).

The book can be obtained from the Secretary, Institution of Royal Engineers. Price 50p.

Quarrying for Large Rock at Akrotiri, Cyprus

MAJOR P W HUTCHINGS, RE, BSc, CEng, MICE

Foreword by CRE NEARELF

The notes for this article were given to me by Major Hutchings two weeks before his tragic death following a year of intermittent illness. He based some of his material on information given to him subsequently by Captain J B Cloke RE, the project officer, and the editing was done by Major D S Shaw RE and myself.

It was felt by everyone that this article should be published separately rather than be incorporated in a future article covering all aspects of the Akrotiri Mole Construction.

Major Hutchings, as SO2 RE NEARELF, was responsible for the preparation of the complex planning report for the reconstruction work and also opened up the quarry before he had to return to UK because of his illness. He considered that the experience and planning data obtained would prove valuable to anyone involved in a similar project in the future.

INTRODUCTION

THE author was Planning Officer for the reconstruction of the Akrotiri Mole in Cyprus under the overall direction of CRE NEARELF. The project was to include the quarrying, transporting and placing of large quantities of rock of 4 ton weight or greater. It might be thought that ample data would be available on the subject of quarrying for large rock but most of the existing literature covers quarry production of stone with maximum fragmentation, the normal commercial requirement.

The works diaries from the original construction were available but it was apparent from them and other sources that much of the rock had been gleaned from the foot of the Akrotiri cliffs using cranes mounted on Z craft and that normal quarrying had been a problem. Therefore planning had to start from basic principles but was assisted by two other reports described later.

AIMS

The aims of the paper are:

- (a) *Part 1.* To describe the procedures leading to the quarrying plan and to emphasize the success or failure of the assumptions made.
- (b) *Part 2.* To evaluate the various operations in the quarry as planning data.

PART 1—THE PLANNING STAGE

The Project

The original Akrotiri Mole was constructed in 1964/65 by the Royal Engineers to provide harbour facilities within the Akrotiri Sovereign Base Area in Southern Cyprus. Unfortunately heavy storms in 1968/69 severely damaged the Mole and rendered it inadequate for its main functions, as will be obvious from photo 1.

In January 1972 approval for reconstruction was given and it was decided that the Mole should be rebuilt on its original line to a modified design provided by DOE. The main tasks were:

- (a) The quarrying of approximately 70,000 tons of rock, comprising main armouring of 4 tons weight and hearting of lesser sizes down to 28 lb weight.
 - (b) Placing the rock in the Mole to a slope of 1 in 3 on the seaward side and 1 in 1.5 on the landward side.
 - (c) Dredging of the entire harbour area to a depth of 8 ft below mean sea level.
- This paper concerns only the first of these tasks although the selection of some of the



Photo 1. Akrotiri Mole after the severe storms of Winter 1968/69.

equipment used in the quarry, notably rock grabs, was influenced greatly by the problem of rock placing during the mole construction.

Planning

Although the decision to proceed with the reconstruction project was not made until 1972 the problem had been under consideration for some years.

Major G B Wellard RE and Captain C P Allain RE among others had prepared reports based on a smaller cross-section than that envisaged now but it was clear from the various factors that to keep the available manpower and plant on site to a minimum the project should be tackled in two main phases linked to the local weather pattern. Therefore the planned phases and relevant timings were:

(a) Phase 1—September 1972 to March 1973—Quarry and stockpile all rock required.

(b) Phase 2—April 1973 to January 1974—Place rock, construct wharf and dredge harbour.

In the event the quarrying was not completed in Phase 1 and had to be continued into Phase 2. Some important reasons for this will emerge later but a basic one was that the original calculations were based on a sketch by DOE plus some assumptions. The final design did not appear until after the plan was completed and it was found that the assumptions had given too low an estimate of the rock quantity required. However, by the time Phase 2 was reached the quarrying operation was working so well that disruption of other work was not critical. Nevertheless optimum use of men and plant required careful replanning and the introduction of shift working.

Manpower

Throughout both phases of the task a Project team comprising a Garrison Engineer, Clerk of Works (C) and fifteen rank and file was established to provide continuous control of the project. The work force was to be provided by 62 (NE) Support Squadron RE for Phase 1 and a Field Troop from UK for Phase 2.

Quarry Site

The other main problem was a source of suitable stone which, fortunately, had

been investigated in 1970 by a TAVR Specialist Pool geologist, Major F Moseley RE (V), DSc, PhD. His conclusions were that:

- (a) The best quarry site was 600 yds South of the Mole on the Cape Gata cliffs.
- (b) The rock generally was in two hard bands separated by a softer stratum and that splitting and easing techniques should produce the required sizes.
- (c) There was ample rock for the task.

Figure 1 shows the quarry site in relation to the Mole and the assumed cross section for the area.

Quarry Size

The calculation of quarry area required was based on the following assumptions:

- (a) Only the upper layer of rock, assumed to be 6 ft average thickness, would be worked.

- (b) The rate of gaining armouring rock would be 20 per cent of the total volume quarried.

Hence knowing the volume of rock required the quarry surface area was worked out and from an assumed average thickness of 5 ft of topsoil, its volume was calculated. Topsoil removal by towed scrapers seemed a straightforward operation.

Drilling

Initially six hand-held drills and one Holman Universal wagon drill were to be available for drilling. After December 1972 two further wagon drills were expected from exercise "LABORN" in Malawi.

Based on the Moseley Report and standard techniques it seemed that the best method of obtaining large rock from the quarrying operations would be to place small charges in boreholes 6 ft deep at about 6 ft spacing and burden, the small charge having the effect of splitting the rock with minimum fragmentation. The boulders could then be eased from the quarry face for loading and removal, a 4 ton rock in Akrotiri limestone approximating to a 4 ft cube.

Trial Blasting

To confirm the quarrying plan it was decided to hold trials during April 1972 but an unexpected major snag was encountered in the shape of the *Eleanor's Falcon*, a rare bird which nests on the Akrotiri cliffs during the spring and summer. Influential local enthusiasts obtained an embargo on the use of explosives in the proposed quarry area before November but CRE NEARELF was given special dispensation for a small trial. Fortunately the embargo was lifted at a later date, allowing blasting to continue into Phase 2, but it was possible to hold only a very limited initial trial. The resulting planning constants showed that it would be very difficult to obtain the rock required during the designated blasting period of three months.

The trial was carried out using hand-held pneumatic drills, the planned borehole layout and a charge of 2 lb of PE 808 per hole. It was concluded that:

- (a) In this type of limestone the output of hand-held pneumatic drills far exceeded the 15 ft/hr given in ME Vol 5, "Quarrying", Table 12.

- (b) The trial hole layout and charge would produce large lumps of rock, some greater than 6 tons in weight.

However when quarrying began in October 1972 both conclusions proved to be wrong. Drilling rates were very low and fragmentation of the rock was excessive, the success rate of gaining large rock being about 10 per cent, half of the assumed figure.

These errors serve to emphasize the dangers of relying too much on the results of a limited trial. The errors were considered to be largely due to three factors:

- (a) The weather was cooler and the ground generally was damp during the trial so the heat and dust effects, which were very oppressive in practice, were not taken into account sufficiently. Nor was the trial drilling continued for more than one full day to test operator fatigue and efficiency on a long-term basis.

- (b) The trial blast was in weathered capping rock which was probably not repre-

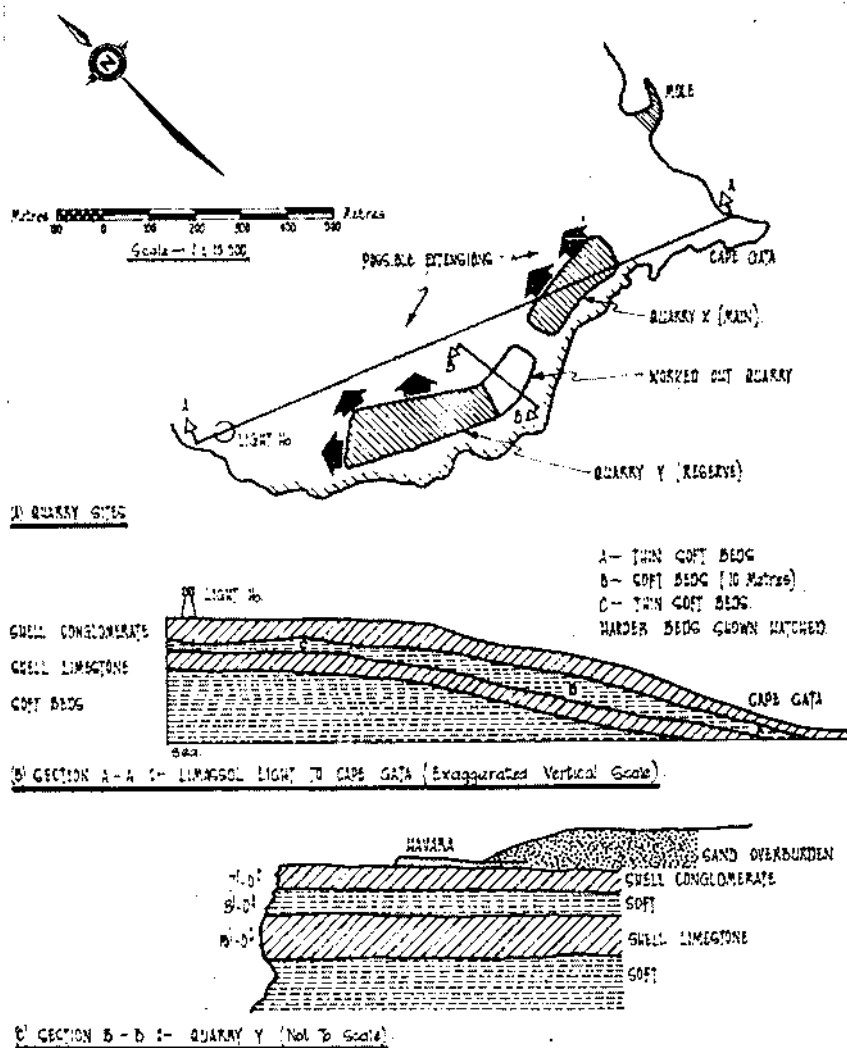


Fig 1. Quarry Location and Geology.

sentative. In addition, there was no vertical free face to which to blast, although the trial site was sloping, so the blast may have been more an excavation cut. Nor was the trial site dug out to check the effects of depth which might have given warning of the low success rate.

