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Contents

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4,250

As Through a Glass Darkly

LIEUT GENERAL SIR DAVID J WILLISON KCB, OBE, MC

The author was commissioned from the Shop in 1939, passing out first in his batch and gaining the Pollock Medal. After a tour as the first full time instructor on the Bailey Bridge, he landed on Sword Beach on D Day as OC 17 Fd Coy and was seriously wounded that evening. Later as OC 246 Fd Coy he was awarded the MC. WW2 ended and after a number of Sapper and staff appointments, including DS at Camberley, he commanded 38 Engr Regt. In 1963 came his first job in Intelligence as Col MI4, this set a new course for the rest of his career. After a year at IDC in 1966 his progress in Intelligence was rapid and he was appointed DCDS(I) as a Lieut-Gen in 1972. He was knighted in 1973. He retired in 1975 in order to take up the civilian post of Director General Intelligence as a Deputy Secretary in the Civil Service, a post he held until Sep 1978. In 1977 he was appointed Chief Royal Engineer after a year as Representative Colonel Commandant.

THE first of the "new look" Journals has followed up much of what was discussed at the Engineer-in-Chief's conference last November. As temporary custodian of the traditions and policy for Corps affairs, I welcome enormously this new endeavour. In philosophic terms I believe we need to look afresh at the fundamentals of the engineer support we provide to the Armed Forces. What factors affect these fundamentals in terms of Defence Policy and strategic policy? I suggest there is a wide field here for discussing, as soldiers with a broad purview, just what is required of us now and in the future. The requirements of the Royal Air Force figure substantially in our thinking in addition to the traditional requirements of the Army. Unless the parameters of the total requirements we have to meet are reasonably clear, it is difficult to be sure that projected technical innovations are necessarily heading for the right goal mouth.

New ways of affecting the battlefield by rapid engineer effort have always been in the forefront of our thinking. As strategic and tactical doctrine moves, it has always been our business to anticipate such changes and to have our technical solutions evolved and ready for production. Given winners in the technical field, organisations may have to change to reap maximum benefit on the battlefield. Commanders in their turn may have to fit their tactical plans closely to the engineer art of the possible.

These are just a few examples of topics that I hope can be explored by articles in the successive issues of the *RE Journal*. Such articles need necessarily to be firmly based on the latest facts and these invite research by contributors before putting pen to paper. The correspondence section of the Journal can become very lively indeed in the wake of researched—and provocative—articles.

I have laid stress on the forward looking aspect. But I am most conscious of the need to record past experiences and techniques as well. So often technical solutions have been developed and then discarded before production took place because the circumstances of the time did not require the particular innovation. Yet changing circumstances may render earlier concepts valid once again. In defensive war in particular, how to bring to a stop the mass onrush of armoured vehicles constitutes an

Lieut General Sir David J Willison KCB OBE MC

area where research into past ideas may yield a jackpot, just as much as the application of the latest technology.

Forward thinking needs to cover all our Corps functions, including Survey, Postal and the multifarious aspects in peace and war of civil, electrical and mechanical engineering. If the powder train truly catches the spark, I fear for the poor editor who will have to handle an ever increasing flow of your contributions.

To read the crystal ball aright lies in your hands as readers of, and hopefully contributors to, this Journal.

Joint Professional Meeting The Use of Explosives

MR H A SWINNERTON, PP Institute of Explosives Engineers and Fellow of the Institute of Demolition Engineers, and MAJOR A J MORTON RAE, Senior Instructor Fieldworks RSME, presented a joint paper on The Use of Explosives to a Meeting of The Institution of Royal Engineers and the Kent Branch of the Institution of Civil Engineers at Brompton Study Centre on 13 March 1979. Over 200 attended and over 150 attended the buffet supper in REHQ Mess after the Meeting. Mr Dennis James, Chairman of the Kent Branch, in introducing Lieut Colonel B R Rawlings who chaired the Meeting, welcomed, in particular, the "Contingents" from Kingston and London University.

Mr Swinnerton, who had served in Brompton Barracks over thirty years ago had entitled his talk "Blast it—I'm here again!" He explained the philosophy of the civil use of explosives. In the minds of the civil experts the clearance and disposal of the results of the explosion were of great importance. For example it was of little value to demolish a structure in minutes to spend the following weeks hand breaking the debris, when, with skill the debris could be readily handable and in some cases (beams etc) could be reclaimed and used again. He emphasized this point when discussing the demolition of a steel beam and slab bridge, the explosives expert split the slab longitudinally with successive cuts to permit the crane removal of the RSJs still encased in concrete. He also discussed the difficulty of demolishing post-tensioned structures, especially some tall buildings. He illustrated his talk with slides and an interesting film which he had "produced".

Major Morton, who had organised a small display to show a range of Service equipment, opened his talk by setting the scene showing that the perceived threat led to the role of the Defence Forces and their priorities. These—in turn—influenced the thinking, organisations and equipments. He explained the aim of military demolitions, the use of the equipment and the "one-shot" philosophy to enable the audience to appreciate the reasons for the different techniques employed by the military and civilian exponents of the art. He emphasized the speed in emplacement, economy of use and simplicity of technique were prerequisites of a "one-shot" success. On the future he concentrated on increased ability to demolish large modern bridge structures.

The formal discussion centred mainly on five areas; the use of remote control detonators; the recognition of bridge types; the desirability of "built-in" demolition convenience at design stage in modern bridges, particularly post-tensioned structures; the responsibilities of Junior NCOs in charge of demolitions and the successive failure to demolish a well known resort pier!

Major General J C Woollett CBE MC proposed the Vote of Thanks to the speakers and the organisers.

The discussion continued informally well into the night and all agreed that it had been a very well attended, interesting and enjoyable evening.

Engineer-in-Chief's Conference 1978

MAJOR A CLEMENTS RE

After commissioning from Sandhurst in 1963 and attending the short course at Shrivenham, the author joined 36 Engr Regt where he served two tours in Aden before being posted to the Gulf as a Sqn 2IC. A tour as Adjt of the Junior Leaders Regt preceded a posting to HQRE 1 (BR) Corps as GSO3 Ops/Int. A spell in RSME followed, firstly in the Sigs Wing and later as GSO3 Trg. His last complete tour was as OC 131 Indep Para Sqn RE (V) and he took the Sqn through the conversion to its new Commando role. He is currently serving as a GSO2 in HQ E-in-C.

INTRODUCTION

THE Engineer in Chief's 1978 Conference was held at the RSME from 20–23 November 1978. The theme on the first two days was an examination of operations on the central front of Europe, both in present circumstances and in the years ahead, and the third day was devoted to more parochial matters, in particular to discussion of a paper on *RE Influence in the Army* by Major M A St C K Sims RE. The Chief of the Defence Staff, Marshal of the Royal Air Force Sir Neil Cameron, was present for the guest night, the VCGS, Lieut-General Sir John Stanier, addressed the conference, and many senior Army and RAF officers, civil servants and scientists were present.

This account of the conference is necessarily very limited when dealing with the operational side due to security reasons and it has therefore concentrated mainly on Corps matters.

OPERATIONS

Today

The scene for *Todays Operations* was set by BGS (Int) DIS, who warned that the balance of power was swinging away from NATO. He gave his view of the Soviet interpretation of détente, which though excluding war with the West does not rule out political conflict or support for "third world" struggles. He stressed the technological advances in Soviet equipment in all three of their Services and the extent of the threat they now pose to NATO.

The Colonel GS of HQ 1(BR) Corps followed with a presentation of the threat facing our forces in Germany and the Corps Commander's concept of operations. He went on to discuss the implications of the political requirement to halt an enemy intrusion as soon as it had crossed the German frontier and the crucial importance of the engineer plan.

The CCRE and his 1(BR) Corps team gave a comprehensive brief on the engineer support given to armoured divisions in BAOR and likely tasks of regular and TAVR RE units in war. The Chief Engineer BAOR went on to describe operations behind the Corps Rear Boundary, and he highlighted the critical importance of the timely arrival from the UK of reinforcements, mainly TAVR.

The discussions which followed the presentations mentioned above were lively and useful, and we were fortunate in having CinC UKLF and the GOC 2 Armoured Division present. The GOC expressed particularly his concern about the loss of flexibility unless the greatest care is taken in planning barriers, particularly minefields.

Major A Clements RE

Tomorrow

The conference then turned its attention to the future, and the Director of Combat Development opened the batting, looking ahead to the 1990s. His presentation dwelt mainly on the importance of delaying the enemy while at the same time retaining mobility for our own formations; his message presented a formidable challenge to the Corps. There followed presentations and discussions on barriers, which included recent developments in mines and research in other fields. Under the heading of *Mobility* the conference heard about, and discussed future trends in, bridging and methods of breaching minefields. It was clear that enormous problems will face the Corps on the battlefield of the future and that the role of the Corps will continue to be of crucial importance.

RE support for the RAF both now and in the future came under the spotlight, and it covered assistance to Harrier operations and the daunting task of keeping RAF airfields open after attack both in the UK and in Germany. It was very helpful to hear from VCAS, Air Marshal Sir Peter Terry, of RAF Plans for the development of future generations of combat aircraft.

CORPS MATTERS

Manning And Recruiting

The final day of the conference was devoted to manning and Corps affairs, and the proceedings were opened by the Deputy EinC, Brigadier R W M Lister.

He gave details of our shortage of officers, but pointed to a more encouraging picture in the field of officer recruiting in both quality and numbers. Regiments will be short of junior officers in the coming year, and Brigadier Lister suggested that commanding officers should beware of merely sharing out more duties on to fewer shoulders. He said that there was plenty of evidence to suggest that as a Corps we tend to over-supervise, and that there is probably scope for further de-centralisation to our NCOs, where quality is generally very high.

Brigadier Lister explained that in the rank of major our problems went further than mere numbers; in present circumstances we were having difficulties in getting as many officers out to all-arms posts as we would wish, and action was necessary to improve this situation. He said that officer shortages would certainly cause difficulty, especially in the shorter term; however, it was vitally important that we so arrange our affairs that officers feel they have a worthwhile job, quality of life, an element of fun, their share of sport and career opportunities appropriate to their talents and interests.

Turning to soldiers he said that though we are now just about up to strength we are heading for shortages. Recruiting is running at a lower level than is required. We are losing too many soldiers after only short service, and we are faced with an otherwise welcome increase in our manpower ceiling. The Deputy EinC emphasised the great importance of doing all we could to cut both recruit and trained soldier wastage. In this connection he said that the Adjutant General had told EinC that he was in no doubt that the Government would honour in full its forward commitment to the Services. He spoke of the importance of the junior entry and of studies on the possibility of accepting more juniors into the Corps. He covered a number of more detailed points, such as the importance of writing good annual reports; the measures that were being taken to improve the selection procedures for NCOs for the training organisation; the shortage of clerks and the need to persuade soldiers to transfer from other employments to the clerical roster; and the critical need to get the really promising young soldier promoted Lance Corporal very early in his service.

Brigadier Lister concluded by saying that the officer and soldier manning picture was not rosy, but equally there are many promising developments, which he touched on, and he stressed the critical importance of retaining in the Corps the trained officers and soldiers we must have to fulfil our role.

Care of Equipment

Brigadier J A Notley, Commander ESG, gave a short presentation aimed at

bringing home the need for more attention to the care and maintenance of plant and equipment. He illustrated his presentation with a selection of "horror" slides of plant and equipment in poor condition

THE SIMS PAPER

The Paper

The EinC introduced Major M A St C K Sims, a squadron commander in 28 Amphibious Engineer Regiment, who had been asked to produce a paper on "Sapper Influence in the Army" which had been distributed to all attending the conference. He had been invited to feel uninhibited by current practice or by the views of senior officers in presenting his case, and encouraged to be provocative. He wrote a good paper which was important not only because of the views it reflected, but also because they are perhaps the views of many younger officers who have much of their careers still before them.

