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Editorial

CATENATION, CALAMITIES, CHYAKERY

At RSME Open Day the Editor heard a story from a Sapper (now seventy-seven years old). His family had been "Navy" for several generations, always enlisting at Chatham. In due course the seventh generation set off from Dover to Chatham to enlist in accordance with the family tradition. As he had no money he walked. On the way he met another young lad who was Chatham bound to enlist in the Royal Engineers. He decided to do the same. He was terrified to tell his family so he borrowed a sailor's uniform, was photographed in it and sent it home. All was well until he had to go home on Christmas leave, in uniform, as was the custom. The game was up! His father was furious and threatened to throw him off the cliff top. Eventually all was forgiven but it does show that traditions can be broken as the story teller was a fourth generation Sapper and a tenth generation Serviceman.

It is impossible to imagine that any reader will be unaware that Christmas 1981 is nearly upon us. Indeed many will have been aware of this since the beginning of September! A shop in the Medway Towns was displaying and selling Christmas "goodies" in August before many of the staff had been on their Summer holidays!!

During this Season of Goodwill it is sometimes difficult to remember that others are likely to be less fortunate than ourselves. No matter the depths of our own misfortunes there is always someone somewhere who is worse off than we are.

Massive destruction by natural forces affect many people but seldom make a personal impact. It may be that the scale of suffering is beyond our comprehension, it may be that we have become inured by media reports, it may be that in most cases the disasters are far away.

Two articles on Disaster Relief are included in this issue of the *RE Journal*. The US Corps of Engineers were quite magnificent in the aftermath of the Mount St Helens disaster—trained professionals who knew what they were doing and how to do it. The Italian Earthquake story is of the help that individuals and individual organistions can give, should give, and (equally important) should not give.

Military Engineers by temperament and training should be ideal for disaster relief operations. The dispatch of formed Engineer units, largely self supporting and with in-built organisation and communication systems, is of course a Government decision, but the retired Military Engineer, either as an individual or in a collective group, has a great deal to offer provided his talents can be organised and channelled effectively. This is no field for the unorganised amateur, no matter how talented and well intentioned. To superimpose unwanted, even useless, contributions and help in disaster situations worsens the plight of those affected and does nothing to alleviate the problems. The two articles show that highly organised help by people who know what is wanted, what to do and how to do it will always be welcome.

In January 1982 a Joint Professional Meeting with the Institution of Civil Engineers and, hopefully other learned societies, will be held in the RSME. This Meeting could herald a year in which we turn our thoughts to "What can I do to help in a disaster situation and how should I go about it?" This could be a Journal theme for 1982.

Christmas is, in addition to the essentially religious meaning, a time for lighter moments. "POM" has been given space to give vent to his opinion of the *RE Journal* over the years. Your attention is drawn to the foot of the Contents Page! He has a point—"Flattery will get you everywhere"—but he absent-mindedly forgot the stamp!

Engineer Support to Urban Operations

BRIGADIER F G BEVAN BA, MINuc E

The Author was commissioned in the RE in July 1956. After a degree course at Cambridge, he served in UK, Aden, British Honduras and Germany. In 1967/8 he attended Army Staff Course. He has commanded a Sqn and a Regt in Germany as well as being a CRE there, interspersed with tours at the MOD and as a DS at Camberley.

THIS article was submitted in its original form as an essay in the Institution of Royal Engineers Competition 1979/80. Some detail has since been amended to remove classified material and to generalise arguments raised on sensitive issues. The views expressed are those of the Author and not official policy.

INTRODUCTION

Although Soviet tactical doctrine is to by-pass built-up areas unless they lie on routes which are essential to the follow-up echelons, the increasing urbanisation of the potential battlefield of Western Europe is reaching the stage at which it may well be difficult to avoid committing first echelon forces to urban areas. The Soviets are aware of the loss to their momentum that such commitment will entail. Inevitably operations in built-up areas impose restrictions on movement, and on observation with a consequent reduction of fire and the effectiveness of supporting artillery. The resultant fragmentation of the urban battle into small independent packets, forces a delegation of tactical command to a level lower than that for which the Soviets train. Nevertheless, the need for through-routes and bridges, and the economic advantages to logistic support may additionally make such commitment inevitable. When the decision is made that an urban area must be captured, the concept of operations will be to push through strong forward detachments of up to regimental strength, supported by artillery and probably heliborne forces, in an attempt to outstrip withdrawing forces and capture vital communications centres of tactical significance. The main body will then follow-up, destroy positions on the forward edge, capture the town centre and mop up the remaining resistance. Small parties of infantry and engineers will be used to cause maximum confusion by infiltrating through alleyways and sewers into rear areas and setting fire to defended areas with flamethrowers.

NATO operational plans concentrate on fighting in rural areas. But increasing urbanisation, and the realisation that the Soviets are likely to have to commit themselves early to vital built-up areas, make it imperative that we exploit the natural advantages to the defender of fighting in such areas, if we are not to allow the enemy an easy route round our defensive positions or through flanking formations. We must make maximum use of the obstacle value of built up areas and of deception and surprise, in order to delay, confuse, disrupt and destroy the enemy. We must also exploit the greater availability of cover, hides and fire positions to try to cause maximum casualties to the enemy using the minimum of our own forces.

Brigadier FG Bevan BA MINuc E

Overall it is considered that the likelihood of urban operations in any future conflict is greater than it has been in the last decade and is increasing. It is therefore important to examine how the Sappers can best provide the support required by the other teeth arms on operations in built-up areas in order to exploit the defender's inherent advantages.

Constraints

Before such an examination can be undertaken, it is necessary to determine the assumptions that must be made and the constraints that apply. First, it is assumed that in any future conflict the civilian population would stay at home. Secondly, it is politically unacceptable to carry out large scale military defensive preparations in populated areas before war begins. Thirdly, it is also unacceptable to destroy valuable assets before it becomes absolutely essential. It is assumed that these constraints will not change. Time will therefore be a vital factor: time to bring forward the essential resources, time to prepare targets for demolition or to prepare obstacles time to fire, and time to evacuate civilians from the immediate battle area. It will therefore be essential to have the ability to prepare obstacles quickly.

It is also reasonable to assume that there will be no major change in the manpower of the Army, and in particular the Sapper part of it. Since it is also unlikely that a major reduction in the scale of the forward obstacle plans would be acceptable, the support provided to urban operations must not require a significant increase in manpower. Clearly costs must also be kept to a minimum.

Humanitarian constraints will also apply. These will exclude the use of nuclear or persistent chemical weapons unless urban areas have been completely evacuated. At the same time the improved construction methods and the strength of modern materials mean that massive charges are required for the destruction of vital targets, such as reinforced concrete bridges, and are liable to cause widespread damage. For the civilian population, such destruction might, at best, cut off their evacuation routes, and, at worst, delay the Soviets in their town with further consequent destruction caused by allied artillery and air bombardment. Prior knowledge of military intentions in a particular town could result in active sabotage of the first stages of preliminary demolitions leading to increased effort to clear rubble from measle shafts or to check and repair charges and circuits already laid. It will therefore be important to adopt single attack techniques. Alternatively active encouragement of the civilian population to barricade their own towns to prevent the Soviets from entering in the first place might pay dividends.

Tactical Considerations

A major factor affecting the decision on whether an urban area is to be defended or not, is the overall design for battle. The first stage is to reassess our divisional areas and decide the tactical significance of each town and village. They will fall into three groups. There will be those which need not be defended because they have no tactical significance; these do not therefore need to be evacuated and some could be barricaded by the inhabitants to our advantage. There will be those which lie on an expected approach route of the Soviets around which a tactical battle is likely to take place: these may suffer considerable damage and evacuation of the local population into the first group should be considered by the Host Nation even though the town or village need not necessarily be defended. Occupation of these will depend on the availability of defensive positions and on their suitability for obstacle preparation. Finally there will be those which must be defended because of their tactical significance, and the inevitability of their involvement in the tactical battle. These may contain important reserved bridge demolitions; or be on vital routes, such as Main Supply Routes or routes which, if not held, would lead to the encirclement of our positions; or be the only significant feature on an exposed flank. Although presentation of the various options will be a "G" responsibility there will be a definite requirement for Sapper advice because of the need to include the defence of towns in the overall obstacle plan.

The next stage is to make an appreciation of the suitability of each town for urban operations. The size and development of towns have changed considerably in the last decade and new construction materials have had a fundamental effect on the strength and variety of buildings. Both the defender and the attacker face specific tactical problems for each type of development and specific problems for each type of construction. The assessment of the ground factor in urban areas is therefore no less important than elsewhere.

Several studies in the last few years have variously divided urban areas for tactical purposes into different types. The simplest division is into five which are (A) narrow close packed areas, (B) areas of regular closed block construction, (C) more open suburban areas, (D) open areas with tower blocks or flats, and finally (E) industrial estates with associated communication networks. Having classified the area it will then be necessary to make an assessment from both the attacker's and defender's viewpoints against six factors: mobility, obstacle potential, observation for fields of fire, protection, command and control, and inflammability. In all cases with the possible exception of (A), defending infantry will have a definite advantage; and in both areas (B) and (E), well sited anti-tank weapons will have an advantage over attacking armour: otherwise, there is no particular advantage to either side. The initial classification by type can be a Sapper responsibility, and since most of the associated factors contain points which are of engineer concern, Sappers should play a major part in the ground assessment.

It is now intended to examine in detail the two most important factors from a Sapper viewpoint, obstacle potential and protection.

Creating Obstacles in Urban Areas

Urban areas have similar characteristics to woods in that they are potentially natural obstacles in themselves tending to canalise and delay movement. We therefore require a means of blocking the routes through or around them. But as has been shown above, towns invariably contain suburban and industrial areas which are often quite open: and the more open they are, the greater the effort required in terms of manpower, resources and time to create barriers. In general therefore, obstacles requiring the minimum effort in these terms will pay the greatest dividend. In all cases obstacles should of course be covered by fire. It is intended to review our present methods of creating obstacles and point out the areas where we should concentrate our efforts for future improvements. These are:

Mines. Anti-personnel mines will be a valuable weapon in urban areas especially where the Soviets are likely to have to dismount. They can be placed by hand or by using *Ranger,* which will be of particular use in more open areas where heliborne troops are likely to land or on the direction of their likely approach. Anti-tank mines will also be useful in more open areas where armoured vehicles can still operate. There will be few opportunities to lay by mechanical means and laying by hand takes considerable effort. Surface laying will be acceptable under many conditions. It is here that the greatest improvement could be made—the introduction of scatterable mines dispensed either from a ground equipment or from a *Ranger* type equipment mounted on an APC or AVRE.

Explosives. These will be required for a number of purposes including the destruction of bridges and buildings, the blowing of craters and the felling of the occasional trees. But new construction methods and materials make the destruction of the former more difficult and there are considerable logistic penalties for using massive point charges. This field has several possibilities for improvements. We should have a variety of shaped charges, preferably self-adhesive; we need a one-shot two-stage charge on similar lines to the American development; and a tree felling charge would save considerable time. Perhaps most important of all would be the introduction of a device for controlling demolitions remotely. We would also benefit from the introduction of equipments to help emplace explosive charges—working platforms, improved bolt guns and beam detectors.

Wire. Dannert and barbed wire have considerable advantages in confined spaces and can be laid by all arms. SWR can be stretched between trees and houses at turret level and a big improvement would be the introduction of a high tensile wire laid to tangle the axles and sprockets of wheeled and tracked vehicles. Wire will be a much more effective obstacle when used in conjunction with anti-personnel and anti-tank mines.

Road/Sewer Blocks. Although special road blocks can be manufactured and emplaced before hostilities by the German territorial organisation, the political constraints on constructing these in urban areas indicates the need to block roads by other means. Several local resources may be available, cars, lorries and trailers, railways stock and rubbish skips. Improvements can be made by filling them with ready mix concrete or rubble. Equally these expedients can be tipped into sewer systems in order to prevent infiltration.

Tank/Vehicle Ditches. Ditches can be dug using CET (Combat Engineer Tractor) and dozers on the front edge of urban areas and the open areas within them. No attempt should be made to use plant to dig through road surfaces because of the time penalty. Where ditches are required in such places there is a possibility of using explosives. It would be feasible to pump or blow slurry explosives along gas or sewer pipes (electrical and water distribution systems are unsuitable), but penalties in time and logistics are probably so great that the method may not be worth pursuing. However a trial should be undertaken to see the effects and whether further plant work is anyway necessary to make an effective obstacle. Again mines should be laid to complement tank ditches. The greatest improvement would be the introduction of high speed excavators for use in urban areas, and this is already being considered for ditching in rural areas.

Rooting. Although the rooting of concrete roads is currently beyond our capability, the rooting of ordinary roads would be a considerable asset in confined areas and would allow anti-tank mines to be concealed relatively easily. The fitting of swivel tynes to the back of AVRE blades, would be a considerable improvement.

Several new techniques for creating obstacles have been examined over the last few years. They include slippery agents to alter the viscosity of road surfaces to cause vehicles to slide; clogging agents which will cause the oil in the drive mechanisms of tracked and wheeled vehicles to clog; remotely delivered demolitions using laser techniques; and the detonation of gases in underground pipes to produce ditches. Depressingly all these new techniques have considerable penalties in terms of cost, manpower, time or logistic support and some are not very effective. The prospect of any novel forms of obstacle being able to make a positive contribution to urban area operations this century is remote with one possible exception. Aqueous and plastic foams, of the rapid hardening or glue type, could prove a valuable asset to block tunnels and confined spaces, particularly when covering surface laid mines. Research into these products should continue.

Assistance with Defensive Positions

The very solidity of modern building construction which makes its demolition such a complex problem, can prove a bonus in providing ideal protection in defensive positions. The concrete tower blocks used to such effect in the street fighting in the Lebanon sustained numerous high explosive artillery bursts without much more than cosmetic damage. There may be more to gain by leaving strong structures standing and using them for defensive purposes. Lower floors would have to be blockaded and escape routes would have to be made secure, but good defensive positions could be found in such blocks usually without having to expend much effort in preparation.

Other buildings may not provide either the same strength or the same initial opportunities for fire positions. Sapper assistance may be required for strengthening walls by sand-bagging or shoring, and for knocking holes and clearing debris and undergrowth to improve fields of fire. The former is time and manpower consuming and it may well be better to avoid buildings which are likely to collapse. However,

during the last war, the Germans made great use of tanks in cellars which proved extremely difficult to destroy, and maximum use should be made of this type of fire position for our tank-killing weapons provided the effort involved can be made available in time.

Thus different types of building pose various tactical and technical problems which will have important consequences in the operational decisions affecting the choice of defensive positions. Once again it is therefore necessary to classify individual buildings into different types based on their protective value, load bearing capacity, availability of fire positions, ease of destruction, and inflammability. It will not always be easy to make a clear distinction between the advantages and disadvantages because the factors may conflict, and it may be that different types of building adjoin each other. Buildings of timber, brick, reinforced concrete and prefabricated materials are often to be found in each type of built-up area although one or more will usually predominate. Nevertheless the value of prior detailed reconnaissance of the individual buildings in the area to be chosen for defence is evident. Indeed some of the factors may influence the choice of area in the first place, particularly inflammability. Most buildings contain burnable material and the likelihood of fire caused by flamethrowers or napalm necessitates the pre-positioning of fire fighting means. But in close packed buildings and some industrial estates the dangers of area fires must be appreciated, and consequently it may be necessary to avoid the centres and take up positions on the edges facing the prevailing wind.

Training

Both the creation of obstacles in urban areas and the assistance that engineers may be called upon to provide armour and infantry in constructing defensive positions, will require training. And yet little is done either theoretically or practically. Urban operations receive less mention on Young Officer and Senior NCO courses than they should, and certainly the number of dedicated training areas where Sappers, let alone other teeth arms, can train in the special techniques required for fighting in built-up areas are few and far between. A study undertaken in the autumn of 1978 concluded that the creation of further training facilities is urgently overdue, and yet nearly three years later, there is little apparent progress although plans have existed for some time. There is clearly an opportunity for Sappers to play a leading part in the construction of such a training complex.

Conclusions

During World War II many of the greatest battles were fought in and around towns and villages, and the Russians in particular showed themselves to be tough and courageous exponents of the skills required for fighting in built-up areas. Today Soviet doctrine is to avoid built-up areas but increasing urbanisation and the importance of many through routes makes it increasingly difficult for them to avoid committing first echelon, as well as second echelon forces, to many urban areas on the potential battlefield of Western Europe.

On the other hand, defensive plans contain little commitment to towns. We have undertaken many studies on this subject, and the growing likelihood of a requirement to fight in built-up areas is frequently admitted. Much of what has been achieved is theoretical and it is high time that more practical measures were taken to improve our capability in this field. There are many acceptable peacetime preparations that could be implemented which would make planning easier, would reduce the load on Commanders and staffs in a time of tension, and would save time in battle. We should implement them now.

Recommendations

In the light of increasing urbanisation, it is recommended that we:

(1) Undertake a re-examination of our operational plans to determine which towns will need to be defended.

(2) Analyse each town to divide it into its relevant type of urban area and decide where best to conduct defensive operations within it.

(3) Carry out a detailed reconnaissance of houses in the chosen areas to evaluate their protective value and the other factors which will affect individual choice of defensive positions.

(4) Decide where obstacles can best be placed.

(5) Assess availability of local resources for obstacles and allot, additionally, sufficient engineer resources.

(6) Place greater emphasis on urban operations in our teaching at our training schools.

(7) Pursue with vigour the construction of a dedicated urban battle training range.

(8) Introduce the improvements in equipments—demolitions, scatterable mines and the others mentioned above—adding to our operational requirements where necessary, the quantities needed for urban operations.

(9) Concentrate research and development on the new techniques which could improve our obstacle capability.

Early Days

MLC

THE 1881 Journal, in some respects, had a peculiarly modern ring. There was mention of possible "IRA" terrorism in Brompton Barracks (a YO on a course was murdered); there was mention of want of productivity in UK steel works; there was even talk of building a strategic coaling base in the Indian Ocean—yes, Diego Garcia itself! The need for early retirement and ways of encouraging it were discussed, as were the advantages of employing Royal Engineer Officers in the Railway Accident Inspectorate. The list is not even then complete. A German, reporting on a major review of the Volunteers at Windsor, and writing in the *Neue Militärische Blätter* (as quoted in the Journal), judged that "the substance of the English and Scots people is sound and that any socialist and nihilist tendencies reside only in the dregs"! One only hopes that recent Inspecting Officers at the RMA have not been expressing their "extreme displeasure" at the want of application and discipline at Sandhurst. But then the Duke of Cambridge, in his Annual Inspections in the eighteen seventies and eighties, consistently seemed to find a lot to criticise at the RMA, Woolwich, but particularly so when, as in 1881, no Sword of Honour was awarded.

The event which called for the most comment in the Journal, was the murder of Lieutenant PLO Roper on the evening of 11 February 1881. He was found shot through the chest on the top landing of No 9 House, shortly after having returned to his room, having dined in the Mess. There were signs of a struggle. The weapon used was a presentation pistol (from the RMA), owned by the YO in the room opposite. This pistol was normally hanging on the wall above the owner's bed. In later evidence a Rochester gunsmith testified to having sold some cartridges of the required calibre to an unknown man on the very day of the murder. The "IRA" must have been on peoples minds. It would have been, perhaps, just too circumstantial if the purchaser of the cartridges had spoken with an Irish accent, but the Coroner established during the inquiry that Roper "was not known for expressing a strong opinion on the Irish question". The whole thing was very mysterious. Robbery was assumed to be the motive, but no suspicious strangers had been seen. No shot, as such, was heard, not even by the sentries—one outside the Mess and the other outside the Guardroom. A public subscription was raised within the Corps (it reached £500), so that a reward could be offered. There was no further report (anyway in 1881) that the police had any idea as to whom the murderer might have been, or from whence he might have come.

In December 1880 hostilities began between the British Government and the Boer settlers in the Transvaal over the return of that territory to Boer authority. (As readers of these notes may remember, the British had annexed the Transvaal from the Boers in 1887, in order to save it from grave internal disorder and from possibly being overrun by the Zulus. This led to the disaster at Isandlwana and the action at Rorkes Drift, before the final overthrow of Cetywayo). The Boers had hoped that the territory would subsequently be returned to their control, but finding that the Gladstone Government would not do this voluntarily, they determined on rebellion. Hostilities began in December 1880.

A series of engagements ended (in February 1881) with the rout of a small British force, which had occupied Majuba Hill on the Transvaal/Natal border. As a result of the campaign (Majuba was not the only British reverse) the Boers won their point and were granted self government in the Transvaal, but subject to British suzerainty.

No RE Unit as such was present at Majuba, but Major T Fraser RE, as a Staff Officer, accompanied the column concerned (in fact an escorted convoy, advancing into the Transvaal for the resupply of various beleagured garrisons). A letter from Fraser, describing the action, was given prominence in the Journal. Majuba, a steep-sided hill, was occupied by about 600 British Troops. The summit was stormed by a small Boer force and the garrison thrown off in much disorder. General Colley, the Commander, was amongst those killed. Major Fraser survived a precipitous fall down the hillside, but by making his way through the Boer positions, and after a two day trek, managed to rejoin the column. Fraser had clearly exhibited much courage, endurance and presence of mind.

The defeat was primarily blamed on poor shooting by the infantry, but from all accounts Captain G R Walker RE, writing to the Journal from the RMC Kingston, was probably nearer the mark. The hill, he suggests, afforded a remarkably poor defensive position; the tactical positions taken up left much to be desired; in any case, a very steep slope is the worst possible foreground for musketry defence (defenders have to lean over and expose themselves when firing down the hillside, and uneven slopes afforded natural cover to any assailant), and the number of men actually manning the perimeter had been too much reduced by holding a too large central reserve. When the Boers arrived in force on the summit, it was too late for this reserve to act. It seems true indeed, that British Arms have sometimes lacked that tactical sense, for which the Germans, for instance, have been so often noted.

In another letter to the Journal the writer speculates on the best way "to proportion labour as regards time, so as to get the maximum amount from an average man". For instance, should field works be organised in 12 or 8 hour shifts—or in other ways? "Last year , the Bessemer steel manufacture of the US actually headed the English production—the first time on record that we have been beaten by another nation". This, it seems, was entirely due to the way in which labour and machinery had been better used in the US steel industry. A point of particular interest was the amount of work obtainable from "strong and healthy men. It is entirely out of the question to expect human flesh and blood to labour pleasantly for 12 hours, and therefore it was decided to put on three turns of 8 hours each. This change was of immense advantage to all concerned". Good men who do their best, the letter concludes, should be encouraged to find their own best method of working. The SME was bidden to carry out appropriate trials forthwith!

Tourists and their behaviour, then, as now, seemed to have been fair game for criticism. A passage in the June 1881 Journal makes painful reading. "The mind of the Cooks tourist is unfathomable". The tourists in question were those who visited the ruins of Baalbeck in Syria, where much of the delicate tracery was out of reach for those who "yearned to have a segment for their mantelpiece". What better than to cause wholesale destruction with pistols—especially as regards the capitals of the Corinthian columns. And what kind of people were the best shots? It seems that the American tourist "carried all before him"!

In the July Journal a long and complicated paper was published on the *Revised*

Memorandum of the Secretary of State for War about Changes in the Royal Warrant. This dealt with changes in the rules for retirement and pensions. As the Editor pointed out "any forecast (of those Officers likely to be effected) that we might publish, would give little additional help to those Officers who are anxious as to their being compulsorily retired, since their escape depends upon the Officers who voluntarily retire during the next six months".

In a previous issue of the Journal, AG7 had published a remarkably detailed forecast of those likely either to be promoted, or who were in line for retirement because of the "new" age restrictions, or who had served too long in a particular rank. For instance—"We believe Colonel Wray will be prevented from getting promotion to Major General, but Colonel Pasley (who under the previous rule at 58 years was precluded from promotion) will be a Major General in 1883"!

The likely effects of earlier retirement were also discussed at the AGM of the RE Widows Society. Should such retirements have an effect on subscriptions to the Society? This was clearly a difficult question, and the Officers concerned were asked to "draw up a case, which the Trustees would be happy to consider before the Meeting of 1882". It was also rather smugly pointed out that Officers who retired, or had to retire, early, were less likely to be faced with service in "bad climates" and would thus live longer. This would naturally be a good thing for the Widows Society as widows would be widows for a shorter time before they themselves died. "I wish", added the speaker, "that those present may all live longer so as to leave few widows, or retire early so as to improve promotion"! Someone commenting today would be more worried about inflation reducing pensions, rather than people succumbing to long service in bad stations!