(c) ANFO was not used in the trial. As its characteristics are very different from those of PE, assumptions about equivalent quantities and effects were inaccurate, as further trials would have indicated had they been possible.

Other calculations based on the trial showed that even if drilling started before the allowable blasting season in November it was likely to be a critical factor so pre-drilling was started in August 1972. However because of the frequent variations in rock quality, the holes became blocked within a few days at best. Pre-drilling might have been effective in homogeneous hard rock but not in the comparatively soft limestone at Akrotiri.

Explosives

Service explosives, if costed, were more expensive than civilian types and insufficient quantities were likely to be available. It was therefore decided that the bulk explosive should be ANFO (Ammonium Nitrate plus 5 per cent Fuel Oil) with special gelatine booster charges and detonating cord ring mains.

Originally it was planned to use the deliberate demolition system of full ring mains but trials and experience proved that the "hasty" method was entirely satisfactory. Safety fuse was preferred to electrical initiation to eliminate any risk of electronic hazard from the powerful RAF radar and wireless units in the vicinity.

Another problem then arose in that, although the local agents for ICI could supply the explosives required, unfortunately they imported only twice a year and the next shipment would not arrive until December 1972. If blasting was to begin on time it was essential to borrow explosive and to repay it from the shipment. With the large number of small holes envisaged detonating cord was a major item and it was estimated that 255,000 ft would be required. Fortunately the Cyprus Sulphur Company (CSC) agreed to supply sufficient Ammonium Nitrate, detonating cord and accessories to last until December 1972 and the Cyprus Cement Company offered sufficient gelatine for our immediate needs. CSC Ammonium Nitrate shipments were bi-monthly so there was less of a problem.

An example of comparative prices at that time was:

Service Plastic explosive	74p per lb
Civilian Plastic explosive	12p per lb
ANFO	2p per lb

Calculations based on the original rock quantities and blasting techniques showed that the following explosives would be required:

ANFO	18,800 lb
PE	3,870 lb
Detonating Cord	254,700 ft

The eventual quantities used for quarrying were:

ANFO	110,265 lb
PE	2,935 lb
Detonating Cord	131,865 ft

The discrepancies can best be explained by the following table:

ITEM	ESTIMATE	ACTUAL
Total Volume of Excavation	86,600 yd ³	151,000 yd ³
Surface Area of Quarry	43,300 yd ²	25,700 yd ²
Depth of Face	6 ft	17 ft to 30 ft
Number of Holes	11,700	3,600
Sizes of Hole	1½ in	3 in
Depth of Hole	6 ft	17 ft to 20 ft
Charge	2 lb PE	
	or { 2 lb ANFO 4 oz PE	{ 30 lb ANFO 8 oz PE

The main points are that, compared with the estimate, the holes though fewer were much deeper and larger, the booster charge was doubled, the actual success rate for winning armouring was half the estimated rate and ring mains were replaced by a single length of detonating cord.

Rock Hauling

Normally Corps projects do not involve the bulk handling of large stone although land reclamation on Beef Island involved 2-3 ton rocks handled mainly by cranes using a three-sided chain sling made specially for the job. On the original Mole wire slings were used but reports indicated that they gave endless trouble and any type of sling was likely to produce problems when used for placing rock underwater.

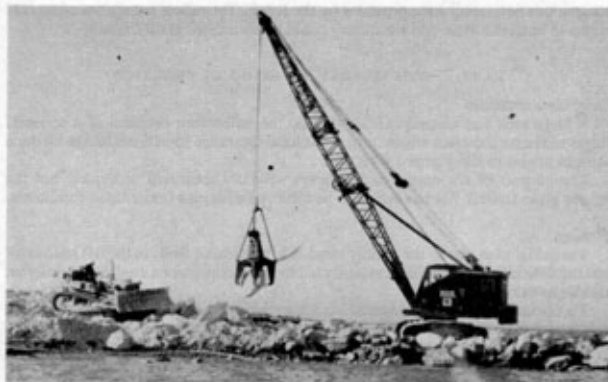


Photo 2. Owen Rock Grab fitted to NCK 406.

Visits to the Limassol harbour project and its quarry showed that rock grabs with three-tines were preferred for both handling and placing.

Unfortunately there are problems with rock grabs. At that time each cost £3,000 and none were available in UK. In addition, a 5 ton capacity grab weighs 2½ tons and its operation requires two ropes compared with one for a crane so the machine radius and capacity are reduced greatly, a factor of special importance when placing rock above water level.

However it was obvious that grabs would be essential for rock placing and desirable for quarrying so two, four-tined grabs were obtained from the Owen Company, USA for use with two new NCK 406 base machines.

A visit to the Portland Stone quarries produced a simple, effective solution for quarry work, in the shape of a single chain used with a crane. The chain is wrapped round three projections of a large rock and hooked back on itself.

Beef Island slings and other devices were tried but in the end the best plant for handling large rock in the quarry was found to be the heavy and medium wheeled tractors and the crane and single chain.

Disposal of quarry waste was easily achieved by dozing it over the adjacent cliffs. With an inland quarry this operation would have been a major problem necessitating many more tippers and loading equipment and extensive final landscaping.

Administration and Logistics

The quarry was close to the extensive base facilities of Akrotiri, which meant that food and accommodation could be provided easily.

62 (NE) Support Squadron RE maintain a permanent detachment at Akrotiri providing reasonable maintenance and repair facilities four miles by road from the site, and the existence at Dhekelia of an RAOC stores section and REME Workshop within the Squadron and the facilities of 48 Command Workshop REME also simplified plant and vehicle repair problems. Explosives were stored very conveniently in RAF bunkers two miles from the quarry. Had this facility not been available storage would have been a major problem involving the construction of bunkers and security fences. A guard would also have had to be provided.

A site office and store were built on an existing hardstanding overlooking the Mole. Two standard 32 ft Twynham Huts were loaned by PSA/DOE and ample

accommodation stores were provided by the RAF. The offices were situated so that access to both the Mole and the quarry could be controlled at all times.

PART 2—THE QUARRY WORKING IN PRACTICE

Stripping overburden

A large area was cleared quickly despite the unforeseen problem of a series of ridges in the rock surface which meant that local clearance sometimes had to be done at right angles to the planned direction.

The outputs of the dozers and scrapers were not measured accurately but the figures given in ME Vol 16 seemed to be achieved with ease under these conditions.

Drilling

The initial plan was to use mainly hand-held pneumatic drills in the 6 ft hard layer but the difficulties mentioned previously led to the evolution of a completely different technique using wagon drills.

To obviate unwanted fragmentation it was decided to drill deeper holes into the soft layer below the 6 ft thick hard band. The charge was placed in this layer thus blowing it out and causing the rock above to collapse in large sections on to the quarry floor. By this means the success rate for armouring rock was increased to between 10 per cent and 25 per cent.

The 6 ft Holman Universal wagon drills were used mainly in the "down-the-hole" (DTH) mode to produce the 3 in dia holes required for ANFO although 1½ in dia holes were produced when required by use of the SL 160 drifter drill conversion set.

The outputs of the wagon drills were:

- | | | |
|-------------------------|--------------------------|---------------------------------------|
| (a) DTH (3 in dia) | 18 ft hole in 20 minutes | } Including movement
between holes |
| (b) Drifter (1½ in dia) | 18 ft hole in 15 minutes | |

The above timings could be improved upon but experience showed that the bits and tubes tended to jam very easily because of the soft nature of the rock and great care had to be exercised by the operator.

Training

Four hours was sufficient time to train a wagon drill operator to work under supervision. After a further two days he could be left to work unsupervised at a slow rate. Full operating efficiency can be achieved within a week but to guarantee correct maintenance by the operator a one week course at the manufacturer's works is recommended.

Blasting

Once the quarrying routine was established the typical hole configuration was depth 17 ft, spacing 10 ft and burden 8 ft. Later, when the second face, 20 ft deep, was opened in the shell limestone below, the hole spacing was increased to 12 ft because this rock was slightly softer. The average charge per hole overall was 30 lb ANFO with an initiation charge of ½ lb of 80 per cent full strength gelatine.

The outputs achieved were:

- | | |
|-------------------|--|
| (a) 4-5 ton stone | 10 per cent of the total blast volume. |
| (b) 1-3 ton stone | 20 per cent of the total blast volume. |
| (c) Hearting | 30 per cent of the total blast volume. |

In practice this gave far more hearting than required and large quantities were dozed to waste over the cliff edge.

Mixing ANFO

Three methods of mixing ANFO were tried:

- Mix Ammonium Nitrate and diesel in a wooden trough.
- Add diesel oil directly to a slit bag (50 kg) of Ammonium Nitrate.



Photo 3. General view of quarrying operations at an early stage.

(c) As for (b) above but with a final mix in the trough.

All three methods worked satisfactorily but No 3 was considered to be the best on this site. For very large charges where a good soaking time was available, No 2 would be most suitable.

The mix ratio was 7 pints diesel to 50 kg of Ammonium Nitrate unless the "soaking" method was used, when the diesel was increased to 8 pints. The holes were charged from the trough using a funnel and scoop, all of local manufacture.

Rock handling

The plant used for rock handling varied a great deal and often depended solely on availability and service ability. The following machines were used with the results shown:

SERIAL	MACHINE	ROCK WEIGHT (TONS) (MAX)	PERFORMANCE
1	Michigan 285 HWT	6	Excellent
2	Michigan 175 MWT	4	Very good
3	38 RB and NCK 406 rigged as crane plus single chain (SWL—11.25 tons)	9	
4	NCK 406 plus Owen Rock Grab	5	Fair
5	38 RB rigged as face shovel	1½	Excellent

All armouring and bearing was stored separately in areas near the Mole, all armouring being painted with a code letter and recorded. Later, during construction, the stone was struck off the register when placed, thus recording the amount used. The double-handling of rock was unavoidable in the circumstances.