The paper opened by saying that there was a widespread view that the influence of the Corps in the Army had declined over the years, and it aimed to examine the subject with a view to recommending how it could be enhanced.

The paper discussed a number of topics which relate to the subject, some of which are shown below:

(a) An analysis of what we mean by influence in the Army, and it pointed out that it goes beyond having our share or more than our share of the top posts.

(b) Discussion of Sapper officers' performance at the Staff College since 1974, going on to question why more of our officers do not get senior all-arms command posts. It suggested that the RE commanding officer is so burdened with the complexities of running his regiment that he fails to shine in the field of tactics. The problem is further exacerbated in its view by the confidential report chain, which is forced on us by our present structure in BAOR.

(c) An assertion that as a Corps we are poor at delegation, and it gave a telling example to make the point.

(d) A discussion on engineer command arrangement in BAOR divisions.

(e) An analysis of PQS2 results with the sinister falling pass-rate of RE officers over recent years.

(f) An argument against allowing so many of our officers to be sent to grade 2 weapons posts.

(g) A plea that we get more of our best majors into all-arms staff posts.

(h) Some views on the employment of PQE officers.

(j) Recruiting and education of officers, and it called for soldierly qualities to be the first criteria in selection. It wanted our officers to be more articulate, and thought we should accept some with arts degrees.

(k) Special streaming and grooming of our most promising officers.

(l) The appointment of Honorary Colonels of regiments.

The conclusions and recommendations are set out in full below.

Conclusions

"Influential positions in the Army are found amongst those jobs which are filled by officers from any Arm or Service which range from the most senior appointment on the Army Board to the principal Grade 2 Staff Officers at Task Force and Field Force Headquarters. Alternatively they are filled by experts of any rank.

Sapper influence in the Army may be on the decline. This can be attributed to:

(a) Sapper commanders not paying enough attention to all-arms matters and so not being recognised as having ability to take all-arms command or staff appointments. A heavy work load and over commanding are offered as reasons for this blinkered approach.

(b) COs, who are amongst the best officers of their age and rank, do not have sufficient access to Task Force or Divisional Commanders. The Regimental HQ could be reorganised to allow the CO and 2IC to advise at Task Force level if the quality of 2IC improves.

(c) A poor performance at PQS2 due to lack of motivation and inadequate preparation, leading to a reduced number of influential Grade 2 jobs.

(d) Insufficient streaming before Staff College to ensure that the best officers are trained for the General Staff, and only those with the desire and aptitude are trained for the more limited Weapons Staff.

(e) Insufficient streaming to create experts of any rank.

(f) Possibly too much insistence in the past that the Corps recruits officers with degree or professional engineer training potential as opposed to soldierly and literary qualities.

(g) A failure to foster our outstanding young officers to ensure that they have every opportunity to reach high rank. Fostering could be implemented through an Honorary Colonel system.

(h) A failure to ensure that the best reporting channels are used to report on COs."

Recommendations

"It is recommended that:

(a) The Sapper CO replaces the squadron commander as the Task Force commander's adviser giving him greater opportunity to be recommended for all arms appointments.

(b) Closer attention is paid to motivating and preparing officers for Staff College training, including diverting our best officers out of the Weapons Stream.

(c) The present emphasis on recruiting soldiers as opposed to engineers is continued and if possible weighted towards recruiting more officers with a literary background as opposed to an engineering background.

(d) PQE officers are recruited for Professional Engineer jobs only.

(e) Experts are cultured in a variety of faculties.

(f) An Honorary Colonel of Regiments system is introduced as an aid to keeping a close watch on the career opportunities of outstanding young officers."

Introduction of Paper

In introducing his paper to the conference Major Sims said that he found his attention drawn increasingly to the animals on the quartering of Great Britain's Coat of Arms—the lion and the unicorn. He felt that perhaps their characteristics have something in common with Sapper officers. Sapper officers could be described collectively as having a lion's heart and a unicorn's mind: a mind which is perhaps a little prosaic though sound in its approach to nine out of ten of life's problems but absurdly eccentric in the tenth. He said that he felt the tenth part was a saving feature, and the balance was what had made the Corps great in the past. We have had fine engineers, academics, lay preachers, administrators and unusual soldiers. In its off-spring the Corps have reason for pride in the Royal Air Force and the Royal Corps of Signals and there is an impressive history of innovation on the battlefield. But Major Sims pointed out that nearly all these examples were in the past, and modern examples are conspicuously absent. He asked whether the presence of the dull and prosaic unicorn characteristic with that saving but small one tenth part of eccentricity had overwhelmed the spirit of the lion. Further questions came to mind. Are we too married and methodist? Do we affect or influence modern warfare as we should? Do we have an articulate voice in the Army which commands respect and attention?

With this provocative introduction he invited discussion on his paper.

Discussion

It will surprise no one that Major Sims had laid the foundations for lively discussion which covered almost every aspect of the Corps. It is impossible to summarise it fairly, but some of the points are shown below:

(a) The attention now being given to officer recruiting was widely welcomed, as was Corps policy to place more emphasis than in the past on leadership qualities and less insistence on academic excellence. For all this there was one officer who argued compellingly against allowing engineering standards to be degraded.

(b) Some thought that our image has become rather dull and that the quality of life in regiments is not as high as it might be.

(c) Many thought that our officers lack all-arms experience and that we must get more officers out into all-arms posts. However, it was equally argued that ultimately the Corps will be judged by how well we do our work in support of the Army, and therefore we must keep good officers running the Corps.

(d) It was thought that too many of our officers are drafted into weapons staff posts and that this is not in the interest of the Corps or individuals.

EinC ended the discussion by thanking Major Sims for his very valuable contribution to the conference in the form of his paper and the discussion it generated. He undertook to take note of and follow up on what was said. He described the setting up of his own officers careers board with the aim of prospering the careers of RE officers in line with their interests and abilities.

E IN C'S CLOSING ADDRESS

In his closing address EinC thanked the Commandant of the RSME and his staff for all the admirable arrangements that had been made for this large and complicated annual event. He said he thought it had been a particularly valuable conference which had produced some excellent debates and he was particularly pleased to have had so many influential guests present.

In reflecting back over the points raised during the conference, EinC said that having heard Brigadier Glover's presentation on the Soviet threat, we as Sappers should be left in no doubt about what it represents for us. We should now be well aware of the complexities of the I(BR) Corps task and we must ensure that our organisation is right, our command and control is appropriate, and that we get the most out of our men and machines. He referred to the VCG's address and said that although the allocation of extra manpower is a great source of encouragement, it was essential to recruit and hold our officers and soldiers. In this connection he stressed the importance of our revised career structure for soldiers and pointed out that already the indications of its effects were good.

EinC emphasised that the future of the Corps rests in our ability to recruit really good young men fit to officer the Corps; everyone has a part to play in talent spotting. He mentioned again his careers board which will monitor the careers of all our officers to ensure that their potential is fully used. He recognised the importance of all-arms experience and he would press hard for the good General Staff grade 2 posts. He touched on the importance of giving the young responsibilities early in their careers, and he endorsed the need for adventure and sport; he stressed that Army life should be fun. He recalled that life in the old days always seemed busy but was perhaps better managed; people were not trying to do the jobs of those two or three below them. More use was made of the talent of warrant officers and sergeants, with the result that they had more authority, dignity and influence which has now been partly eroded. He was well aware that many of our problems started at the top, and he suggested that all from himself downwards should relax more and allow responsibility to rest where it properly belonged.

In concluding, General Campbell said his message was to move forward with hope, but he suggested it is not a time for faint hearts. He reminded the conference that we have a fine record which is the envy of the Army. The future presents a challenge which we must face together, as there is some important thinking to be done. He stressed the importance of good communication for the development of and the exchange of innovative ideas at all levels. He urged a greater use of our journals and magazines, and said he wanted to hear as much from the ranks of the Corps as the Corps did from him.

* * * *

Restructuring of Engineers in 1st British Corps 1975–78

COLONEL G W A NAPIER MA

The author joined the Corps as a Sapper in Nov 1950 for basic training at 1 Trg Regt RE, Malvern. After Officer Cadet training at the RMA Sandhurst, he joined 12 Fd Sqn in Korea in 1953. He attended a three-year degree course at Cambridge University from 1954 to 1957 and, following Junior Officer training at the RSME Chatham, he was seconded to the Ghana Army as a Tp Comd. He was Adjutant of 113 Army Engr Regt (TA) from 1960 to 61 and then joined 33 Indep Fd Sqn RE in Cyprus as second in command. After attending the Staff College at Camberley in 1964, he joined the Staff of HQ Land Forces Borneo from which he returned in 1967 to take command of 5 Fd Sqn in BAOR. He was promoted Lieut-Col in 1970 and served as GSO1 in RARDE, MOD Central Staff and latterly as GSO1 RE HQ 1st British Corps.

INTRODUCTION

SOME years ago a certain senior officer in the Corps used to say "The day when the Chief Engineer BAOR does not get up at the E-in-C's Conference and outline the latest proposal for the reorganisation of Engineers in BAOR, I will know the time has come to retire". Retire he has, but his ambition remains unrealised. The familiar cries in the past two or three years have been: "We've seen it all before", "Why can Sappers never get it right", "Round the same old buoy again". The restructuring which followed the 1974 Defence Review was possibly the best opportunity that has presented itself since the war to start with a clean sheet of paper and build an Engineer organisation ideally suited to providing the necessary support to all arms. Yet the impression remains in many quarters that it still is not right.

Now that restructuring is complete a review of how the present situation has evolved serves as a useful vehicle to highlight the areas where perfect solutions may in fact be unobtainable and why the continuing evolution of Corps organisations is inevitable and desirable. However there may be some fundamental principles which should not change and it would be worthwhile to attempt to identify these.

INITIAL STEPS

The initial steps in restructuring in 1974 were conducted in considerable secrecy. Comparatively few people were "in the know". The blueprints that emerged at the end of 1974 were intended as vehicles for trials in 1975. Phase 1 of restructuring, the formation of one of the new Armoured Divisions, was to start in the autumn of 1976. Time was therefore short and in the event there was very little room for manoeuvre from the 1974 blueprints, an illustration of Lesson One in all studies, that the first shot cannot afford to be too wide of the mark.

The parameters within which restructuring is to take place are now too well known for repetition in more than outline:

(a) *The "Principles"*: Loss of a level of command (a brigade), increased span of command and concentration of specialist functions.

Restructuring of Engineers in 1st Britih Corps 1975-78
Colonel G W A Napier MA

(b) *The New All Arms Organisation*: Four Armoured Divisions, the Artillery Division, command of Battle Groups direct from Divisional Headquarters.

(c) Reduction in manpower of about 10%, largely to fall on the logistic tail.

Within these Army-wide parameters the Sappers had to lay down their own as a basis for planning. These also had to take into account the equipment changes due to occur coincidentally during the period of restructuring principally the introduction of the Chieftain AVLB (Armoured Vehicle Launch Bridge), the CVR (Command Vehicle Reconnaissance) series and the CET (Combat Engineer Tractor), and the phasing out of the Mark VII mine. The engineer parameters became:

(a) All combat engineers in 1st British Corps would be concentrated in four large Armoured Divisional Regiments.

(b) The CO of the Armoured Divisional Engineer Regiment would be the CRE.

(c) The Field Support Squadron would subsume the responsibilities of the Headquarters Squadron for regimental administration.

(d) The Armoured Engineers would become armoured bridging only with a Troop in each Divisional Regiment.

(e) The Amphibious Engineer Regiment would be reduced from seventy-two to sixty manned rigs.

(f) All Corps requirements for Engineer Resources would be concentrated within the Corps under the "One Base" principle.