At the AGM of the RE Institute, Colonel W Porter (later to produce Vols 1 and 2 of the Corps History) wished to congratulate the Editor on the great improvement in the *RE Journal*—"during the last few years each number seemed to be better than the preceding one". As indicated in previous editions of "Early Days", the writer of these notes would not exactly agree—but who better to make such a judgement as one who was a contemporary reader with the literary skill and judgement of Major General W Porter!

The 1881 Journals were enlivened by an "ongoing" correspondence about Coach Wheels. This was one of those subjects which could well have been expected to appeal to the Mathematicians, or near-Mathematicians, so well represented in the Corps. (One is reminded of a more recent correspondence concerning the course taken by a greyhound chasing a hare!) However, in this case the writer found the technical quality of the response disappointing!

"Coachbuilders say that the further the hind wheels are from the front wheels of a carriage, the heavier will be the draught. No doubt practically they are right, but will anybody demonstrate mathematically why this should be so". Thus ran the first letter. In later correspondence various reasons were advanced. With longer carriages, for instance, some of the momentum, which carries the front wheels over an obstacle, is lost by being absorbed within the carriage itself; the compression in the road surface, made by the front wheels, is more restored by the time the back wheels of a longer carriage reach the same spot; the less the distance between the front and back wheels the less the divergence in their tracks when there is a curve; the weight should be thrown on the larger back wheels than shared more equally between the two pairs of wheels; pairs of wheels have a tendency to travel in different directions, through swing or sway, the greater the distance between them. And so on. The correspondence reached no conclusion, and no mention was ever more made of x or θ. The disappointed inquirer, in a final letter, blamed himself for not having set out the original problem sufficiently clearly. By implication he did not seem to think much of the technical acumen of the readers of the Journal. His final letter seemed to have effectively killed any further interest, as the correspondence then came to an abrupt halt. One wonders what Colonel Porter made of it all!

For the present reader the most interesting paper published in the 1881 *Profes-*

sional Papers was the Prize Essay for 1877. This was on "The duties of the Royal Engineers in time of War and the best organisation for enabling them to carry out those duties". The Author, in an excellent summary of Corps History from the formation of the Military Artificers in Gibraltar in 1772 to the wholesale reduction of the Royal Sappers and Miners after the Napoleonic Wars, tells us that no Sapper units were present at Waterloo, because such units had been sent to Flanders as *Siege* and not as *Field* Companies, and thus were not mobile. However, in June 1815, immediately after Waterloo, steps were taken to organise Divisional Field Companies of Sappers and Miners for the advance of the Allied Armies on their way to Paris. By 1819 as indicated above, all such units had been disbanded, and from this time on we find the Corps devoting itself to civil pursuits.

The Author is in no doubt that the "Corps owed its subsequent augmentation, perhaps even its existence, to the fact that it was found economical to employ it in various civil works in England and the Colonies". Survey played an important part—the first major augmentation was the formation of three Companies, in 1825, to conduct the Trigonometrical Survey in Ireland.

The Sapper, so the Author points out, became in danger of exchanging his position of a soldier for that of an artisan. "An Engineer who is a good soldier but an indifferent architect, will always be serviceable. The place of the Commanding Engineer in an Army is at the side of the General Commanding—seizing the opportunity when his own branch of the service can advantageously operate in battle".

The Author has hard comments to make about the French Engineers in 1870—"a body of hybrid Officers, who knew nothing thoroughly, who have become neither accomplished soldiers, skilful Engineers nor able architects. The very knowledge of their own impotence isolates both from soldiers and Engineers. When War breaks out these Officers have neither the bodily nor theoretical preparation for the requirements of active service". In later passages, the Author hammers away at the principle, (illustrating this time with favourable comments on the Austrian Army) that Sappers must be good soldiers first. The Author further complains that though the basic recruit training at Chatham, in all aspects of Field Engineering, was excellent, unit training was poor. "No Companies, except those who happen to revisit Chatham, received any further instruction".

Should, asks the Author, the Royal Engineers, as a Military body, be remunerative to the nation in time of peace? Yes, comes the reply, but not if by so doing they lose "one jot of efficiency for War". He casts doubt on whether Officers (except in India) with Works Departments gain "that activity of body as well as brain knowledge, of quickness of judgement as well as calm reasoning powers". "To the contrary" the Author concludes, "the above desired qualities are rather destroyed, and thus the Country will not benefit".

In the May 1881 Journal there was a fairly detailed account of how the Colonial Engineer in the Straits Settlements (a local Captain RE) had had to organise a Fire Brigade in Singapore—an illustration of "one of the multifarious activities that may at any time fall to the lot of an Officer of the Corps". Whatever may have been the attitude to the Fire Service, it seems that the importance of the science and art of ballooning—with its many possible military uses—was less readily apparent to the Establishment.

The Balloon Society held its second outdoor meeting in September 1881. One of the objects of this meeting was to encourage the formation of a Volunteer Aeronautical Corps as a branch of the Volunteer Engineers. "Nearly every Army on the Continent has now a Balloon Company . . . and the utility of such an addition has been amply proved in both peace and war. Even our own War Department has not shown itself insensible to the advantages". The inference as to the then outlook of the War Office was clear! Perhaps the advantages of steam over hand pumps were more readily comprehended!

Operation Relief
Italian Earthquake 1980

MAJOR A I M GREGOR MCGREGOR MBIM

Angus Gregor MacGregor went through the RMA Sandhurst in 1950/51 and was commissioned into the Royal Engineers. He served in the Middle East and Germany at various times, and also took part in the 1956 Suez operation. Whilst in command of the Engineer Base Workshops in Germany, he supported the Sapper team sent to the Skopje earthquake. He completed the Long E&M Course, qualifying in both. In 1968, he was invalided out of the service and works for the Calor Group.

INTRODUCTION

At about 7.30 on the evening of Sunday, 23 November 1980, the earth began to tremble. It had often trembled in that area before, but on this occasion it went on for over 90 seconds, and was more severe than any recent experience. It was wintertime, dark and cold, very cold by the standards experienced only a few weeks before. Vesuvius could not be blamed on this occasion, as this was an earthquake.

It was only next morning that the world heard about the earthquake and even then the news was very patchy. Naples was mentioned, so was Avellino, later reports mentioned Potenza and Salerno. It was not for about three days that the scale of the disaster began to emerge. Help was to hand from a number of sources, both within Italy and outside. The Italian Army had made contingency plans after an earlier earthquake. As time progressed, the Italian Army found it had a disaster on its hands out of all proportion to anything experienced in recent decades. The plans certainly did not envisage anything on this scale—it was as if Kent and Sussex had been devastated. Stories about the Mafia, bandits, disease, corruption and Italian inefficiency were spread by the world press.

RELIEF

People in Britain responded in many ways, but many were put off by the press reports, believing that any help from them would go straight into the hands of the Mafia and bandits.

The form of response was a problem for individuals. Medical aid can only be launched by Governments and very specialised agencies like the Red Cross. Apart from actually going out with one of the agencies, the individual cannot help here. Food in fact is not a problem as most countries have stock piles of both commercial and government food in the form of tins, dried milk and the like. An earthquake has the effect of destroying homes and possessions. It is necessary to have some things in order to use the relief food and in winter, in particular, clothing to offset the loss of home comforts, however slender these may be. The poor people in the mountains had precious little before, and they had even less now.

Britain responded in many ways. Money was collected to support the relief agencies. Organisations collected vast quantities of badly needed clothing and sent it

Operation Relief Italian Eathquake 1980 Major AIM Gregor MCGregor MBIM

out in juggernauts. One British farmer collected pots and pans from neighbours and drove his loaded lorry out to the earthquake area.

Having been involved with the Skopje disaster years before, admittedly on the fringe, and knowing the problems, having visited the place many times subsequently, I felt the urge to help. I also noticed a general desire to help in the head-office of the Calor Group where I worked, but people did not know how. I proposed a scheme to John Bragg, the Managing Director. He was particularly busy, but on Monday, 8 December 1980, he agreed to back the scheme. This was to launch an appeal for money from the employees of Calor in order to buy a caravan, equip it fully and I offered to tow it to the earthquake area. We did not wait for the money to come in, because the need was urgent and concurrent action was taken on several fronts.

PREPARATION

The first action was to form a committee. Reg Morton, a senior Accountant,

volunteered his services as Honorary Treasurer. Ann Maw, chairperson of the Calor Group Social Club, set about equipping the caravan so that a family of 5/6 could move in straight away. This included bedding, pots and pans, cutlery, crockery and even the lesser but important things. Chris Treacy, one of the buyers, found a local caravan retailer, Jenkinsons of Taplow, who offered to supply a Sprite Major caravan at cost. It was double glazed, had a cooker, a refrigerator, a built-in gas heater, loo/wash room and a penthouse lean-to. We had reckoned on the occupants having to live in the caravan for years rather than months, and this affected our choice. Chris also became the communications link man. I made contact with the Italian Embassy, where Signors Abati and Orsi could not have been more helpful or more efficient; they issued a special Embassy Permit and other papers.

Wednesday night saw my son Tony and myself finalising our planning for the journey. He had volunteered to accompany me to Italy to deliver the caravan. We had decided to tow with my own 6 cylinder lwb Land Rover Safari; it was most likely to get through the snow and rubble. We could then spend a few days in the 'quake area towing caravans up to the mountains; vehicles with suitable 50mm tow balls were in short supply. This is why caravans delivered by sea remained in Salerno and other ports so long. Our Land Rover had been converted to run on gas (LPG—liquified petroleum gas in the form of propane) as well as on petrol. LPG is cheaper, cleaner, less pollutant to the atmosphere (low on carbon monoxide, no lead and no NOXs) and better for the engine.

Three basic routes were possible: via France, Switzerland or Austria. The Swiss restrict trailers over a certain length: the French route, even using the Mont Blanc tunnel was longer, tolls are charged (could we persuade the French to be kind?); the French and their roads are unpredictable, especially in winter. Using the Austrian route—Zeebrugge, Aachen, Munich, Brenner—gave us a shorter journey, good roads known to be kept clear even in the worst blizzards, no tolls, easy passage of the Alps, and more predictable drivers. LPG was available all the way on this route, whereas the French route would have meant buying expensive French petrol.

Maps and other navigational and informative material was selected from the cupboards at home, including what would be needed should plan "B" have to be implemented.

THE OUTWARD JOURNEY

On the morning of Thursday, 11 December 1980, Jenkinsons delivered the

Photo 1. Leaving for Italy

caravan to the head office in Slough. After loading the equipment, we headed home to add our own kit. Our own "Q" services had been busy during the morning. The village shopkeeper offered to help and supplied tin openers and brushes. He appreciated that a tin opener was needed to open the relief food tins (a fact not always appreciated by the donors of aid) when the existing one was below a heap of rubble.

We stopped at a Parkplatz near Koblenz for breakfast. Tony lit the caravan's externally flued gas heater as the temperature was sub-zero. Moments later we evacuated, smoked out by fumes. The internal finish of the heater burns off when lit for the first time—a lesson learnt—*test everything* before departure.

We stopped again for refuelling and lunch at Karlsruhe. The heater was now working and it was still sub-zero outside. The Polizei almost appeared to be escorting us; three cars pulled in to our lay-by. Finally, 585 miles from Zeebrugge we stopped for the night just short of Munich at Langwiederzee. It was still very cold with deep snow, but thanks to our now fume-free heater, we were warm and cosy—but only until 0500 hrs. At that hour the heater stopped heating and the drop in temperature woke us up. It was now −20° outside and of course the Calor gas (butane) in the caravan's cylinders had stopped vaporising. Butane has a boiling point just below water's freezing point. We had to warm the cylinders in hot water to start the butane vaporising again. This incident dictated an earlier start than planned after the arduous previous day. By now heavy snowfall caused some concern, but nothing could stop us. We crossed the Plain of Lombardy, through heavy fog to Chianti (another night stop) and on again to just short of the Rome ring road. Between the Rome toll station and the ring road there is a Service Area run by Pavesi. As we drove in we were hailed by people whom we assumed were street traders, and therefore to be ignored, but they rushed up to us, saying in English—"You must be Denis"—which I denied. We had bumped into the leading edge of a Round Table group!

THE ROUND TABLE

Credit must be given in no small measure to the Round Table. As at Skopje years before, they produced hundreds of caravans and members and volunteers towed them out. Some caravans were new, some secondhand, most were only "as supplied". Some lacked all equipment. We felt very proud of our fully fitted Sprite.

This particular Round Table group of 28 caravans, each with a crew of two, had crossed to Calais, and it was at Calais that the "street traders" had last seen their leader who was called Denis, who drove a Land Rover and was expected north of Rome. The Group had been scattered as it made its way through France (Mont Blanc and the more southerly route). Here, north of Rome, the Round Tablers were watching the Autostrada and flagging in every caravan which passed by, hoping some were towed by Round Tablers. They did not know where to go and report. When the local acting self-appointed leader realised that we knew the area he asked for help. They had driven almost non-stop by alternating drivers and were weary and hungry. We could indeed help as our "Q" services must have foreseen this or expected us to be away much longer. It is essential to have good planning in the "Q" services.

We had intended going through Rome, then go on to the Caserta Service area (north of Naples) for the night. We then planned to enter the Relief Collect Centre in Naples soon after first light on the Monday. We were amused when they queried the wisdom of going through Rome because of the bandits widely reported in the British press. Did we not appreciate the danger? The Round Tablers decided to stay put, collecting caravans as they appeared on the Autostrada, and to direct them to Caserta and to us.

Off we went, straight through Rome, stopping at the Forum and Colosseum to film. No sign of any Mafia, thieves and such like and certainly no bandits. We reached the Caserta area where we parked in a most obvious position. We made contact with the local Police post and explained that we might be joined by many more caravans. 1830 hours, the appointed meeting time came, and went, no Round Table caravans appeared. After our early start we decided to turn in at 2230 hrs. Suddenly, even before we were asleep, there was banging on the door. Who was it? Bandits? Mafia?

or had we parked in the wrong place? A head came round the door and in English said: "We have been told to report to the Major". So there had been no change of Round Table plans which we had suspected, nor had Denis materialised. We invited them to have a drink. They could eat in the cafeteria round the corner. At midnight, two and a half large fiascos (1·88 litres) of Frascati later, they departed knowing what the plans were. Tony had by now earned the title of Adjutant.

Both Tony and I awoke at about 0500 hrs next morning. Mistakenly we opened the door to look out and a cry went up—"They're awake". Then a new head appeared and said "We have been told to report to the Major". During the night another eight caravans had drifted in and I was now in command of a caravan train. Later two more appeared making twelve in all.

We gathered the crews around us to brief them. They were to be lined up over there in single file with our Land Rover in the lead, by 0720 GMT sharp (there was some confusion as to what the local time was). "Any questions? Fine. Any problems report back—off you go". And off they went at the double, like new recruits keen for the challenge to come. The Adjutant was despatched to contact the Police and organise the escort, now badly needed. He was also to alert Caserma Boscariello via the Police.

0710 hrs and the Police escort arrived from Naples in the form of a driver, a very large Police Sergeant in an Alfa Romeo. The Sergeant had a commanding aura about him. His green and red baton never left his hand and never stopped wagging. The Adjutant gave the signal to start up. Needless to say, the traffic on the autostrada came to a grinding halt as the Sergeant waggled his baton. The convoy overtook everyone (they were flagged down by our tame Police) and only one car overtook us and then wished he hadn't. It was the height of the Naples rush hour and there were police at the junction where we were to join the Tangentiale. A wave of the baton stopped all traffic—except ourselves. It was like that all the way. Finally, Caserma Boscariello, one of the main report centres set up for relief work, was in front of us. The gates opened and we all drove in. It was about 0800 GMT, Monday, 15 December 1980 and we had arrived in the earthquake area, one week after the launching of the scheme.

THE DISASTER AREA

Caserma Boscariello was a very large barracks, which is partly used for supplies and lends itself to this temporary role. It was here where we got our first taste of Italian bureaucracy. Although they knew we were coming—we and the police had got the message through that morning—they had done nothing until we arrived, except to warn the guard on the gate.

There was now the long process of reporting our presence to Central Control, obtaining allocation instructions, informing the lucky Province concerned, obtaining from them an escort and organising "elevenses" for us in the cookhouse. From this moment on we were locked into the system, and the Army and Police between them controlled allocations and movement and security of all relief work. I made my number with the local CO who, having discovered a former Regular Officer in command of the convoy, became very helpful. Nonetheless it took three people constantly on two telephones to organise things, and we were there for two hours.

Whilst waiting, I chatted to various Officers. Two interesting points came out. Firstly they did not fully appreciate for at least three days, the full extent or intensity of the disaster. All communications had gone, the roads in the mountains impassable, and the people affected more concerned with their immediate problems than in telling the outside world. All the roads go through hundreds of small villages where they narrow because the houses are built so close together. When the houses collapsed the roads were then blocked by hundreds of tons of rubble.

The second point was their embarrassment over the juggernaut loads of old clothing arriving daily from Britain. They had tried turning some of it back, but suffered the wrath of the press who said they were turning away badly needed aid. There was a large hangar loaded to the gunwales with the stuff and a large squad of

Photo 2. A Common Sight

soldiers picking through it and loading lorries. One of the Majors picked up an old corset (without even laces) and explained that such items were useless. He said that less than half would be of any use and even then it needed disinfecting and washing. This put a load on what was left of the local laundry services at a critical time. The rest, he said, could only be burned and the whole operation wasted valuable man-power which could be better used elsewhere. They did not dare to stop doing it because of the bad press, and the lorries just kept coming.

At last the new police escort arrived from Avellino Province where we were to deliver our caravans. I said farewell to our old friendly Sergeant who had then been on duty for over twelve hours. The next problem occurred. The Round Tablers were reluctant to go up to the mountains. They had heard of the terrible diseases, the Mafia and the bandits, and yet another tremor. The night before a block of flats had collapsed taking another nine souls with it. We persuaded them to go to Avellino and Tony and I would ferry the caravans from there. Some were certainly fearful, understandably after the press reports. One can only assume papers have to be sold somehow, irrespective of the cost to others.

Back to the Tangentiale and motorway and the Bari branch towards Avellino. The mountainous area slowed us up badly. We stopped on the slip road at Avellino West and again waited. They knew we were coming, but did nothing until we arrived. Eventually we were allocated to Solofra, a small town 17km to the south east. We persuaded three Round Table caravans to come with us, the rest unhitched their caravans in the local barracks.

The Provincial Government buildings in Avellino had been destroyed by the earthquake. All control had been taken over by the military who worked to the priorities laid down by what was left of the Civil Administration. Everywhere was evidence of the disaster. It was sickening to see and it made us think we should have made more haste to get there. Some villages had been wiped out and were being sealed off, disinfected, and marked as cemeteries and their names deleted from maps. Some places had lost a lot of people, like Lione where a generation died. All the youngsters and teenagers had been at two discotheques. The roads were not generally passable. The Army, though heavily stretched, was very evident and had obviously held the line.

SOLOFRA

At last, the new escort (they looked tired and had been on duty over 14 hours)

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arrived, and we headed for Solofra, but with only three Round Table caravans. It had been a thriving town and when the earthquake hit, most people were outdoors at a festival. The result was only 29 had died in the 90 seconds, a few due to heart problems died later, but everyone had lost his/her home. The weather had turned wintry and soon they were to have snow too, just to add to their problems.

We reported to the Mayor, Signor Tonino Guarino, who put the Town Seal on our Embassy Permit as a receipt. He said he did not know how to thank the people of Britain for their generosity which he found overwhelming. He insisted that we had a meal on the town, it was the least they could do and the answer no was not acceptable. He issued us with our own soldier guide, who took us to the local football field. This was the only flat area for miles and was being used as the town collect point for all aid. It again was under military control and the Commander was an Army Doctor—they were so stretched that even doctors were being used. Here the caravans were parked and two Round Table crews left.

Alberto, an Italian student at Nottingham University who had answered the call for volunteers, had offered his car since he was driving home for Christmas. He had a small Continental 1300cc car, which had done well so far. His crew man, John, was an English student from Lincoln who had been promised a lift back in one of the other cars.

Our soldier took the four of us to the restaurant named by the Mayor. This was a concrete building with pot-brick infill. The concrete frame had survived but the gaps in the walls were many and large. This sort of damage was common and meant buildings like the local school were still usable (the Mayor was ensconced there as his parlour had collapsed and it also housed many families) though draughty. But most buildings there were traditional brick or stones and had totally collapsed. The earthquake had been in the rock strata and this is why the mountains caught the worse part. Naples is built on sand and so suffered only minor damage. The dwellings perched on the mountain sides had to move with the rock they were built on. In these situations the wisdom of using reinforced concrete was clearly evident.

Our soldier guided us back to the barracks acting as control. This was to collect more caravans and take them to their final destinations. The Army Major in charge of the caravan allocations showed us the lists for Avellino Province only. They were formidable. Solofra still had the need for another 208 caravans and the Province as a whole over 5,000 and still being added to as more information came in.

Finally as the rain came down, the time had come for us to leave. Alberto dropped a bombshell in the nicest possible way, by asking what we proposed to do about John. He had volunteered to help on a no-cost basis and certainly pulled his weight. We said we would take John to the British Embassy in Rome—they would know exactly what to do.

THE RETURN

We said our farewells and headed north. Her Britannic Majesty's Embassy in Rome is easy to find, but what a memorial to British architecture, especially in that area. We arrived at noon, just in time to be told it closed until 3.00pm local time. We had a very long lunch and then returned. After two hours discussing the matter and telephone calls it was clear the Embassy was unable to help (we thought the willingness might in fact be there) so we now had a passenger. None of the airlines could help. They would fly Italians free, but not Britons.

All the way north through Italy we noticed convoys of ACI lorries carrying and towing caravans. They were working round the clock with relief crews taking caravans to the south. The Italian Automobile Club was evident elsewhere working at full stretch. 50mm tow balls on the back of vehicles were in short supply and local caravan clubs were also helping.

Going over the Appenines nearly brought us to a halt. A blizzard was blowing from the north and vehicles were blocking the way. The fog had been replaced by bad weather on the Plain of Lombardy. We kept to our plan of going through Switzerland now the caravan was no longer with us. We hit the German border in darkness and

the bureau de change was closed. We were short of currency, had run out of LPG, and were low on petrol. A long time ago I had spent about £4 7s 6d on a DM 50 note which I placed in the very back of my wallet. I suddenly remembered it, and we were saved.

The next day we had to divert to the river side road at Bingen, because snow was falling heavily, and the Autobahn in the high ground to the west was getting blocked. By Koblenz things improved so we tried the Autobahn again. We reached Zeebrugge with a little problem in the shape of John. We couldn't hide him as he was of good proportions. We had tickets by courtesy of Townsend Thoresen, but he didn't. Once again they turned up trumps and we were on board. We dropped John off in Parliament Square at an early hour in the middle of the night. He hitch-hiked home to Lincoln in just over three hours.

Finally we were home in Chobham (Surrey of course). We were tired, hungry and thirsty, but pleased with ourselves.

SOME THOUGHTS

Service people are blessed with the ability to organise and carry through projects and operations. They do it as second nature and think nothing of it. When a bit of a hiatus occurs, it is easy to condemn it, as one could have with that Round Table group. In spite of any such shortcomings, the Round Table have done a wonderful service. In spite of the hard work and effort, we both enjoyed the operation and would do it again, without a moment's hesitation. It has occurred to us that an organisation, semi dormant perhaps most of the time, is needed when things like this happen. A simple Ops Room near Dover and another in a caravan perhaps on the motorway just south of Rome, which was in contact with Central Control, would have been simple to set up. Help could have been despatched with proper instructions, singly or in multiples, and met at the other end and directed immediately to where it was needed. Perhaps that is something that retired Army Officers could set up in readiness.

Whilst in the British Embassy we were told about a British driver who had sought help. He parked his lorry with two caravans on top and one in tow, so that he could have a meal. When he came out, he found his lorry had been stolen, but the caravans had been unloaded and left behind!

One last thought, having heard all the criticism of the Italians. Most of us will remember the Aberfan disaster in South Wales some years ago. That was minute compared with the 1980 Italian disaster, but most of us will remember the traumas and the recriminations at that time. If we had been hit by that earthquake, could we have done better than the Italians?

After-note:

In September 1981 (two months ago and ten months after the disaster) my wife and I visited the 'quake area. The Calor caravan is occupied by the De Vite Nicola family including five children and one grandparent. Solofra has changed considerably and we were very impressed with the progress which has been made. New buildings and extensive repair work were most evident. It was clear that the Mayor and his local Council had a firm grip of the situation.