Typical quarry cycle and output

Once things were going well a two-day cycle was working at any face, Day 1 being drilling and blasting and Day 2 clearing the resultant rubble.

The quantity of explosive for the average blast comprising 36×20 ft boreholes was 600 kg ANFO initiated by 15½ lb of 80 per cent Special Gelatine, giving a gross

output of 2,130 cu yd, or between 3,215 tons and 3,860 tons. Of this, on average not more than 60 per cent was suitable for use and between 30 per cent and 40 per cent would actually be used in construction.

These results indicate a gross output of between 2.44 and 2.92 tons per lb of ANFO used. However it must be remembered that the aim was minimum fragmentation and that the rock characteristics were by no means ideal for standard blasting techniques.

SITE ORGANISATION

Main quarry

(a) 1 Project Officer	
1 MPF	
8 POM's operating	1 x Michigan 285 HWT (not initially)
	2 x Michigan 175 MWT
	1 x Michigan 75 LWT
	2 x D8H Dozers
	1 x D6C Dozer
	1 x 12 cu yd scraper
	1 x 8 cu yd scraper
	1 x 38 RB Face Shovel
	1 x 38 RB Crane plus chain
	2 x NCK 406 plus Owen Grab (Phase 1 only)
5 Dvrs driving	5 x Aveling Barford 10 cu yd dump trucks (from a total of 7 max)
1 Cpl (Shotfirer)	} Drilling using 2 x wagon drills and 2 x 315 cfm compressors plus mixing and placing explosive
6 Cbt Engrs	
1 Dvr driving	
	4 ton cargo and towing explosives trailer

Workshop and administrative support

(b) 1 Sgt	Fitter Plant
4 NCO's and Sprs	Fitters Plant
1 Spr	Fitter Engine
1 Spr	Welder
1 Civ	Fitter (Maintenance trailer operator)
1 Sgt	Resources
1 Sgt	Administration
1 L/Cpl	MT NCO
3 Dvrs	For unit vehicles
Total personnel : . 37	

CONCLUSIONS

During the planning stage certain assumptions were made which were later found to be somewhat optimistic but sufficient extra time had been allowed to cater for this. However they serve to remind one that:

(a) Time spent in reconnaissance is seldom wasted.

(b) Limited trials tend to verify one's expectations, so be suspicious.

Certainly the trial blasting was limited in scope by the embargo but the drilling methods and blast results could probably have been investigated more thoroughly, thereby providing more accurate planning constants. The inaccurate assumptions regarding drilling methods and rates, quantity and type of explosive and blast effects could have had serious repercussions had the project been in a remote location geographically. As it happened the plan was easily adjusted and changes in stores requirements were achieved without difficulty. The extension of quarrying into Phase 2 could, in different circumstances, have had an adverse effect on this phase in terms of the availability of men and machines.

There is no doubt that the larger wheeled tractors are the best machines for

handling rock in a quarry although the crane with single chain is excellent, particularly where a small amount of large rocks is concerned. For smaller debris the face shovel again proved its worth in a familiar role. The rock grab was disappointing in the quarry but ideal for the accurate placing of large rock on the Mole later.

Explosives gave no trouble in operation but the acquisition of the large quantity of Ammonium Nitrate required in this case could well take considerable time and effort in less-developed countries. Movement of prilled Ammonium Nitrate in bulk may require armed escorts as in Cyprus and site storage and security could pose a continual problem elsewhere.

The Holman wagon drill performs admirably provided that operators are careful to avoid jamming. Hand-held pneumatic drilling for prolonged periods in conditions of extreme heat and dust is impractical although its use at low output on shallow faces might be acceptable. The training of drill operators causes no problems on site except the time required but the instructor at least should have attended a short course at the manufacturer's works with particular emphasis on the maintenance aspects.

Although the plant operators generally were inexperienced their basic training enabled them to cope until they gained confidence. However, all had been trained on machines with hydraulic controls and rope-operated machines were unknown to most of them. Therefore, as with the wagon drills, training on site had to be undertaken. It is recommended that on any future large plant project considerable pre-training should be carried out.

Regarding the winning of large stone, it is considered that blocks of a specified size and shape can only be produced at considerable trouble and expense and then only in favourable ground geologically. The jointing and bedding planes will dictate the maximum size of stone capable of being produced by primary blasting. In homogeneous, hard rock areas, the object will only be achieved at the expense of extensive line drilling, presplit blasting and delicate secondary blasting, probably an uneconomic proposition.

Adequate allowance must be made in the schedule of plant and labour for maintenance of haul roads. In similar conditions they must be graded, watered or oiled and rolled frequently to prevent failure and to reduce the incessant dust problem.

Problems of administration and logistics are usually the most difficult aspects of major projects such as this but the favourable location contributed greatly to the success of the project. There were few logistics problems and administration generally was simple.

Despite the marked differences between initial plan and actual operation the aim was achieved in that the necessary quantities and sizes of rock were produced within the time frame of the Mole Project without causing any delay to its estimated completion date. This quarrying operation was one of the largest ever undertaken by the Corps and proved yet again that tried and tested principles and systems are ignored at one's peril, that simplicity and thoroughness in planning and method always pay dividends in terms of results and that the Sapper is as adaptable as he ever was.

PORTRAITS AND SILVER OF RE HQ MESS

PUBLISHED BY INSTITUTION OF ROYAL ENGINEERS PRICE £1.50

THIS beautifully illustrated book contains the photographs and descriptive details of fifteen Mess portraits and forty-one pieces of Mess silver. It is a fascinating reference book on the familiar items we have seen and on which our knowledge, (for most of us to say the least), is sketchy. Which portrait was the first to be acquired by the Mess? Which piece of silver is the most valuable? Who was Ko? Who was the first engineer officer to command a British army in the field? The answers to these questions and many others are yours for the asking price.

On Plant Economics

CAPTAIN F G HULTON, RE, MA

THE plant fleet of the Army today is largely based on the recommendation of the Lindsell Committee. Probably the most important of these was that standard commercial plant should be bought in preference to specially designed military equipment. As a result the vast majority of the plant in the Army is of normal commercial origin.

A logical extension would appear to be the application of standard commercial management methods to the fleet of standard commercial plant. However in many cases the plant, though of standard commercial design, is held to cover most uncommon contingencies; it would be quite inappropriate to carry out a detailed analysis of the uses in peace of plant held solely for high priority wartime tasks (a category that includes almost all machines held by field units). But when we consider the plant that has been obtained for peacetime projects, or for any war role, other than those calling for immediate action or of the highest priority, then an economic analysis of the costs of ownership and operation of the plant can be useful.

Cost is the measure of the *relative values of unlike resources*. Because in peace military values tend to be theoretical it is difficult to cost most military resources. (The relative prices of tanks and of mines may be known, but without up-to-date experience it may be difficult to decide whether it is more profitable—i.e. more likely to win battles—to spend the limited funds available on tanks to destroy tanks or on mines to destroy tanks, and to decide the balance in investment between tanks and mines). But in the field of civil engineering plant the experience of civil engineering constructors is available. The *technical* methods of civil contractors are examined as a matter of course, but the *financial* methods attract less attention.

The costs of plant may be divided into fixed costs and variable costs, into the costs of ownership, and the costs of operation. In the long term ownership costs are variable as a machine may always be sold, but in the short term the costs of ownership are fixed and it is only the costs of operation that are variable.

Ownership costs include:

(a) Cost of capital—the money invested in the machine could have been invested in a deposit account and could have produced income. Cost of capital is the income that the capital could have produced if used in the most profitable alternative way.

(b) Depreciation by time.

(c) Storage and time maintenance.

(d) Insurances, taxes, etc (not usually applicable to the Army).

Operation costs include:

(a) Cost of fuels, lubricants, spare parts, etc used.

(b) Cost of operator.

(c) Depreciation by usage.

(d) Usage maintenance.

(e) Transport costs.

While most of these costs are obvious the first is often neglected. The Lindsell Committee investigated the suggestion that commercial firms should hold stocks of equipment on call to the Army at short notice. The Army would pay a retainer for this lien on commercial stocks. This system would have applied to machines that might be needed in war or emergency only. They concluded: "Financially the arrangement is not attractive. Interest and storage charges would amount to the capital cost of the equipment in about twelve years without any tangible asset being left to the Department. Having regard to the quantities in relation to Army stocks of "C" vehicles and construction plant, compensatory savings on storage and maintenance are unlikely to be significant."

Assuming the last sentence to be correct (which may be doubted) let us consider a machine costing £10,000 with, after 10 years, a resale value of £1,000. Let us assume

that a commercial firm would charge £1,000 per year to keep such a machine available.

Case 1—Ownership

(a) Cost of capital at 10 per cent for 10 years	£10,000
(b) Depreciation over 10 years	£9,000
(c) Maintenance, etc (for this example)	Nil

Total cost of ownership for 10 years	£19,000
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Case 2—Lien

(a) Cost of Lien at £1,000 per year for 10 years	£10,000
(b) Depreciation (in all circumstances)	Nil
(c) Maintenance (in all circumstances)	Nil

Total cost of lien for 10 years	£10,000
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In this case, which has been simplified by not compounding the interest, etc the cost of ownership over 10 years amounts to £9,000 more than the cost of lien.

It may be suggested that at present day rates the situation will have changed. So for a second example we may consider a similar machine but with an interest rate of 12½ per cent and a Lien rate of 20 per cent then:

Case 1—Ownership

(a) Cost of capital at 12½ per cent for 10 years	£12,500
(b) Depreciation over 10 years	£9,000
(c) Maintenance, etc (for this example)	Nil

Total cost of ownership for 10 years	£21,500
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Case 2—Lien

(a) Cost of Lien at 20 per cent for 10 years	£20,000
(b) Depreciation	Nil
(c) Maintenance	Nil

Total cost of Lien for 10 years	£20,000
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Even with a rate lien which seems artificially high there is still a saving of £1,500. It might plausibly be argued that the extra convenience of ownership justifies this cost—but what about the inconvenience of maintenance, storage, control, etc? In any case this comparison may show costs in a more significant light.