Organisation

Throughout 1975 the organisations arising from these parameters were subjected to a very detailed scrutiny which was to culminate in the trials in the autumn. Preliminary examination and CPXs (Command Post Exercises) revealed numerous weaknesses even before the autumn exercises and this decided the CCRE to undertake these exercises on the basis of a trials organisation which appeared to be nearer to the eventual required solution.

The main changes included:

(a) The establishment of a full Colonel CRE in addition to the CO of the Divisional Engineer Regiment.

(b) Numerous additional posts in the command and control structure to allow particularly for adequate communications cover.

(c) The division of the very large Field Support Squadron into a Forward Element, comprising essentially the Armoured Engineers plus all that which could be carried on wheels; and a Rear Element, essentially the echelon with the more static support elements.

(d) Consequent upon (b) and (c) the reduction of the strength of the Field Sections from nine to about seven.

Manpower

At this stage it is worth examining the problems of apportioning manpower a little more closely. This was the critical consideration in 1975 when it was necessary to focus very clearly on what were the true priorities. Then, as now, it was necessary to be sure that each Sapper could be justified in the light of the contribution he would make towards defeating the enemy. Who was more important, the combat signaller in HQRE or the combat engineer building a Medium Girder Bridge (MGB)? (Photo 1).

Were either of these more necessary than the infantryman operating his MILAN? Of course all are interdependent but if the right balance was to be struck and if the proliferation of inessential overheads was to be avoided the criterion of operational effectiveness needed to be applied rigorously. For example a Field Squadron Headquarters is some forty-two strong. The majority of these, at least thirty, exist purely for the purpose of planning and executing the work of the nine productive Field Sections and six items of productive equipment (CET and LMD (Light Mobile Digger)) that exist in a Field Squadron.

Two questions arise.

First, do we really need large "Independent Field Squadrons"? Could not the

Photo 1. "Who was more important, the combat signaller in HQRE or the combat engineer building a Medium Girder Bridge (MGB)?"

administrative responsibilities for Squadron Headquarters be taken on by RHQ in the restructured Regiment leaving a command element with light logistic content as in an Infantry Company? These possibilities were considered in 1975 in considerable detail. Without rehearsing all the arguments it is sufficient to say here that the "Dependent" Field Squadron was found to be neither desirable or possible. Spread as it is over the battlefield the individual Troops and Sections of the Field Squadron cannot depend on RHQ for logistic backing; furthermore moving and regrouping as they must they cannot be dependent on host other arms units. There is also the question of planning of tasks. The capacity for this must exist in Squadron Headquarters. It was concluded that without doubt we support the all arms battle best through an organisation based on the Field Squadron with its own administrative capability as well as the full operational planning and command structure. There is no escape from the fully-fledged Squadron Headquarters about forty strong.

Less clear is the answer to the second question. Do we need twelve mechanised Field Squadrons in 1st British Corps? It is difficult to discuss this without an examination of the operational scenario which the security limitations of this article do not permit. There are other Army-wide considerations too. However it remains a possibility to reorganise our 144 APC (Armoured Personnel Carrier) Sections under fewer Squadron Headquarters, each one saved is some thirty men available to boost some other capability.

Another area for serious examination is equipment manning. The divisional engineers as finally restructured have 282 prime movers. Each requires at least one driver, many two. REME backing is required roughly on the basis of one REME soldier per three prime movers (or ten RE men). Of the 282 prime movers 141 are FFR (Fitted For Radio) vehicles and carry over 300 radios and a bill for a number of operators over and above the combat signallers who are driving the vehicles. The total number of plant operators, drivers, radio operators and REME included in the divisional engineers' overall total of 950 is 371. Of course transport and good communications are essential but the point is that each enhancement in this area brings with it a manpower bill from which there is no escape.

Restructuring Of Engineers In 1st British Corps 1975-78 (1)

As to plant, again a rigorous consideration of true priorities is essential. The civil engineering comparison of machine equals x thousand men does not necessarily apply when the product is demolitions prepared and mines laid. A Size 2 tracked dozer may play its part in getting men underground or digging obstacles but it must be thought of as a package: the dozer, the lowloader, three operators and some REME backing. Furthermore, its firepower is nil.

Nine-Man Sections

A constant nagging temptation throughout the restructuring exercise was to reduce the size of the Field Section from nine men, indeed, the original Wide Horizon establishments showed one eight-man Section in each Field Troop. The 1975 trials establishments dropped the Field Section strength to between seven and eight simply to produce the cover for the extra posts that were required (CRE, signallers, armoured engineers etc). This matter was focused upon in some detail. Could we get away with only eight men and so save 144 out of the overall Corps engineers establishments? This view looked most attractive for a time and was supported by those who argued that there are few engineer tasks that actually require nine men. The matter was resolved by wiser heads pointing out that in the realities of war there are operational considerations (casualties, local protection etc) which divert men from actual engineering, and the CCRE therefore made a stand on the principle of the nine-man Section. 144 Field Sections of nine men each became a base line agreed by the Corps Commander from which the divisional engineer organisation should be built. It continues as a valid principle which can not only be clearly interpreted by Sappers, in terms of a certain amount of productive work which can be executed, but is also understood and is accepted by all arms.

RESULTS OF THE 1975 TRIALS

Divisional Engineers

The trials on *Ex Spearpoint* in 1975 demonstrated that the original Wide Horizon Armoured Divisional Engineer Regiment could not cope without a substantial increase in man-power to cover principally the communications elements that it lacked and to maintain Field Section strength at nine. The CCRE therefore argued for an increase in Sapper manpower cover of 153. This was the major outcome of the trials which had also demonstrated the necessity of the post of CRE to be established at HQRE in the rank of full Colonel and of concentrating the Armoured Engineers into a Corps Armoured Engineer Squadron. Some elaboration on these two points is necessary.

The CRE

The first suggestion that the CO of the new Regiment would be unable to cope with the responsibilities of CRE as well came from the early CPXs which preceded the eventual FTX (Full Training Exercise). These were conducted by 1 Division operating in a Wide Horizon Armoured Division mode. In short, the CRE was fully committed to Divisional Headquarters. His second-in-command had to run the Regiment in the field, deploying and redeploying three Field Squadrons and controlling the very large Field Support Squadron.

Further CPXs gave a clear indication that the trials would not succeed unless a CRE was appointed and, as has been stated earlier this is what was done. The extra manpower required was only four per Division since the command and control structure for the CRE had to exist whether or not he was the CO of the Regiment or an additional full Colonel. This is because whatever happens the engineer plan will derive from the divisional plan and will depend for its execution on close liaison with the divisional staff.

The engineer command and control functions in war can be summarised as:

(a) Commanding the Regiment deployed on tasks in an area 60 × 25km.

(b) Commanding additional units: eg TAVR Regiment, Amphibious Squadron.

(c) Planning future tasks: eg river crossings, MSR (Main Supply Route) maintenance, river arc obstacles, ADMs (Atomic Demolition Munition).

(d) Giving the GOC engineer advice.

It was found on the trials that the function of commanding the Regiment was considerably more of a commitment than had been envisaged. The CO's overriding responsibility was (and always will be) to his three Squadrons' task and the soldiers carrying them out. Even on the exercise there were frequently matters which required the CO's personal attention and the motivation of the men under his command that could only be achieved by face-to-face communication. In war, with its additional pressures resulting from enemy action, this is going to be even more the case.

It was also considered that in peacetime, lack of a CRE would produce a similar dilemma for the CO of the Regiment. The CO's overriding responsibility was to the training of his Regiment, about 900 strong, and to their administrative efficiency. It was argued that it is generally accepted for the RA, RAC and Infantry at least that this task requires the full time attention of the CO and his personal presence in barracks and out on training. Moreover, the demands of Divisional Headquarters on the engineer commander are many and varied; operational planning including ADMs, all-arms training planning, preparation for TEWTS (Tactical Exercise Without Troops) and study days, engineer project planning, commitments to Corps Headquarters and a very considerable volume of cap-badge policy matters. These matters could not be attended to by the CO if he was also going to make his Regiment function properly.

The very real disadvantages of establishing a full Colonel CRE were also considered. These have been the subject of much discussion subsequently including during the presentation by Major Mike Sims at the E-in-C's Conference in 1978, the essence of the point being that with a full Colonel CRE at Divisional Headquarters the voice of the Lieut-Col CO would not be heard sufficiently to allow him to make his mark at a vital stage in his career to the detriment of the careers of Sapper officers (and hence the Corps) in the long term.

Whatever the eventual outcome of this argument, there was no doubt that in the circumstances of a single very large engineer regiment in the armoured division the CRE was necessary. That this was achieved has done much to relieve the stresses and strains of implementing restructuring. It also accounts for the influential voice which Sappers have in the divisions (to the envy incidentally of the Bundeswehr Sappers who would dearly like a permanently established CRE at Divisional Headquarters). Some common ground in this matter can perhaps be identified:

(a) A CRE is required at Divisional Headquarters, the only argument is whether or not in peace he can be also the CO of the Divisional Regiment.

(b) The CRE will be required to be present at Divisional Headquarters. There is no escape from this. It simply will not do to argue that CREs must educate their GOCs to do without them. Events show this to be impossible.

(c) The command structure of vehicles, radios and the necessary operators will continue to be required whether there is a separate CRE or not. There is a negligible manpower saving to be achieved by duplicating the CO and CRE.

The Task Force HQ

A major complication to designing a workable command and control structure for the new divisional engineers was the arrival on the scene of the Task Force Headquarters (Photo 2). As is now well known this emerged as the major overall finding of the *Spearpoint 75* trials which showed that an intermediate point of command between Divisional Headquarters and Battle Group was in fact required. A frenzy of activity occurred in December 1975 to work out how this could be done and this actively coincided with the special-to-arm work that was in hand. For Engineers there were really only three options to consider:

(a) To start again with a clean sheet of paper and go for a regiment per task force on the model of the brigade regiments. Using hindsight many people now feel that this would have been the best answer. However, at the time it could not be seriously entertained. In the climate of manpower and rank economy that prevailed at the time

Photo 2. "A major complication to designing a workable command and control structure for the new Divisional Engineers was the arrival on the scene of the Task Force Headquarters."

a proposal to double the number of RHQs and COs would have had no chance of success at all. Moreover, for public consumption at least, there was no question of the new task forces appearing as the old brigades. They were strictly the right and left command arms of the headquarters of the Armoured Division.

(b) To support Task Force Headquarters by locating with them elements of the RHQ, that is leaving "Engr Plans" at Divisional Headquarters but splitting "Engr Ops" between the two task forces. The effect of this would have been to place the total "Engr Ops" command capability with the Task Forces leaving nothing for commanding the Divisional tasks which it was envisaged would be required to be carried out in addition to the tasks strictly concerned with the in-contact battle. It was therefore decided to go for:

(c) To support Task Force Headquarters from a Field Squadron, reverting to the proven major/one star commander relationship and leaving a "third" Field Squadron to give balance to the Divisional Engineers.

This very brief account skates over the surface of the many arguments that were explored at the time. Much depended on how the Task Force Headquarters would develop; whether genuinely as a small command-only group or more in the nature of the old brigades. In the event the tendency has been more to the latter with the result that the idea of splitting RHQ is tending to be favoured.

Armoured Engineers

The 1975 trials presented two major problems for Armoured Engineers. First the proposed AVLB Troops were simply too light in manpower to operate in any way except as carriers of equipment to be called up and emplaced by Field Squadrons. This was because there was no recce or command capacity built into the Troop at Section level; but this negated the chief characteristic of the AVLB, its armour and hence its ability to operate in close support of tanks. To make the AVLB dependent on mechanised Sections was imposing a severe limitation on it. Incidentally so was the idea of its support being provided by CET once AVRE (Armoured Vehicle Royal Engineers) went out of service. The question of AVRE had however to be delayed and will be discussed later in this article.