* * * *

Mount St Helens—One Year Later

MAJOR J M RAYNOR RE, B Sc

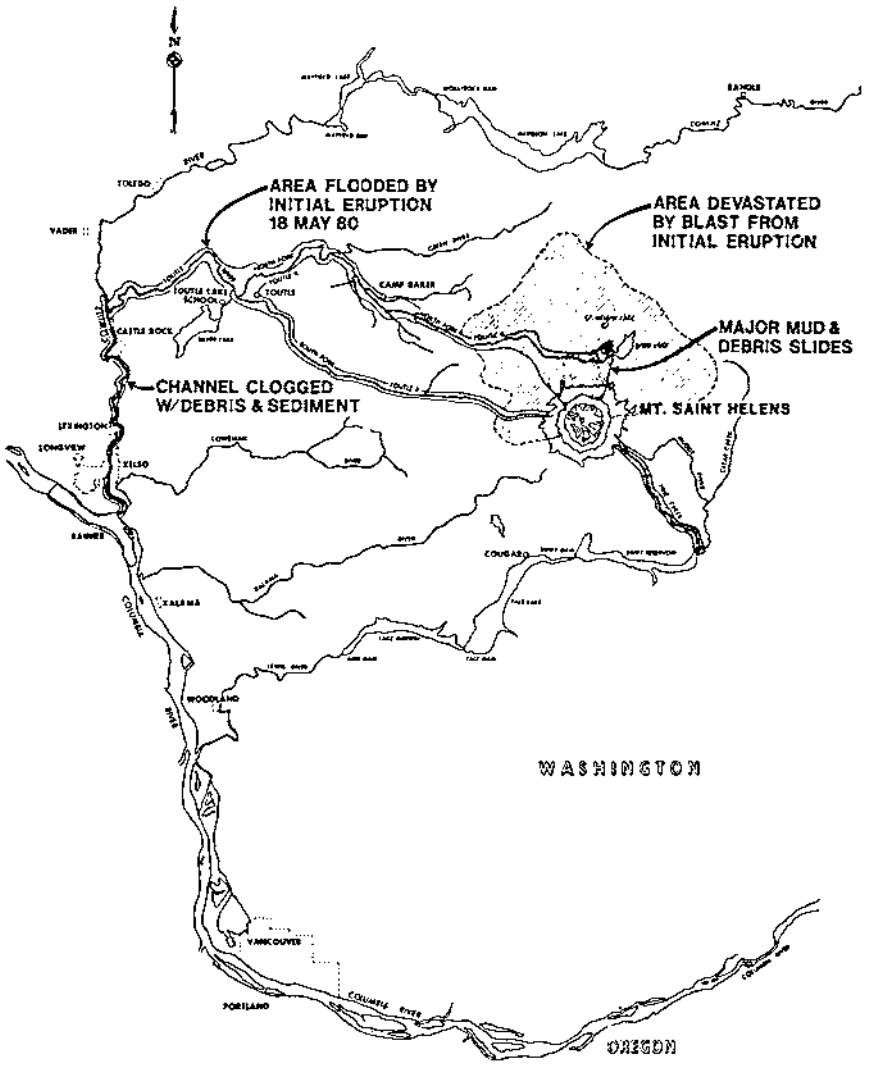
The Author is currently attached to the US Corps of Engineers at Portland, Oregon as part of 22 Professional Engineering Course (E&M). Commissioned in 1968, he served with 22 Engr Regt at Tidworth before attending 24 Degree Course at RMCS. He then served as a Tp Comd in 21 Engr Regt at Nienburg before going to Jnr Ldrs Regt RE as a Sqn 2IC. After a 6 month tour in Ulster he was selected as the Army Watch Leader for the Auckland to Rio De Janeiro leg of the 1977–78 Round the World Yacht Race. After the race he went to Colchester as a GSO3 RE in HQ 7 Field Force and then AI Search at Chattenden before starting his PET course.

All photographs are by courtesy of US Army Corps of Engineers.

On 18 May 1981, after more than a month of minor eruptions and earthquakes up to 4·2 on the Richter scale, Mount St Helens, in the southwestern part of the State of Washington exploded with a force estimated at 10MT (500 times the size of the bomb that largely destroyed Hiroshima). Over 1·3 cubic miles of the mountain were blown away in its most violent eruption in about 3,500 years. (Photo 1). It was

Photo 1. Mount St Helens during eruption

Major JM Raynor RE B Sc



triggered by an enormous avalanche on the mountain's north face, where pressure from the upwelling magma had created a 320-foot bulge of the mountain's side. This avalanche was the largest ever recorded by the US Geological Survey, and was responsible for the unusual lateral explosion to the North.

The lateral blast devastated an area of 156 square miles in a 170 degree arc to the north of the mountain, uprooting mature trees up to 17 miles away. A giant cloud of ash was blown 10 miles up into the atmosphere—the finer particles have since circumnavigated the world.

The first indication of the extent of the damage caused by the eruption happened the following day when a freighter moving up the Columbia River to Portland went aground in the middle of the 40-foot dredged channel. This channel was blocked by an estimated 55 million cubic yards of debris reducing its depth to as shallow as 14 feet in spots for a distance of 9½ miles. The Corps of Engineers' fleet of three hopper dredges was called in from their various tasks along the Pacific coast and put to work as quickly as possible while contracts were placed with civil pipeline dredges for the

bulk of the work. The Corps' dredges were able to provide a limited channel in five days of continuous work, and ships were able to pass the shoal during high tide "windows"*. In the early stages of dredging, about 25 percent of each day's work was lost due to the continuing flow of debris being washed down into the Columbia River.

The last trapped ship moved downriver on 14 June 1980, but it took until the end of November to remove 15 million cubic yards of debris and restore the full channel section through the shoal. Winter flood flows removed yet more silt, and normal maintenance dredging work is now being done.

The Corps of Engineers embarked on an intensive program to restore a 50,000 cfs channel in the Cowlitz before the peak flows expected in December. Dredging started at the mouth of the Cowlitz River on 10 June 1980. To get maximum output as quickly as possible, two large (350-ton) pipeline dredges were moved overland about five miles through the town of Longview. A team of service engineers was deployed in front of each unit to take down overhead wires, and a team behind to put them up again. (Photo 2). At the height of this phase of the work, the Corps' contractors had a total work force of 850 men on 23 miles of river, employing an additional 10 small pipeline dredges (8 to 14-inch pipe), 33 draglines of 2 to 10-yard capacity, 20 large (7–10 cubic yard buckets) backhoes—several of which were shipped brand new from their Eastern factories and assembled on the site, 17 tower draglines, and 175 pieces of loading and hauling equipment (mainly self-loading scrapers and dump trucks). The first excavation job was to cut a 15 by 100-foot pilot channel down the river, permitting the water-logged material close to shore to drain so that it could be removed by the land-based equipment. This cut was then expanded to a channel with a carrying capacity of 50,000 cfs. (Photo 3). Other measures included arranging for additional flood storage at the local reservoirs by draining them below normal operating levels as December approached. The construction of

Photo 2. Utility Company employees move cables/wires as dredge *Art Riedel* moves through the streets of Longview on 28 June 1980

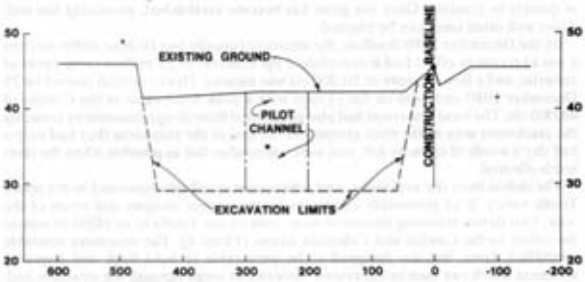


Photo 3. Typical cross-section of 50,000 cfs channel in Cowlitz River

improved levees to protect the local townships also began in June. Contractors were left to decide how to do all this work, and were paid on the yardages moved.

One contractor built a berm down the centre of the river, and by moving a dam at the upstream end, was able to use self-loading scrapers in the resulting shallow water. Once they got a 5-foot depth over the length of the contract, the dam would be moved and the other half of the river excavated. The silt flowing down river filled the exposed half channel by the time the other half was excavated. Another technique was to put a dragline excavator onto the berm to extend its bucket reach across the whole width of the channel when access to either bank was restricted. The spoil was dumped onto the berm to drain, and then loaded by wheeled excavator into trucks and carted away.

Disposal sites were provided free by the private owners of about 4,400 acres of riverside property. The Corps of Engineers has included a mulching and grass seeding clause in all its excavation contracts to restore the use of the land to pasture

Photo 4. South Fork debris retaining structure

Mount St Helens 4

as quickly as possible. Once the grass has become established, producing top soil, Alder and other trees can be planted.

By the December 1980 deadline, the intensive (usually two 10-hour shifts, six days a week) recovery effort had accomplished the removal of 35 million cubic yards of material, and a flow capacity of 50,000 cfs was assured. Heavy rainfall started on 25 December 1980 and went on for 2½ days with a peak flood value in the Cowlitz of 48,000 cfs. The local reservoirs had also performed their design function by reducing the catchment area of the river system. At the end of the rainstorm they had only a half day's worth of capacity left, and were emptied as fast as possible when the river levels allowed.

The debris from the avalanche, and subsequent mudflows deposited in the upper Toutle valley, is all potentially erodeable by the normal streams and rivers of the area. Two debris retaining structures were built on the Toutle in an effort to reduce the inflow to the Cowlitz and Columbia rivers. (Photo 4). The structures resemble earthfilled dams, but are designed to be permeable to hold back and impound sediment which can then be excavated. Riverwater seeps through the structure and, in times of high flood, over the spillways. The gravel core is covered by a special filter fabric to trap finer particles. The heavier ones settle out as the flow of the river is slowed by the structures. The spillways were initially constructed of rock-filled gabions with their upper surfaces covered by 6 inches of gunnited concrete, thus allowing water to flow through the structure while maintaining a degree of protection from scour. During a winter storm, one of the ponds formed by the local tributaries being dammed by the debris flow overtopped its natural dam and quickly eroded it away. This flood surge, carrying a large amount of heavy debris, both logs and boulders, came up against the partially completed North Fork barrier. The flow was greatly reduced by the embankment, but one of the spillways was destroyed. This has since been successfully replaced by a 4-foot thick layer of roller compacted high

Photo 5. Early photo of North Fork of the Toutle River showing about 12 miles of the mud slide and the new crater in Mount St Helens

Mount St Helens 5

Photo 6. Recent photo of the mud slide in the North Fork of the Toutle River. The debris retaining structure is in the foreground. The river is presently flooding the North half while the South half is being excavated. The darker texture on the end of the mud slide is due to successful aerial seeding designed to stabilize the material. In the background the crater (some 14 miles away) is still slightly active

density concrete. Drainage channels have been dug for most of the remaining large ponds, including Coldwater Lake, while the remaining bodies of water are being closely monitored to prevent a reoccurrence.

The North Fork barrier has a capacity of at least 6 million cubic yards of sediment, while the smaller Southern structure will retain some 600,000 cubic yards. To date, over 5 million cubic yards of material have been removed from behind the North Fork structure, and 1·5 million yards from the Southern one.

The problem of the Cowlitz River was even more formidable.

The US Geological Survey, reporting of the flooding of the Toutle and Cowlitz valleys, spoke in terms of mudflows on the mountain's northwest flank "destroying"

Mount St Helens 6

several rivers. An estimated 46 billion gallons of melted glacial ice, plus the outflow from Spirit Lake, mixed with ash, sand and debris, came down the mountain at 30 miles per hour, coursed through the Toutle river system, spread out into the Cowlitz River, and hence to the Columbia. About 2,000 residents evacuated their homes as larger floods on the Toutle's south fork followed the first one.

With river channels already clogged by mudflow material, a second flash flood set the highest flow ever recorded in the lower Toutle downstream of Silver Lake. It was produced by mudflow from only a few square miles of the 470-square mile drainage basin, yet was considered greater than an equivalent 100-year period flood. A third silt-laden flood several hours later was three times as great, reaching a height of more than 53 feet at one point, 30 feet higher than the earlier flood. This flood was considered comparable to a 10,000-year occurrence. The floods destroyed 301 homes, wiped out 12 bridges, logging vehicles and equipment, and millions of board feet of stocked logs.

Surveys taken in the aftermath of the eruption showed the upper 17 miles of the Toutle's north fork were completely filled in with mud and debris ranging from 10 to 600 feet deep. (Photo 5). An estimated 50 million cubic yards of material was deposited in the Cowlitz River, reducing its flow capacity by about 90 percent. Where it normally could carry up to 70,000 cubic feet per second (cfs) of flood water, it had only a 13,000 cfs capacity. In addition, the Corps' estimate that last winter's rains have washed down an extra 14 million cubic yards of debris into the Cowlitz itself.

In addition to these two main structures, a series of eight sediment basins have been constructed wherever the river gradient permits in order to trap additional sediment in the Toutle River system. Their rate of infill is being carefully monitored, as a total of 20 million cubic yards of debris are expected to come down the Toutle and Cowlitz rivers over the next year. It is expected that a total of 15 million cubic yards will eventually be trapped by the North Fork structure, and 2 million cubic yards behind the South Fork structure. Material deposition is expected to continue until 1987. (Photo 6).

There is always the possibility that unusually heavy rainfall could cause more extensive erosion in the upper Toutle valley than expected, leading to the uncontrolled silting-up of existing channels and catchment areas. This threat of future flooding will remain with the local population, and the Corps of Engineers, for the next few years.

The eruption recovery effort is the most extensive and expensive emergency operation ever undertaken by the Corps of Engineers. More than $240 million has already been spent or committed—largely to excavation contracts, and the Corps estimates that $600 million more will probably be required over the next six years for flood control and navigation maintenance. So far, the Corps has excavated about 80 million cubic yards of material—enough to cover a football field to a height of seven miles!

* * * *

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SAFE CONSTRUCTION FOR THE FUTURE

Proceedings of a Conference in London: Price £8·50

THIS book examines various aspects of safety on construction sites with particular emphasis on hazards associated with new building techniques and hence the new means of prevention required. The effects on safety of the interface between designer and contractor are presented, along with the need for close liaison between the two parties.

Belle Vue Barracks, Bradford

THE HOME OF 272 (WRA) FIELD SUPPORT SQUADRON RE (V)

CAPTAIN B FOSTER RE (V), FFB, MBIM

The Author left the Regular Army in 1974 after 24 years regular service, 16 of these as a Clerk of Works Construction. He served two tours in Malaya, one with the ETC at Kluang and the other with 28 Commonwealth Brigade at Taiping. Other overseas tours were with the British Gurkhas in Nepal, the WD Works Organisation and the MPBW at Dortmund and with 1st Fortress Sqn in Gibraltar. In 1967 having completely recovered from a serious illness he became an instructor, teaching C of W (C) students, at the RSME. In Gibraltar in 1972 he was promoted to WO1 and appointed acting GE on Phases II and III of the Europa Road Realignment Project. After leaving the Army he joined the staff of Bradshaw Buckton & Tonge, Consulting Civil & Structural Engineers at Leeds as a Site Engineer/Surveyor. He has recently been appointed an Associate of the Practice. Six months after leaving the Regular Army he was commissioned into the TAVR and is serving with 272(WRA) Fd Sp Sqn RE (V).

Part I Past History

Early on the morning of 30 October 1979 the Drill Hall, Officers and Sergeants Messes, the Caretakers house, general offices and stores of this 118 year old Barracks standing off Manningham Lane, Bradford were almost totally destroyed by fire. At the height of the blaze more than fifty firemen and fourteen fire appliances battled to douse the flames but only managed to save the basic shell of the building complex. Equipment worth more than £12,000 was lost plus a great deal of property owned by the Messes, the West Riding Artillery Trustees and the Squadron, many of these items being of historic value. Although the Barracks were old and somewhat bleak, the buildings were in fact very spacious and full of character, the Drill Hall alone was a spectacular example of Victorian construction with a huge semi-circular timber arched roof of some thirty-two metres clear span.

The Barracks is today the home of 272 (WRA) Field Support Squadron, Royal Engineers, (Volunteers) being part of 74 (Antrim Artillery) Engineer Regiment. The Regimental Headquarters are located in Belfast and the Regiment is assigned to NATO, being part of the LSG to the 6th Field Force. Over the years the Military Units and Regiments who have served at the Barracks have changed many times but proud traditional links with the past and Bradford City remain and this is well illustrated by the bracketed letters (WRA) incorporated in the Squadron's title which emphasises the unit's past Royal Artillery evolutionary history.

It all started 120 years ago with the appointment on 28 September 1859 of Captain Samuel Cunliffe-Lister, as Commanding Officer of the 5th Company Yorkshire (West Riding) Rifle Volunteer Corps. The idea for a part time Army to supplement the comparatively small regular force came about in 1859, when England was facing the threat of a French invasion. Captain Cunliffe-Lister, (later Lord Masham), founded two companies, the 5th and 6th Company of the Yorkshire Volunteer Corps (Infantry) in Bradford in that year. The following year the 2nd (Bradford) Corps Yorkshire (WR) Artillery Volunteers were formed by Lieut Colonel George Wood,

Belle Vue Barracks, Bradford Captain B Foster RE FFB MBIM

with Lord Frederick Cavendish as Honorary Colonel. Belle Vue's purpose built Drill Hall was completed in 1861 and extended in 1880.

Bradford Volunteers sent two companies to serve in South Africa from 1900–1902.

When the territorial forces were formed at the beginning of the 20th Century the Infantry Company, part of the 6th Battalion of the West Yorkshire Regiment (The Prince of Wales Own), made its Headquarters at Belle Vue Barracks along with the Gunners of the 2nd West Riding Brigade RFA, and served as part of the 49th (WR) Division in the 1914–1918 war.

When war broke out, the Regiment was re-organised and trained at Doncaster. With the 45th it went to France in May 1915, and remained there until the Armistice in November 1918. It fought at Neuve-Chapelle, Ypres, the Somme, Passchendaele and Valenciennes.

The 2nd/6th Battalion (West Yorkshire) Regiment was formed in 1915. After training it went to France in 1916 and fought with the 62 Division in Ancre and the Somme Valleys. For most of the war the Infantry element was commanded by Lieut Colonel H O Wade and the Artillery by Lieut Colonel Sir Edmund Whitley. Sadly only a few members of the 6th Battalion returned to England, 600 officers and men having been killed.

After the Armistice the Battalion reformed at Belle Vue Barracks, the Bradford

Photo 1. The remains of the interior of the Drill Hall. Sappers salvaging what little was left

Belle Vue Barracks, Bradford 1

Gunners became the 70th (WR) Field Brigade and later Field Regiment; training at Valley Parade Drill Hall, close to Belle Vue Barracks, for twenty years. Their rivals, the 6th Battalion The West Yorkshire Regiment were based at Belle Vue Barracks. In 1937 they converted from Infantry duty to Searchlights and remained in this field when entering the 1939–1945 war under the Command of Lieut Colonel C H Underwood.

The 70th (WR) Field Regiment was mobilised in 1939 and began to train in England and Scotland. It landed at Brest on 10 June 1940, but returned to England three weeks later being one of the few Regiments to get its guns home. Later the Regiment served in the North African Campaign landing at Algiers in January 1943. That September it sailed for Italy forming part of the initial landing forces.

The proudest moment for both the 70th (WR) Field Regiment Royal Artillery (TA) and the West Yorkshire Regiment (The Prince of Wales Own) came when they were both granted the freedom of the City of Bradford on 5 September 1945. Detachments of both Regiments were given special permission to return to England for the ceremony.

A brochure produced by the *Yorkshire Observer* to commemorate the occasion stated: "In adding the name of the 70th Field Regiment to the Freemans Roll, Bradford became the first city in the Kingdom to offer such an honour to any Regiment of the Royal Artillery and so made Military History".

The Territorial Army was reformed after the War and the 70th became the 270th (WR) Field Regiment and drilled at the nearby Barracks at Valley Parade. The 584 Light AA Regiment amalgamated with the 270 on 1 May 1955 as part of the reduction in anti-aircraft units. The two Regiments became the 370th (WR) Field Regiment and Belle Vue Barracks was chosen as the Headquarters; the Valley Parade Drill Hall being sold.

Recently Lieut Colonel C P Rigby TD JP recalled that just after the War the Territorial Army was in such low strength that Officers had to take turns to do different duties such as driving, and radio operating to keep things going. The Golden Jubilee of the Territorial Army was celebrated in 1958 with a Parade marching from Belle Vue Barracks to the Cathedral where a service was conducted by the Regimental Chaplain the Reverend L E Pickett. On 1 February 1961 the Field Regiment was amalgamated with the corresponding Field Artillery Regiment at Leeds, under the title of 249 (WR) Field Regiment RA (TA). The new Commanding Officer was Lieut Colonel C P Rigby TD and the Honorary Colonel was Colonel C R Bottomley TD, who previously Commanded the 70th (WR) Field Regiment RA (TA) between 1933 and 1937. In 1967 on the reorganisation of the Territorial Army the 249th Regiment lost its guns and became a Home Defence Unit. A year later the Prime Minister announced in Parliament the disbandment of all Home Defence Units, and this was so completed at Bradford by early 1969.

So ended the 110 year service of the Bradford based Royal Artillery and the West Yorkshire Regiment.

Shortly after, the Royal Artillery at Belle Vue were succeeded by two Volunteer Units formed initially to a large extent from their old personnel—the 272 (West Riding Artillery) Field Support Squadron RE (Volunteers) and "A" (West Riding Artillery) Company, 3rd Battalion, Yorkshire Volunteers.

The original Freedom of the City of Bradford granted to the 70th Field Regiment is enjoyed by both as direct descendants, and in the case of the Royal Engineers, was confirmed by a Special Conferment of the Privileges on 3 October 1969 designating them and their descendents as direct descendents of the 70th (WR) Field Regiment. 272 Squadron was first commanded by Major G S R Hunter TD RE(V), late RA, who subsequently Commanded 73 Engineer Regiment (V) at Nottingham and in 1975 became Deputy Commander 29 Engineer Brigade.

Since those early days the Squadron has gone from strength to strength with an excellent recruitment and training record. In 1978 272 Squadron left 73 Engineer Regiment (V) and joined 74 (Antrim Artillery) Engineer Regiment (V), an interest-

ing and auspicious "marriage" considering the common Royal Artillery backgrounds. The present Officer Commanding, Major D W Davis TD RE(V) took Command of the Squadron on 1 April 1977 and now has the challenging task of steering the Squadron through the immediate problems that lie ahead.

Luckily most of our training is done "out of house" at various camps around the country but our Tuesday evening Drill Nights did at first pose a problem but was soon solved for us. Almost immediately after the fire the Bradford Education Authority gave permission for us to use part of Manningham Middle School which stands next to the Barracks. This has been a godsend and provides us with a Gymnasium for Muster Parades and several classrooms, for these facilities we are more than grateful and it does illustrate the good relationships that have been maintained with the City Authorities.

Our TAVRA Headquarters at York responded immediately and magnificently providing us with three huge 50ft long Port-a-Cabins for use as Squadron Offices, QM Stores, and ACF Area and detachment offices, who also share the Barracks with us. For the Caretaker and his family a Mobile Home was acquired, the very unit that had been used by the Television staff on location filming for Emmerdale Farm series shown on Yorkshire TV. Miraculously nearly all the Squadron Documents and Records were saved from the fire, much to the relief of the Administrative Officer Captain B A E Mellett and his staff. Within weeks an existing isolated brick building which had escaped the fire had been converted into an Armoury to take the brand new personal weapons, the orginal weapons all having been declared BLR.

Despite the many problems following the fire, morale remained high and this was reflected at the Remembrance Parade on 11 November which saw the largest turnout for this Parade in five years. In addition our recruiting figures have soared, probably due to all the media publicity.

The Squadron Paraded on Friday 4 January 1980 at 2000hrs and proceeded to Bellerby Barracks, Catterick Camp to fire the Annual Range "Shoot to Kill" classification, no mean feat and a good example of our continued survival considering that all weapons were brand new, coated in oil and each required to be zeroed from scratch!

Meanwhile plans to rebuild the Barracks have been completed, demolition of the

Photo 2. The famous entrance to a now roofless shell.

Belle Vue Barracks, Bradford 2

remains of the old building has started and re-building is under way. It has been forecast that the re-build will take at least two years; so in the intermediate period we will have to make the best of what little accommodation we have.

Part Two of this three part article will deal with our survival and the progress of the re-building programme.