The Lindsell Committee ignored the cost of capital. Many military financial decisions are still based on crude ideas of book balancing—although the Defence Vote is not allocated on a purely annual basis, it still often appears as if the allocation of funds is rigidly tied to the financial year. This may be unwise (Luke 19–21 . . .), it serves neither the Army nor the taxpayer if military funds are inefficiently used. Military capital is no cheaper than any other capital. It may also be doubted whether it is necessary to pay in peace for the use of national resources in war, in past wars governments have made wide use of their emergency powers to direct resources.

The previous paragraphs have dealt with machines that are not required so urgently in war that they must be held by the Army in peace. But even the plant that must, for operational reasons, be held in peace has its costs.

Let the hourly operating cost of a machine be V_c

Let the yearly ownership cost of a machine be F_c

Let the planned hours run per year be N

Then Total Annual Cost, T_c $= F_c + N.V_c$ (1)

and hourly running cost, H_c $= \frac{F_c + N.V_c}{N}$ (2)

These equations illustrate two points.

The most economical machine is the one for which T_c is minimum. So if a machine is to be used seldom (ie N is low), then the most economical machine will be that

with lowest fixed costs; but if a machine is to be used frequently (ie N is large) then it may be worth buying a machine that costs more but has lower operating costs.

As most commercial firms plan to use their machine intensively they will tend to buy machines with low running costs; but as military machines may be used only spasmodically or in an emergency it may be better to buy cheap machines with high running costs in preference to expensive machines with low running costs.

The hourly running cost H_c is made up of two elements: the fixed cost element $\frac{F_c}{N}$ and the variable cost element V_c . A plant hire firm must charge more than $V_c + \frac{F_c}{N}$

to make a profit, but it may reduce loss on any price above V_c . (An idle machine still costs its fixed costs, so any income above variable cost may be set against fixed cost). If the Army owns machines for which V_c is high, either because of the nature of the machine or because of high transport costs, it may be cheaper to hire civilian machines rather than use our own. This may occur in seasons when the plant hirer is more concerned with reduced loss than with making profit, and also when we undertake projects overseas for which transport costs would inflate our V_c . (However training requirements might still justify the use of military machines in spite of increased costs).

A detailed financial analysis of the military plant fleet would make tedious reading, but even the simplest economic analysis of the costs of owning and operating plant shows that we may usefully apply economic methods to military plant:

(1) By calculating the cost of ownership we can work out the cost of holding unused civil engineering plant. Only if the true cost is known can it be correctly decided whether the extra costs and difficulties of emergency acquisition in war justify the ownership of plant in peace.

(2) Some plant must, for operational reasons, be held in peace. The projected usage of this plant in peace will enable the comparative costs of ownership and operation to be correctly balanced when purchasing.

(3) An accurate knowledge of the variable costs of our machines will ensure that military plant, obtained for use in war, is not used when the hiring of civilian machines would be cheaper and would not adversely affect training.

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SOME 800 issues of the *Journal* have been published. Of these some 750 back issues are available for sale to Members of the Institution of Royal Engineers.

In broad terms:

(a) Between 1872 and 1904 the *Journal* was published monthly and combined the functions of both the *Journal* and *Supplement* as we now know them. In appearance it was rather like a foolscap version of the present *Supplement*.

(b) Between 1905 and 1922 it changed and became very like the *Journal* of today although it was still published monthly.

(c) Since 1923 the *Journal* has been published quarterly.

The earliest issue available is No XIV published in 1872 (one copy only) and despite its age every word is readable. Some of the covers of early issues are faded and dusty and show their age. The value of these back numbers on the open market would vary from pence to pounds, depending on the content, rarity of issue and the degree of acquisitiveness of the prospective buyer.

As sales are to be confined to Members only, a flat rate of 50p per copy will be made regardless of the open market value.

Memoirs

BRIGADIER H E C DE CHASSIRON, CBE

Born 18 July 1908, died 11 February 1974, aged 65

HUGO ERNEST CHARLES DE CHASSIRON had three successive and successful careers—as a soldier, with industry and latterly as a management consultant.

Of his early days his many friends and colleagues write with some envy, of his ability to play ball games and his remarkable brain. At Haileybury, “he was not easy to get to know—reserved, too clever for some and pretty intolerant of fools”. Once the barrier of reserve was broken, however, his friendly and good humour personality came through. Later, “He was a most acceptable ‘Head of Batch’, being incapable of doing anything in a pompous way, yet carrying a lot of personal dignity. His brain was one of the very quickest—he could learn more in thirty minutes’ concentrated study than some of us could learn in a week of toil”; “He seemed to have no difficulty in achieving a First in the Tripos while we more ordinary mortals were slaving long hours for a Third. His handwriting was appalling and it was always a mystery how the examiners were able to decipher his papers. He was an above average performer at well nigh any ball game he cared to take up. He was a first class wicket keeper and was unlucky not to get his Blue at Cambridge. Like others with a quick mind, he was inclined, certainly at that time, to be impatient with those who took longer to arrive at conclusions which were, to him, quite clear from the start. Although on occasions he could be a man of moods he had a great sense of fun, a caustic wit and could be a gay and stimulating companion”.

During the Second World War he spent most of his time in staff appointments where his quickness of mind served him in good stead, particularly in Combined Headquarters and with Lord Mountbatten in South East Asia. Had fortune placed him more frequently in the right place at the right time, his remarkable intellectual talents might have accelerated his climb to the top. His staff appointments after the War, his work in America and with SHAPE are a matter of record but it is important to remember that his last appointment was Deputy Director of Manpower Planning, as this was the springboard for his later careers.

He retired from the Active List at his own request to go into Industry. As an Assistant General Manager he joined the R & D Department at English Electric and was closely involved in establishing the technical teams needed to design and build the Magnox Nuclear Reactors. He was then made Managing Director of D Napier and Sons of Acton, a subsidiary of English Electric until the aero engine part of the firm was sold to Rolls-Royce in 1962. He later became the General Manager at Fylingdales for the Radio Corporation of America, where his task was to maintain at a very high state of serviceability one of the most complex computer systems in the world at that time. This was a remarkable proof of his versatility.

His third career probably gave him the most personal satisfaction. He had developed a missionaries’ zeal for finding employment for the older men whose talents he felt were being sadly wasted by early retirements, redundancies, etc. As a Management Consultant he was able to give expression to his firm conviction that these very able men could and should be redeployed into a second career. His pioneer work in persuading senior management that these men, often forty-five years old and over, should be employed and had a worthwhile contribution to make, in the right team, ensured that much management talent was not lost to this country.

Hugo de Chassiron could and did, inspire respect and affection among all those who knew him.

CMA, AHD, JAH, ARJ, JFDS, JKS, CLR

BRIGADIER G O N THOMPSON, DSO, OBE

Born 14 May 1904, died 19 February 1974, aged 69

BJC writes:

Guy Thompson joined 46 Division as CRE at a time when the Sappers were not a little tired and weary from spear-heading the slow divisional advance up Italy. His enthusiasm and leadership revived flagging spirits and he was always to be found "up front" when things were sticky.

Later, after the Division had broken through the Gothic Line, the line of advance from Rimini towards Bologna slowed down to a series of set-piece assaults across river line after river line against stubborn opposition in increasingly unpleasant conditions of mud and flood. For the Sappers it was a nightmare "flog" which was maintained for four months without a break. It required all the powers of leadership to keep the sappers going and Guy Thompson would always be remembered by those who served under him at that time as a continual source of encouragement, strength, understanding and help—and by others as the Commander who achieved great things from his team.

On the same period JHSR writes:

The CRE—Guy—a dedicated and professionally most capable Sapper—was truly ubiquitous. He was always to be found where things were most difficult and crucial no matter how "hot" the situation. There can be no doubt that he was an inspiration to his Sappers. Notwithstanding the tremendous strain under which he had to work, he always retained his calm and unflappability. It is beyond question that he personally contributed very much to the considerable success of the Division in those difficult days. In late December the Division moved to Greece, where in the period of civil strife and reconstruction, his Sappers played a leading part. When the war ended in Europe in May 1945 he moved with the Division to Austria and was again a "tower of strength" to his engineers and to the divisional staffs. Perhaps one of the fondest memories of Guy is that, no matter what the pressure and strain, he was always a very good companion, and in the Mess in the evenings he was ready to take sides in spirited but friendly argument.

To the GSOI of the Division, another Sapper officer, many years his junior, he was indeed friend, counsellor and companion, always ready to listen and to give sound and carefully weighed advice.

GRMHM writes:

He was a man of very great ability and a Christian gentleman in the fullest sense.

When he took command of the Engineer Base Group Egypt he inherited some formidable disciplinary problems. In the two previous years there had been a constant succession of Courts Martial and a very high crime rate; some of the worst characters in the Canal Zone had collected in the Group.

By always believing the best of his people and by his fairness and courtesy, he did not succeed in eliminating crime but by the time he left the crime rate had fallen to a mere trickle.

He brought a very keen brain to bear on every problem and was not a great believer in the rule book—there always seemed to be a refreshing breath of cold air about the office. It took a lot to upset him.

CERH writes:

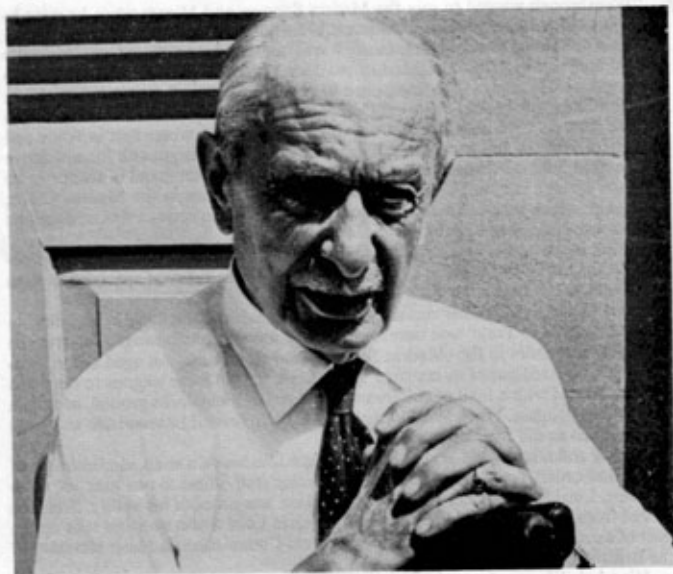
Guy Thompson was Assistant Chief of Staff Plans and Policy, Allied Forces Central Europe. As Deputy Chief of Staff, Allied Land Forces Central Europe, I had much to do with him personally. I also know the high esteem in which he was held by his immediate superiors, French and American, and I know how successful Guy was in persuading the officers of the seven different countries and three different services to accept a common policy and to agree to a common plan. No mean effort! His success was due in part to his high intelligence, and in part to his tireless energy, but chiefly, I think, to his scrupulous honesty which commanded universal respect.