Restructuring of Engineers In 1st British Corps 1975-78 (2)

The second major problem that the trials revealed was that of deploying the Armoured Engineers into battle and providing the specialised backup from within the regimental echelon organisation. Controlling the AVLBs from the Forward Echelon just did not work. This was because they were not in fact a resource to be simply moved forward; they were operational Sections to be deployed tactically. The Field Support Squadron had neither the reconnaissance capability nor the communications to achieve this. The difficulties that this presented on *Spearpoint 75* gave rise to the proposal to centralise the four AVLB Troops into one Armoured Engineer Squadron. This would be primarily a peacetime arrangement which would avoid the costly (in manpower terms) solution of splitting the Field Support Squadron, but it was envisaged that the Squadron Headquarters would be able to play some role in providing the special-to-arm backup required by Armoured Engineers.

This idea was supported by a number of other factors which for peacetime reasons argued strongly for centralisation, the most important of which was training. In peacetime conditions when the drain on manpower for courses, leave and extra-regimental commitments is so marked, the Divisional AVLB Troops would have great difficulty in giving the full backing required for exercises and unit training. Under the centralised arrangement a Divisional Troop can be boosted up from another Troop in times of difficulty.

A further important consideration is the individual training and career of the Armoured Engineer tradesman. This could tend to become overlooked in dispersed sub-units but in a centralised organisation can be properly planned.

The need for proper equipment management also supported a centralised organisation. There can be little argument that dispersed Troops would find maintenance of the highly complex equipments difficult whereas in a centralised unit with its own workshop, Technical QMS and single chain of stores supply a more positive approach is possible.

All these factors were considered at the conclusion of the Wide Horizon trials along with the obvious disadvantages of centralisation: the loss of identity with a particular Division and the inevitable separation of armoured engineers from combat engineers and the consequent lack of experience of working together. The advantages of centralisation were overriding and so was born the Corps Armoured Engineer Squadron (Photo 3) and so died the idea of splitting the Field Support Squadron with the expensive manpower implications of this course.

Amphibious Engineers

Compared with the Divisional Engineers, restructuring of the Amphibious Engineers was relatively free of headaches. (Photo 4.) In the end, the original proposal for a three Troop organisation in each of the two Amphibious Squadrons was abandoned in favour of the two Troop form that now exists. The main problem was that with manpower cut severely there was after restructuring no way of finding

Photo 3. "... and so was born the Corps Armoured Engineer Squadron ..."

Restructuring of Engineers In 1st British Corps 1975-78 (3)

Photo 4. ". . . restructuring of the Amphibious Engineers was relatively free from headaches."

the capacity from within the Regiment for the specialist training within the unit without putting a number of M2 rigs off the road. This problem was later alleviated by the provision of manpower under "Overstretch".

Engineer Resources

Reshaping of 65 Corps Support Squadron was also a reasonably painless affair. The policy was determined by the requirement to hold more stores in the Corps area. For security reasons it is not possible to debate further the background to this decision but suffice it to say that the new Squadron emerged with increased manpower and enhanced capability against a well-reasoned charter for the Squadron against what was foreseen as its likely operational role. Some modifications were subsequently found to be necessary and will be touched upon again later.

Barrack Accommodation

Constantly in the background during the deliberations following the 1975 trials was the question of barrack accommodation. Restructuring led to a complete reappraisal of the accommodation in the Corps area and the Key Accommodation Plan was well advanced by the beginning of 1976. This had entailed detailed revalidation of all barracks to compare the available accommodation with the synopsis entitlement of incoming units. This painful and soul-searching process could not be repeated to allow for any radical suggestions that might have arisen following the trials.

A particular difficulty for Sappers was the fact that although it was possible to show that the accommodation for the AVLB Troops in the original concept did not in fact exist, it was far more difficult to squeeze out of the Key Accommodation Plan a barracks for the new Corps Armoured Engineer Squadron. That this was successfully achieved (albeit only by the summer of 1976, a matter of months before the moves were to take place) was due only to the fact that the Key Accommodation Plan, involving all units in the Corps, still had a degree of flexibility in it. This would not necessarily be the case in any future evolution.

DEVELOPMENTS SINCE 1975

1976 was the year for the initial implementation of the results of the 1975 trials. Engineer Corps Troops were the first to reorganise and this was followed by the formation of the 2nd Armoured Division in the autumn. It was a time for battling for

Restructuring of Engineers In 1st British Corps 1975-78 (4)

accommodation and equipment and sorting out the physical effects of the "General Post" that restructuring required but there was little evolution on the policy side. *Spearpoint 76* was however a further major focus for considering organisations and the two most important matters that emerged were the requirement to codify more clearly the Engineer command and control arrangements in relation to other arms and to establish how Armoured Engineers were to be handled.

Command and control became the subject of a carefully worded document issued by the CCRE and since reproduced in *Engineers in the Corps Tactical Battle*, a pamphlet now on general issue. Its main effect was to establish HQRE as clearly separate from RHQ and to arrange for HQRE to be properly manned. It is not intended to argue in this article for one or other system of command and control and therefore this matter will not be discussed further here. A degree of licence between Divisions is inevitable in view of their differing roles and the differing personalities of the Commanders. The essential matter is to ensure that the necessary ingredients are there to allow for command to be exercised properly and for Commanders to receive the support and advice they require.

AVRE

Armoured Engineers became in 1977, the major evolutionary consideration because of the realisation that the imminent departure of AVRE was an event totally inconsistent with the operational requirements of 1st British Corps. AVRE was due to go out of service on the arrival of the Combat Engineer Tractor (CET). The slippage in the CET programme had allowed the temporary retention of AVRE but, to cut a long story short and to sidestep the need to embark on operational arguments which are necessarily classified, it was decided in 1977 to put this retention on to a permanent basis.

Much negotiation and discussion has taken place since this decision was made and the future shape of the Armoured Engineers; where they are to be located and how organised, should emerge in the not-too-distant future. The form is however likely to be a unit centralised in peacetime and so organised that it can provide the necessary support to Divisions in war without becoming an incubus on the Armoured Divisional Engineer Regiment for purposes of deployment, operational control and logistic support. Thus the principles that were established during 1975 are likely to be followed.

Overstretch

The entirely unsurprising result of restructuring was that units found themselves overstretched from the point of view of peacetime administration. This was inevitably built in to the original parameters which assumed that the increased span of command was possible. It was also built in to the decreased man-to-machine ratio. The sufferers from the effects of restructuring were the orderly room clerks, QM staffs and their ilk who now, often with fewer men, had to take on more work. Set against the background of the declining financial position of the soldier in relation to his civilian counterpart, overstretch became a matter of great concern and the subject of urgent studies in the autumn of 1977 based largely on the experience of the 2nd Armoured Divisions first year in the new form. (It should be noted that in this context *overstretch* does not include the *overcommitment* to which Sapper units in particular are prone although the one reflects on the other.)

The priority for manpower to relieve overstretch was given to equipment-intensive units and therefore the principal beneficiaries in Engineer units in 1st British Corps were the Amphibious Regiment and the Armoured Engineer Squadron. Thus some of the anomalies of restructuring which have already been referred to were rectified. Some fourteen posts will also be added to each Armoured Divisional Engineer Regiment from which it is hoped that there will be an improvement in the quality of life among the administrative elements.

Engineer Support and Equipment Management

This account would not be complete without a brief reference to the developments that have occurred during restructuring in the field of Engineer Support. The

first step came in 1977 with the recognition by the CCRE of the unfavourable man-to-machine ratio that restructuring had produced. Accordingly a detailed study was conducted into the means for improving this by means of reducing the holdings of equipment and vehicles. The very far-reaching proposals that the author of the study, Colonel Peter Morrison, produced are now being trialled and will be reviewed early in 1979.

With this as background it was necessary to review the whole question of the way in which Engineer Support is provided covering the peace and wartime holdings and control of stocks and the requirement for engineer workshops at Divisional, Corps and Army level. The indications are that there is a requirement in peacetime for a far greater emphasis than the architects of restructuring conceived on the control by Engineer staffs not only of items of engineer origin but of all those items that are used principally by Engineers and which now fall under the definition of Engineer Resources used by HQRE 1st British Corps in *Engineers in the Corps Tactical Battle*.

Photo 5. Restructured and Reorganised but still smiling!

Restructuring of Engineers In 1st British Corps 1975-78 (5)

CONCLUSIONS

There seems little doubt that the search for the ideal organisation of Sapper units in 1st British Corps and the best method for Command and Control did not end with Restructuring. There are many reasons for this, principally perhaps the fact that all arms organisations are unlikely to remain the same. Sapper organisations are particularly prone to change, however, because of the introduction of new equipment and techniques.

The experience of Restructuring, for all that it may not have come up with ideal answers, does give some guidance for those who may be involved in future evolution. The constraints that Restructuring imposed have led to a number of anomalies that need rectifying but these do not necessarily require radical measures for their rectification. If no other lesson emerged it is that it is unrealistic to entertain visions which go wildly outside the limits of the real hard facts of life, these are: manpower cover, actual assets of vehicles and radios and (sometimes overlooked by visionaries) the bricks and mortar of the barracks occupied by existing units.

To go further than this on "lessons" is embarking into contentious areas. Contention being perhaps a desirable feature of the *RE Journal* the following are offered as some conclusions as seen from one viewpoint during the period of Restructuring:

(a) Establishments must always be designed to provide sufficient men adequately to man the equipment in peacetime. Short cuts in this matter result in overstretch and reduced operational readiness.

(b) Too heavy an overburden of command and control and other non-productive elements is immoral; it is better to have fewer points of command adequately staffed with communications and watchkeepers than to try and spread the assets too thinly.

(c) The Field Squadron about 200 strong and capable of operating independently from an RHQ remains the best basis for Engineer organisations.

(d) The strength of the Field Section should be maintained at nine men. If improved mechanisation allows for reduced numbers of field sappers the numbers of Sections should be cut rather than their strength.

(e) The CO of the Armoured Divisional Engineer Regiment cannot double as CRE in peace unless the strength of the Regiment and the scope of its activities is greatly reduced. In war a CRE will be required to be present at divisional headquarters all the time.

(f) Armoured Engineers should be concentrated in peace.

(g) Engineer staff must take on increased responsibility for all resources and equipment used primarily by engineer units, not only those of engineer origin.

* * * *

The Harrier Ski Jump on Dry Land

LIEUT-COLONEL N H THOMPSON RE, BSc, CEng, MICE

Lieut-Col Thompson has commanded 38 Engr Regt at Ripon since March 1977. After Shrivenham he started earning his pay as a Tp Comd at Maidstone and then served as ADC to GOC North West District. He was a Sqn 2IC in Cyprus, returning to RSME to attend a Long Civil Engineering Course and staying on afterwards as an Asst Instructor. Thence he went to Quetta Staff College followed by a spell in Defence Intelligence. He commanded a Fd Sqn (Airfds) at Waterbeach. His last appointment was a Civil Firm's attachment to Howard Doris on the Ninian Central Platform construction.

SINCE 1974 British Aerospace has been developing the Ski Jump launch techniques for Harrier in conjunction with the Ministry of Defence. Successful trials for Sea Harrier resulted in plans for building such ramps on Royal Navy vessels. The Royal Air Force showed considerable interest in developing this concept to suit land-based Harrier operations as the Ski Jump greatly reduces take-off distance for a given all-up weight by converting horizontal momentum into vertical momentum.

Fairey Engineering, the manufacturers of our Medium Girder Bridge (MGB), struck on the idea of making an MGB Ski Jump and on investigation they found that the dead weight deflected shape of the single storey MGB, in lengths of about 100 to 150 feet, closely approximates to the profile required for a Ski Jump giving an exit angle of 15°. A simple design was then produced so that a demonstration could be staged as part of the 1978 Farnborough International Air Show. Readers will know that the Harrier Ski Jump stole that show and sales of Harrier were undoubtedly assisted. Fairey Engineering were much encouraged by the enterprise and are now working on the design of a portable kit suitable for tactical use.