Acknowledgements and thanks are extended to the West Riding Artillery Trustees for their assistance in providing details of the past History of Units serving at Belle Vue Barracks.

The Sandringham Folio

MAJOR I F G WHITTINGTON, RE, B Sc, MIOP, MBIM

Commissioned into the Corps from RMA Sandhurst in 1966 the Author served in Airfd Sqns both before and after obtaining his B Sc (Eng) from RMCS Shrivenham in 1971. An Army Svy Course in 1973 was followed by three years as an Asst Div Offr at the Ordnance Survey before commanding the Cartographic Sqn of the Royal Australian Survey Corps while on a two years exchange appt. On returning to UK in 1979 he assumed his current appt in MOD Svy 2a, which includes responsibilities for map specifications and design of special products such as the folio described in the article.

THE Royal Engineers have been training map makers since the early nineteenth century. In the early days this was undertaken at the Royal Engineers Establishment Chatham, Kent, and included training for Officers and NCOs of the Corps, for employment in the Survey Companies of the Ordnance Survey, the Survey of Ireland, and the Survey of India. With a much increased requirement for survey support being brought about by the technological changes of the two World Wars, survey schools were set up in a variety of locations to meet the war training needs. The successor of these establishments, the School of Military Survey, moved to its present location at Hermitage, Berkshire, in January 1949, into a dilapidated camp, originally constructed in 1944, as a Military Hospital Camp and then used as a Refugee Camp. This camp, much improved by the staff and soldiers in the early years, became the site for the rebuilding of the School which started in 1976 and culminated in the official opening of the rebuilt School of Military Survey by Her Majesty The Queen on 27 June 1980.

The School of Military Survey provides instruction to Royal Engineer officers and soldiers in the techniques of Field Surveying, Air Surveying, Cartography and Map Reproduction and Distribution. There is also a wide range of general courses mainly for servicemen (including map reading instructors courses and courses for specialists of the Royal Navy and Royal Air Force) and courses for civilian technicians from other government survey organisations. A large number of the students at the School both military and civilian, come from Commonwealth and foreign survey organisations.

When Her Majesty opens a military training establishment, such as the School of Military Survey, it is customary for her to be presented with a gift that has been prepared by the students of the establishment as part of the training undertaken

The Sandringham Folio Major JFG Whittington RE B SC MIOP MBIM

there. In the case of the School of Military Survey, the logical choice for such a presentation is that of a map. When considering what such a map should portray, it was necessary to consider firstly what type of product could be undertaken as part of the training syllabus which would reflect the essence of the military map makers training and secondly what type of product would be of some practical benefit to the Royal Household.

To meet the first requirement, to decide on a single product into which could be distilled the essence of the military map makers' training was not simple. In the end it was decided that the essence of this training was to be able to take an existing map from some other survey organisation, add to it topographic revision and then enhance it with simple and effective overprinted information; the "new" map to be produced in the minimum of time and printed in a limited quantity to meet an exacting deadline. What more exacting deadline can you have than a "Royal Opening" in three months time without any ideas as to what map could possibly meet the second requirement?

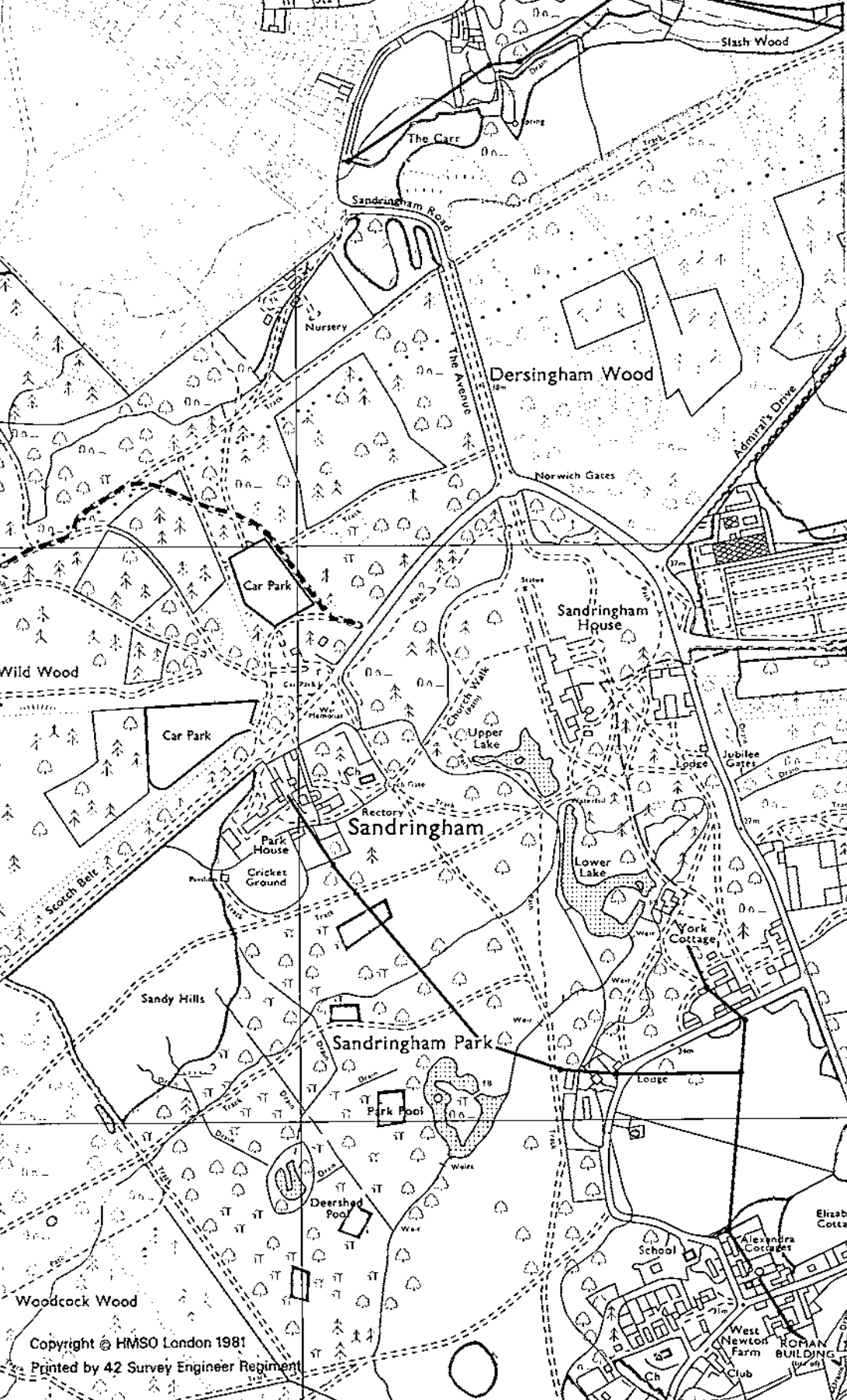
During the search for a suitable product to meet the second requirement, a visit was made to the Sandringham Estate Office. There it was discovered that, although the Estate Office was well supplied with large scale plans, the only general picture of the whole estate was provided by an old mosaic of air-photographs mounted on the wall of the Estate Agent's office. It then became apparent that the second requirement could be met by the production of an enhanced general map of the Sandringham Estate as a replacement for this ageing photo-mosaic.

Having decided on the product, it was then necessary to decide on the scale and specification. The Estate, some 20,000 acres in Norfolk, roughly 17km east to west by 10km north to south, falls conveniently onto seven sheets of the Ordnance Survey's 1/10,000 scale series, giving a finished format, at that scale, of 2m × 1m. Here we had the ideal "existing map" at a suitable scale to form the basis for the project. In consultation with the Estate Agent and his staff, the estate management information, suitable for portrayal by a simple overprint on the proposed general map, was extracted from estate records and compiled onto the basic Ordnance Survey product. From this the specification was derived.

As the main purpose of the product was to portray the Royal Estate, it was decided to only enhance the map within the boundary of The Estate. To further emphasise the area, all detail outside the boundary of The Estate was reduced by screening the black linework (40%) and enhancing the boundary itself by a 10mm purple vignet.

Within The Estate the main road network was enhanced by a 20% red infill. The density of contour information was reduced by leaving only the index contours from the Ordnance Survey product, to be printed down in the conventional brown. This "opened out" the map to give space for the land use information subsequently overprinted. The main network of drainage was enhanced with differentiation maintained between open water and water authority watercourses (enhanced in blue) and estate land irrigation drains (retained on the black plate). Cultural revision was added to the black plate, where relevant, together with full depiction of all overhead power lines. Underground water mains and electricity lines were also depicted, by pecked lines, on the blue and red plates respectively.

To this enhanced base the various categories of land use, required by the Estate Agent, were added. A yellow plate was compiled to indicate the main agricultural divisions, with a 2mm solid line being used to portray the boundaries of the individual tenant farms, and a 40% stipple infill being used to portray the areas, such as orchards and studs, that are directly controlled by the Estate Office. The forest management information was compiled onto a green plate with areas of "General Woodland" being portrayed by a solid infill, areas of "Dedicated Woodland" by a 60% infill (with 5mm diagonal stripes used for areas "Dedicated" but not yet planted) and "Country Park Woodlands" by a 40% infill. All other vegetation types within the area of The Estate were portrayed by the conventional Ordnance Survey symbol printed down in solid green.



The size of The Estate as mapped precluded its production as a single sheet at 1/10,000 scale, and as it fell conveniently within the standard Ordnance Survey sheet lines, it was logical to use the Ordnance Survey format as a basis for a folio of seven maps. To this folio was added an index page showing the layout of the subsequent map sheets using a full colour 1/50,000 scale extract, enhanced with the Estate boundary and with 1/10,000 sheet lines/sheet numbers superimposed in red. Underneath the extract was compiled the legend to the folio maps, the whole being laid out in such a way that the index page could be mounted as an eighth sheet forming a montage two sheets high and four sheets wide suitable for wall mounting.

The linework enhancement was produced by the students of an advanced cartographic course, using the conventional techniques of scribing and masking, with the vignet produced by the conventional photographic techniques taking special care to ensure that the width of the vignet band was retained across sheet edges. The maps were printed by the students of an advanced lithographic printers course using a single colour Heidelberg SORD Z Double Demy lithographic press in seven colours using standard 110gsm high wet strength paper. Two set of maps were carefully selected, one for binding into the single volume made up of the index page and seven folio maps, and the other set being mounted as a single montage for display and use at The Estate. All the production work was undertaken by military students as part of their course work while under instruction at the School of Military Survey and was executed under the guidance and supervision of the permanent staff.

The fly-sheet of the bound volume was hand inscribed with the salutation:

"Presented to their Colonel-in-Chief by All Ranks of the Corps of Royal Engineers on the occasion of the Opening of the new School of Military Survey at Hermitage 27th June 1980"

with the presentation being made to Her Majesty the Queen by the Chief Royal Engineer, Lieut General Sir David Willison. The montage of the Maps of the Sandringham Estate at 1/10,000 scale can be seen gracing the wall of the office of the Estate Agent, at Sandringham, where it is hoped it is proving to be of "some practical benefit to the Royal Household".

* * * *

The Magic Casket—An Executive Toy

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

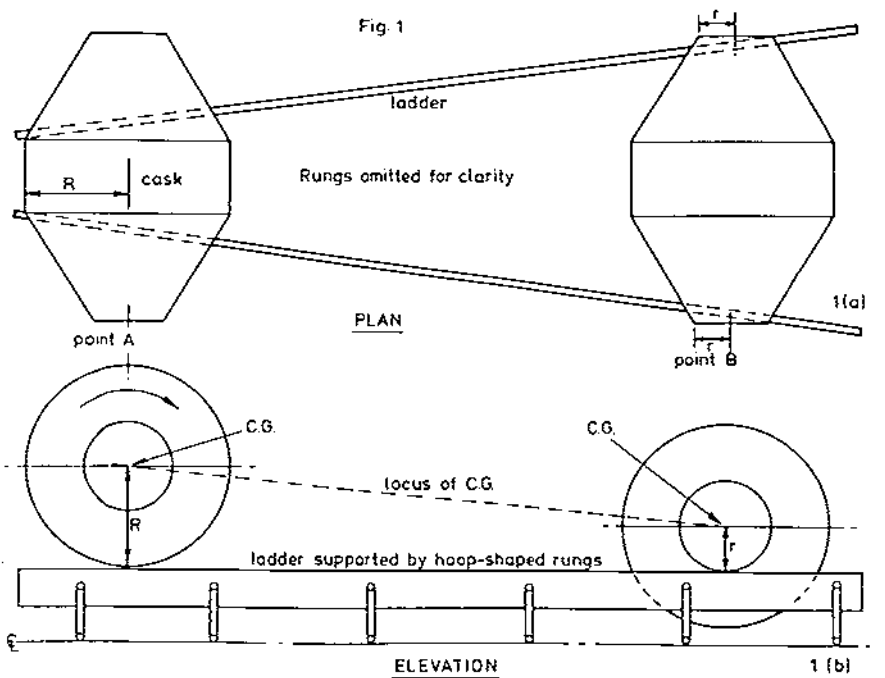
Re-printed by kind permission of "Model Engineer" Magazine

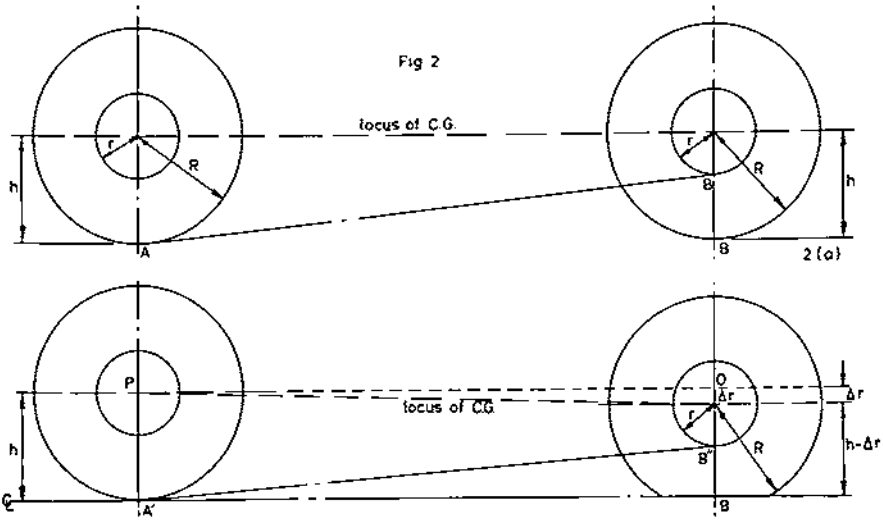
SOMETHING I saw in Brompton Barracks, Chatham, as a young Army Officer planted in my mind a speculative engineering conundrum, which lay there forgotten for over fifty years. Recently, it was resurrected by a model I saw at a model engineering exhibition in Newport, Gwent; and now it has blossomed into the Executive Toy shown in the photograph. In days gone by the Orderly Officer was periodically required to check the Sergeants' Mess beer stocks; and when I did this on one occasion the Mess Caterer brought to my notice a curious sort of ladder, negligently abandoned there by the brewer's drayman. It was tapered from a width of about 8in at the narrow end to about 15in wide at the other end, with "hooped" rungs so that when a barrel—known incidentally as a cask—was rolled along it, the bellied waist of the cask would not foul the rungs below it.

It will be seen from Figure 1 how a cask placed at Point A stands with its waist (Radius R) on the narrow end of the ladder; but when it is moved to the other end of the ladder, to Point B, the ends of the cask (Radius r) rest on the ladder. Therefore, as seen in elevation, Fig 1(b), the centre of gravity of the cask will descend a distance of R-r while rolling from Point A to Point B, even though the ladder is level. Furthermore, because the ladder was smooth, the cask did not require much encouragement to make it roll almost of its own accord from A to B.

This phenomenon was probably an old chestnut in the Sergeants' Mess; and some of the more analytically minded Members may have pursued its ramifications a long way. But to me it was entirely new and utterly baffling—so much so that I never attempted to think it out. I could not, however, help realising in a nebulous sort of

Fig. 1

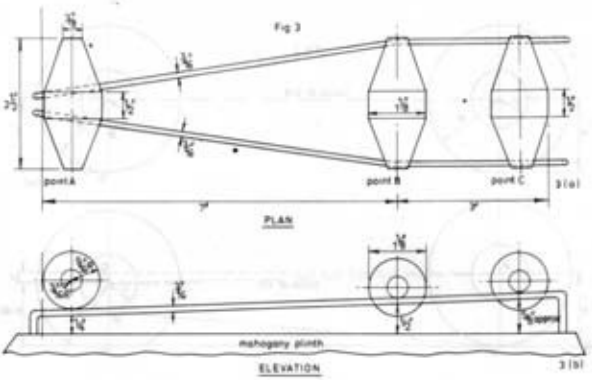




way, that if it were possible for a cask to appear to roll horizontally, while actually losing height, it ought to be possible to make it appear to roll uphill, while not actually doing so. At the exhibition last year there was an item labelled "Barrel that Rolls Uphill" or words to that effect; and it instantly attracted my attention. I was not interested in the suggestion that it incorporated a principle used by British Rail to prevent the wheels of the Advanced Passenger Train from shuttling from side to side at high speed. What fascinated me was that it seemed to supply the answer—or one step towards the answer—to the questions raised, but never answered, long ago in Chatham. I stood spellbound before it.

It seemed at first sight that the model was arranged on the lines of Fig 2(a). It consisted of a solid metal casket—it was too small to be called a cask—resting on a pair of polished rails. The rails diverged from a narrow gauge at Point A to a wider gauge at Point B; but at B the track had been raised (as I thought) to a point B′, such that BB′ = R-r. As the casket moved from A to B′, its centre of gravity would remain at a constant level although the casket, itself, looked as though it were rolling uphill. It was beautifully made and the designer had been extremely cunning (it was designed and made by Mr D M Parsons of The South Gwent College of Further Education); for the casket did all its rolling by itself! The secret of the model is revealed in Fig 2(b). On closer inspection it was evident, that the sloping trackway did not slope from A to B′, but from A′ to B″, and the distance $BB'' = R - (r + \Delta r)$, where Δr is very small compared with r; in fact, so small that the eye did not perceive it. All that the observer noticed was that the casket apppeared to roll *uphill*; the fact that the centre of gravity of the casket descended, during the process, a distance = Δr was not discernible.

The spectators at the exhibition were allowed to play with the model themselves, and position the casket wherever they fancied; but unfortunately they mostly placed it at B″, expecting to see it roll downhill. When nothing happened most of them gave it no further attention and moved on. Occasionally a spectator placed the casket at Point A and watched it roll of its own accord to the buffers at B″, where it stopped with a click, and that was all. Unexpected though it was, more action seemed somehow to be called for; and some simple way of promoting more movement was needed. Perhaps at this stage my subconscious mind took over. It must have been doing its homework over the years; for as soon as I got back to my workshop I was able to sketch out Fig 3—or something like it—on the back of an invoice for paint!



Construction

The casket in my toy was made from an off-cut of aluminium alloy as shown in Fig. 3. The rails were made of pieces of stainless steel rod and were set on a steadily rising incline above a wooden plinth from A to C; but whereas the gauge of the trackway increased from A to B, the rails were parallel from B to C. Wherever the casket was put on the rails—except at exactly Point B—it rolled one way or the other. Suppose it were placed at A, it performed its now familiar trick of rolling of its own accord to Point B. During this run its centre of gravity had been descending, but its mass had been gathering momentum, sufficient to carry it on (upwards) towards C. When I had got all the dimensions right, the casket would run almost up to C, where it ran out of momentum, halted and began to run back down to Point B. By the time it had got to B it would have gathered sufficient fresh momentum to carry it towards A. When the casket had been well polished—and the rails too—the casket would run freely back about three-quarters of the distance from B towards Point A. There it would again run out of momentum, halt and reverse towards B. As will be seen from Fig 3, Point B is the lowest point in the travel of the casket, and in the better models of the toy, the

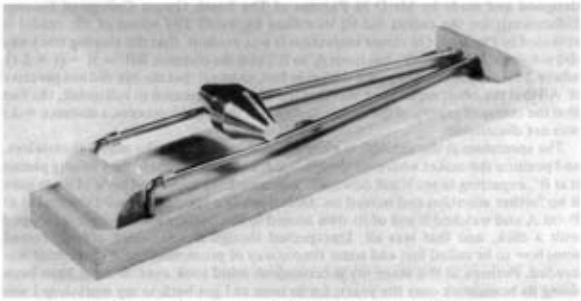


Photo 1. The Magic Casket. *Photo: Terence Soames (Cardiff) Ltd*

The Magic Casket-An Executive Toy

casket, having been awarded the epithet "Magic", would make 20 to 30 transits to and fro, on either side of its lowest point at B. In this way the action was prolonged sufficiently to provoke thought.

The dimensions given in Fig 3 turned out to be about right; but, depending on the workmanship, they sometimes needed modifications to give the best results. I also found it advisable to insert a circular spirit level, like a fish eye, at the centre of the plinth; and to mount the plinth on three small rubber studs. In this way there was less likelihood of the operator supposing he could get his Magic Casket to perform when set up on (say) the sofa.

The whole exercise is mildly absurd; but to my astonishment I have had to make many Magic Caskets to satisfy my friends, and one of them sold a few in the Middle East. If the Magic Caskets upset the Balance of Payment with the Sheikdoms of Arabia I shall owe my luck to the Sergeants' Mess Caterer of long ago, and to the model seen last year in the exhibition. But as Aristotle said on several occasions over 2,000 years ago: "It is not once nor twice but times without number that the same ideas appear in the world". He may even have discussed this very problem with one of his friends as they "perambulated" to and fro along the shady paths of Athens.

* * * *

The Lisanelly Suspension Bridge

CAPTAIN T C CORFIELD RE, B Sc

Tim Corfield graduated in 1978 having read Civil Engineering at RMCS as a University Cadet. After a POSU Course at Sandhurst and 67 YO Course at RSME he joined 1 Armd Div Engr Regt (now 21 2 Troop of 7 Fd Sqn during their Op Descant *tour Nov 80—Mar 81. He is now a Sqn Offr with 3 Trg Regt RE.*

Introduction

During a tour in the Sapper role in Northern Ireland a Troop Commander is often confined to section-sized tasks, such as construction of cover from view (CFV) fencing and sangar building, and given little opportunity for troop-sized projects. 7 Field Squadron was therefore lucky during their recent *Op Descant* tour (November 1980—March 1981) to have several "troop" projects involving considerable technical content, testing the Troop Commander, his SNCOs and Section Commanders in both plannning and execution. One such job was the Lisanelly Suspension Bridge in Omagh.

Background to the Task

There are two barracks in Omagh. St Lucia Barracks houses 6 UDR and Lisanelly Barracks houses the QDG, who are serving a two-year resident infantry-role tour. The Barracks are separated by the River Strule, 30m wide, which is fast flowing and liable to serious flooding. For the past forty years they have been connected by a

The Lisanelly suspension Bridge Captain TC Corfield RE B Sc

suspension bridge for pedestrians. The Barracks share facilities, for instance the Naafi Shop is on the Lisanelly side while the PSA Offices are on the St Lucia side. Thus when the bridge was declared unsafe, during a PSA periodic inspection in 1980, it became important to replace it quickly, since without it soldiers and their families faced the frustration of a two mile journey into the town to cross the main road bridge.

The original bridge was a narrow timber trussed suspension bridge spanning some 41m, suspended from two inch diameter steel cables, supported on two 7·5m steel towers. Having stood for over forty years much of the timber had rotted, and the steel had rusted. When strands of the steel cable were analyzed at the Royal Military College of Science, it became apparent that the main cables had also rusted to such a degree that normal safety factors were not satisfied. The only parts of the bridge deemed strong enough for inclusion in any new construction were the mass concrete anchorages and the steel towers.

While the old bridge was removed and a new one constructed, access between the two camps had to be maintained. Our predecessors, 29 Field Squadron, constructed a 14-Bay Triple Single Bailey Bridge, building from the Lisanelly side of the river, with a three-bay Single Single approach bridge. Once this was in place the old suspension bridge was stripped of all but the main cables.

Design Centre Royal Engineers at HQRE Lisburn had meanwhile produced drawings for a new bridge of similar form to the old one, using the same anchorages and towers. By the time 7 Field Squadron arrived in the Province the drawings had been approved and a budget of £10,000 allocated. The Squadron was tasked with replacing the bridge and removing the Bailey by 6 March 1981.