BRIGADIER J E CHIPPINDALL, CBE, MC

Born 17 November 1887, died 9 March 1974, aged 86

JOHN ERIC CHIPPINDALL was the second son of Colonel W H Chippindall, a distinguished Royal Engineer, who for many years was the last survivor of General Gordon's final expeditions in the Sudan.

Commissioned into the Royal Engineers in 1908 he served with distinction on the Western Front throughout the First World War. He was appointed OC 219 Field Company (Glasgow) RE in April 1915 which was in support of the 97th Infantry Brigade of the 32nd Division. He was awarded the MC in 1916.



Between the World Wars he was responsible for many construction projects including Habbanyia Airport and in recognition of his services he was awarded the CBE in 1937. His first achievement, and certainly the one which gave him the most personal satisfaction, was when as Chief Engineer III Corps BEF he played an important part in the retreat to Dunkirk. His understanding and control of his engineers was a very important contributory factor to the escape of our forces. As Chief Engineer Eastern Command he was responsible for the engineer work on the defences of SE England at one of the most critical periods of the War. He retired in 1943 and although he was deputy director of Opencast Coal Production and later became the financial director to a group of companies he still found time to join the team of officers who helped in the production of Volumes V, VI and VII of the *History of the Corps of Royal Engineers*.

He will be remembered by his many friends in all walks of life for his incisive and ready wit and for his integrity and kindness.

To his two daughters we extend our deepest sympathy.

JDF

Brigadier J E Chippindall CBE MC

MAJOR-GENERAL LL WANSBROUGH-JONES, CB, CVO, CBE

Born 2 July 1900, died 8 March 1974, aged 73

IN writing a tribute to Llewelyn Wansbrough-Jones and listing his achievements it is very easy to give the false impression that he was a precise, unruffled, dry technician with boundless energy but without human qualities. Immaculate, unruffled and energetic he certainly was but he had an abundance of all the desirable human qualities. He has been described as "a giver in spirit, with immense energy and an amazing capacity for hard work".

JFDS writes:

"Wansbrough wanted to join the Madras Sappers and Miners when he went to India in 1934. Although he was unsuccessful he got as near to it as possible with a post as A G E Bangalore. Needless to say it was not long before he got what he really wanted and he was given command of the 14th Field Company then at Corps HQ in Bangalore. He enjoyed life and joined in all the activities of a station in India at that time. He played hockey with the Company, polo and squash and was a keen and capable shot. In 1936 he took the Company to Waziristan, where first in Wana and then in Razmak, he had experience of command of a full strength unit in semi-active service conditions. He proved himself to be as successful in command of troops as he was later in high staff appointments. He made many friends in the Madras Corps, friendships which survived many years of separation. When contact was renewed, he was the same happy companion as in his younger days."

Earlier in his career he had attended a Long Transportation Course (an apprenticeship for his later success as a Movements and Transportation specialist at high level), and of the India tour JRSWE writes:

"One of the skills of this charming, kindly and talented man lay in his being an engine driver. 'The Train' was usually one of the amusements arranged for children at Christmas parties in the (Madras Sapper) Bangalore Mess. An aged steam locomotive was coaxed out of its stable in Workshops, hauled some wagons to the Mess compound and with a load of children went on to the Fieldworks ground, around a loop and back again. When Wansbrough was there to drive it he seemed to enjoy the trip as much as did the children."

During and after World War II he really came into his own as an administrator of the highest order. To have been a successful senior staff officer to two exacting commanders, Lord Montgomery and Lord Robertson was proof of his ability. When he retired from the Active List in 1955 it was to rejoin Lord Robertson and take up the post of secretary-general to the British Transport Commission and later secretary of the British Railways Board.

His whole life was devoted to service to others. After his retirement he did excellent work as general manager of the National Association for Employment of Regular Sailors, Soldiers and Airmen, he was a prominent member of the Committee of Management of the United Service Club, and nearer home, he was Chairman of the Royal Engineers Association for several years. As many will know he was deeply involved in the successful amalgamation of the old REA and the Royal Engineers Benevolent Fund.

Although essentially referring to the last years of Wansbrough's life, the address given by the Rector of Danbury at the funeral service was relevant to the whole: "Wansbrough's death has been the occasion for obituary notices recalling his achievements during his years of service. They reflect the range of his gifts and the extent of the contribution he was able to make to our country's life. We in Danbury have known him as a worshipper, a friend and a christian. The seven years for which I have known him have been years of retirement. After such a career these years could have been an anti-climax but Wansbrough was never one to cry 'Ichabod'. He lived absolutely and fully in the present. He had discovered the secret of fulfilment to which George Herbert gives us the key."

'Teach me my God and King
In all things Thee to see;
And what I do in anything
To do it as for Thee.'

For Wansbrough, God was a god of the present moment and so he was able to give himself absolutely to each present moment as it came. This came out in his attitude to his retirement. I ask you to note three things that I thought noteworthy about him in this respect.

First of all, he was always eager to widen the horizons of his thinking and to deepen his range of understanding and sympathy. Secondly, he remained alert to the avenues of service which were available to him. There was his work with SSAFA, with the resettlement of service personnel and with the local Home of St Giles and their care for the lepers. Thirdly, and most importantly, he was keen to deepen his friendship with the One whom he had known as saviour and now as judge. In this he found great help and comfort in the poetry of the psalmists and of George Herbert. Like calls to like. They spoke of God and enabled Wansbrough through their writings to draw closer to God, which is the christian's proper concern, especially in retirement.

About sixteen months ago Wansbrough was severely ill and he faced the eyes of death with typical courage. He was able in his remarkable recovery to pick up the threads of his work and service again. He did so, not to escape the fact of mortality, but because the pattern of his life simply had to reassert itself, this pattern of living fully in the present moment. And as he found his Master in that present moment so we may be confident he will find his Master in the hereafter."

MAJOR-GENERAL G S HATTON, CB, DSO, OBE

Born in Grenada, BWI, on 13 February 1899, died 24 March 1974, aged 75

GEORGE SETON HATTON was one of the brilliant officers who came into the Corps via RMC Canada, indeed he was to become one of the most enthusiastic members of the UK Branch of the RMC Club of Canada.

AGPL writes:

I first had the privilege of serving with George Hatton when he was Adjutant RE Troops at Aldershot in 1931. To a young and very green subaltern newly joined from three years of courses at Chatham and Cambridge his dynamic personality made a lasting impression. He set an example of firm but fair discipline and tremendous enthusiasm as a professional soldier, a fearless horseman and an excellent tennis player.

We next served together twenty years later when he was Major-General Administration of Northern Army Group in Germany. It was a stimulating experience to serve directly under him. There was the same dynamic personality and the same enthusiasm, but also a formidable reputation based on his remarkable series of active service staff appointments—from Brigade Major to Brigadier General Staff on the G side and a unique range of A/Q experience at Division, Corps and Army level. He was in my opinion an outstanding MGA. Although at times a hard taskmaster, he was an inspiring chief and a real friend to his staff. He always did what he thought to be right, quite irrespective of the effect it might have on his own career. With him there could be no compromise with truth as he saw it. He was a great innovator and many of the reforms he advocated were brought in years after he had retired. . . .

HS writes:

It was with deep regret that I heard of George Hatton's death. We first met when he was an instructor at The Staff College, Haifa and I was a student. He was a brilliant and forceful teacher for whom we all had a wholesome respect. He was, in fact, rather frightening. The course took place at the time of Dunkirk when the

general situation was at its worst. It was George's unpleasant duty to give us a resumé of the military situation several times a week. He was far too intelligent not to realize how desperately serious it was but had no intention of showing pessimism, so his talks often ended up with the phrase, "Time is on our side". This became a Staff College joke—nobody appreciated it more than he did.

On leaving the Staff College I was posted to Alexandria District that was then forming and found that George was to be my boss. I must admit that my spirits sank as I felt that I should never be able to measure up to his standards. I was commiserated with by my friends who said, brightly, that I should not last five minutes with George Hatton. The result however was exactly the reverse. My time on his staff was a very happy one, I learnt a great deal and nobody could have been kinder or



Major-General G S Hatton CB DSO OBE

more considerate. During the rest of the war our paths were continually crossing especially when he was with 7th Armoured Division and later at SHAEF.

I shall always feel deep gratitude for his help and kindness to me.

HECW writes:

To all who knew "General George" his sudden death has come as a great shock. He has always been such a vital and active person that it is very difficult to credit that he had reached the age of 75. He was a man of the highest integrity who was not prepared to compromise on matters of major principle and was as fearless in his approach to officers senior to him as he could be to his equals and subordinates.

There is no doubt that his metier was primarily as a Senior Staff Officer although he had proved himself no mean Commander at the end of the war. In particular it was his flair for Administration, in every sense of the word, that brought him his success. He was exceptionally far seeing, sometimes almost futuristic, in his approaches to Administration about which he had forgotten more than most of his contemporaries ever knew. He was years ahead of his time in his advocacy of the introduction of helicopters, as a normal means of logistic transport, in the field and in the use of television in time of war. He endured with great good humour the many suggestions that were made to him that he had large blocks of shares in Westlands and Pye!! But time has justified his foresight!

George Hatton never spared himself and worked his staff hard. Nor did he ever mistake any geese for swans. However, once his confidence had been gained he was very approachable to his immediate staff, always prepared to listen and, if he did not agree with what was being said, would go to great pains to point out the reasons for his dissent. Sometimes his single-mindedness of purpose and his determination and directness of approach caused a few ruffled feathers among those not in daily close contact with him, but he was ever ready to make amends, without sacrificing his aim, if he became aware of those feelings. He was a warm and human person who went to great pains to look after those who served him well. He had a nice sense of humour and was as delighted as I was when, after he had given me leave to go to the Cheltenham National Hunt Festival, I returned to tell him that I had backed *Hatton's Grace* to win the Champion Hurdle Cup at 33/1.