Based on details of interaction between the aircraft and the Ski Jump contained in a special British Aerospace report, Fairey Engineering were able to design a relatively simple prototype ramp using mainly standard MGB parts supported by piers of Christchurch Cribs.

In order to obtain the required profile the complete ramp was constructed in the horizontal position with one end then being raised to a pre-determined height with the other end remaining on the ground. The natural sag which resulted stemmed about 80% from elastic bending under dead load and 20% from free play between the top panels. This provided the required geometry with the dead weight supported entirely at the two ends.

Intermediate supports were then introduced to react aircraft loads only. Pre-tensioned wire guys were also used to react any small negative reactions at these intermediate supports. These guys also assisted in reacting lateral and longitudinal forces. Because of the huge downblast from the aircraft engines, all loose items, such as deck units and outrigger support panels had to be positively restrained by fixing clamps or by pre-tensioned retention straps.

The ramp itself consisted of three parallel girders made of top panels joined by deck units and flanked by outrigger support panels. At the raised end, the three girders were connected by a steel cross-beam, which in turn rested on the dead load pier supports. The ramp continued beyond the pier supports for two bays, one of

Lieut Colonel N H Thompson RE

which incorporated hinge panels, as used in multi-span MGB, and the final bay used ordinary top panels. The deck units rested in rubber liners to reduce noise and were tied together to stop them bouncing out.

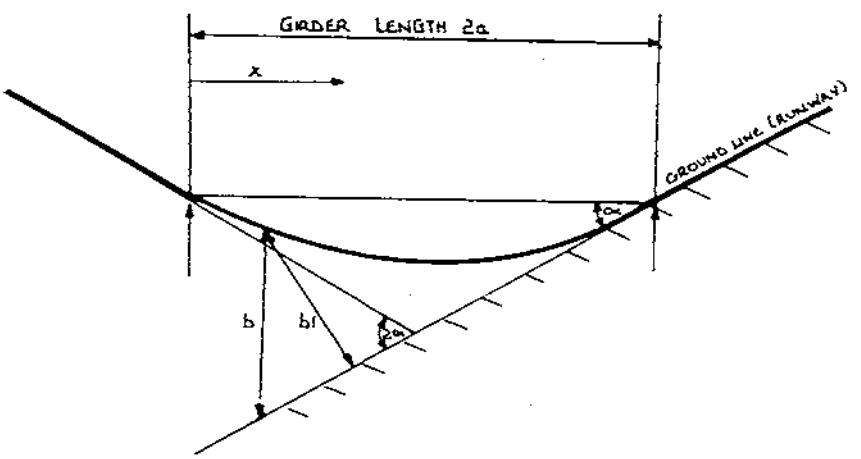
The basic parameters which determined the deflection of the ramp were established by experiment. The maximum height of the ramp above ground (b_1) and the maximum angle attained by the ramp (α) were found from the following expressions:
The vertical height of the ramp:

$$b = \frac{a(2a - x)}{r} + \frac{w}{3EI}\left(2a^4 - 2a^3x + \frac{ax^3}{2} - \frac{x^4}{8}\right) - \sqrt{r^2 - (a - x)} + \sqrt{r^2 - a^2}$$

Angle attained by the ramp:

$$\alpha = \frac{a}{r} + \frac{wa^3}{3EI} \text{ radians}$$

(The exit angle at the end of ramp being $= 2\alpha$)
where a = girder half length
w = dead loading per unit length of girder
x = distance from raised end of ski jump
r = free play radius of curvature
EI = equivalent girder stiffness
The Farnborough Ski Jump was 126 ft long, thus:
a = 63 ft
Also:
w = 0·08 tons ft
EI = $6{\cdot}98 \times 10^4$ tons ft^2
r = 2215 ft



Taking into account a 0·75° rise in the ground at the ramp base, the exit angle was
14·21° + 0·75° = 14·96°, say 15°
and the highest point on the ramp was
15·50 + 1·65 = 17·15 ft above the base.
Dead Load. The dead load of the ramp was 0·08 tons/ft per girder. As there are three girders the dead load over the three was 0·24 tons/ft.
∴ total dead load = $0{\cdot}24 \times 126$
= 30·24 tons
With dead weight distributed on each of three girders at both ends, the weight on each point of contact was about 5 tons. The additional two bays at the raised end of the ramp weighed 2·7 tons, ie 0·9 tons per support, so the total dead weight on each of the raised supports was approximately 6 tons.

Live Load. To each of the above reactions can be added the live load from the aircraft. The quoted all-up weight for a fully laden Harrier is 20,000 lb, (approximately 9 tons), but since most of the weight is transmitted through the main and nose wheels beneath the fuselage, most of the live load is borne by the central girder. The extreme maximum dynamic load per wheel was taken as 20,000 lb, making a proof factor of more than 2. At the worst case, when the aircraft was situated at one end of the ramp, the maximum live-load exerted on the appropriate support of the central girder was about 13 tons.

Lateral Load. To combat any lateral motion by the Ski Jump, the ramp was anchored by shear connections at the base and by wire guys. Friction alone could react lateral forces as much as 5 tons, though it is unlikely that this would be necessary as this would be extreme loading based on the limit of the nosewheel steering capacity.

Longitudinal Load. Longitudinal load resulting from drag of the aircraft undercarriage was negligible. However, pier reactions to ramp and aircraft weight act in a direction normal to the surface of the ramp. At the top of the ramp, which was inclined at 15°, the longitudinal load on the central girder amounted to 1·5 tons from the dead weight and 3·5 tons from the aircraft. The supports were so designed that these forces acted through the framework and there was no overturning tendency.

Wind load. To calculate wind load a basic speed of 40 ms^{-1} (89 mph) was chosen, which gave a total lift on the ramp of 33 tons. The attachments and wire guys had a capacity of more than 50 tons.

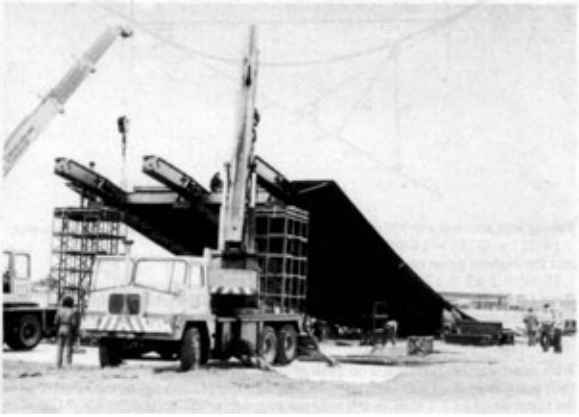
In assessing the structural adequacy of the MGB components, normal MGB factors were used, ie

(dead load) + (dynamic live load × proof factor) = (proof capacity)

where the proof factor was the normal MGB in-service factor of 1·5. The same principles and factors were used in the analysis of special components.

The natural starter for the task of construction was 38 Engineer Regiment, which has supported Harrier in UK and BAOR since the start of its off-base operations. A troop from 32 Field Squadron happened to have been demonstrating MGB at the

Photo 1. The Ski Jump is built horizontal then one end is lifted by cranes.



The Harrier ski jump on dry land

Photo 2. A Harrier taking off at Farnborough International Air Show.

Regular Army Equipment Exhibition and were therefore ideally suited to build the Ski Jump. They were made available for five days and worked under the direction of Fairey's experts. A concrete lead up to the bottom of the Ski Jump had already been poured. It took only twenty-four Troop hours to construct the prototype Ski Jump and after practice it is estimated that this time could be halved. No special skills were needed other than Combat Engineering and a sound application of safety rules.

The first trial take-off by a Harrier was a breath-holding moment and its success gave a great thrill to all involved.

It would appear that there is considerable scope for Fairey Engineering to develop a field Ski Jump, but there are still many technical difficulties to be overcome. A broken Ski Jump is one thing, but a broken Harrier is quite another in terms of both price and pride. More impedimenta in the field is to be resisted if at all possible unless significant advantages accrue, and it is for the RAF to decide whether they really want instant Ski Jumps. Even if the answer is thumbs down from the RAF, other British Aerospace customers may favour the idea of buying simple, rapidly erected mobile Ski Jumps.

We were delighted to be involved in this enterprising exercise and wish the manufacturers of MGB every success.

(The author wishes to acknowledge that design criteria and outline calculations were kindly supplied by Fairey Engineering; they have not been amended or metricated).

Early Days

MLC

THE subject for the RE Institute Prize Essay set in 1879 was "Warfare against uncivilised races; or how to fight greatly superior forces of an uncivilised and badly armed enemy". 1879 was the year of the Zulu War in South Africa, and the start of

The Harrier ski jump on dry land (2)

major troubles in Afghanistan. Both theatres were to provide instances of victory, yes, but also of carelessness, disaster and defeat. The prize essay was surely designed to reflect the lessons learned!

In South Africa the Colonists had taken on a formidable enemy. The Zulu *impi* organisation enabled them to co-ordinate large bodies of men in rapid cross country movement. They were adept at the use of the covered approach and the swift, surprise attack. Under all circumstances the wise Commander maintained a closed perimeter for even a one-night camp, and strengthened his *laagers* with earthworks whenever possible. A Sapper contingent was a valuable part of any force. "We have been experimenting with hurdles as a means of passing 7 pdr guns across boggy valleys. Our activities could be much increased if we could only leave the roads" wrote one RE officer. There is a familiar ring about that!

In 1878 Boer intransigence and high handedness (their own President in the Transvaal, Bergers, had accused them of ill treating the natives . . . "you have shot them down, you have sold them into slavery and now you have to pay the penalty . . .") had inevitably led to a clash with the Zulus. This would have meant the extermination of the Boers themselves if the Natal Government had not annexed the Transvaal. Sir Bartle Frere, the British High Commissioner in South Africa, further determined that there could be no security for any of the white farmers, so long as the Zulu armies under Cetshwayo remained in being. By January 1879 relations with the Zulus were in the hands of the C-in-C, Lord Chelmsford. Chelmsford advanced into Zululand in three Columns—he himself accompanying the centre one, which crossed the Zulu frontier (the Buffalo River) at Rorkes Drift. It was part of this Column which was surprised and cut to pieces at Isandhlwana—about twelve miles beyond the Drift.

Despite being warned that the camp at Isandhlwana was unsuitably sited, because of the excellent cover afforded by the surrounding hills and ridges, Chelmsford maintained his highly arrogant opinion that he had come to attack and not be attacked! The camp also had been neither *laagered* nor entrenched. The troops (or that half of the Column which had remained in the camp—the other half, with Chelmsford, had already resumed the advance) paid the penalty that very day.

The Natal newspapers later alleged that Chelmsford had attempted to put the blame for the poor dispositions at the camp onto Colonel A W Durnford RE. Durnford had been summoned from Rorkes Drift with his force of Natal Native Troops, only on the morning of the battle, and on his arrival was immediately in action. He was killed after a most gallant last stand, in which he, and those remaining with him, managed to delay the Zulu advance sufficiently to allow some of the force to flee in disorder back to Rorkes Drift. "Poor" Durnford—to use Chelmsford's phrase—was the senior officer present at the time and therefore could be conveniently held responsible for conducting the battle. The newpapers were equally incensed that Chelmsford made Colonel Harness, a senior officer in the Column, who had been uniquely able to observe the events of that day, a member of the subsequent Court of Inquiry. As a member of the Court, Harness was barred from giving evidence—the strong inference being that such evidence would not have been flattering to the C-in-C.