Off Site Preparation

The Squadron was to manufacture all the components in the workshops at 325 Engineer Park and it was necessary to calculate:

(a) How much steel plate and angle would be required to make all the various steel parts.

(b) How many metres run of timber, of what dimensions, would be required to produce all the elements of the truss and decking.

(c) The exact number and type of all the nuts, bolts and washers for the complete bridge.

Once these calculations had been done the materials were ordered and most were speedily delivered to the Engineer Park.

The design called for a soft-wood deck supported on oak transoms in turn suspended from the cables by steel hangers; the structure being given stiffness by a timber truss and tortional rigidity by a steel channel running longitudinally and bolted to the transoms. Each joint was bolted through steel gusset plates.

On 15 December the first work started. A group of three Metal Workers and three Carpenter and Joiners moved into the workshops with the task of machining all the steel and timber components. They had to produce up to sixty-four of each item and the tolerances had to be small to ensure that the completed structure would fit the gap exactly. In order to achieve this they produced a series of accurately constructed templates based on a master bay of bridge which was constructed, checked and adjusted first. When all the components had been machined the timber was treated and the steel painted with primer.'The timber was pressure-impregnated with "Treatim" and this process involved complete immersion of the timber and ensured that the preservative was absorbed even in the bolt holes which were all pre-drilled. Thus no untreated surfaces came into contact with water or steel. The bridge components were painted at this stage. Once the bridge was constructed there would be many areas which would be impossible to reach.

As a form of rehearsal, the bridge structure was assembled in a hangar at Ballykelly. At this point it was carefully measured and checked against the size of the gap, and—credit to the tradesmen—it was exactly right. Each component of every

bay was then numbered to ensure an exact final fit on site.

Work on Site

While the workshop work was being done, work was also starting on site. This involved refurbishing of what remained of the old bridge and positioning the various constructional stores. These included two scaffolding towers and an aerial rope-way constructed of two half-inch diameter SWR cables each 100m long. These were tensioned with Trifor jacks and secured to 3:2:1 Park Picket anchorages. A traveller consisting of an adjustable working platform for up to four men was then suspended from the ropeway.

Work in earnest then started. The first job was the replacement of the old cables by the new ones. Each weighed about three metric tonnes, and when unloaded was under three metric tonnes tension, thus it was not simply a matter of cutting one end and reeling in the other. Firstly a winch vehicle was placed on each side of the bridge, the one on the home bank fitted with an extra winch rope giving it a total range of 70m. This was connected to the main cable just above the anchorage, and the strain taken. The second winch was connected to the cable on the far bank. The cable was then cut at both ends, and one winch paid out while the other winched in. When the winch on the far bank had winched in all its rope, the main cable was attached to an Ordnance Picket Holdfast set while the winch cable was pulled out and attached further up. This process was repeated until all the cable had been recovered onto the far bank. Problems were encountered when the clamps connecting the winch cable to the main cable came up to the bearing surface. In the end they had to be lifted over one by one, a Trifor jack taking the weight and a crowbar easing them over. The same method was used for erecting the new cables.

Since the new bridge was similar to the old one, the easiest way to set the correct tension in the new cables, was by similar geometry, making them the same length as

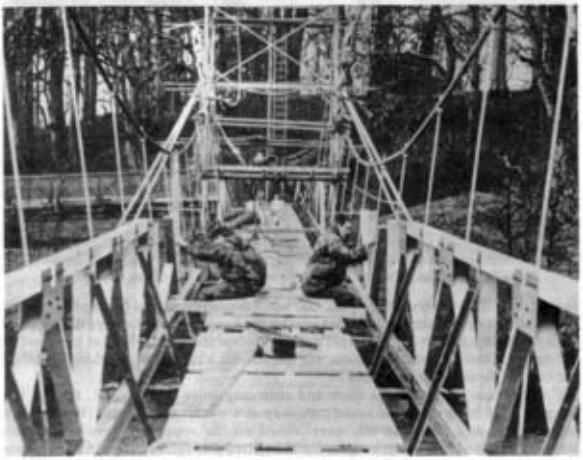


Photo 1. The bridge under construction, working from both ends towards the centre. The traveller can be seen in the centre of the photo with two welding gas bottles positioned centrally

Photo 2. The bridge, almost complete, viewed from the top of one of the towers

the old ones. This proved difficult because when the old ones were checked they were different, not only in total length, but also all the hanger positions were different on each cable. In addition hangers were not equidistant from the towers at each end of the cables. Thus a frantic afternoon was spent, with a calculator, working out what the correct measurements should be.

Construction of the bridge deck and stiffening truss then started. Firstly, the hangers were hung using the aerial rope-way as a working platform. Then the oak transoms, each a four-man lift, were placed on the rope-way traveller and the traveller adjusted so that the hangers could be fitted through the holes in them. Once each transom was levelled and bolted in place a section of decking was laid. Throughout this phase of the construction it was important to build from both ends of the bridge towards the centre in order to ensure symmetrical loading of the towers.

The Lisanelly suspension Bridge 2

When all the transoms were in place and the decking laid, the bridge had a pronounced rise in the centre because there was still some sag in the cables between the towers and the anchorages. It was tempting to adjust the cable tensions since it looked as though they were too tight. The temptation was resisted and it was decided to rely on our calculations and trust that the weight of the stiffening truss would bring the bridge down to the desired level.

Once this stage was reached the aerial rope-way was no longer needed, and the steel channel was bolted in position. Again this was done working out from the banks at both ends. Once this was completed all that remained was to add the stiffening truss itself, and the guard rails. This final stage went very smoothly.

Because all the holes were drilled 2mm oversize to ensure easy assembly, there was a considerable amount of flexibility in the structure until all the bolts were tightened. it was at this stage that the bridge was finally levelled, both laterally and longitudinally, using the bolts on the hangers to raise and lower the transoms.

Finally on 12 February the bridge was declared complete, and having added a sign admitting responsibility, the Troop gathered together to watch the Deputy Commander 3 Infantry Brigade, Colonel Peter Field, cut the white tape and declared it open for traffic. Lieut Colonel Charles Bond, CO QDG, generously donated a Magnum of champagne which was dispensed amongst those who had been involved.

Recovery of the Bailey Bridge

The celebrations over, the next phase of the task was tackled. This was the stripping of the temporary Bailey. The locals felt that the Bailey was bigger and better than the new bridge and failed to see why all our hard work was necessary. They obviously did not perceive the significance of it being war reserve stock! Not having built the bridge we were aided in the strip by a report on the construction from the previous Squadron. The various construction roller grillages were accurately positioned and levelled. The site was restricted, so it was decided to recover the bridge using winch vehicles placed at an angle to the bridge, with their cables led round change of direction blocks to give the correct pull on the bridge. This method proved very successful and gave us valuable extra space on site, since no booming vehicle was required.

Finally the bridge was jacked up and the nose built on the far bank as we slowly winched back. From this stage the strip took four days to complete including the

Photo 3. The completed bridge viewed from Lisanelly Barracks looking towards St Lucia Barracks

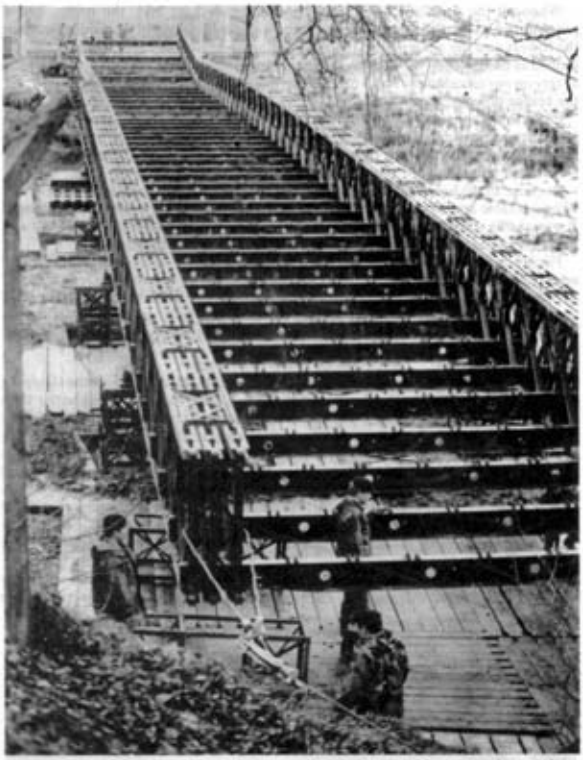


Photo 4. The Bailey Bridge boomed back ready for the strip. Note the restricted site and the cables connected to the winch vehicle off-site

moving of some forty vehicle-loads of stores back to 325 Engineer Park. The strip of the bridge was a considerable challenge in itself, taking into account that the troop had little expertise in Bailey bridging.

Conclusion

With the Bailey removed, it was finally possible for us to stand back and admire our work. The task was very satisfying. Both aspects of the task had been challenging in their own way and provided a complete change from the BAOR soldiering that the Troop had been used to and served to remind all of us that a Sapper has to be versatile and by definition ingenious!

* * * *

A History of Steam Road Traction in the Royal Engineers—Part Two

LIEUT COLONEL J E NOWERS RE, B Sc (Econ)

Chapters 1, 2 & 3 were published in Part One, RE Journal Volume 95 No 3 of September 1981, *and covered the History up to, and including, the "Steam Sappers".*

4. Templer

Most Steam Sappers were delivered to the SME at Chatham. However Steam Sapper No 24 was delivered to the Balloon Corps in 1885 and christened *Balloon.*

The Balloon Corps was run by a remarkable Officer who was not a Sapper. James Lethbridge Brooke Templer was a member of the Militia, the King's Royal Rifles. He was born in 1846, the son of John Templer, Master of the Court of Exchequer. He was educated at Harrow and Trinity College, Cambridge, and in 1889 married Florence Henrietta, third daughter of J S Gilliat MP, once Governor of the Bank of England.

Templer had the foresight to see the value of steam traction in military operations. Until the early 1880s all traction engines for British military service were built by Aveling and Porter, apart from the two Thompson Steam Gunners. Templer much preferred the engines built by John Fowler of Leeds and in 1882 the RE Committee considered such an engine but decided against acquiring it. However it was probably Templer's influence which caused the Committee to even consider a Fowler engine.

Templer was an enthusiastic amateur balloonist and in order to understand the part he played in the development of military steam traction we must now consider the history of the war balloon.

Military balloons were first used in the American Civil War. A British Officer, Captain F Beaumont RE had attached himself to Lowe's Balloon Corps and had been duly impressed. On returning to England he and a brother Officer, Captain G E Grover RE, made persistent but unsuccessful efforts from 1862 to 1873 to persuade the British Army to recognise the military value of balloons. As members of the Ordnance Select Committee they even arranged to hire a balloon from the American, Henry Coxwell, filling it with coal gas from the WD gasworks at Woolwich Arsenal and using it for demonstration ascents at Woolwich and Aldershot in 1863. In 1865 the WO decided there was no use for balloons "in times of profound peace". The successful use of balloons by the defenders in the siege of Paris during the Franco-Prussian war generated some interest.

Henry Coxwell offered to supply two silk balloons at a cost of £2000 for use of the Ashanti Expedition of 1873 but the offer was declined as too costly.

In 1878 an experimental balloon team was formed at Woolwich under Captain H P Lee and Captain Templer who brought his own balloon, *Crusader,* with him. The Government allotted £150 to the team to build the first British military balloon, the 10,000cu ft *Pioneer.* Military aeronauting was clearly the province of the Royal Engineers and Templer, as instructor in ballooning, was paid 10/- per day, on flying days only, to instruct RE Officers in the skill. He was to use his own ballon until *Pioneer* was ready.

As a militia-man Templer was in some respects like a civilian. His salary was a matter for negotiation and he could not be moved around at the whim of the War Office. Military Officers came and went but Templer remained, becoming more and more experienced in the design, construction and use of balloons until he became the foremost authority, certainly in England.

Pioneer was completed in 1879 and in 1880 balloon training was begun in Aldershot and a detachment took part in the annual manoeuvres there. Military balloons were normally tethered and all potential balloon observers were trained in free flight

so they would know what to do should a balloon break free. Many free flights were made and in 1881 Templer nearly lost his life during one. In December he took off from Bath in the military balloon *Saladin* accompanied by Walter Powell, MP for Malmesbury, and Lieutenant Agg-Gardner, to make meteorological observations. The weather deteriorated and at dusk they lost sight of the ground under low clouds. They descended and, finding they were being driven toward the Somerset coast, decided they must land immediately. Templer brought the balloon down near the edge of a low cliff overlooking Bridport Bay but the grapnel would not hold and the balloon continued to drift toward the sea. Clutching the valve line Templer jumped from the basket and shouted to the others to do the same. Agg-Gardner obeyed but Powell hesitated. Templer hung on to the line until his flesh was cut to the bone but Powell was swept out to sea and never seen again.

In 1882 Templer moved his growing establishment to Chatham to join the SME. A balloon detachment accompanied the British force sent to Bechuanaland in 1884. The following year, with the death of General Gordon at Khartoum, more detachments were required to accompany the relief force. A scratch team of men and balloons was sent out under Templer's command. Whilst the part played by the balloons in the campaign was very minor, military ballooning had been transformed into a reality. On the evacuation of Suakim in 1885 Templer collected anything which could be of use for the Balloon School.

At this time balloons were made of varnished cambric and were inflated with coal gas at the nearest gas works. Templer considered hydrogen to be a superior gas but had to solve several problems before he could make use of it.

The first problem concerned the material of the balloon envelope. Hydrogen is a very searching gas and varnished cambric has a high leakage rate. Templer resolved to use goldbeater's skin, a light, strong, flexible and relatively impermeable material. It is made from the caecum or blind gut of an ox, each animal providing about 1½sq ft of skin. It was a difficult material to work with but Templer found an Alsatian family named Weinling in the East End of London who for years had been making and selling toy balloons made from goldbeater's skins imported in barrels from the Continent. He persuaded the family to enter Government employment and set them up in a workshop at Chatham. They produced their first envelope in 1883, the 10,000 cubic foot *Heron* which later saw service in the Boer War. Templer had great trouble managing the seven Weinlings at Chatham. The method of joining the skins was a jealously-guarded secret so no other workers could be employed. In practice the basic principle was quite simple. Joining overlapping pieces of clean, wet skin with gentle pressure caused the tissues to grow together and a permanent gas-tight joint resulted. Templer's balloons normally had seven thicknesses of skin. Goldbeater's skin continued to be used until 1930 when it formed part of the ill-fated R-101. Production at Chatham was halted when one Weinling was sent to prison for three months for assaulting a policeman. However all troubles were eventually overcome and the Weinlings served the Balloon Establishment and its successors for over thirty years.

Having devised a suitable envelope the next problem was to ensure an adequate supply of hydrogen in the field. The portable generators of the time were cumbersome and slow. The Lavoisier generator was developed in 1783 and involved generating the gas by passing steam over red-hot iron. In 1861 during the American Civil War, Lowe had used the wet sulphuric acid and iron process. The generator was mounted on a 4-wheeled, horse-drawn carriage and could inflate a balloon in 2½hrs using 1600lb of acid and 3300lb of iron filings. Templer decided to use the electrolysis of water to produce free hydrogen and to store it under pressure in small cylinders which could be taken into the field. In 1899 an electrolysis plant had been working at the Balloon factory for some time. Storage of the gas in metal cylinders was first suggested in 1875. The biggest problem was to devise a gas-tight seal and this was not achieved until 1884 when cylinders came into general use. This was one of Britian's most notable contributions to military ballooning. By 1890 the French

were storing gas at 300 atmospheres and could inflate a small balloon in fifteen minutes.

Templer used steam traction engines to haul a complete balloon train in the field. A balloon train usually consisted of up to five wagons carrying the gas cylinders, known as "tube wagons", a water cart and a wagon carrying the balloon, basket and winching gear, all drawn by one engine. One such train joined the Aldershot manoeuvres of 1889—preceded by the man with the red flag! The train took three days to travel from Chatham to Guildford. On the return journey the engine was unable to haul the complete train up Guildford High Street so the engine was uncoupled and roped the wagons up one at a time. Brigadier Broke-Smith recorded: "It was market day and the combination of a dense crowd, a doubtful wire rope and wagons filled with compressed hydrogen caused the Officer-in-Charge an anxious half hour".

The performance of the new unit so impressed the Staff that in 1890 it moved to a new and larger depot by the Basingstoke Canal at Aldershot and was included for the first time in the Army Establishment as the Balloon Corps.

For the next ten years, in parallel with his work on military balloons, Templer busied himself with steam road transport. He aroused much public interest and was often seen on his engines around Aldershot and Farnborough, even taking Mrs Templer shopping in a trailer drawn by an engine.

5. Fowlers

Earlier, it has been shown that the first steam engines supplied to the Army were built by Aveling and Porter. Toward the end of the 19th Century the Army turned towards Fowlers, perhaps under the influence of Templer.

The first Fowler engines for the War Department were purchased in 1884 when two were sent to Egypt, probably to work under Templer who was in charge of the balloon detachment at Suakim. No record can be found of the activities of these engines. Perhaps this is not surprising since Templer was not an RE Officer and at this stage he had not attracted the attention he drew later.

By 1870 Fowler was established as perhaps the foremost British builder of steam engines and agricultural machinery. His products were exported all over the world. Two ploughing engines worked for the Germans during the Franco-Prussian War and in 1872 Fowler established a subsidiary company at Magdeburg, now in East Germany.

In 1874 Fowlers sent an engine to Russia for trials in competition with Aveling and Porter's "Steam Sapper". Another engine was sent to St Petersburg for trials in 1876. The Fowler participation was supervised by Max Eyth, a German who was Fowler's development engineer. After many trials and tribulations, which included bursting a steam pipe in front of the War Minister and the Grand Duke, things improved. Eyth reported in a letter home "But now again a little sunshine—real work. We had to fetch some cannon together from various earthworks and bring them to their winter quarters and our engine suddenly showed up in its true light. We reached places which until now had been inaccessible to any road locomotive. After the first day of this new work Aveling withdrew his engine to St Petersburg and we completed the tasks to be finished in three days and in spite of all the accidents an order for two engines of a new type is assured. Aveling, of course, has got six".

In 1877, Max Eyth's *Steeplechaser* with 12ft diameter hind wheels appeared. It was tested by the military authorities in public trials at Woolwich Arsenal and was eventually sold to a civilian customer who had it rebuilt on more conventional lines.

These trials brought Fowlers into contact with Mr J A C Hay, Chief of the Machinery Section of the Ordnance Department, who wanted a hauling vehicle for guns and stores on road and rail. Fowlers accordingly developed an Artillery siege train traction engine which was far ahead of its time. It had a vertical steel boiler producing steam at 150psi to a single inverted cylinder. A 5ton crane jib was placed at the front. Between the jib and the boiler was the driver's platform with fuel

bunkers on either side and the water tank below. Wood could be used as fuel. It had compensating gears allowing the engine to turn in its own length, and a pair of winching bollards. The winch rope could be paid out front and back. The drive to all these powered facilities was through bevel gears and incorporated worm and pinion to avoid the use of brakes. The engine was rated at 8nhp and had an all up weight of 12tons. The hind wheels were 6ft 6ins in diameter.

The prototype was extensively tested at Shoeburyness in 1879. It hauled a train of fourteen field guns, weighing 34ton, at 4mph. The crane jib was used to mount the 68pdr gun barrels. It drove a powered gyn to lift a 12ton gun and the capstan winch hauled a 10ton train. A 38ton gun and carriage was hauled from a barge across the beach and over a sea wall. It towed a 40pdr gun weighing 40ton over marsh until everything was sunk to the axles and then used its wire rope and capstan, first to free itself and then the gun. On the railway it towed a 38ton gun and carriage up an incline of 1 in 40 and a train of rail wagons at 8mph.

Although it conclusively proved its value on these trials, nothing more was heard of this remarkable engine.

In February 1897 one of Fowler's new road locomotives arrived at Bloemfontein in the Orange Free State, accompanied by James Robinson, a Fowler representative. *The Engineer* for 8 December 1899 published Mr Robinson's account of his experiences:

"President Steyn kindly consented to go to the railway station, crack a bottle of champagne on the wheel of the engine, and made a speech in Dutch relative to traction engines and steam ploughs in his State.

"The new engine was to be demonstrated publicly since the Dutch farmers were not impressed with descriptions in catalogues. Bloemfontein made a general holiday for this event. A military band played us through the town and several of the Free State Mounted Police were in attendance to keep the crowd clear of the engine.

"The wagons not having arrived from England, I got six ox-wagons, and, by means of a length of wire rope fixed beneath them, connected the lot to the engine, using the dissel booms simply as rigid bars to keep the wagons from running into each other when going down steep gradients. On these wagons I had about thirty tons of coal in bags, and in addition to this about one hundred Boer farmers mounted the wagons, making probably another five or six tons.

"We ran the engine through the main streets of the town, and then, by special request, we crossed a very bad *spruit* outside the town, where President Steyn had driven in front of us to see us cross. Hundreds of the Boer population had assembled here to see us stick fast, as feeling was running very high at the time against anything English. We crossed this *Spruit* in good style, without the last hitch, when the Boers assembled could not refrain from giving us a good cheer".

Later Robinson met President Kruger in Pretoria and secured a verbal order for one engine from him. Robinson also visited Kimberley. "I had the pleasure of seeing several of my firm's double-engine steam ploughing tackles at work on the diamond fields harrowing the blue ground which is brought up from the mines and spread on the floors or fields to be disintegrated. Naturally I solicited an order for some more of this machinery, but was informed by the chief engineer that another set was on its way out from England".

Also in 1897 the War Department began a new series of traction engine trials at Aldershot and, in August, Fowler's supplied one of their latest engines, front and rear axles were sprung and it had three road speeds with a patent locking device which allowed only one gear to be engaged at a time. It could take a 60ton train twelve miles on one tank of water.

Extensive trials in Long Valley were completed satisfactorily. It travelled at 8mph and even 12mph and hauled stores from Aldershot to Salisbury Plain, some sixty miles, in one day.

Three further engines were ordered in 1898 and a total of fifteen engines and about forty wagons joined the manoeuvres on Salisbury Plain that year. Among the

spectators were the Duke of Connaught and Prince Louis Napoleon. The most successful engine was Fowler's *Lion* type and further orders followed.

With the coming of war in South Africa, Fowler's were well-placed to meet military requirements for steam traction. Not only had they worked closely with the military authorities in recent years, their engines had performed well on trials and manoeuvres and, above all, they had experience of operating conditions in South Africa.

6. Further British Experience

From 1882 to 1894 the RE Committee continued its interest in steam traction. Steam Sapper No 24, *Balloon*, already mentioned was rated at 8nhp and mounted a crane jib at the front and carried a dynamo above the smoke box.

In 1886 another Steam Sapper, Works No 2105, was delivered fitted with a dynamo. It also had specially sprung hind wheels. At this time the wheels had tyres of steel since rubber was very expensive and not very durable. Much experiment was done to try to reduce the shock and vibration caused by driving on solid wheels. Some manufacturers favoured large rear wheels and examples were built up to 12ft in diameter. An alternative approach was to insert springing between the ends of the spokes and the wheel rim. By 1894 spring wheels were generally abandoned in favour of a sprung rear axle.

In 1890 a Steam Sapper with a dynamo was used during manoeuvres to generate electricity for searchlights and for lighting camps.

In 1891 Aveling and Porter built two road rollers for the Army. They had perfected the design of the front rolls as early as 1879 and the same design is still in use today on modern rollers. A convertible roller, No 3220, was built for the Royal Engineers in 1893. It was a traction engine which could be converted to rolling work by replacing the front wheels with rolls. Convertibles were not very successful since a gear ratio suitable for road haulage was too fast for rolling and vice versa.

In 1893 eight traction engines joined the Berkshire manoeuvres. (Photo 5). They were built by Aveling and Porter, Fowler and Howard. Five were owned by the Army, the rest being hired for the occasion. Three of the engines were more than twenty years old. Nevertheless the engines performed well, moving 356ton of supplies and camp stores from Aldershot to Ulfington, Idstone, Liddingstone and camps on the way. No accidents occurred in spite of the ages of the engines and the cost of steam transport was half that of horse transport even though most of the engines were agricultural machines rather than military traction engines.

Steam Sapper *Queen* went from Chatham to Aldershot, seventy-two miles, in 26hrs and went straight out on other work. Steam Sapper No 24, *Balloon*, drew 24ton of freight to Idstone, seventy miles in 30hrs, rested for 8hrs and then did twenty-two miles to Aldershot. It should be noted that the slow speed was due to the Red Flag Act, still in force.