This very inadequate tribute to a distinguished soldier and master of administration makes no attempt to trace his military career or his later work in co-ordinating Civil Defence in Canada. All this is on record for all to see in *Who's Who* and other publications. It is in every sense a personal tribute from one who was privileged to serve him on a number of different staffs and to count him and his charming wife Mary as true friends. It was in family life, perhaps, that one saw the best of George Hatton because he was a most devoted husband, step-father and step-grandfather and the sympathies of all who knew them will go out to Mary, Jill and the children.

AGPL concludes:

. . . I had the pleasure of meeting George and Mary Hatton frequently in his final retirement after he had returned from his appointment as Deputy Civil Defence Chief in Canada. We enjoyed the same warm hospitality that we had become used to in the old days in BAOR, and always came away stimulated by the freshness of his ideas and comments on the events of the day.

Correspondence

Lieut-Colonel A W H Woods RE (retd)
The Gables
109 Lache Lane
Chester CH4 7LT
28 April 1974

MAJOR-GENERAL B E C DIXON CB CBE MC

Sir,—No writer of the memoir about Major-General Dixon in the March issue mentioned his outstanding work after his retirement at East Kilbride New Town.

I therefore enclose a supplementary memoir as I feel the matter is of sufficient interest to be recorded in the *Journal*.

Our families were in touch after the war and finally with my wife I attended his cremation at Stafford on 12 October 1973.—Yours faithfully, A W H Woods.

SUPPLEMENTARY MEMOIR

MAJOR-GENERAL B E C DIXON CB CBE MC

No Memoir of Dicker can be complete without a mention of his important work after his retirement as the first General Manager of East Kilbride Development Corporation which was formed to build the New Town of East Kilbride.

He took up this appointment in 1948 and retired in 1962 on age. When he arrived there was nothing except the old village at the site. He had to start from the beginning in sole charge.

The whole district was laid out in a number of separate residential areas each complete with its shopping centre and public buildings. There were separate areas for industrial development. He wisely started by constructing the roads and drainage first followed by the houses. When he left the population was some 40,000 and now it is nearly 70,000.

The Development Corporation fully appreciated the great work he did and last March they planted an oak tree in his memory at the Civil Centre. His widow was invited to attend the ceremony and was afterwards treated to an excellent official lunch. The speeches were full of praise for all Dicker had done for the town.

I first met Dicker and Biddy when we were SOs RE at Northern Command, York in 1937–8. When he was at East Kilbride I visited them twice on my way to Scotland, in their nice old house in the village. I was very impressed on touring the works by the general tidiness and orderly progress with none of the disorder and sea of mud which usually exist at these developments.

He used to speak of his great admiration for the late Major-General Sir Eustace Tickell, when he was Director of Works at Cairo in the early days, for his extraordinary foresight as to the requirements of Stores and Equipment especially in the provision of a fleet of self-propelled lighters built in India. These considerably eased the S and T problems during the subsequent advances and retirements along the coast. Dicker undoubtedly learned many useful lessons which helped him in his later work.

After leaving East Kilbride they went to live in the village of East Stour near Shaftesbury. Biddy by this time was handicapped by arthritis and it was here that his last illness started in 1969. He had to go into hospital at intervals but was always cheerful. They finally moved to a village near Stafford to be near a married daughter. A barn in the grounds of his daughter's house was converted into a delightful cottage, but it was only completed shortly before he died under the devoted care of his wife and family. He is survived by his wife and two married daughters.

The impact he made on the civilians of East Kilbride, where his permanent memorial stands, testifies to his ability and strong character.

Major-General R L Bond CB CBE DSO MC
The Dykeries
Compton
Guildford GU3 1EE

THE GODSELL DIARY

Sir,—I was most interested in the diary of K B Godsell in the March number of the *Journal*. He does not curiously enough mention an incident which was recounted to me after the retreat was over. I do not know whether there are any Members of the Institution who could verify it.

Roderick Pottinger (who was a close friend of mine) was marching behind a column of transport and spotted three Uhlans riding alongside the transport. No one had recognized them, probably thinking they were French cavalry. Pottinger was a fine revolver shot; I think he shot in the Army VIII before 1914. He rode after them, gave the alarm and shot all three with his revolver before they had time to gallop away.

He and I only met for a minute or two in a shell hole on the Menin Road in November 1914 and I had no time to ask him about this story. He was killed during the Hill 60 fighting in May 1915.

I should be interested to know if anyone remembers the incident.—Yours sincerely,
R L Bond.

Major R J Francis BSc MICE AMBIM
19 Lynch Road
Farnham
Surrey

EXTREMISM

Sir,—Your editorial in the Journal of June 1974 filled me with misgivings, for the reasons that follow.

Extreme positions are at the current limit of experience, knowledge or perception. The true limit may be much further away. Those in the extreme position can see further than those who confine themselves to the centre. Kipling's "dreamer whose dreams come true" was one of the much-needed former kind.

The "character", whose courage, wit and intelligence take him to the extremities, is one of the few able to inspire the less gifted, and far more numerous, men who inhabit the centre.

No mature sapper I ever met was deceived into thinking that a "character" was necessarily a character. We all knew that the stimulation had a price.

One cannot help wondering whether there is another, unstated, problem. Has the lack of good manners made the extremist so much more offensive than his pre-war counterpart? Are the extremists splitting an otherwise strong Corps? Is the Corps too weak to cope with an upsurge of rudeness or divisiveness?

I remember the "characters" I knew with much affection, and I do not blame them for the waste of time spent following false gods. A non-extremist Corps consisting of centre-ground mediocrity would have been a very dull, and an extreme, alternative.—Yours sincerely, R J Francis.

Book Reviews

THE LONGMOOR MILITARY RAILWAY

BY D W RONALD AND R J CARTER

(Published by David and Charles, Newton Abbot. Price £4.75)

Weaversdown, Hollywater, Gypsy Hollow, Whitehill, Liss Forest Road—names that conjure up memories for many Sappers, especially those who were employed on Transportation duties in the Royal Engineers—are all associated with the Longmoor Military Railway, the "LMR". D W Ronald and R J Carter have obviously done a great deal of research in compiling this comprehensive and interesting history of a military training railway which came into being in 1903 when 53 Railway Company began the work of building a light railway between Longmoor and Bordon for the conveyance of army huts between the two sites.

The authors trace the long and happy association of those two famous railway companies, 8th and 10th, with this unique railway running from Liss to Bordon through the pines and heather of the downs. They illustrate the text with numerous excellent photographs, including a magnificent colour plate of "Gordon", (a 2-10-0 locomotive and one of the heaviest and most powerful to be owned by the military), in the blue and red livery of the LMR. They give details, without frills, of every locomotive used by the LMR from the three 18-inch gauge steamers "Mars", "Venus" and "Flamingo" (originally delivered to Woolwich Arsenal in 1886), to the Stanier 2-8-0 "Lieutenant WO Lennox VC". Fourteen appendices give a complete record of practically everything pertaining to the Longmoor Military Railway, from locomotives and rolling stock to timetables and statistics. Many readers will be surprised when they read of the number of films that have been made using the LMR as a location.

It was in 1906 that the first standard gauge locomotive, "Bordon", was brought into

service. Work on the engine shed, workshops and storerooms also started around this time and in 1908 the railway was officially designated the Woolmer Instructional Military Railway. 1914 brought a fever of activity to Longmoor and over 60,000 trained railwaymen, operational and constructional, qualified at the training centre. Between the wars Longmoor became the happy training ground for men of the Railway Units Supplementary Reserve. When the Second World War started the centre was already known as the Longmoor Military Railway and it was an essential cog in the Allied war machine. By the end of the war more than one third of the total Corps strength were transportation troops and, of those, some 76,000 were trained at Longmoor.

St Martin's Garrison Church, which holds within its walls a collection of memorials to the men of the Transportation Services who fell in the two World Wars, was originally a forage barn, but there can be few collections of modern stained glass windows equal to the memorial windows in this railwayman's church.

Longmoor Military Railway was unique in that it incorporated into the permanent way a wide variety of rails, sleepers, fastenings, turn-outs and associated fittings because men being trained as platelayers had to be familiar with all types of equipment in order that they could fulfil their role in any part of the world. Many types of signalling equipment were in use for the same reason.

After the formation of the Royal Corps of Transport it was decided by the powers that be that the limited requirement for military railwaymen no longer warranted the extensive training facilities provided at Longmoor and, after a last Public Day held in July 1969, the closure ceremony took place on 31 October in the same year.

D W Ronald and R J Carter have created an excellent record of the achievements of the railway facilities at Longmoor. A great number of Sappers, who I am sure will read this book, will look back with pride on what was a most successful and unique training establishment.

HJ

THE HUNDRED DAYS OF DARIEN

RUSSELL BRADDON

With a Foreword by HRH The Duke of Edinburgh

(Published by Collins, London. 222 pages. Price £3.25)

Until 1972, when the British Trans Americas Expedition, led by a Sapper (Major Blashford-Snell) succeeded in their venture, no previous expedition had ever driven a convoy of vehicles from Anchorage in Alaska to Tierra del Fuego in the southernmost tip of South America. Even if the whole journey could be done on the Pan American Highway it would tax the administrative ability of the organizers as well as the endurance of the drivers and the reliability of their vehicles. But the Pan American Highway is interrupted by what is known as the Darien Gap. This consists of a 200-mile stretch of territory without roads or tracks, lying between Panama and Columbia. In this Gap there are mountains, ravines, rivers and swamps, mostly covered by dense jungle through which a trail must be hacked and the vehicles winched or rafted where they cannot drive. Moreover, the climate is vile and wild animals, insects and reptiles of ferocious habits add to the difficulties.

An experienced Author, Russell Braddon, who was not himself one of the participants, has described the Expedition in a book called *The Hundred Days of Darien*, which has a Foreword by HRH The Duke of Edinburgh. He has done his work in the manner of a reporter, after the event, from interviews with the participants and reference to letters, reports and documents both official and unofficial. (One of his sources was General Caldwell, the E-in-C at the time, who was a staunch supporter throughout.)