Naturally the 1879 Journals were full of events in South Africa—particularly Major Chard's epic fight at Rorkes Drift and the disaster at Isandhlwana. (See Article by Major General R C A Edge in the *Sapper* of December 1978). Chard's tremendous reception at Chatham and in his own West Country were also reported in detail. It seems that Chelmsford also returned in some triumph (before he was relieved of his command by Sir Garnet Wolsey he had, in fact, brought the Zulu Campaign to a conclusion by capturing Cetshwayo and dispersing his armies). The *Annual Gazette* for 1879 recorded somewhat tartly "the Standard asks seriously whether our national fibre was not deteriorating when the heroes of a petty war were received with such transports of enthusiasm, including Lord Chelmsford, Colonels Buller and Pearson and Major Chard. Next to the successful officer the conspicu-

ously unsuccessful comes in for the largest share of public notice, and even popularity—for mere mediocrity is little tolerated in these sensational times"!

Campaigning in South Africa was, then, a commander's nightmare. A Column while actually on the march was almost impossible to protect. There were often no roads to speak of, and the standard supply vehicle was the heavy Cape wagon drawn by a team of up to twenty oxen—needing an "almost inherited expertise" to drive them. Progress was painfully slow and a Column became spread over many miles. Why no mule trains? why no Kaffir porters? were questions also asked by the Natal press.

Mules and porters would certainly have made Chelmsford's life much easier. They were to come—but only "in due course". One is reminded of Churchill's immediate reaction on being given command of the 6 Royal Scots Fusiliers on the Western Front in early 1916 (as a result of the Dardanelles he was dismissed from the Admiralty and, although an MP, elected to offer his services to the Army). In a regime of position warfare he was, for instance, soon to express his scorn and condemnation of the field telephone equipment. As First Lord of the Admiralty he had already (on behalf of the Army) anticipated the requirement for a machine to deal with barbed wire and machine guns. As CO 6 R S F, he sighed for a "good shorthand writer and some power." Pray, why no mules and porters?!

This was an age when the VC was awarded (and earned!) with comparative frequency. Furthermore, it seemed that the announcement of the award was made not long after the deed. In the case of Chard, the action at Rorkes Drift took place on 22 January 1879. His VC was gazetted on 2 May 1879. Surely the moral effect was all that much more, compared with the long delays which have accompanied awards in more recent times. At the start of the 1914 War, this time on behalf of the Navy, Churchill was instrumental in persuading King George V that awards should not be delayed until the end of the War—whenever that should be. The King's attitude now seems difficult to understand!

Rorkes Drift and Isandhlwana were only two of the major events in South Africa, which dominated the pages of the Journal in 1879. Royal Engineer officers must have been thumbing their pocket books as "fort" after "fort" were built in Zululand or on its borders. These may have been a far cry compared to the various fortifications, from the Thames Estuary to Plymouth, which had been built comparatively recently in the UK. But to fortify, say, a typical mission station, with its stone church, store house, dwelling house, and outbuildings (Rorkes Drift was a good, if small, example) had much in common with its bigger brothers. In the Zulu campaign, Fort Ekowe, with a perimeter of some 500 yards, was the best known. With its surrounding ditch, complete with traverses, parapets, covered way, gallery, barbettes, bastions, splinter proofs and caponiers, the plans and diagrams published in the Journal could have been illustrating something far grander than hasty field works. Ekowe even had its sally port and drawbridge!

Ekowe was cut off from January 1879 until it was relieved in April. In fact the Zulus seem to have considered the position too strong, as the post was never directly attacked. Captain Wynne, the senior RE officer, had much to do and plan, both within and without the Fort. His diary was quoted extensively in the Journal. There was no communication with the main body, on the River Tugela about 30 miles away, except finally by improvised heliograph. In reply to the initial signals Wynne first tried to make do with a large white canvas structure, mounted on trunnions, but his improvised dots and dashes were not seen. In the end, and despite the smallness of the only mirror available, they managed to signal back in a more conventional way!

Captain Wynne unfortunately succumbed to fever and overwork. His diary ended in mid-sentence.

A resolution was put before the AGM in 1879, that a stained glass window should be placed forthwith in Rochester Cathedral to the memory of Colonel Durnford and Lieutenant MacDowel (another RE officer killed at Isandhlwana). This somewhat odd proposition was hotly debated. The erection of a memorial of this nature while

the War in question was still being fought was strange indeed. In the end, the meeting decided to postpone any action until the conclusion of the War and then to erect a general memorial to all ranks of the Royal Engineers, who may have been killed or who might die during the War. Reading between the lines, it seems that the imputations against the skill and conduct of Colonel Durnford, during the Isandhlwana disaster, were still keenly felt, and that a body of opinion in the Corps wished there and then to show where the Corps as a whole stood in this matter.

It was in 1879 that notices first appeared in the Supplement, stating that the Committee of the RE Institute had in view the compilation of a History of the Corps, and any relevant material would be welcome. It would have been this notice which ultimately resulted in Major General Whitworth Porter's excellent Volumes 1 and 2 of the Corps History, which were published some ten years later.

One of the subjects that gave rise to quite considerable discussion in the correspondence columns of the Journal, concerned the best method of surveying and filling in detail on a map once the necessary fixed points had been established—was the use of a plane table or prismatic compass the most efficient? Today this could seem to be a non-subject. However, except in the Survey of India, where the plane table had proved to be far and away better than the compass, it seems that elsewhere the use of the latter was standard practice. Captain Holditch RE, of the Survey of India, appears to have appealed in vain for the use of the plane table to be taught at Chatham as well as the compass. Lieutenant Kitchener, who had recently played a major part in the Survey of Palestine had, on the other hand, found the prismatic compass quite adequate.

Kitchener admitted that to build up a survey only by compass angles and pacing was a very inaccurate method. The proper number of fixed points were also necessary. However, there was a great saving in time when there was need for neither levelling nor for orientating a stand. There was also the clear advantage of the extreme portability of the compass. There was, of course, much truth in the latter statement when movement was on horseback. But Holditch claimed otherwise!

Kitchener, in one way or another, appeared fairly frequently in the Journal of those early years. There then seemed to be no trace of the highly forbidding figure of later times!

The RE Widows Society, then, as now, held its Annual Meeting in conjunction with the AGM. It seems that in 1827 the pension had been £60 per year. It had later been reduced to the then sum of £55, with a lump sum bonus of £25. It was proposed at the AGM that the time had come to restore the rate to £60. There were the usual good reasons for not doing this, and the Meeting cautiously requested that a further report should be made at a future meeting! What £60 (or even £55!) in 1879 would be worth in comparison to today's pension, does not bear thinking about!

The AGM also decided to elect the then Secretaries of the RA Institution, the Civils and the RUSI as honorary members of the RE Institute, for the time they held their appointments. There was also a suggestion in the same issue of the Journal, that an annual *Conversazione* should be held jointly with the Civils.

Officers posted to Barbados were advised that two special qualifications would be useful. These were energy and determination. Otherwise little fight would be put up against the predominant and most infectious failing in the Colony—to let "ill" alone! We also learn from the Journal that NCOs below the rank of CSM in Survey, Submarine Mining and in Telegraph Companies, could be promoted without regard to proficiency in Field Works. The place of "Combat Engineering" in the Corps does not seem to have been a new problem!

One wonders why exactly in 1879 there had to be a Commission of Inquiry into "the affairs of Wellington College." Colonel G T Chesney was gazetted as one of the Commissioners in July 1879, but no detail is given for this one bald announcement!

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The New Computer System for the Royal Engineers

D R TROTMAN BSc, MSc (Eng), CEng, MIERE

The author received his BSc degree in Physics, Mathematics, Electronics and scientific French and later, in 1960, his MSc degree in Electrical Engineering at the University of Nottingham. He was commissioned in the Royal Corps of Signals and also spent some years in industry and the AERE, Harwell. Since 1962 he has been at RSME Chatham, initially as Lecturer in nuclear engineering, then as Senior Lecturer with additional responsibilities for electronics and computer science. He is now Head of Dept, Science and Computer Branch. He is also a permanent member of the RE Computer and Microform Steering Committee and acts as the E in C's adviser on computer training and application software.

INTRODUCTION

This article is divided into several sections in order to separate the computer technicalities from the non-technical. The divisions fall conveniently under the headings of Background, System Design, Brief System Specification, Software, Time Sharing and Training, and Applications. An Annex is included to provide the technical reader with a detailed specification. Non-technical readers may prefer to concentrate on Background and Applications.

BACKGROUND

Many will recall our trials and tribulations some fifteen years ago to purchase a new or second-hand computer, to be installed at the RSME Chatham. Computer Training began in 1963 as a result of Long Course Officers being obliged to operate computers with contractors and consultants during their civilian attachments. As we possessed no equipment at all ourselves, courses were supplemented by visits to RMCS, Medway College and the Royal Naval Dockyard, Chatham. Of necessity, the course was limited to "how computers worked" and "how to write simple programs".

However, in the early 1970's, Dame Fortune smiled upon us in the shape of RAF Strike Command. They were about to replace their Elliott 803 computer with a much larger ICL 1900 system. Thus in due course this Elliott machine was installed in the former electronics laboratory of the Technical Training Group (as it was then called). In this location it functioned, on and off, until February 1979. It has been a good system, and it is perhaps sad that its "off" periods increased rapidly with age, and associated maintenance became more of a problem.

SYSTEM DESIGN

Anticipating this demise and also the increasing need for computer-aided instructional technology, a joint study was started in 1976 by staff of the RSME and the Royal Engineer Training Development Team (RETDT). From this early study sprang Project RECAPES, (Royal Engineer Computer Analysis and Production of Examinations System), which now involved the Army Committee of Instructional

D R Trotman

Photo 1. The Hewlett Packard System 1000/45. Showing the main console with, L to R, the console keyboard, the high quality printer plotter and the 180cps printer all in the background. Two of the four terminals are clearly seen in the foreground.

Technology (ACIT), Army Education Branch A Ed2c and a number of ADP branches in MOD.

The Science and Computer Branch, RSME, were charged with system design and discussions with almost thirty manufacturers followed for the next twelve months.

Two main options emerged. Firstly, a computer system based on microfilm technology, which for a time at least, looked very attractive; and secondly, a computer employing a high speed data bank management system.

It was the second option which was finally selected on the grounds of cost, compatible expandability, versatility of application and perhaps above all that the computer peripherals (terminals, printers, optical mark readers etc) were similar to those found in any other computer environment. With microfilm on the other hand, the specialist skill was photography and graphic art and involved the ability to use sophisticated "non-computer" equipment.

BRIEF SYSTEM SPECIFICATION

Thus, some two years after our first meeting, the RSME took delivery of the latest Hewlett Packard Series F processor in the form of System 1000/45 and it was installed, during March 1979, in the space vacated by the retiring Elliott 803.

A more detailed specification is given at the end of this article at Annex A, but a brief pen picture can be given here.

The computer is housed in a desk cabinet, the desk top providing a convenient location for the system video console, card reading equipment and printer plotter, with the magnetic memory storage and main processor in the cabinets.

The magnetic memory is capable of handling 40 million characters as programs and data storage, which will allow the computer to become a vast repository of readily accessible information using a secure file reference system. In addition the video screens allow drawings to be displayed as well as text, with a magnification of the display up to sixteen diameters and then to provide full pan of the enlargement, which is tantamount to having a picture 16ft wide. The screens are interactive, that is

The New Computer System for the RE (1)

their display can be modified using graphics commands or manually by a cursor on the screen. Five such screens are provided, with four of them set up as terminals.

A high speed printer, capable of printing at 180 characters per second, provides the main output facility. In addition a very high quality (but slower) printer plotter provides simultaneous drawing and printing. An additional device called a graphic tablet enables the user to input drawings up to 20 inches square (310mm square) direct to memory or video display.

It can be seen therefore, that this computer possesses many important features associated particularly with its graphics capability and its versatile memory retrieval system.