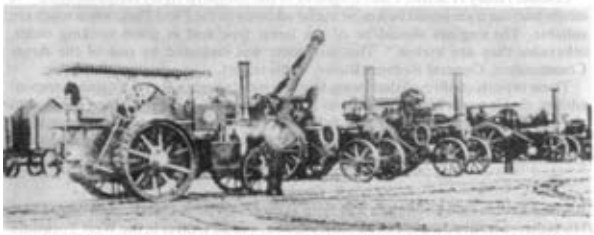


Photo 5. The Traction Engine Brigade on review in the Berkshire manoeuvres of 1893

A History of Steam Road Traction in the Royal Engineers-Part Two

In 1894 the RE Committee recommended to the Inspector General of Fortifications that the title of *Steam Sapper* should cease to be used. From then on the machines were to be known simply as *traction engines* or *road engines*. Sadly, the Inspector General agreed.

The *RE Journal* of 1 November 1895 published a report from Captain H F Gaynor RE on the use of steam transport in manoeuvres held in SE District. He wrote rather apologetically . . ." as there may be some in the Corps who take an interest in this subject". Four trains were employed, three being lent by the SME. One of these was allocated to the RE and two to the Army Service Corps. No details were recorded of the fourth train. The engine of the RE train was fitted with a pump and used for water supply.

Once again steam transport proved cheaper than horses and opinion was hardening in its favour for bulk transport in the rear of an Army.

Captain Gaynor, who did a mechanical engineering course at Armstrongs, and served as Assistant Instructor, SME Workshops from 1893 to 1898, unfortunately, and somewhat ironically, died as a result of a fall from a horse when a student at the Staff College in June 1899. His technical knowledge and experience was a great loss to the Corps.

In 1896 a new Highways Act was passed. It repealed the Red Flag Act and set a new speed limit of 14mph. The occasion was marked by the first London to Brighton Emancipation Run in November 1896.

Having shown conclusively that mechanical traction was cheaper than animal traction the Army bought more engines. All available machines took part in the manoeuvres on Salisbury Plain in 1898. They were used for hauling guns and supplies and pumping water for camps. One engine on 6cwt of coal pumped 35000 gallons of water a day from a spring through ¾ mile of pipe with 110ft head to ten camps on a hill. "This effected a saving of at least seventy pairs of horses". Another engine was fitted with flanged wheels and used for shunting on rail sidings.

In the official report, the Commander-in-Chief, Field Marshall Lord Wolseley said: "The manoeuvres show clearly that mechanical traction by means of traction engines is an efficient supplement to animal traction, especially in carrying supplies in rear of an Army. Engines of latest construction are specially serviceable and able easily to draw four wagons with a total load of 25ton up steep gradients, and moved easily wherever the ground was fairly hard".

Colonel Arthur Mackworth, Chief Engineer of the Northern Army reported: "Steam traction was largely used in the conveyance of materials for water-supply . . . and I am greatly indebted to Lieut Colonel Templer, who placed at my disposal the engine drivers and fitters of the balloon factory, and was instrumental in obtaining for use traction engines from the various firms with whom he had had previous dealings". He went on, "of those we used Messrs Fowler's compressed (compound?) engines were undoubtedly the best all round".

Colonel Henry H Settle, Chief Engineer of the Southern Army recommended: "A steam traction train would be a most useful addition to the Field Park, when roads are suitable. The engines should be of the latest type and in good working order, otherwise they are useless". This last point was endorsed by one of the Army Commanders, General Redvers Buller, in his report.

These reports confirmed that steam traction was entirely a Royal Engineer responsibility, that it was a useful addition to animal transport and a promising solution to the problems of water supply in the field. As a result three more trains were ordered and driving of engines was included in the instruction given to Royal Engineer Young Officers during their Workshop course at Chatham.

7. Crompton

Rookes Evelyn Bell Crompton was born at Sion Hill near Thirsk on 31 May 1845. His father, who lived the life of a country squire, was an Officer in the West Yorkshire Light Infantry Militia. During the Crimean War the regiment was embodied and

ordered to Gibraltar to relieve garrison troops who were going to the front. The Cromptons went as a family taking their own horses and hogsheads of ale.

During their stay HMS *Dragon,* commanded by his mother's cousin, Captain Houston Stewart, called at Gibraltar en route for the war. Crompton joined the ship as a guest and was eventually enrolled as a Royal Naval Cadet in order that he could visit the front. He was not yet eleven years old. After an eventful voyage he saw Sebastapol and was awarded the Crimean Medal and Sebastapol Clasp.

In Autumn 1856 he returned to Sion Hill and went to Harrow School in 1858. During the school holidays he began building his own full-size road engine *Bluebell* using the estate workshop facilities. He eventually completed the engine, building much of it himself, but on trial its performance was disappointing.

On 21 April 1864 he was Gazetted as Ensign in the Rifle Brigade. Whilst at the Depot in Winchester he met a certain Captain Redvers Buller. In October 1864 he sailed for India and duty on the North West Frontier.

In 1867 he had his workshop and parts of *Bluebell* sent out and amused himself by turning out dogcarts for his fellow Officers and rebuilding *Bluebell.*

In December 1868 he was appointed ADC to the Commander in Chief Sir William Mansfield. This brought him into contact with the Viceroy, Lord Mayo, who was impressed with his ideas of fast steam road travel. As a result he was seconded from military duty to the Post Office who ran a bullock service on the Grand Trunk Road. Crompton prepared a scheme for a steam transport system and in 1870 he was appointed Superintendent of the Government Steam Train. He ordered a Thompson road steamer from England and built the associated trucks in the Post Office workshop at Allighur. The first trial of the Thompson Steam Train was an exciting occasion—a wagon of ammunition caught fire, but was unloaded safely. Apart from a lack of power the trial was satisfactory.

The Government gave funds for four trains to be purchased and Crompton returned to England to discuss the design of the engines with Thompson. The new engines were to be built by Ransomes of Ipswich and the first, *Chenab,* was ready for trials by the end of May 1871. On its first run the wood fuel produced sparks which set fire to the grandstand at Ipswich Race Course.

On 6 June 1871, Crompton married Miss Clark, and took her on a trial run in *Chenab* from Ipswich to Wolverhampton for the Royal Agricultural Show. The party consisted of Crompton and his new wife, a maid, a draughtsman with his wife, two pupils, drivers, stokers, a fitter and a boiler maker. Passing through Cambridge, a bystander glimpsed the wife and the maid in the "bus-like" wagon and remarked he had never before seen ladies travelling in a threshing machine.

At the Show the "bus" was used as the judges room. At Stafford Railway station a number of distinguished visitors, including the Dukes of Devonshire and Sutherland, Sir Frederick Bramwell and Sir John Fowler, asked for a demonstration of the speed and manoeuvrability of the train. Crompton obliged by driving the train in circles and figures of eight whilst gradually increasing speed. When he stopped and went to the bus to receive their congratulations he found most of the passengers terribly seasick.

On returning to Ipswich they found the next engine, *Ravee,* ready for trial. Crompton decided to run her to Edinburgh and back. They had many adventures on this trip. The engine and its bus had rubber tyres and finding the passengers received electric shocks when alighting Crompton devised a hanging wire to earth the static electricity. They were sold coal by the bowl. They looked so dirty they were refused accommodation at a hotel where even the commercial travellers, who were the usual clients, declined to sleep in beds they had occupied. At one point they were refused water for the engine. Crompton sent a man with a suction pipe up to a small reservoir, started the pump and began to fill the engine. An Inspector arrived and said: "You are stealing our water". "Are we?" said Crompton and stopped the pump. They exchanged more pleasantries whilst, unbeknown to the Inspector, the water continued to syphon and soon steamed off with full tanks. *Ravee* was a great success. It had an improved "field type" boiler and Crompton arranged that all four engines

should be so equipped. Crompton returned to India in 1872 with his wife and *Chenab* and *Ravee*, leaving his deputy to supervise the erection of the remaining two engines, *Indus* and *Sutlej*.

The engines were based in Rawal Pindi and in October they began regular runs to Attock. In 1873 the Commander-in-Chief held manoeuvres at Hassam Abdul. *Chenab*, *Ravee* and *Indus* worked for the commissariat and were seen at work by Lord Roberts.

By the end of 1874 Crompton had shown mechanical transport to be cheaper and better than animal transport. The only real problem was the rapid wearing of the rubber tyres. Crompton devised metal "clip-shoes" to reduce the wear and running costs then compared with those of commercial operators in 1925. The steam trains were fifty years ahead of their time.

In 1875 Crompton was released from his appointment to return to England and the Government of India granted him an award of £500 in recognition of his services.

He found a distinct lack of interest at home in steam road transport and he turned his attention to electricity. By 1878, when he founded his own firm, Crompton & Co at Chelmsford, he was one of the foremost electrical engineers in the country, pioneering street and house lighting in particular, and became President of the Society of Electrical Engineers.

In 1896 Dr John Hopkinson, who had succeeded Crompton as President of the Electrical Engineers, talked of forming a Corps of Electrical Engineers as a volunteer branch of the Royal Engineers. In 1897 a scheme was submitted to the War Office who accepted it with Hopkinson as OC and Crompton as senior Captain. Preliminary training was carried out at Alum Bay, Isle of Wight.

Sadly, Hopkinson was killed whilst on holiday with his family in the Alps. Crompton became OC and by 1898 had recruited many volunteers for the EEs or "enormous eaters" as they became known. The new Corps took part in the Army Review at the Horse Guards in July 1899.

* * * *

The Procurement of Plant for the Royal Engineers

MAJOR A J LOCH RE

Commissioned 1946, served with Indian Army (QVO Madras S&M) until 1948. Regimental postings until 1958 including Instructor Officer Cadet Sqn RE; Sponsor for Plant, War Office, 1958–61; OC 41 Plt Pk Sqn; Bomb Disposal Penang; MOD and RARDE developing demolition and BD equipment; attachment with Costain; RSME as SO2 Plt and CI PRA Wing and finally in 1977 back to MOD as Plant Sponsor again, but with much less responsibility than in 1958! Was not allowed to attend Tech Staff Course in 1960 as then E-in-C considered that all RE Officers were technical. Has now held four Tech Staff appointments!

Introduction

Plant is vital to the Corps. There are few combat engineering tasks that do not use plant at some stage and there cannot be many projects that are not plant oriented.

The Procurement Of Plant of the RE Major AJ Loch RE

The Corps' plant fleet consists of over 3000 machines. The vast majority are either commercial earthmoving "C" vehicles and RE cranes (about 2000) or Engineer Construction Plant (ECP) (about 1000). The remainder are either military specials such as the Combat Engineer Tractor and the Light Mobile Digger or are non-RE cranes and material handling equipment (MHE).

Although we hold such a big fleet there are very few Officers who understand how it is procured and what are the implications and difficulties. "We buy under Lindsell" is the stock answer, referring to the *Report of the Plant Working Party* chaired by Brigadier Lindsell in1966 as if it is a magic password that somehow results in plant being available in depots. "We buy commercial machines, keep them for a set number of years and then replace them" is a slightly more knowledgeable answer but still does not explain the system and the problems.

The Procurement System

The procurement system for the commercial earthmoving C vehicles and ECP can best be explained under the headings:

WHY do we hold these machines?
WHEN do we buy?
WHAT do we buy?
HOW do we buy?

WHY? Most of the C vehicles are justified against the operational role of the units who hold them, as is some of the ECP such as that required for Rapid Runway Repair and for the compaction of tracks, route diversions and hard standings. More plant, and particularly ECP, is required to enable the Corps to maintain a general engineering capability so that it can react quickly to unplanned engineering tasks. Quickly is the important factor because this rules out hiring or buying specially for the task. The remainder is held for training, either of individuals or at unit level, especially for UK based units whose operational plant is held in BAOR.

WHEN? Procurement is the matching of what we have got against what we should have, or to put it in MOD parlance, matching assets against liabilities.

The procurement cycle starts in October every year when the liabilities are checked at the MOD Equipment Forecast Form (EFF) exercise. The EFFs show the current authorised holding of every unit and the forecast changes to that holding. The purpose of the exercise is to ensure that all the agreed alterations are included. The important figure, for reasons that will become apparent, is the holding as at 1 April 2½ years later. The checked EFFs are fed to the computer which produces in the following February the Manpower and Materiel Conspectus (Materiel) (MMC Mat) which lists all the plant liabilities by types, units, theatres, reserve holdings etc, to give the total liability. At the same time the computer produces also a record of all the plant held (assets) showing the year in which it was bought.

A recommendation of the Lindsell Report was that plant should be held for a fixed life and then cast (sold) regardless of the use that it has had. The reasons were to enable the Corps to maintain a fairly up-to-date fleet, to reduce the problems of maintaining out-of-production machines and to avoid having to undertake expensive rebuilds. The casting life of most machines varies between 10 and 15 years, which is when it might be expected to have reached 6000 hours working and be requiring a major overhaul. Machines can be cast before the end of their fixed life if the repair cost exceeds the residual value worked out by an agreed formula.

Application of the casting life to the record of the plant held gives the total forecast in-life assets for up to 10 years ahead. This is compared against the liability given in MMC Mat and a 10 year Long Term Equipment Programme (LTEP) is produced which shows what the Corps needs to maintain its fleet with in-age machines. In March the LTEP is discussed with the finance and procurement branches of MOD, to ensure that funds are available and that the buys can be provided by industry in the quantities and at the time required. The LTEP is then converted into the Long Term Costings (LTC) to go through all the financial stages until it is eventually passed by

Parliament early the following year as part of the Defence Estimates. Procurement can then take place in the immediately following financial year to meet the agreed liability as at the 1 April of the subsequent year. Hence the 2½ years between EFF and matching assets to liability (see Table).

The value of the Corps' fleet of C vehicles and ECP, sponsored by HQ E-in-C, is rather over £120 million at current replacement prices and as the average life of a machine is 12 years the average annual spend, just to maintain the existing fleet, is about £10 million. Or to put it another way, about 250 new machines should be bought every year.

WHAT? A recommendation of Lindsell was that buying contracts for a particular machine should run for 5 years. This was to stop the proliferation of different makes of machines that could occur if every buy was open to competitive tender. It also reduced the testing of new machines of one type to not more than once every 5 years.

If there is a 5 Year Best Buy (5 YBB) running that machine is bought. The difficulty occurs when the 5 YBB has run out because then the Corps has to confirm or update the type of machine required, which is done by writing a Military Requirement (MR). The MR says, in non-technical terms as far as possible, what the Corps requires the machines to do. Another Lindsell recommendation was that proven commercial machines should be bought, so the MR has to take into account what is commercially available and is likely still to be available when the buy takes place. The MR is initiated by HQ E-in-C and, after discussion limited mainly to the RSME and the procurement branch, is issued throughout the Corps for comment. The final MR represents the agreed statement of requirement against which procurement will take place. It is the equivalent of a General Staff Requirement (GSR) which is used for the development of military special equipment.

HOW? The final MR is passed to the Procurement Executive who write a Technical Specification against which suitable manufacturers are asked to tender. The tender submissions are considered at a Tender Assessment Meeting and at this stage factors other than the machine's specification are considered. The price will be important because the finance branch will always favour the least expensive. Other factors will include the manufacturers ability to build in the required quantities, whether the manufacturer has been assessed by the Quality Assurance Directorate and what content of the machine has a foreign origin.

Normally two machines are chosen to undergo evaluation trials at MVEE (Christchurch). The aim of these trials is to check the machines against the Technical Specification, and hence against the MR. Trials should take only 3–6 months depending on the complexity of the requirements and the problems that arise. Whenever possible there will be user participation in these trials to provide an opinion on the acceptability of the machines for the military role. Normally the RSME will take part in some of the MVEE Trials, or do a separate short Trial, but when the size of the buy justifies it there should be a full scale Trial and then the evaluation will take appreciably longer. At the end a report is produced and the manufacturers are asked to re-tender in the light of the results of the trials. A Tender Acceptance Meeting is then held to choose which machine will go into service and a contract is placed. The first machine off the production line is quickly re-checked by MVEE to ensure that it still meets the requirements and, assuming that everything is alright, deliveries will then start.

The Problems

The problems and their implications are best dealt with in the same sequence as that given above.

There is normally no stock of spare machines so it will take a minimum of 2½ years to react to an increase in plant establishment. If the proposal gets to MOD after July it will miss that years EFF exercise and so take 3½ years, always supposing that there is a 5 YBB scheduled. The practice of robbing reserve holdings to meet increases is no longer allowed. The only other way is to remove machines from units with a less

important requirement, which is unpopular with the loser.

Changes in plant establishments involving increases have to be compensated by decreases of a similar value, normally from within the same unit. Over a number of years plant establishments may cease to be related to the unit's real needs and become the best mix possible within an overall financial limit for that unit. It is necessary therefore to have a periodic review throughout the Corps so that reductions and gains can be balanced among all units. This happened in the mid 1960s and has happened again in 1981 under a Plant Review chaired by Lieut Colonel B R Rawlings RE.

The funds available for the procurement of plant are sufficient only to maintain the fleet at the current level. Any increase in capability will have to be the subject of a special case for additional funds and will have to compete with bids for extra requirements throughout the Army. Usually any increase in capability will be possible only by accepting a compensating reduction elsewhere, ie it will be a change in capability not an increase.

The biggest problem currently is financial restrictions which can be in the form of outright cuts in the buying programme or by postponing buys. Cuts can be accommodated only by reducing the holdings of plant or by buying cheaper machines which will not meet the agreed requirement. In either case the Corps plant capability will be reduced. A cut of £1·5 million in any year, while it may be insignificant in the tank or missile programmes, represents a 15% cut or possibly 37 machines which is more than one Engineer Regiment's total holding.

Postponing a buy can be accomodated by retaining over-age machines, which will maintain the capability but will accentuate all the problems of trying to keep running old plant when the spares support has been run down. Postponed buys can create procurement difficulties; for example the buy may be delayed beyond the end of the 5 YBB and if the contract period is not extended there will be a further delay while a new machine is selected. Even if there is a 5 YBB running there is no guarantee that, in these recessionary times, the manufacturer will be able to continue to build the Army machine over a longer period.

The most difficult task for the sponsor is writing the MR for the C vehicles. Although most will be for replacements for in-service plant it does not always follow that the new machine should be the same type. The operational role may have changed or the in-service machine may have proved to be unsatisfactory. The first stage is therefore to confirm the role of the machine and to define the essential characteristics. This will indicate the sort of machine required and from this a detailed requirement can be built up. This will not be easy because of the conflicting requirements of the different theatres and different operational roles. For example UK still requires a degree of airportability which will limit the weight while BAOR has no airportability requirement and wants big powerful machines. ADR requirements are different from combat engineering requirements which are different from project engineering requirements. Buying different machines for the different roles would restrict flexibility of deployment and would create a manager's nightmare, but some degree of specialisation can be achieved by changing the priority of the requirements in successive buys.

As the Corps is committed to "buying commercial" the next stage is to assess what is available. Unfortunately the Corps' requirements are in several aspects very different from the commercial user. For example the civilian does not need a good road mobility or towing capability for most of his wheeled plant and even if he had it he would not be allowed to use it by law. The civil user normally buys a machine for one task so does not require versatility and alternative ancillaries. The civilian operator goes home every night so does not require kit stowage and, as he will be working on one site, he does not need to carry a spare wheel and a comprehensive tool kit. And so on . . . The result is that while we "buy commercial" it is very rare that the eventual military machine is not Modified for Military use, or even Much Modified. When the MR is being drafted a reasoned judgement has to be made on

how much manufacturers can be asked to modify their standard machines without raising the price excessively and without introducing unreliability because of the unproven changes. A guess has to be made also about the evolutionary product improvements that will have taken place on commercial machines before the buy takes place. All this requires a detailed knowledge of the civilian plant world and considerable experience of service plant to avoid repeating mistakes. Incidentally it is always interesting to see how many of the military modifications are adopted by the manufacturer and incorporated either in the commercial standard build or as an option.

The MR must therefore be a compromise between what the Corps would like and what is commercially available, but it does not end there because the financiers will always insist that the cheapest machine is bought that will meet the stated requirement. It is necessary to try and think of all the ways in which the requirement could be met and to consider if the solutions are acceptable. Any that are not must be written out of the MR or, more correctly, only the acceptable solutions must be written in. At the same time however the MR must not be so restrictive that it limits competition nor must it tell the manufacturer how to meet the requirement in too much detail; the manufacturer may, after all, know a better way of doing what we want.

There exists a host of Defence Standards intended to help the designers of military specials achieve reliability and commonality. The list of those applicable to vehicles runs to about fifty pages. However invoking any but a very few will go against the policy of buying proven commercial machines. It is difficult to comply even with the important ones and very careful consideration has to be given to the whole question of Defence Standards. For example requiring the machines to be designed and built in metric units may limit the buy to continental products. Ignoring this Standard may result in the type of machine that the Army wants now being bought but what problems will there be in keeping it running in 15–20 years time when the vast majority of other Army equipment is metric? Meeting the lower temperatures laid down in the climatic Defence Standard for North West Europe will require a special type of insulation on the electrical wiring harness which some manufacturers may be unwilling to supply. Even some of the steel used in the machine may fail if heavily loaded at the stated lowest temperature. Is it vital that the machine is reliable in these conditions? Requiring the machine to be fitted with an engine from the approved range has to be worded very carefully. To increase their chances of winning the contract a manufacturer may offer an unproven installation of an approved engine rather than his well tried unapproved engine. Which is preferable? (One manufacturer who has supplied the Army since the last war with very satisfactory machines has never submitted any engines for approval).

The evaluation Trial machines are provided free by the manufacturers at considerable commercial risk because there is, at the best, only a 50% chance of winning the contract and recouping some of the expense. It is, therefore, one thing to provide a civilian model for these Trials, which has some resale value at the end, but it is a very different thing to build a prototype military machine. Some manufacturers may not be willing to do the latter in which case the difficult decision has to be taken whether the civilian model is going to produce a valid Trial report or not. During the Trials it may become apparent that modifications are required to make the machine satisfactory. Minor ones can be carried out during the trials but the manufacturer may be unwilling to do a major modification. Again a difficult decision will have to be taken whether the proposed changes can be accepted on trust or whether the machine must be considered to be unsuitable until it is proved otherwise. It gets very difficult when the machine is good in all other respects and would be the obvious choice if only one or two points had been corrected and tested.

The last important problem with the MR is that it must be right first time. If, during the course of the trials, it is apparent that the Requirement, and hence the Technical Specification is wrong a change would normally mean going back to the tendering

stage because another manufacturer might be able to offer a better price against the new specification. This would result in an unacceptable delay to the introduction into service of the new machine. Similarly if on introduction into service the machine proves not to meet the operational need the only way to make a major change would be to cancel the 5 YBB and start with a new MR accepting several years delay in the procurement programme. It must be remembered that machines will be in service for at least 10 to 15 years after the end of the 5 YBB so errors in the MR will have to be suffered for a long time. Even minor modifications when the machine is in service may be difficult because funds are limited.

Writing the MR for ECP is easier because the military use is much nearer, if not the same as, civilian use.

The MR is similar to the GSR for a military special, but in many respects is much more difficult to write. The sponsor of a GSR has to decide what is wanted, and he may have the results of a feasibility study to help, obtain financial agreement and then the designer will provide, but of course it is never quite as easy as that. However since there is no competition in meeting the GSR it can be altered during the development stage and there should be no risk that the final product will not be right.

The contracts branch will normally require the buy to go for competitive tendering unless they can be convinced that only one machine will meet the Army's need, in which case single tender action will be allowed. Competitive tendering requires the bids to be capable of being compared which means the MR cannot allow very different solutions. When the buy is small, say under ten machines, and limited to one year only the finance branch will probably not allow the expense of evaluation trials and the machines will have to be chosen as a result of only a paper assessment, a procedure full of risk.

Lindsell envisaged that buying commercially proven plant would reduce the time required for procurement because it would eliminate the need for development and for a long evaluation trial to assess reliability. It would also result in up-to-date plant being bought. Unfortunately the procurement process still takes much too long, mainly because of the current staffing levels in the Procurement Executive and at MVEE, and because of the financial uncertainty on how much money will be available in the future. Under the present procedures it should take about 4 years (see Table) from the time the MR starts to be drafted to when units start receiving the first of the new machines, but it is taking currently 5 years or longer. This creates at least two problems, firstly if the new 5 YBB immediately follows the previous one there will be insufficient unit experience with the previous machine when the MR is drafted for the subsequent buy and secondly it is stretching to the limit the capability of foreseeing, when writing the MR, what is going to be in production when the buy takes place. It may also mean that towards the end of the 5 YBB the machine being manufactured for the Army is not the current commercial model. In one instance at least, a manufacturer had discontinued making the offered machine by the time the contract was placed for the start of the 5 YBB. A production line for the Army buy had to be re-established specially.