In his Foreword, HRH The Duke of Edinburgh notes that "There are two sides to every expedition: the technical details of the project and accomplishment and the story of the behaviour and endurance of the people involved". This book deals mainly with the people, most of whom were soldiers—many of them Sappers—a few civilians and two women. Originally the vehicles consisted of two Range Rovers, but a Land Rover was added later. Support was given by overseas base organization that had to be able to procure at short notice a wide range of requirements from almost any part of the world at the request of those in the jungle. At one time £1,000 was needed from London, at another a couple of back axles from Coventry were required; which gives an idea of the versatility of the base personnel. Because the Expedition depended on generous sponsors, it was also important to keep in touch with them and with the news media. There was thus room for men and women of

many accomplishments to man the various groups of the Expedition.

In the jungle, these groups consisted of a Recce Group, a Range Rover Group, a Scientific Group, a Group in charge of the pack animals carrying supplies and baggage, and so on. There was also a group with a light aircraft for dropping what was required into the jungle. The Author leaves the reader (or anyway your reviewer) in some doubt of the composition of these various groups; but this does not detract from the vividness of a swiftly moving narrative. This is what the Author sets out to provide, rather than a quasi-military report.

The Author does, however, convey one impression very powerfully, which your reviewer hopes is a false one. The impression is given that the Expedition contained too many jarring personalities. Not a single character emerges from the story in an attractive light; they are all portrayed as comparatively odious. It is as though the Author, trying to avoid painting all men as saints, has gone to the other extreme and painted most of them as men of unmitigated coarseness. It is hard to believe that they were really like that; and because their obscenities are frequently recorded *verbatim*, many readers will be thoroughly shocked.

However, if you can take that in your stride, you will find the pages slip quickly by, and you will finish the book at a sitting. If you begin—as your reviewer did—with only a hazy idea of what the Expedition was attempting, you will end with a well-informed appreciation of a fine achievement of which the Corps may well be a beneficiary.

MCAH

D DAY

WARREN TUTE, JOHN COSTELLO AND TERRY HUGHES

(Published by Sidgwick & Jackson Ltd, London. Price £3.95 UK only)

The publication of this book was timed to coincide with the 30th Anniversary of D Day 6 June 1944. It tells the remarkable tale of the fulfilment of the pledge given by Sir Winston Churchill after the evacuation, between 28 May and 3 June 1940, of 225,000 British and 113,000 French and Belgian troops from the Dunkirk beaches by the armada of little ships when the outlook was indeed grim. He promised that Britain would fight on if necessary for years, and if necessary alone, and that we would "go back".

Within four years almost to the day of the last little ship leaving the Dunkirk beachhead the greatest invasion armada the world had ever known set out from the ports of Southern England and Wales, assembled in the Channel and landed British, Canadian and American troops back on French soil. Parachutists and gliderborne troops landed on the flanks of the ground forces. Air cover was absolute.

The Atlantic Wall, protecting the Normandy coast line, was breached but the breakout battle from the beach heads was violent and hard fought. Reminiscent of the great gale of November 1854 during the Crimean War which wrecked several supply ships off Inkerman and turned the British base area into a sea of mud and the gale that wrecked the beach area of the Dardanelles on 28 April 1915 during the Gallipoli Campaign, a freak Channel storm sprung up on D+13 and blew a full gale for three days and nights. It caused great havoc on the invasion beaches and this calamity seriously affected the Allied build-up. By the time the storm had blown itself out the American First Army had only 3 day's supply of ammunition left and the British Second Army, already two brigades behind the planned build-up before the storm, was three divisions short.

The battle of the build-up was however won and by 9 July, after thirty-three days of heavy fighting, the town of Caen was entered by British and Canadian troops. The slogging match was not yet over and heavy casualties in men and tanks were suffered until the German forces were trapped by the British, Canadians and Americans in the "Falaise pocket" 15 miles South of Caen. Here on 22 August 50,000 Germans surrendered, between 10,000 and 12,000 having been killed among the wreckage of their own transport and destroyed tanks. To the British it was a fitting revenge for Dunkirk. Two days later General de Gaulle entered a liberated Paris in triumph. The invasion had achieved its first great victory. The whole of France, Belgium and Holland were soon to be free and in less than a year the German Naval, Land and Air Forces surrendered unconditionally.

Admiral of the Fleet Earl Mountbatten fittingly wrote the foreword to the book. The success of OVERLORD rested largely upon his forethought, drive and imagination during his time as Chief of Combined Operations from October 1941 to October 1943.

Each of the three-man team of authors has had experience in films and television and they have called upon this technique to produce a profusely-illustrated and absorbing presentation of the planning, direction and carrying out of one of the most formidable allied

amphibious operations in history.

There is perhaps one criticism of this excellent history namely the frequent derogatory references to General Montgomery, a general who had far more successful battle experience than any other involved in the operation. Finally with the present day Irish problem very much in mind it is worth remembering that throughout the mounting of OVERLORD the Republic of Ireland was a grave security risk being a valuable base for enemy agents which maintained both German and Japanese Embassies. On the other hand the Royal Ulster Rifles were deeply involved in the Normandy landings. Their 1st Battalion formed part of the 6th Airborne Division Air Landing Brigade, and their 2nd Battalion formed part of the 8th Infantry Brigade which spearheaded the 3rd Divisions landing on SWORD Beach. The Royal Ulster Rifles was the only Infantry Regiment of the British Army to have two Battalions in the D Day Order of Battle.

JL

THE MALAYAN RAILWAY KERETAPI TANAH MELAYU

J A STANISTREET

(Published by The Oakwood Press. Price £1.05)

The Author, who is a serving Sergeant in the Royal Army Ordnance Corps, has a remarkable flair for penetrating any railway organization and for encouraging busy officials to reveal the "vital statistics" of their trade. In 1970 he formed the Rheindahlen Railway Circle and gave great pleasure to its 100-odd members by arranging, over the following three years, a series of "expeditions-in-steam" into the Deutschen Bundesbahn.

In 1966, Allan Stanistreet was serving in Malaya and characteristically set about the railways of that country. The result is a modest but very comprehensive book which, as railway historian P. Ransome-Wallis acknowledges in his Foreword, fills a gap in overseas railway literature. The author is thus in a position to give pleasure to an even wider audience than he enjoyed in Germany.

After a brief history of the railway which began in the State of Perak in 1885, the book develops in the form of a series of essays on the various functional components—track, signalling and motive power. Then comes Chapter Four, almost as if the author anticipated in the reader by this time, a mild attack of mental indigestion. It is the story of a footplate ride on the Day Express from Singapore to KL and this will be enjoyed by those of us who like their public transport as seen through the eyes of the driver. Subsequent chapters deal with the remaining functional aspects of the railway and the statistical appendices will remain a tribute to the author's industry and attention to detail. The book is well illustrated with interesting photographs of locomotives old and new, workshop and signal box interiors and some views of station scenes which will induce nostalgia in those who were lucky enough to serve in Malaya. There is a system sketch map and an extract from the Main Line Timetable 1968.

The enthusiast will want this little book on his shelf; it is also highly commended to those who would like an inexpensive reminder of one important and efficient aspect of Malaya.

DRC

Technical Notes

CIVIL ENGINEERING AND PUBLIC WORKS REVIEW—OCTOBER 1973

"Shrinkage and Creep Properties of High Strength Structural Concrete." A detailed examination of the shrinkage and creep properties of high strength concrete, carried out at the University of Sheffield, is presented in a clear and valuable article in this issue. The tests were carried out with concretes of 100–120 N/mm² cube strengths over periods of loading up to two years, and are still in progress. The data establish the order of shrinkage and creep strains to be considered in design when working stresses of 30–50 N/mm² are used in practice. The results show that the drying shrinkage of high strength concrete could be well below or higher than normal concrete depending on the type of concrete. Specific creep at 650 days varied between $43\text{--}66 \times 10^{-6}$ mm per N/mm² and was considerably smaller than that of conventional concrete.

The test results present good evidence toward establishing the values of drying shrinkage and specific creep strains to be used in the design of structural elements in high strength concrete. This may be of economic value in prestressed concrete design where the stresses

at transfer and working loads can be substantially increased beyond their current design values if high early strength concretes are used.

CIVIL ENGINEERING AND PUBLIC WORKS REVIEW—NOVEMBER 1973

"Optimum Moment Redistribution for RC Continuous Beams." The new Code of Practice in Concrete Design (CP 110; 1972) has adopted the concept of plastic behaviour at ultimate collapse loads in the design of RC structures. An article by C B Saw of Aberdeen University demonstrates the concept of partial redistribution of bending moments based on an elastic solution of continuous RC beams. The maximum amount of bending moment that can be redistributed is now 30% as against the 15% allowed by CP 114; 1965. The article illustrates that greater advantage is gained by reducing the support moments as against the span moments. This has the particular advantage in reducing the congestion of reinforcement at the supports where the satisfactory compaction of concrete is often a practical difficulty. The article outlines the theoretical differences between the two Codes of Practice showing that the reinforcement required in continuous beams is up to 8% less in end spans, up to 6% more in intermediate spans and up to 20% less at all supports.

"Paving Materials for Motorways and Trunk Roads." An interesting article detailing a measure of comparison between "black top" and concrete road pavements. Rigid concrete road miles are increasing every year and as the author states the relevant question is no longer "Are concrete roads any good?" but "How much of the motorway market will they eventually secure?" The percentage of road contracts now in concrete is above 25%. Perhaps one of the major reasons for the increase in concrete roads has been the development of the plastic concrete grooving machine. The economics of the maintenance of flexible "black top" roads against the concrete pavements appear to depend on the claims made for the grooving operation (done during initial construction), which may give an effective life of the grooved surface approaching the design life of the road itself, i.e. 40 years. The plastic grooved surface has to prove itself worthy of this claim and overcome the associated problems of noise and surface water drainage. Once it can be shown that the wearing rates of grooved surfaces will give a maintenance free surface then the competition between the two pavement types will be extremely competitive.