SOFTWARE

A very powerful control program known as RTE IV allows multi-user multi-programming operation, offers priority scheduling of concurrent programs and even reports store errors and simultaneously provides recovery so that the computer may continue without stopping.

However, the most valued feature of this computer system is the exceptional Data Base Management System (DBMS) known as IMAGE/1000 and QUERY. This enables the user to build up secure fully structured data files on magnetic disc and by using QUERY provide speedy access using simple English-type commands. The data may be text, drawings or maps, or a further index for deeper searching into another file. The software also includes ALGOL, FORTRAN and BASIC as the main operating high level languages. BASIC is fully compatible with the language used on the Hewlett Packard HP 9845 and HP 9835 desk top computers, which are being phased into certain RE units from early 1979 to 1981. Thus the Royal Engineers are in the unique position of using a single computer language, BASIC, for field use, design work, file data, management, ADP and of course, training.

Also available is a powerful set of plotting routines known as GRAPHICS/1000. Two levels of command language are possible, one for the novice user and the other for the experienced programmer, by providing advanced plotting routines. Again English-type commands are used, such as AXES for drawing the axes of a graph and PENDN (pen down) for lowering the pen to the paper.

The Corps will also have access to the Hewlett Packard Library of Contributed User Software (LUCAS) which offers low cost programs on data handling,

Photo 2. The main console unit, with the entire memory and control circuitry housed in the left-hand pedestal, and the two 20 million character disc stores on the right.

The New Computer System for the RE (2)

Photo 3. The graphics terminals have a refreshed display so providing zoom, pan and scrolling of 6,000 letters of text. A mini-cartridge tape capable of holding 110,000 characters is shown to the right. Each terminal will hold two of these cartridges.

mathematical and numerical analysis, statistics, scientific and engineering applications, management sciences, such as Programme Evaluation and Review Technique (PERT) and accountancy.

TIME SHARING AND TRAINING

The computer is very well equipped for time-sharing with its four on-line graphics terminals and therefore can be made freely available to other users to develop their own application software or to utilise existing library software. However, the immediate implication is a shortage of skilled BASIC programmers in the Corps, and certainly this resource is very limited within the RSME. Training started in 1978 using a micro-processor known as the Commodore Personal Electronic Transactor (PET) whose BASIC language is very similar to Hewlett Packard except for the extensions to the language. This opportunity is being given to staff and students who are already skilled in programming the HP 9810 desk-top computers currently in service with RE. As in the case of the HP 9810, the BASIC language will form an integrated part of various RSME courses particularly for Officers, C of W's and Surveyors Engineering, and their projects will continue to be computer orientated where applicable.

An estimated 600 personnel still serving with RE have attended HP 9810 programming courses and this nucleus must be our spearhead for the large demand of programmers over the next three years for HP 1000/45, HP 9845 and HP 9835 computers. It is perhaps regrettable that many of our best programmers have been attracted to more highly paid appointments outside the Services.

COMPUTER APPLICATIONS

Food for Thought

With such a powerful computer many applications spring to mind. Clearly all those of a purely engineering nature are already well known and need not be repeated here. An extensive library of software, largely purchased from Hewlett Packard, is expected to be built up as rapidly as possible, (or as money will allow), to cover standard engineering requirements. However past experience has shown that numerous applications are not standard, and herein lies much food for thought.

The New Computer System for the RE (3)

Project Recapes

Having now seen the extent of the HP 1000 system it should be easier to understand the applications that are now possible that could not have been contemplated on the old Elliott machine.

Project RECAPES is our main priority, which will provide for the first time ever a random question selection process from a computer data bank of multi-choice questions, compile the examination papers according to well defined parameters and print out combined text and drawings in a strict examination format.

The analysis aspect of examinations has already been in use for six years using the Elliott 803. So a completely re-written version of this software is to be produced as Phase I of the Project, so enabling Science and Computer Branch to provide a continuation service. One major change will be to enter student response cards via the optical mark reader directly into the computer. The analysis program then evaluates students scores, class position, average marks, standard deviation and test reliability. In addition a Table of Responses to each question is produced together with Index of Discrimination (ID) and Facility Value (FV), (formerly known as Difficulty Value, DV).

Although student records are not part of RECAPES, the final phase will develop this aspect of student and soldier administration. Thus all students results and progress can be stored in the data base, both as examinations scores and written commentary by the DS. It should also be possible to select likely candidates for Clerk of Works courses, for instance, using a simple coding procedure. The complete project in computer-aided instructional technology is being sponsored by ACIT who are funding the major part of the hardware. Consequently this project will receive the lions share of ADP effort at the RSME, until its completion in two years time.

Engineer Information

Although the computer may appear to be heavily committed initially, independent use of the system from its four terminals is possible without interfering in any way with each other or with RECAPES development.

Thus a proposal to store engineer information on a computer could well become a

Photo 4. The graphics terminal keyboard showing the standard typewriter keys, plus many additional keys for control, automatic plotting, text editing, vector generation and special functions.

The New Computer System for the RE (4)

reality. Again the data base management system would provide the solution and this could allow a great deal of cross-reference so that information may be extracted under a variety of headings. One aspect of this information storage would be local intelligence, itemising such details as water supplies (and whether river, catchment or underground sources), location of civilian heavy plant or transport, mass burial grounds (as a result of a nuclear strike), reliable communication routes with possible facsimile transmission and even compatible computer systems in the event of the prime system being damaged. This kind of information is needed quickly and accurately in time of war, and consequently needs to be amassed in peacetime and continually updated. Careful thought is required to decide on the best possible format to provide neat readily assimilated solutions and it should be remembered that the information output is only as good as that which is put in initially.

Real-time intelligence such as fall-out patterns could be generated on the graphics display. Both local and global maps would be retained in the computer data-bank. This would enable the user to display a map upon demand and then draw (using a light-pen or cursor) the fall-out pattern directly from radiation data received in the fall-out zone. Or alternatively data could be keyed in and plotted by software control. In the absence of radiation data, patterns could be computed knowing estimated size of weapon, wind direction and velocity and height of burst. This would enable adequate warning downwind some time before the fall-out arrived at say 100 miles from GZ.

Mobilisation Planning

The basis of any computer-aided system is to reduce the amount of human handling and allow the computer to perform these tasks more efficiently.

At a mobilisation exercise in 1978 the author suggested a method for matching incoming troops to nominal rolls and arranging for their most efficient departure. The computer program was code-named CANASTA, Computer-aided Nominal Arrival and Simulated Trooping Authority. The program performed three tasks, namely, matched arriving troops to existing nominal rolls, automatically arranged substitutions by rank and trade and printed out the completed draft details. These tasks normally involve considerable clerical effort, but with computer backing only two or three typists would be required to enter each arrival's number, rank, name and trade details directly into the computer. The computer will then complete the task.

CONCLUSION

This new computer with its excellent peripheral equipment and perhaps the finest data base management system to be found on any mini-computer can provide the Corps with an excellent management tool for instructional technology, engineer information, design and planning of E, M and C projects, mobilisation planning, using the large number of qualified computer personnel within the Corps. By the early 1980's the Corps will be in the unique position of having totally compatible computing equipment and interchangeable software throughout and planning must go ahead now to organise its total implementation by that date.

ANNEX A

System Specification

To provide some idea of the capability of the Hewlett Packard System 1000/45 computer, its detailed specification is outlined here:

(a) A high performance F-series processor with hardware floating point instructions and scientific instruction set firmware, with 128K bytes (1 byte = 1 character) of high density memory of 150n-secs access time.

(b) Two magnetic disc drives providing on-line access of 40M bytes using one fixed and one removable disc on each drive. Average access time of 33 milli-secs and a transfer rate of almost 10^6 bytes/sec.

(c) A powerful graphics terminal acting as a control console fitted with dual 110K byte mini-cartridge tape transports. A full 128 character set, drawing set, maths

character set with display modes white on black and black on white. Also provides zoom, pan and scrolling of the video display.

Input

Input to the computer is achieved by several different methods:

(a) Through the console video keyboard in the form of text or direct drawing, both displayed on the screen.

(b) A 310mm × 310mm (20in × 20in) graphic tablet which enables any drawing to be digitised and then displayed on the screen, also stored on disc or mini-cartridge if required.

(c) A card reader capable of reading both punched holes and hand entered pencil marks, reading 300 cards/minute. The prime ADP purpose of this peripheral is to read student response cards for examination questions or questionnaires.

(d) Four interactive graphic video terminals, to the same specification as the main console. All are simultaneously on-line to the computer, and could be located remotely if necessary.

(e) Standard keyboard printer, providing hard copy input, on a 15in platten.

Output

Output is available as hard copy at the 180cps matrix printer or at the high quality printer/plotter. Output may be displayed at any of the five video screens, or stored magnetically on any of the ten mini-cartridges or the two high speed disc units.

Limit State Design and the Combat Engineer

CAPTAIN M S CAMPBELL BSc, CEng, MICE

Stuart Campbell completed his Long Civils Course in 1975 and, after 18 months as Second in Command of 4 Field Squadron, returned to the Civil Engineering Wing at Chatham as an Instructor. His main teaching subjects are Structural Analysis and Steel Design.

INTRODUCTION

THIS article is about a design method called Limit State Design, which may suggest that it is of interest only to the chartered engineers of the Corps. The implications of the method, and of the new British Standards and Codes of Practice which use it, are however much more extensive than for example merely in changing the area of reinforcing steel in a concrete beam. Limit State Design will in future affect our training, our pamphlets and our designs.

The universal civilian acceptance (perhaps under pressure) of Limit State Design for civil engineering structures is almost inevitable. The EEC has accepted the method as the basis for design codes which, it is intended, will eventually become the

Captain M S Campbell

only permitted design standards that can be used in any EEC country. In consequence, our future engineering graduate officers will receive university training different from that given now and may not be familiar with the simple elastic theory of design, on which our existing Military Engineering pamphlets are based. It could, of course, be argued that improvised bridge design and bridge classification can be done, as now, without any engineering understanding at all, simply by following a series of simple calculations.

The major limitation of our present combat engineering calculations is that they do not tell us the strength of the bridge structure with any certainty. Most readers will have seen a Class 10 bridge crossed safely by an infantry APC (Class 16) without any apparent damage to the bridge. This is because of the built-in safety factor in the elastic design method. The safety factor has to be about 1·7 in normal use because bridges usually wear out because of metal fatigue caused by cyclic loading, and not because of static overload. Limit state design may not allow a significant increase in the normal classification of a bridge, but could give a better prediction of the heaviest possible abnormal load that will just cross the bridge without collapsing it.

The purpose of this article is to explain the limit state design method, and compare it with the methods of elastic and plastic design, which are probably more familiar to many readers.

DESIGN IS ABOUT SAFETY

The purpose of a structure is to hold something at some distance above the ground; and the aim of the design process is to achieve this economically and safely. Any engineering calculation, however, includes fundamental uncertainties. How strong is our material, for example? Steel is produced in a steelworks where quality control is rigorously enforced, and where samples of the finished product are tested to destruction. Concrete, on the other hand, can be of very varied strength depending on the constituents used, and how they are mixed, placed and compacted. Furthermore, no amount of test cubes will demonstrate the concrete strength if the cubes have been handled differently from the concrete used in the main pour. And how accurately can the loads on the structure be predicted? A room in a new barracks may be earmarked as a TV room but, under some later reorganisation, may actually become the Chief Clerk's stationery store. The change in floor loading will be considerable. In general, therefore, one can never say precisely how safe any structure is.

The elastic theory of design achieves a safety factor by reducing the allowable stress in the material to some value below that at which the material would yield. The structure is then designed to carry its full estimated working load.

Plastic design, on the other hand, assumes that the material will reach its yield point, but only under a load which is several times the predicted working load.