A peculiarity of the commercial buy procedure is that while the sponsor, in this case HQ E-in-C, represents the user and writes the MR saying what the Corps wants, he does not have the final say in what machine comes into service. The sponsor is one of the committee that chooses the machine but the final say is with the Chairman who is from the Procurement Executive. The sponsor can be and is sometimes overruled, usually on the basis of initial cost. Normally the cheapest machine which the evaluation trials have shown meets the specification will be bought, not necessarily the best. Opinion, gut feeling based on years of experience, and even projected whole life costings cut little ice and an undesirable feature not anticipated in the MR may have to be accepted regardless of the consequences. Frequently no machine meets the specifications in all respects and choosing the machines for evaluation Trials or making the final choice after the Trials, becomes very difficult. The detailed requirements that the sponsor considers are important and those he is willing to cede

Procurement Programme by Financial Years			
"When"	Financial Year	"What" and "How"	
	1	Apr	Work starts assessing requirements MR prepared
		Oct	Prelim MR issued Comments on MR
Last chance to amend unit estb Jul EFF exercise Oct MMC (Mat) issued Feb LTEP Meeting March	2	Apr	Final MR issued Tech specification written Tenders called for
		Oct	Tender Assessment Meeting Chosen manufacturers requested to provide machine for trials
Treasury action Estimates agreed by Parliament Feb	3	Apr	Evaluation trials start
		Oct	Draft trial report available Acceptance Meeting
Buying year starts	4	Apr	Contract placed Manufacture starts
		Oct	First-off trial Delivery starts
Assets to match liabilities	5	Apr	Issue to units starts

may not agree with the views of the rest of the committee. It is then anybody's guess whose views will prevail.

These are just some of the problems which can occur during the procurement of plant, many more may arise. However, they should be sufficient to explain why, despite the best efforts of the sponsor, we may not get what we would like when we want it.

Conclusion

The procurement of plant is, even at the best of times, not easy and currently it is bedevilled with problems. The sponsor always acts in the best interest of the Corps but there are many difficulties to be overcome.

To ensure that the right machines are procured the sponsor requires a considerable knowledge of military and commercial plant and this can be gained only over many years of involvement. The sponsor also requires informed assistance from users in the field on changes in the operational roles and in the shortcomings of in-service machines. The Corps is not noted for passing on information and lacks, at present, sufficient plant knowledgeable officers to provide the grass roots input.

The Corps will get only the plant that it deserves. Whether it will get the right plant in future remains to be seen.

Author's after note.

Since this article was written an important change in the procurement procedure has been proposed.

At present the LTEP is based on the number of machines required to maintain the fleet at its authorised strength and in agreeing to the programme the finance branch undertake to fund it. The cost of machines, while important, is not the main factor.

It has now been proposed that in future each sponsor will be given a fixed slice of the

Equipment Vote and it will then be up to the sponsor to decide what and how many to buy. Thus the LTEP would be finance oriented.

If this happens the cost of each machine would become very important as more expensive machines would mean less machines. The MRs would have to be examined very critically to ensure that every detailed requirement was fully justified against its cost, and the result could well be that the military machines would be much closer to the civilian models and their limitations would have to be accepted.

* * * *

An Indefinite Article

POM

TWENTY years mutual manipulation of the military posting system is not to be enterprised upon, nor taken in hand inadvisedly, lightly or wantonly, but the initial and ephemeral advantages of choosing one's own way unencumbered by the ambitious urge, can lead to a full and interesting career. I use the term career not to denote a carefully planned and industrious pursuit of rank, but rather a hedonistic romp through the military machine. The morality of this may be questioned, but the advantages of living in one's own home for seventeen unseparated years cannot.

Whilst such domesticity is considered unnatural and unsporting in the services until the senior critics approach their own retirements, there are disadvantages. Two-yearly postings and the complexity of *MFO Regulations* normally succeed in sublimating the male's propensity for hoarding. Not so for me. Nothing is thrown away and everything has a place found for it. This in part explains why I now have the most complete collection of *RE Journals* outside the Corps Library. It also explains what this article is about.

A short while ago I was carrying out a well-intentioned but half-hearted cull of my collection, when I was struck by the changing styles and contents of the articles which were revealed, if not exposed, by my casual browsing. Indeed this revelation was so stark as to be positively full-frontal. Here in print was the Corps' steady and determined elimination of the inspired and intelligent eccentricity which had made it so great and respected in the past, a process which has culminated in the present day acceptance of the hard-working, self-serious military norm. This norm was humiliatingly publicised in the deliberately provocative and uninhibited paper presented at the 1978 E-in-C's Conference which caused so much amusement to Other Arms who, mercifully, did not believe that it carried the Corps' *Good Housekeeping Seal of Approval.*

The articles in my collection could be summarised as developing from the questioning *Whither the Corps,* to some of the more recent and banal offerings which could be codified as *Wither the Corps.* For those whose frenetic efforts to assuage the effects of self-imposed overstretch do not allow them the time to stand back and look long at themselves, I felt that a short article might be in order. An article which at worst would confirm the downward drift but at best might provoke a *Damascus Road* conversion. To spare the blushes of some and reprisals from others, I have refrained from naming the authors or from presenting sufficient detail for them to be identified. Sure and certain identification in some cases is not possible due to the use of *Nommes-de-Plume* or other camouflage devices designed to enflame the reader with indifference. In one case, the ever changing styles of a prolific and senior contributor either indicated that he was a late literary developer, or that he had held a YO Essay Writing test and was syndicating their work.

My collection really dates from the late "Fifties" when we bought our house. By this time two of my own articles to the Journal had been rejected, although one was later printed in *Blackwood* having been contributed by my CRE. For this he received a certain notoriety as an advanced thinker and, more importantly, the fee. This was

only right as he had risked his name. A few stories from Korea still persisted, having elephant-like been a long time in gestation, but their predecessors had set a trend for a flood of "Lessons Learned" from all over the earth which we were then bestriding. Whilst the "Wind of Change" was, with hindsight, apparent in the sky, the storm cones had not been hoist over the Empire.

The "Lessons Learned" and the tales of rugged remoteness were good and readable. My own article on the need for Dragon Gates on Jeep Tracks in Hong Kong had been instantly rejected on the twin grounds that it was not only racially provocative but that my construction methods were suspect. It was comforting therefore to revisit the scene of the crime last year and to find that whilst the Gate had been removed by a well-meaning Missionary, reinforced concrete in incapable hands can resist nature in the long term. But, here was early warning of the slide towards "Self Advancement" articles.

Over the next few years the Journal became the vehicle for modest accounts by Officers serving in the Near to Middle East together with a carefully orchestrated series from Christmas Island. In these, so unfailingly successful and resourceful were the Authors in overcoming the vicissitudes of their theatre and the apparent incompetence of everyone else, I tended to remote myself from these supermen whose "Baton Holding" capacities were thus so openly displayed. I found their writing to be as inspiring as that of the minor prophets—good stuff certainly, but deadly dull and repetitious and of little apparent relevance to mere mortals, and so I became more aligned, issue by issue, with the 98% of the Corps who could not, or did not write and who clearly were not going to be responsible for the fate of the Army or the New Towns of the future.

I therefore sent a Letter to the Journal suggesting that as more lessons could be learned from the many, ill-concealed failures that we were perpetrating whilst Engineering for Peace, we might run a Prize Essay Competition on "Lessons Learned from my Inadequacy/Incompetence/Short-sightedness as a Squadron Commander/Project Officer/CRE on Project/Exercise . . ." This letter was returned personally by the E-in-C no less, but in spite of his clear concern for my future, my letter was not published.

Then the PQE world took over for the best part of a decade. Intelligent articles written by intelligent people for intelligent readers again left me with the growing doubt as to whether or not the Corps and I were on the same wavelength. Granted my engineering education had been somewhat curtailed after an unpromising Special Inter B Sc Course at Shrivenham. I had been lured onto this whilst in Hong Kong by a corrupt signal which had ommitted the vital "B Sc" from the title, and I was well past Singapore before it was corrected. I have not liked radio ever since and only took up with Intelligence to avoid an RSO Course.

Each increasingly esoteric article on engineering was accompanied by graphs of such complexity and so cluttered by data points that they resembled a well-worn cover of the *Fish Friers Weekly*. Compared with the unintelligible text they were a welcome art-form in their own right. One, illustrating *Pretensile Stress in Reinforced Concrete Structures in Sub-Arctic Conditions* could, by only the slightest deviation in the "X" cursor, equally well illustrate the regularity of attendance at my local church by retired Sapper Generals, as determined by their "Star" ratings set against "Distance". The more I study this graph, the more I realise that it would be far easier for the majority if the Colonels Commandant Garden Party were moved next year from Minley Manor into the New Forest.

The New Forest and Minley Manor have already featured in a true account of my accident prone journey to Chatham. (*RE Journal* June 1980). This article, my first to be printed, had been given a refreshingly rapturous welcome by the many who had not been able to understand the other articles in that issue, or who by age and lack of seniority could not identify with the only other understandable offering—the Memoirs. The article did however appear to have reintroduced the inevitable chink of light at the end of the proverbial dark tunnel. We had entered the dark ages when

the then Deputy Engineer-in-Chief had snuffed out the last heroic and, with hindsight, historic flame of controversy in response to *Dowsing as a Means of Detecting Mines*.

Since then there has been a noticeable interspersion of the really heavy stuff with some lighter articles. One from my first Squadron Commander on driving a railway train in the Burma Retreat, nearly made the alltime "Top Ten", which include the 5th Field Company's ride from Aldershot to Wyke Regis whilst troop-trailling the GS Bicycle and one on the minimum number of canes to be held in a unit so that every Officer would always have one to hand. It is of interest that the Authors of these articles all left the Corps early. The Editorials too are now increasingly pungent, witty and short, and on this note of blatant flattery I close, having taken the precaution of enclosing a stamped addressed envelope.

Memoirs

MAJOR GENERAL R K MILLAR CB, DSO, DL

Born 29 June 1901, died 17 April 1981, aged 79

ROBERT KIRKPATRICK MILLAR of Orton was the son of Professor J H Millar. He was an outstanding scholar of Edinburgh Academy in mathematics and science, as Senior Ephor and Captain of Cricket and Rugby football.

A Devoted Scot, he was "Jock" from the moment he joined as a Cadet at the RMA; and as "Jock" he was loved and admired throughout his service in the Corps. He was gifted at all games; in particular he excelled as a wing threequarter winning his cap for Scotland (1924), for the Army XV (1923, 24, 25), and scoring two tries for a London XV against the All Blacks.

Commissioned in 1921 he served in India and China (1925–33), in Norway (1940) and in NW Europe as CRE 15 (Scottish) Division (1942–45) with great distinction being awarded the DSO and five times Mentioned in Dispatches. After the war he was promoted to Chief Engineer, Scottish Command and then to Engineer-in-Chief Pakistan. His distinguished career stems chiefly from his own character, leadership and ability; but credit must be given to the quality of basic Young Officer training at the RMA and SME in 1919–23.

Added to his "Officer Qualities" Jock had many other talents and interests. He was musical with a flair for rhythm (piano, drum, tap-dancing) and an ear for languages. He had a great sense of humour ranging from sparkling fun to satire, and was the life and soul of any party (often at the piano). But also he had deep (maybe Celtic) feelings; he hated "showing off" of any sort and also favouritism, this reacted on himself in a failing (if it is a failing) of being too modest; he had a passion for "fair play" and equal compassion, always put into active assistance, for any individual or minority he felt unjustly treated.

His first overseas posting was to 4th Field Company at Roorkee, a Company which had a "Pathan" Section. On posting to India Officers had to learn Urdu, no easy task; but Jock, typically worked hard to learn Pushtu as well as Urdu on behalf of his

Major General RK Millar CB DSO DL

Pathans. Later, on active service on the NW Frontier he became a legendary figure; respected and trusted as a leader, his music appealed to Bengalis and Pathans, as a Scot he understood clans, he spoke Pushtu, his dry humour they understood and lastly (not mentioned above) his quizzical expression left them guessing. After Pakistan became independent, Jock, then CE Scotland, was an ideal selection as Engineer-in-Chief. He served Pakistan so well that his tour was extended to four years, a remarkable achievement. His memory will long be honoured in Pakistan.

Of his service in war and peace with Scottish Formations, General Sir Gordon MacMillan, of MacMillan KCVO, KCB, writes:–

"I doubt whether any Divisional Commanders, including myself and Tiny Barber who succeeded me when I was wounded, were better served by their CRE's than we were by Jock Millar when we commanded the 15th Scottish Division.

"The debt which the Division owes him and his four Companies is quite tremendous. From our landing on D + 6 to the end of the war he and his men performed a vital role in our operations, at record speed and in all conditions, including participation in most assault actions.

"The Divisional history praises the part played by the Divisional Engineers in every operation. The Division carried out sixty-three bridging assaults, probably more than any other Division, including the Seine, Maas, Rhine and Elbe. Describing the successful bridgehead across the Aart Canal the history says 'that when all was said and done it was the Field Engineers who made the bridgehead possible, day and night they worked devotedly under fire and at the end only 30 out of 150 assault boats were afloat. Here the Sappers added another memorable page to the glorious annals of the Royal Engineers'. The credit for this remarkable record must be given to Jock; whose drive, inspiration and indomitable efficiency never failed. The fact that he was Mentioned in Dispatches fives times and awarded the DSO is witness to the appreciation of his superiors for him and his Sappers.

"I was fortunate enough to have him as Chief Engineer when I was GOC-in-C, Scottish Command in 1948–52. Needless to say he coped with the less dangerous, but more complicated, problems of peace time soldiering with the same cool efficiency he displayed as CRE 15 Division."

After retirement Jock took an active part in farming his land at Orton, on his beloved Speyside; and became a Deputy Lieutenant of Morayshire.

He was a devoted and beloved father and grandfather. He married Frances, sister of a Sapper friend, and daughter of Colonel W G Beyts CBE and there are two surviving sons, Peter and Sandy.

GNT

BRIGADIER THE RT HON LORD WIDGERY PC OBE TD DL
Lord Chief Justice of England 1971–80

Born 24 July 1911, died 26 July 1981, aged 70

John Passmore Widgery, lawyer, was commissioned into the Corps as a 2nd Lieutenant on 23 September 1938, to serve in the 26th Battalion RE (London Electrical Engineers). He became its Adjutant on the outbreak of WW2, and later rose to command it, while still under the age of thirty. After a series of wartime commands and appointments, in late 1943 he was appointed to command a special Air Defence Regt in the new 21st Army Group, which he landed in Normandy in 1944 and commanded throughout the campaign into Germany. He was appointed OBE, and awarded the Croix de Guerre and the Belgian Order of Leopold.

Returning home after demobilization he set about restructuring his legal career, and was called to the Bar in 1946. While he was actively creating a practice for himself as a Barrister, he was offered, and accepted, command of one of the newly forming Air Defence Regiments of the new TA. He quickly recruited it to the required strength and gained for it an outstanding reputation, with the result that in 1951 he was appointed to command a Brigade.

Meanwhile his legal reputation was growing fast, and in 1958 he became the first post-war Barrister to be given silk. In 1961 he was appointed Judge in the Queen's Bench Division at the age of fifty and only thirteen years after being called to the Bar. In 1968 he was appointed a Lord of Appeal, and in 1970 Lord Chief Justice of England. He was knighted in 1961, made a Privy Councillor in 1968, and a Life Peer in 1971. His wife Ann survives him.

John Widgery always maintained to his close friends that he owed much to his military service, which not only developed his skills as a leader and administrator, but also gave him an appreciation of the importance of organizing his own daily life with a strict self-discipline if he was to achieve an immense amount of work without sacrifice of time for essential recreation, and participating generally in human affairs. That at a critical period of his career he was able to command a Brigade while at the same time building up a massive legal reputation is some measure of his success in this respect.

He was one of those always-successful, unruffled, courteous COs that Commanders long for, and soldiers willingly die for. Few Sappers can have risen to greater heights.

B C-C

BRIGADIER E F KYTE CBE, MA, FICE

Born 9 December 1915, died 28 December 1980, aged 65

Eric Frank Kyte was born in Maymyo the son of a tea planter working in Burmah. He was educated at a Preparatory School in Britain, partly at St Josephs in Nainital (India), and partly at a crammer. That he passed into the "Shop" after such vicissitudes does credit to the schoolboy; and the way he climbed from near bottom of the list on entry to very near the top, when he left, augured well for the future.

He joined 34 (Hall's) Batch in 1934, and with several kindred spirits got himself posted at the first possible opportunity to Kitchener Barracks, where the "eye of Authority" was less keenly focussed on YOs than in Brompton; but this did not prevent one contributor to this Memoir observing—on his Batch Night—that "here was a vigorous and robust character likely to be the sort of Officer one wants to have about on any warlike enterprise".

From the start he worked hard and played hard, taking part with zest in the corporate life offered by the Army and the University. He took an Honours Degree at Cambridge; he excelled at squash and at hockey; he learnt to handle a boat at an early age, taking part in at last one Fastnet Race in the 1930s; and in general he went through life giving generously of his talents, and dealing with his fellow men in a way that won him many lasting friendships. He was in fact a thoroughly good man.

From the SME he went to 55 Field Company at Catterick "where his main activity appears to have been fox hunting; and a scurrilous rumour filtered to the South that Eric's manner of conducting an All Arms Fieldworks Course was to set a task in the morning and vanish on horseback till the late afternoon, when he would convert the day's work into a night operation by ordering a repetition to be undertaken after dark."

Brigadier EF Kyte CBE MA FICE

In 1939 he went with the BEF to France and returned over the Beaches of Dunkirk amongst the last of the rearguard. He was selected thereafter as Adjutant to the CRE of 6th Armoured Division, then training in East Anglia. He made his mark on one contributor to this Memoir, who was then a Troop Commander, by "the example he set and the thorough and meticulous way he approached his duty, yet without any trace of pomposity". It was during this time that he met and courted Cicely, then a young Ambulance Driver, whom he married in 1942. A splendid tale is told of those days: how Eric "jumped into a sports car with Cicely at his side, and with a cheery wave and a shout of 'I must be off now', he reversed into a lamp post!"

From 6th Armoured Division he was promoted Major to take command of 9 Field Company, shortly after it had been converted to Airborne. The Company was one of the best Field Companies in the Home Forces, but had been upset by what it considered the off-hand manner that its role had been changed by the War Office. Morale had slumped; two or three Officers and many Other Ranks had applied for transfer back to conventional units. The outlook was unpropitious; but Eric arrived and all was changed in a few days. Even crusty old soldiers, whose ages were against them, begged leave to remain with their old Company, and take their chances for the future. Few men could have achieved so startling a change so swiftly, and the Company never looked back.

"Perhaps he was too good for us," but in 1943 Eric was taken for Staff duties in Washington with the Combined Chiefs of Staff. Cicely could not go with him, but when Eric was posted to Burmah to join Wingate and his Chindits, she "worked her passage" to the Far East to join Force 136 of the Special Operations Executive, and they met from time to time on leave in various places. Their son, Peter, was born in Rawalpindi in 1945, where Eric had become CRE at the newly formed Indian Airborne Division. This posting was followed by a long spell of Staff work: first in America at Fort Belvoir, and then for three years on the Directing Staff at Camberley. From 1952–54 Eric was in Hong Kong in Works, and his (then) CRE pays tribute to "his quick grasp of the essentials of a job", the like of which he had never before tackled.

At the end of this tour Eric and his family embarked in the Troopship *Empire Windrush* for a passage to the UK; but in the Mediterranean the ship sank. Eric and most of the young Officers jumped into the sea "as life boats were in rather short supply"; and Eric organized a few castaway soldiers on to a makeshift raft that floated nearby. Unhappily it turned out to be attached to the sinking ship by a stout rope. "Undaunted, Eric produced a Sapper knife from his pocket and cut the raft free before it was hauled under". Meanwhile, despite considerable immersion, he kept his cap on his head and his epaulettes on his shoulders, so that when he was picked up it was clear that he was a Senior Officer. "This worked to the advantage of his family, and all three of them were given sanctuary in the Captain's cabin of the Aircraft Carrier that came to the rescue."

After another spell at the War Office, Eric commanded an Engineer Regiment in BAOR followed by three years in command of a TA Group in London. He then became Deputy Commandant of the RSME, and the Corps is in his debt for the skill with which he contrived to get "the living standards modernised without much loss in traditional values". From Chatham he went to the National Defence College in Canada and later to special employment in the Ministry of Defence. This was followed by a spell in Aden, then a hot spot in both senses of the word. His final appointment was Chief Engineer Eastern Command, and he retired in 1969. He then worked till two months before his death as an Inspector in the Department of the Environment.

For the last two years of his life he had fought, without complaint, a most painful type of cancer. He only gave up a few days before he died, when he was barely conscious. He was nursed at home till two days after Christmas and died in hospital the next day. Some say this was "his finest hour".

His Memorial Service at Lechlade, in the village Church where he had been a

regular worshipper, was attended by some of his brother Officers and their wives, by many of the local Branch of the Dunkirk Veterans Association, and by many neighbours from the locality. One tribute he would have particularly liked was that paid by the Shrivenham Shoot, in whose Syndicate he was an enthusiastic Member "without making a sensational contribution to the bag". They called a halt to their shooting, which had for weeks been scheduled for that particular day, and, still dressed in shooting clothes, they attended the Service, but resumed their guns as soon as it was over.

All who knew Eric Kyte have lost a staunch friend; and we who remain send our sympathy to Cicely and to his son Peter. We mourn a man whom we greatly admired, and we salute a memory that we all cherish.

FWJC, JRC-B, EMH, FHL, AJIP, JCW, MCAH

COLONEL W E BROWNE MBE

Born 19 June 1902, died 12 February 1981, aged 78

WILLIAM EDWARD BROWNE (Bill) lived an amazingly rich and adventurous life which few can emulate yet all might envy. Coming from a military background his academic career began at the age of eight at Kasr el Nil Garrison School in Cairo where he remained throughout his school life, with the exception of one year in England at Lady Cochrane's seat at Sunnicotts.

After WWI he joined the Desert Survey in Egypt as a Cadet under the then Director, Dr John Ball, who developed great faith in Bill's ability not only as a surveyor and brilliant mathematician but also as a man of initiative and drive who was willing to go anywhere and do anything.

Bill left Egypt when it achieved independence in 1936 and came to London to study at the School of Mines. Shortly after his studies began, Sir Malcolm MacDonald, the engineer who designed and built the Aswan Dam, invited him to join a project in Spain. To a true nomad with a knowledge of many languages (French, Spanish and two dialects of Arabic) this was an offer too good to refuse. This in turn led to further offers which saw him employed both before and after WW2, by the Turkish Petroleum Co, the Iran Petroleum Co, the Anglo Iranian Oil Co and finally as Chief Surveyor of British Petroleum, the post from which he retired in 1951.

As an Army Reservist, Bill was recalled prior to the outbreak of WW2 and on 3 September 1939 was posted to 14 Survey Company mobilising at Fort Widley. In the early days of the war he rapidly established a reputation as a first class surveyor, able soldier and a real character with considerable intellectual ability, impressions which were amply confirmed in later years. It is indeed fortunate for the Army that early recognition was given to his ability. He was employed on many special and difficult technical tasks such as the survey connection between England and France and that between Denmark and Norway. To this original-thinking man the problem of connecting the triangulation systems of the latter countries, across the 60 miles wide Skagerak, was stunningly simple—by simultaneous observations to flares dropped by aircraft, the observers on each side being linked by radio. Such was his fame that in 1945 he was asked by the United States authorities to connect the satellite tracking station in the Bahamas to the mainland in Florida using a similar technique.

Colonel WE Browne MBE

In the early days of the war Bill was sent to the British Expeditionary Force awaiting the anticipated German offensive along the Franco-Belgian frontier. He remained with 14 Field Survey Company during the bitter winter of 1939–40 and was forced to retreat with them to Dunkirk from where he was evacuated. Later he commanded 521 Corps Field Survey Company RE, then located at West Byfleet, but as planning for the return to France proceeded his talents were exploited in the Survey Directorate of GHQ Home Forces and later in the planning staff of Chief of Staff, Supreme Allied Command. When General Eisenhower returned from North Africa and set up Supreme Command Headquarters with a combined British and American staff Bill was moved into that HQ where his outstanding ability was fully appreciated.