"Scaffolding." The November Special Feature is a four article feature on the design and uses of proprietary scaffolding including a comprehensive report on stability tests carried out at the Thames Polytechnic as a follow up on previous model tests reported on in the June 1972 edition of *Civil Engineering*.

CIVIL ENGINEERING AND PUBLIC WORKS REVIEW—DECEMBER 1973

"Piling." The Special Report of this issue is on piling. A short review of current methods is given but the feature articles in the Report mainly deal with steel sheet piling. A development in this field is to move away from the temporary nature of sheet piling and to design for incorporation in the final works as a permanent part of the structure. This is achieved by the use of standard pile sections or half sections welded to universal beams, e.g. the Larssen Unissen Pile. Apart from the obvious applications in marine engineering and very deep excavations, composite pile/beam sections have been used by British Rail Western Region to form bridge abutments for a new underbridge on a section near Shrivenham. This application is bound to grow, both because of the savings in overall costs and because the piling contractors become more involved in the complete contract.

"Fibre Reinforced Concrete." Perhaps it is fitting that fibre reinforced concrete should feature in the December issue of 1973. It has been in practically every other issue throughout the year! This month's article is a report on the First International Symposium held on 11 October 1973 in Ottawa. The symposium served to consolidate the feeling that fibre reinforced concrete is here to stay and was no longer a myth or a laboratory fabrication.

JTS

THE MILITARY ENGINEER JULY-AUGUST 1973

Articles of interest in this magazine are:

"Field Fortifications for Tomorrow", which gives a brief history of tests which have been carried out to test the effectiveness of various field defences and aircraft shelters. It mentions triggering screens and states that the standoff required for rounds containing up to 4 lbs of TNT is 16 in and for rounds containing up to 15½ lbs it is 78 in.

"Controlled Excavation Blasting." This article gives information on the methods of pre-splitting and blasting used to excavate for a replacement lock on the Black Warrior River. Care was necessary to avoid damaging the adjacent lock and dam. Other articles of interest are "An Engineer Company in Managua" which mentions the work done to assist in the clearing operations immediately after the earthquake. "Adventure Training for Construction Engineers" covers on-the-job training for construction tradesmen which is being carried out in Germany.

THE MILITARY ENGINEER SEPTEMBER-OCTOBER 1973

Articles of interest in this magazine are:

"Stair Pressurization for Fire Protection." A 22 storey building was used to carry out tests. Its stair-well was pressurized, using a large fan, to maintain a pressure of 0.3 in of water across the stair-well doors. Smoke and fire tests showed that the system was feasible and that the stair-wells remained smoke free during the tests.

"Multi-purpose Tunnel at New Melones Dam." The method of construction of this tunnel, 23 ft diameter and steel lined, is given in some detail. The tunnel is 3790 ft long and allows the river to by-pass the dam construction site. When the dam is complete, it will be used for irrigation and as an overflow system.

Of the other articles, "Longest MAB" covers the construction of a 1100 ft Mobil Assault Bridge across the Rhine and "Dam Construction in Permafrost" gives details of the problems which have been encountered in Alaska.

RG0

THE MILITARY ENGINEER NOVEMBER-DECEMBER 1973

Articles of interest in this magazine are:

"Military Engineering in the Sinai Desert." This article is written by an Israeli officer, and is split into two sections, "Engineer Offensive Operations" and "Engineer Defensive Operations". The main problems seem to have been the provision of routes across difficult country and through minefields in the offensive, and the repair of roads to support the logistic units. In the defensive, construction and repair of fortifications and the removal of wind blown sand are the major tasks.

"Pavement for Wide Bodied Jets." Details of some of the projects, on which slip form pavers have been used, are given. It states that slabs 17 to 21 in thick and 50 ft wide can be placed in one pass. On one contract 16,930 cu yds of concrete were placed in one day.

"The Space Shuttle." A description of this space craft is given. It is a winged craft which can be launched into orbit, and lands in a manner similar to a normal aircraft. The main use, visualized by the author, for this type of craft is the placing, repair and recovery of satellites. Space tugs and their use are also mentioned.

"Epoxy Patched Concrete Pavements." This article describes the repairs carried out to a concrete pavement damaged by a combination of heavy aircraft and freezing-thawing conditions. The epoxy concrete used attained a strength of 6,000 to 7,000 psi in 5 days. The success of these repairs has meant that the method is now used as normal maintenance.

Other articles of interest are "Buildings in the 1972 Managua Earthquake", which gives information on the extent and course of damage to various types of building. "Sub-Cofferdam Complex" gives some details of a figure eight cofferdam and rock anchors used on a lock and dam construction contract.

THE MILITARY ENGINEER JANUARY-FEBRUARY 1974

This magazine is an Anniversary Issue to mark the 55th year of the *Society of American Military Engineers*. Most of the articles are reports by the Chiefs of the Military Engineer Services. These reports give details of construction and new equipment which are planned in the near future.

Of the "other articles", "Elevated Snow Roads in Antarctica" give details of the design and construction of snow roads for wheeled vehicles. The winds keep the roads clear of snow drifts. Special pavers are used to pulverize and level the snow, rollers are used for compaction. Natural hardening is then allowed to occur, and a period of 7 to 21 days is required for the process. "Heat Scarifier for Pavement Maintenance" gives some useful details on the use of "overlays" to restore asphaltic concrete pavements, where the surface has deteriorated from oxidation. "Shipwrecked Bridge" is an interesting article on the repair of a railway lift bridge which had been damaged when rammed by a large ship.

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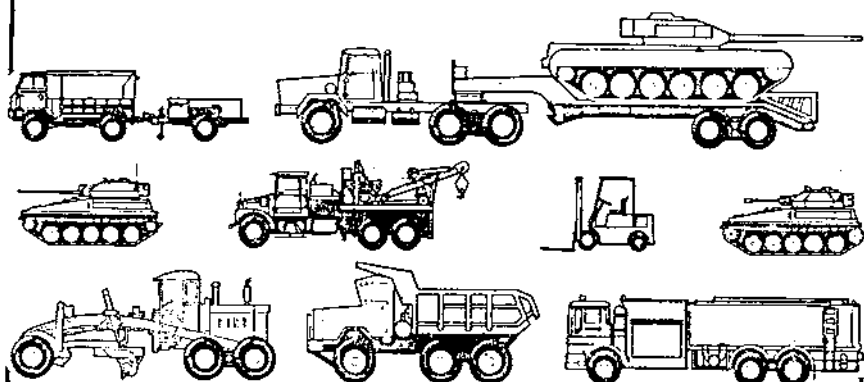
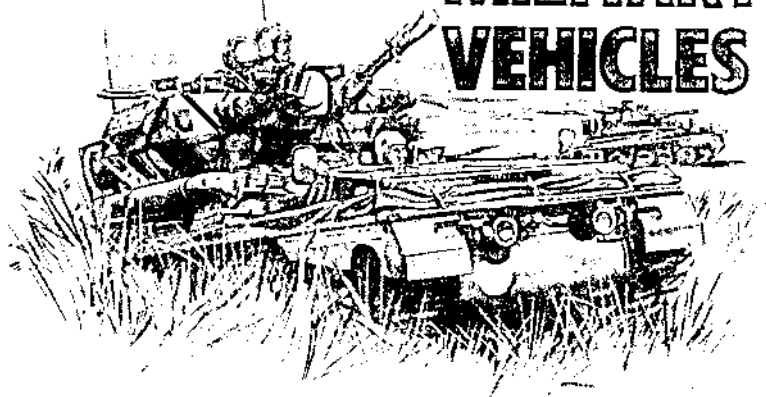


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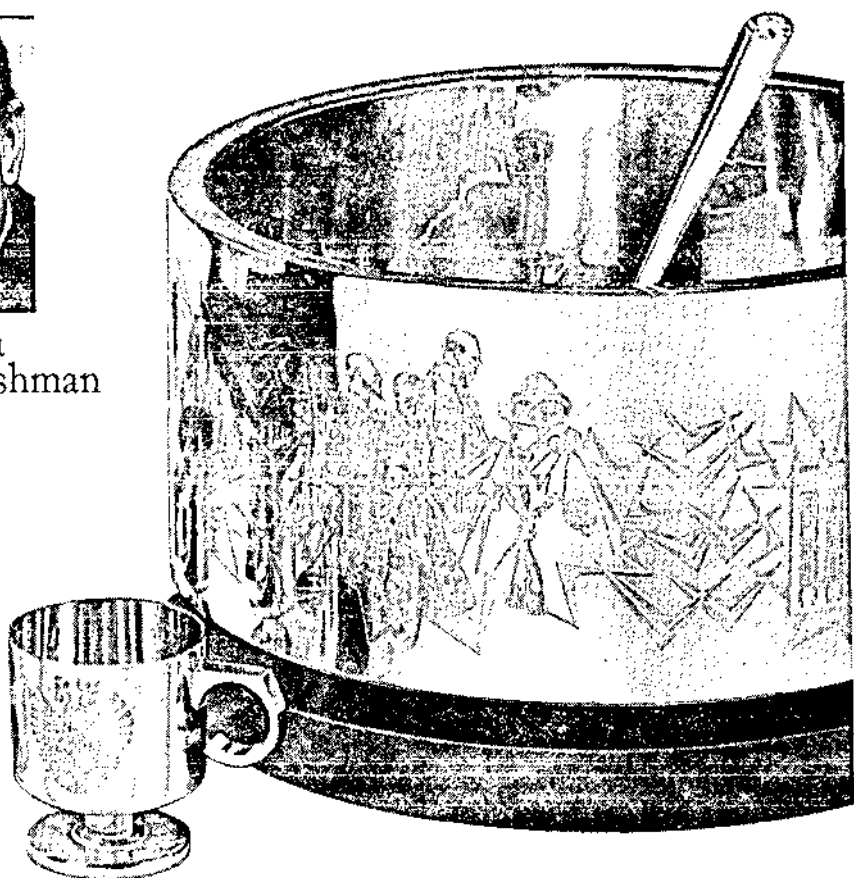


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Full details may be obtained by writing to The Head Master The Gordon Boys' School, West End, Woking Surrey.

ARTICLES FOR THE JOURNAL

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