The results of his work in Supreme Headquarters were disseminated to all Allied survey units in preparation for *Operation Overlord* and after the invasion had begun he was totally involved in collating all available technical material sent back from the theatre of operations. The German surrender came in May 1945 with Bill in Frankfurt from where he eventually returned again to the UK to continue his civilian employment and also to remain as a Territorial Army Officer.

In 1949 he was appointed the first CO of 135 Survey Engineer Regiment, Territorial Army. The early days of this unit were difficult and everything had to be started from scratch. The first summer camp at the School of Military Survey in August 1950 lasted eight days and was attended by 46 all ranks. The second camp, at St Margarets Bay near Dover in July 1951, was for fifteen days and was attended by 200 all ranks including two Supplementary Reserve units. Bill's original appointment as CO was for three years as he was expected to continue in his civilian occupation of Chief Surveyor of BP until 1952, however he had accumulated so much leave by his work on survey detachments in the field that he qualified for retirement as early as August 1951. There is no doubt that the high standards demanded within 135 Regiment in his period as CO laid the foundations for the spirit, enthusiasm and dedication which still exist in the 135 Field Survey Squadron of today.

Those who worked for or with Bill in either his service or civilian career were impressed by his perfectionism. He was at times infuriating to a degree but everyone learned that he expected the highest standards, and provided them. On one occasion Dr L J Comrie (Head of Scientific Computing Service and first publisher of Peters Tables) said that when given some of Bill's astral observation from Southern Persia to compute he could find absolutely nothing wrong with them even though they extended over two seasons work in extremely arduous terrain.

After retirement he and his wife Myra bought an island in the Bay of Islands off the east coast of New Zealand on which they built a house, much of the work by their own hands. Forests were planted and cattle taken over. Sailing was one of his great joys and he was an expert in navigation, writing articles and books on the subject. Unfortunately his health was not good, due to diabetes and a troublesome heart, and their life on the island presented its own problems making every-day life difficult for a person in any but robust health. Motor boat trips to the mainland to obtain provisions and meet their friends were a regular feature of life and on one of these Bill must have had a black-out for the boat piled up on the rocks and he had to be taken to hospital. He and Myra inevitably concluded that the island life was no longer possible and they moved back to the mainland. Bill could now show his skill as a gardener and photographs taken by him still show the lovely rose gardens which he and Myra produced. He was also a talented artist. Each Christmas friends have received cards with reproductions of his pen and ink sketches of some feature of his local landscape.

At the end of the war Bill was awarded the MBE for his services and on retiring from the TA was promoted to Brevet Colonel. He was a Fellow of the Royal Geographical Society and in 1945 received their Murchison Grant for work on geodetic survey and in extending triangulation over long distances at sea.

His many friends all over the world regret his passing but at the same time they will cherish the many warm memories of his friendship and of his very rewarding life. To

his wife Myra and sons Julien and William and their families we extend our deepest sympathy in their loss.

EWB, ABC, WHH, BStGI, WPS

BRIGADIER R P G ANDERSON

Born 12 April 1900, died 4 June 1981, aged 81

RONALD PATRICK GEORGE ANDERSON, "Andy" to his contemporaries, was a "character". He was sometimes misunderstood by those who did not know him well but was loved and respected by those who did.

To the former he might have appeared as a martinet with a pedantic interest in the *minutiae* of military accounting, concerned only with correctness. To the latter this imposing and stern military figure concealed a man who played Rugby for Richmond and the Army, a man of sympathy, humour, a gift for mimicry, a most amusing raconteur, a man with a heart of gold. You had to know him to appreciate his worth and talents.

Andy set his own standards and expected others to follow his lead. He was blessed with integrity, with the patience to examine problems in depth and a remarkable memory which enabled him to master masses of detail. Military administration and methods came to him easily and he used this to fight for those who needed help. He would tackle anyone to get a grievance redressed or an injustice set to rights. He must have stirred up many a hornets' nest in high places, but he did not care. This may have made him some enemies but it won him the hearts of many men.

Early in his career he had worked on the first topographical survey of the Gold Coast, he had served in India and on the North West Frontier, later he was in the Normandy Landings and with the Army of Occupation in Germany.

As Commandant Engineer Training Establishment (ETE) in Hameln from 1946–48 he was also Commander Hameln Garrison. This was a Sapper paradise with the largest peace time Sapper Officers Mess in BAOR. The ETE was a mini RSME and Andy went to considerable lengths to train younger Officers to accept responsibility by giving them their heads, albeit under control, and allowing them to develop pride in their own achievements. This pride in themselves, in the ETE and in the Garrison meant that few who served there will ever forget him or his wife Enid who did so much to introduce the young wives to overseas service. There can be little doubt that the excellent relationship between "town and sword" in Hameln, which later led to the "Freedom" award to the Corps, was built on the firm foundations set by the "father of the garrison".

On return to UK he commanded a TA Engineer Group in London. He was adept at smoothing relations when it really mattered. Combined with his knowledge of how to get things done, his strength lay in making the system work, particularly when he was Commander Training Brigade at Cove. It was during this tour that he commanded the Sapper contingent in the Coronation processional march. Attention to detail was evident everywhere; ensuring that all (including himself) were fit, and the exact marking out of the parade ground to portray obstacles on the official route, among many other things. After the march itself his insistance that no Officer so much as loosened his belt until all the Soldiers had been refreshed and cared for

Brigadier RPG Anderson

emphasising his deep understanding of men.

Anecdotes are legion but one has particular appeal as he had no answer! On an Admin Inspection he insisted that all the "sick and sorry" be on parade, if necessary seated on chairs. He spoke to them all enquiring why they could not be on the "parade proper". "Excused boots, Sir", "Broken Arm, Sir", etc, etc and then, from an asthmatic Sapper, "Excused breathing, Sir"!

On retirement Andy continued his life of service by making a considerable contribution to local government. He was a Surrey County Alderman and a Farnham Urban Councillor who served on a number of major Committees, some of which he chaired; among them the County Further-Education Sub-Committee. He was also a Governor of a number of educational institutions.

It is difficult to sum up the views of his colleagues and friends but they all indicated that he was a man of many talents and should be remembered for his real service to the Corps and for his own standards of discipline and devotion.

KFD, MCAH, AM, GRMcM, CDS, LGST

BRIGADIER R M W BUSK OBE, BA

Born 20 April 1926, died 15 March 1981, aged 54

Robert Michael Westby Busk (Mike) was educated at Stowe and Cambridge where he graduated in Mechanical Sciences in 1945. He joined the Army as a National Serviceman in January 1946 and was granted an Emergency Commission in the Corps in December 1946. After training at the Transportation Training Centre, Longmoor, he embarked for Japan to join 980 IWT Heavy Workshop. He was granted a Regular Commission in 1948.

Between 1948 and 1950 he served as a Staff Captain in GHQ FARELF and it was here that his love of sailing took pride of place in his leisure hours. He sailed a dinghy, a boat which he had helped build, from Singapore to Lingga Island in the then Netherlands East Indies, a return journey of well over 200 miles.

Mike joined 23 Supplementary Course at Chatham in September 1951, at which time students were encouraged to go in for "gut feel" sports, which included sailing. REYC gained an extremely competent and enthusiastic member. He was noted for being unflappable and methodical, even in the fiercest storms, and he never flagged no matter how hard the going. Following a well-established pattern for sportsmen of note, Mike was posted to the SME at Chatham after completing the Course and thereafter his sailing talents were fully exploited in REYC races. He qualified for the Services Yacht Proficiency Certificate and as a REYC Coastal Skipper.

In August 1952 Mike was posted to the permanent staff of the School of Military Survey; the work of land surveyors clearly captured his imagination for he applied for and joined the Long Survey Course in October 1953. As a student he was noted for his commonsense, reliability, conscientious approach and for his aptitude for solving all manner of practical problems.

Brigadier RMW Busk OBE BA

On finishing the course late in 1954 he was posted to the Middle East as Adjutant of 42 Survey Engineer Regiment. The Survey staff in the theatre, having been crying out for some time for their share of good regular young Officers, were told by the War Office that they were being sent a winner. And a winner he was. Quietly efficient, equally unflappable and methodical in his work as in his sailing, he worked and learnt apparently effortlessly and gave wonderfully loyal service. He threw himself without stint into everything that went on in the Regiment and at the same time continued his sailing, regularly racing a Firefly on the Great Bitter Lake. He had the demanding task of carrying out the administrative arrangements for the move of the Regiment after fifteen years in Egypt to Zyyi in Cyprus, a move that went without any real hitches. The printing machines stopped one evening in Fayid and re-started the next morning in Zyyi!

His former Commanding Officer in Cyprus writes "I could not have asked for a better man. Conscientious, soldierly and immensely hard-working, he was blessed with a sense of humour which kept him sane and cheerful in the face of the impossible demands made upon him by his new master during the settling-in-period, for which I remain eternally grateful."

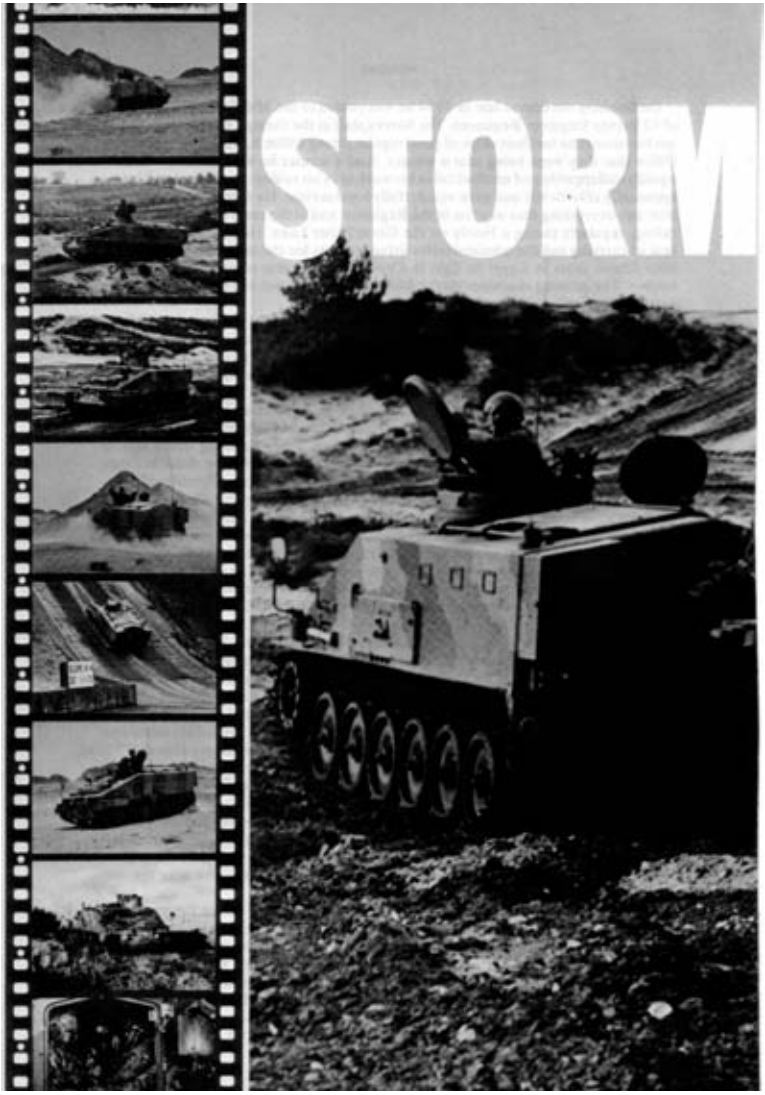
In late 1959 he took part in a Naval Expedition to Norway before joining the Ordnance Survey as an Assistant Region Officer and later, Region Officer in Nottingham. He was appointed DAD in Survey 2 MOD in 1962, a posting which was to have a significant influence on his future career and in which he demonstrated qualities of methodical and meticulous planning, coupled with considerable ability as a diplomat in international relations in the field of mapping and charting. These qualities were invaluable later when he became AD Survey 2, and again as Chief of Geographical Section in SHAPE where his major task was to weld together the often conflicting map and chart requirements of national forces and to formulate plans for production which were acceptable to all. In this he excelled and he earned the respect and admiration of the mapping community of all NATO nations. His ability and dedication in this field were recognised in the award of the OBE in 1971 at the end of his tour as AD Survey 2.

For all his natural ability as a Staff Officer there is no doubt that Mike equally enjoyed regimental soldiering. He was OC 84 Field Survey Squadron in Singapore between early 1964 and late 1967 before being promoted and appointed AD Survey 2. At the end of the latter tour he became CO 42 Regiment at Barton Stacey; this was the beginning of a period of intensive commitment to regimental life for both Mike and Bridget. In particular Mike's concern for every facet of the lives of his men came very high in his priorities; he was also seen regularly at Barton Stacey church.

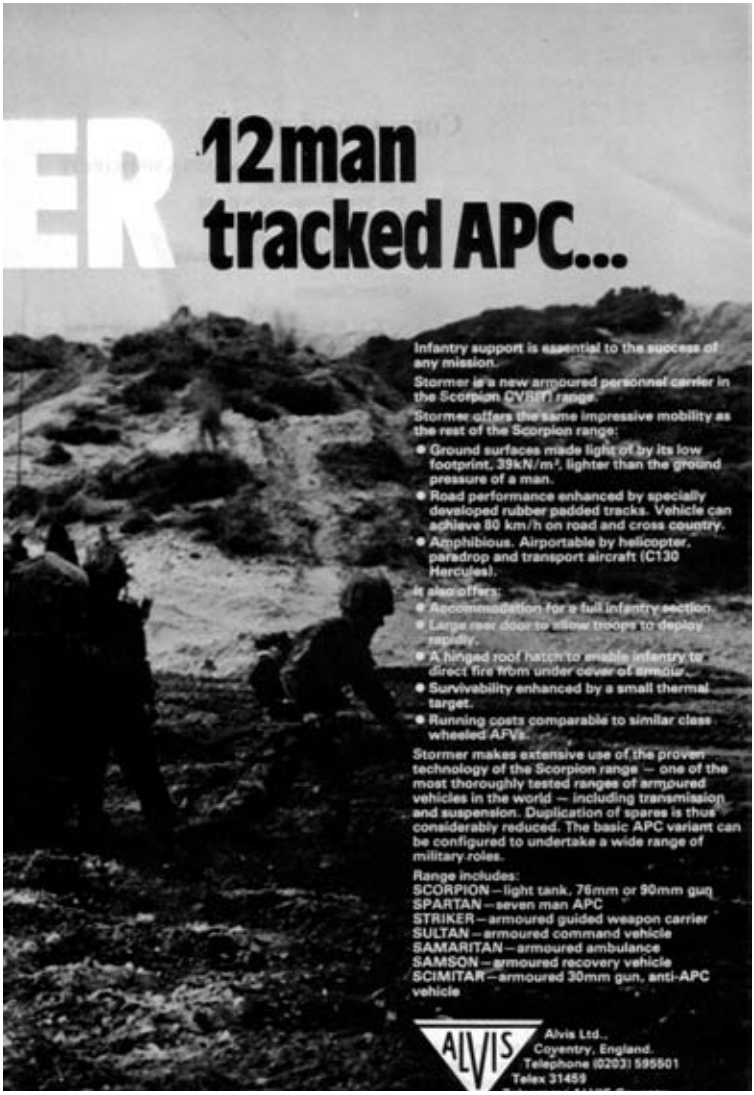
Working either with or for Mike was both a pleasure and a privilege. Never a cross word, respect for opposing views, wisdom in his advice, appreciation of any help rendered to him, loyalty and reliability were his hallmarks. He was always available if you wanted to "bend his ear" on any problem and his advice often showed wisdom and a quick grasp of the situation. Advice was given with courtesy and tact and left you with the impression that you had solved the problem yourself. He will be remembered as a gifted, modest man who usually let someone else take the credit—perhaps this should be his epitaph.

Mike was taken ill in June 1980 after attending his last major function—the opening of the School of Military Survey by HM The Queen. His illness, which it transpired had begun years before, progressed slowly but inexorably to his death in March 1981. This illness he bore with tremendous courage, and all those in contact with him during that period were inspired by his indomitable spirit and the encouragement he gave to others in hospital with him. To his widow Bridget, their son and two daughters, we offer our deepest sympathy in the loss of a fine husband and father.

EWD, MHC, JSH, BStGI, FMS, RFS, RMS



Stormer 1


ER 12man tracked APC...
Infantry support is essential to the success of any mission.
Stormer is a new armoured personnel carrier in the Scorpion CVR(T) range.
Stormer offers the same impressive mobility as the rest of the Scorpion range:
• Ground surfaces made light of by its low footprint, 39kN/m², lighter than the ground pressure of a man.
• Road performance enhanced by specially developed rubber padded tracks. Vehicle can achieve 80 km/h on road and cross country.
• Amphibious. Airportable by helicopter, paradrop and transport aircraft (C130 Hercules).
It also offers:
• Accommodation for a full infantry section.
• Large rear door to allow troops to deploy rapidly.
• A hinged roof hatch to enable infantry to direct fire from under cover of armour.
• Survivability enhanced by a small thermal target.
• Running costs comparable to similar class wheeled APVs.
Stormer makes extensive use of the proven technology of the Scorpion range — one of the most thoroughly tested ranges of armoured vehicles in the world — including transmission and suspension. Duplication of spares is thus considerably reduced. The basic APC variant can be configured to undertake a wide range of military roles.
Range includes:
SCORPION—light tank, 76mm or 90mm gun
SPARTAN—seven man APC
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SULTAN—armoured command vehicle
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SAMSON—armoured recovery vehicle
SCIMITAR—armoured 30mm gun, anti-APC vehicle
ALVIS
Alvis Ltd.,
Coventry, England.
Telephone (0203) 595501
Telex 31459

Stormer 2

Correspondence

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QUEENS' BRIDGE

Sir,—I found the article by Colonel K M Robertson on the Queens' Bridge in the June Journal most interesting as I had been involved in maintaining the original Bailey in 1961.

At the time, I was serving in 44 Field Park Squadron RE (Major Don Allison) part of the 4th Divisional Engineers (Colonel Tony Poynder) as a twenty-one year old Lieutenant. I had crossed over the bridge whilst returning from leave and had reported on its bad state of repair to the powers that be. To cut a long story short, six months later, I took my Troop to Well for a two weeks maintenance exercise.

We had a busy time tightening up the sway braces, transom clamps and bracing frame bolts as well as replacing over sixty panel pins and applying drum after drum of preserving grease. We camped in the water meadows beside the bridge and were very well entertained by the villagers who could not have been more hospitable. This was my first contact with the Netherlands and little did I know that ten years later I would be in my element working for a predominantly Dutch Company.

I enclose a photograph that you may or may not be able to reproduce, showing a party from the troop coming ashore from one of the piers—a few were due for demobilisation as some of the last National Servicemen.—Yours Faithfully, C G C Brousson

Queens Bridge

Lieut Colonel J M Cormack MBE MC
13 Prospect Row
Brompton
Gillingham, Kent ME7 5 AL

UNITED SERVICES CHATHAM RUGBY FOOTBALL CLUB

Sir,—The enclosed photograph of US Chatham RFC has been presented to the Club by Brigadier O J R Orr OBE. It depicts the team of 1925/26, 1926/27 or thereabouts. Some of the names are known (and some of the initials) but not all.

Any member who can help further identify any of the players is invited to write to me with all the information he has.—Yours sincerely, John Cormack

Back Row L to R: Murray; Graham; O J R Orr; Hutchinson; Hornby; ?; T F White; Hunt
Front Row L to R: Holloway; Longland; L G Thomas; ?; ?; Wilkinson; G D McK Sutherland

Book Reviews

METZ

THE UNKNOWN BATTLE METZ 1944

ANTHONY KEMP

(Published by Frederick Warne, London. Price £7.95)

THE story of this battle is not one of great strategy but an account of small, bitterly contested engagements at a time when the whole Allied line was threatened with winter stalemate. It is more a story of heroism on both sides and suffering from appalling weather conditions.

Patton's 3rd US Army came into prominence during the break-out from Normandy and the headlong pursuit across France after which it faded from the scene, only to reappear in the headlines during the Ardennes offensive in December 1944. This book is concerned with the non headline period between September and December 1944.

Given a temporary breathing space by the Americans' supply problems, a scratch force of German troops dug themselves into some pre-1914 forts and gave Patton a taste of 1914–18 warfare for which he had neither the talent nor the temperament.

The book will appeal to those who like a good story as well as to those who are interested in what actually happened (and why) and the influence of Metz on the outcome of the Ardennes counter-attack.

PB

United Services Chatham football Club

THE FALL OF FORTRESS EUROPE 1943–45

ALBERT SEATON

Published by B T Batsford Ltd, London. Price £9.95)

COLONEL Seaton is both Russian and German speaking. This book is based mainly on German material although other language sources, particularly Russian, Italian and Anglo-American have been used.

By the midsummer of 1943 the Wermacht had fallen back behind the Straits of Sicily in the Mediterranean and had begun to build, with feverish haste, the Atlantic Wall in the West and the East Wall in Russia—in fact to construct their Fortress Europe, with the intention of defending it to the last.

The Author sets out simply and concisely the political, economic and military organisation of the Third Reich, its strength and its weaknesses. He traces the chain of events within Germany during the last two years of WW2 that saw the Fortress liberated or overrun, and the whole of the Reich engulfed, and then inundated, by the invading armies of the Allies.

The Maps are clear, the photographs interesting and the Index is more than adequate. Readers who are striving for a balanced view will welcome this book.

PB

DIESEL ENGINES (SECOND EDITION)

J N SEALE revised by J HARTLEY

(Published by Butterworth & Co. Limp Price £1·75)

THIS book, one of the thirty plus Newnes Questions and Answers Series, explains the working principles of the diesel engine and includes examples of some modern engines. The accent is on automotive and car diesels and covers reduction of noise, smoke and fuel consumption as well as turbocharging and auxiliary equipment. SI units are used throughout but there is a conversion table for those who are unwilling to think in these units.

The information is well presented, with clear diagrams and a good index and will be of interest not only to those involved with diesels but also to those who are simply interested in them.

EEP

THE ARMOURED TRAIN—ITS DEVELOPMENT AND USAGE

G BALFOUR

(Published by B T Batsford Ltd. Price £9·95)

THIS book, a welcome addition to the Batsford books on Railways, is a fascinating account of all the armoured trains that have operated in Great Britain and of all recorded proposals for such trains. To enhance the scene the author has gone outside GB to the American Civil War. Franco-Prussian engagements, various colonial campaigns and the Boer War. He also pays deserved tribute to the invaluable services of the Polish Army in WW2.

This book is well illustrated with photographs, maps and line diagrams (some from the Corps Library), a short but detailed Appendix and an extensive Bibliography.

EEP

REVISED PRICE LIST FOR HISTORY OF CORPS

BECAUSE of reprinting the prices of Individual Volumes and Sets of *The History of the Corps of Royal Engineers* have been revised. The policy of the Institution is still to recover costs only from Members.

PRICE LIST 1981

		MEMBERS	NON-MEMBERS
Volume I	Norman Times–1860	£ 4·50	£ 9·00
Volume II	1860–1885	£ 4·50	£ 9·00
Volume III	1885–1914	£ 4·50	£ 9·00
Volume IV		£ 3·50	£ 7·00
Volume V	1914–1939	£ 5·50	£11·00
Volume VI		£ 4·00	£ 8·00
Volume VII		£ 3·50	£ 7·00
Volume VIII	1939–1948	£ 4·00	£ 8·00
Volume IX		£ 5·00	£10·00
COMPLETE SET		£29·50	£59·00

Postage & Packing, Surface Mail UK: £1·43 per volume up to £2·65 per set
Post & Packing, Surface Mail Overseas: £6·00 per volume up to £15·00 per set

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2. By Bankers Order of:
   (a) 9 monthly payments of £3·70
   (b) 4 quarterly payments of £8·30

The set will be despatched on receipt of Bankers Order, *plus cheque to cover p&p.*
Sets for non-Members can only be purchased by a single payment of £59·00, *plus p&p.*

ARTICLES AND CORRESPONDENCE FOR THE JOURNAL

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

ARTICLES

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

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

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

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

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

Three further awards are made each year:—

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

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

The Arthur ffolliott Garrett Prize (to purchase or help purchase a piece of silver, value £20) for the best article on the technical aspects of logistic engineering or survey by a Serving Regular RE Officer not above rank of Lieut Colonel.

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

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

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

CORRESPONDENCE

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

The submission dates for Correspondence on published articles are therefore:

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