The approaches to safety in these two methods appear similar, except that the factor of safety is applied to different variables. Generally, however, the results will be different, because elastic and plastic design methods do not assume similar conditions under which a structure becomes unusable.

WHAT IS A LIMIT STATE?

At this point we must introduce the term "limit state". A limit state is reached when a structure can no longer do the job for which it was designed. A building, for example, would become unusable if it collapsed, but could also be considered unusable if the floor beams sag so much that doors are jammed in their frames. Alternatively the beams could be so flexible that the occupants get seasick walking across the room. This sagging of the beams does not necessarily imply the imminent collapse of the structure, so these are examples of two entirely separate limit states which would come under the general headings of "ultimate" and "serviceability" limit states. We must now identify what limit states, if any, elastic and plastic design methods are trying to represent. Plastic design considers what has to happen to a structure for it to

become a mechanism, and so fall down. A stable structure becomes a mechanism when a sufficient number of "plastic hinges" have been formed. As long as there are less than this number of hinges, the structure remains stable and can carry more load even though some points in the structure (the "hinges") no longer have any reserves of bending strength. The plastic design method aims to predict collapse, which is the ultimate limit state.

In elastic design, "failure" is supposed to occur when the outer fibres of the member are at yield stress. However, a beam, for example, can carry more load than the elastic "failure" load. If the deflection of the beam is calculated, it may exceed allowable limits (as given in Codes of Practice) at loads less than the "failure" load. We must conclude, therefore, that elastic theory is not able to predict any limit state. This is further demonstrated by the fact that elastically designed simply supported and continuous beams, under different combinations of point and uniformly distributed loads, have factors of safety against collapse ranging from 1·7 to 2·4. It is not logical that one beam needs a factor of 1·7 to be safe whilst another needs 2·4.

LIMIT STATE DESIGN

The main feature of limit state design is that it recognises that a structure will have several, unrelated limit states and uses appropriate equations to calculate the loads which produce the particular limiting effects. The collapse limit state would use plastic design equations, and deflections under load can be calculated using elastic theory. It should be remembered that a serviceability limit state is not absolute, as is collapse. One authority may suggest a figure for the maximum deflection of a beam, and another something completely different. Neither is "right", but the different values may each be more appropriate to particular circumstances. For deflection purposes we can use equations based on elastic theory without involving ourselves with the illogical elastic "failure" condition.

There is not one factor of safety for limit state design, but several "partial safety factors" are applied to the loads and the material strength of members. The combination of these partial factors gives an overall safety factor for the structure. The material factor depends on the risk of not achieving the characteristic strength specified, and so the strength used for design is factored down. The factor is not constant but depends on such things as the standard of workmanship and site supervision: concrete strength is more likely to vary than that of steel, so the partial safety factor for concrete would be the higher. For loads, the safety factor attempts to quantify overload and so factors up the calculated loads. The self-weight of the structure can be calculated accurately, but the imposed load could be much more variable, and so would attract a correspondingly higher partial safety factor.

To summarise, the material is assumed to be weaker than specified and the loads heavier.

THE NEW EQUATIONS

If this more logical approach to the use of safety factors and the identification and calculation of limit states were the only changes being introduced by the new concrete, steel and bridge codes (to name but a few), it is probable that the new codes would be more readily accepted by civil engineering designers. However, it has been known for a long time that loads predicted by simple elastic or plastic theory do not always closely resemble those observed in real structures. Much research work has been done in recent years and, from the large number of experimental results obtained, new design formulae have been deduced. These are included in the new codes.

The new formulae are invariably more complicated than those which they replace, and many contain modifying factors which result in the designer having no "feel" for what is happening in the actual structure. It is implied that these new formulae give highly accurate results and yet contain "constant" material property terms, like yield stress, that are in practice found to be variable. The researchers are

often accused of inferring complicated relationships from a graph of almost randomly scattered experimental results points, and also of including terms, which many engineers would call "fudge factors", to make the theory match the experimental results. One could question, for example, the relevance of Euler's critical buckling load in an idealised, pin ended strut to the compressive strength of a concrete column in a rigid multi-storey building frame.

LIMIT STATE MILITARY ENGINEERING

To assess the effect of limit state design, and the associated new British Standards and Codes of Practice, on combat engineering we must decide what changes are significant. Most combat engineers will deny any knowledge of contemporary design codes, and yet all that these contain is the accumulated wisdom and experience in a particular subject that has been built up over many years. The rules that we currently use for bridge classification or design are based on what is generally accepted as good practice, and what our military pamphlets have done is list rules of good practice for the subject that they describe. Their source of reference has been codes of practice. If we are unknowingly conforming to codes now, we can continue to do so, provided that our new pamphlets are competently drafted.

It would also be wrong to assume that new codes have fundamentally changed good practice. Concrete continues to require reinforcing steel in the tensile zone, and welds will still crack if the welding is done in the pouring rain. For the man on site, new knowledge may modify some of his working methods, but in general very little would change.

Design calculations will be different, but if a designer is mindlessly following a design sequence which says "the next step is to use this equation to calculate that quantity" one incomprehensible equation is no different from another. Even the freedom to choose partial safety factors can be reduced to a drill by listing recommended values for particular circumstances.

A comparison with the evolution of minefields from "rows and strips" to "panels" may be helpful. The equivalents of new theory were the rather complicated percentage kill/mine spacing/number of rows graphs which appeared in about 1970. These were later reduced to simple rules like "a tactical minefield consists of X rows of mines at Y metres spacing". The organisational plan became necessarily more complicated, but only the troop and squadron management actually have to understand it. For the Sapper, sitting on the minetrain in the pouring rain, "good practice" is still that he should be a man on the assembly line, unscrewing mine caps, putting in fuses and screwing down the caps again. The modification is that good practice now requires him to wear his NBC suit and have his respirator to hand.

CONCLUSIONS

Limited state design is a more logical approach to structural safety than that of the elastic or plastic design methods. It will result in lighter structures or, conversely, it can show that an existing structure is capable of safely carrying higher loads than were calculated for it by other methods.

The design equations and sequences in our pamphlets will change, but should be no more difficult to use than those which we now have. The complicated civilian codes of practice can safely be replaced by simple design rules applicable to particular structures.

* * * *

WAVELL—The Army's New Command and Control System

COLONEL R JUKES-HUGHES MBE, CEng, FICE, MIHE

The author has been CRE 2nd Armoured Division since January 1977. He has previously commanded 48 Field Squadron, Land Force Anguilla and 39 Engineer Regiment (Airfields). He has served, among other places, in Norway, Malta and Malaya.

INTRODUCTION

IF 1976 was the year of Restructuring and Exercise Spearpoint and 1977 the year of the Jubilee Review, so, to those of us in Headquarters 2nd Armoured Division, 1978 was the year of the WAVELL Trials—the trials of the Army's first ADP (Automatic Data Processing) transmission system in the field. It was a year which many of us approached with some trepidation. The author was no exception; two courses at Chatham and Shrivenham had failed to leave him any the wiser about what a computer was or what it could achieve. Yet two of the most remarkable features of the trials were the speed with which even the most unlikely officer mastered the system, and the enthusiasm with which it was greeted in the end by Commanders and Staff alike. It was a most rewarding year, and those of us who were involved in it had little doubt that we were in at the start of what is arguably going to be the greatest revolution in command, control and communications systems in the field since the invention of Semaphore.

WAVELL is being introduced into the Army in two phases. Stage 1, in which we are involved, lasts for about three years (up to the end of 1979) and covers the development, technical trials and user trials of a system sufficient to equip one armoured division and Headquarters 1st British Corps. Most of the hardware trialled was "off-the-shelf" civilian equipment. Stage 2, which is now under development, will extend the existing system to the other three armoured divisions and their task forces during the early 1980s. It will incorporate the immediate lessons learned in Stage 1, and will use militarized hardware. The Stage 1 trials were conducted on a Royal Signals technical exercise early in 1978, followed by a series of five divisional command post exercises. The Stage 1 equipment is being retained by the division to gain further experience during 1979.

BRIEF DESCRIPTION

The Equipment

The most obvious feature of the WAVELL system is the Visual Display Unit (VDU), a unit much like a television set with a keyboard alongside it (fig 1). The keyboard is similar to a conventional typewriter keyboard, but it has a few special function keys for things like paging backwards and forwards through the text, and

Colonel R Jukes-Hughes MBE

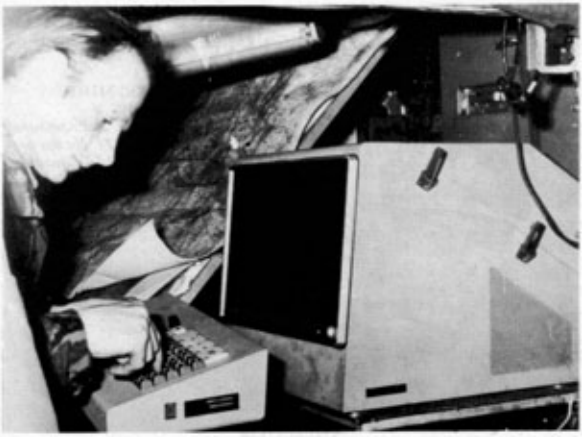

Figure 1. A staff officer operating a VDU at task force headquarters. The production equipment will be slimmer, lighter and more rugged

generating "hard copy" print-outs. The VDUs used during the trials were standard civilian equipments; the Stage 2 models are likely to be lighter, slimmer and more rugged. There were four VDU's at divisional headquarters during the trials, which were located on the Operations, Intelligence, Plans and Engineer/Movements desks. They were duplicated at Step-Up (alternative divisional headquarters). A further two VDUs were located with Operations and Intelligence at each task force headquarters, but these were not stepped up. Other branches of the headquarters including logistics will have VDUs when the system comes into service in Stage 2. Each divisional and task force headquarters also had a thermal printer for producing "hard copy" print-outs—a small neat unit which types at impressive speed.

Each VDU is linked by a cable to a WAVELL terminal close to its headquarters complex. At divisional headquarters and step-up (and at Corps level in 1979) this is known as a Terminal Equipment Vehicle (WAVELL), or TEV(W). It is illustrated at fig 2. The TEV(W) is an air-conditioned container mounted on a Bedford 4-ton truck, and contains a computer (or Central Processor Unit), a magnetic disc store, a magnetic tape cartridge unit used for loading the store with programmes and data, a hard copy printer and keyboard for systems control, and a second printer for periodic print-outs of "fall back" data. The latter could be printed automatically on a continuous cycle, so that if a computer goes off-line the fall back data could be used as a basis for manual staff work until it comes back on again. When it comes back on-line it is updated automatically with data from other computers in the system. VDUs at task force headquarters are linked by cable to a Land Rover terminal (fig 3) containing much the same equipment as the TEV(W) less the second printer. It will be replaced by an AFV in Stage 2. The WAVELL terminals at both divisional and task force headquarters are connected into the BRUIN trunk communications system. The third type of installation is the Isolator, which is mounted in a similar Land Rover to the task force terminal and contains virtually identical equipment. Isolator Units are located at each Communications Centre, and are used to monitor the trunk communications system and select the most suitable channels for transfer-

Wavel - The Army's New Command and Control System (1)

ring data. The locations of the various equipments are shown diagrammatically at fig 4.

How it Works

The general idea is that each headquarters has its own information bank or "data-base" in its WAVELL terminal, and all the WAVELL terminals are linked together by the trunk communications system. When any staff user puts a piece of information into his own computer, the same piece of information is transmitted automatically to the data-base of every other headquarters to which it is relevant. This not only happens automatically, but almost instantaneously.

Information is stored, retrieved and displayed by the use of a number of pre-defined "formats", or page displays of information. These are fed into the magnetic disc storage beforehand by inserting a tape cartridge, rather like a car radio cassette, into the magnetic tape cartridge unit. For example, there is a format for "Unit Data", with a page display of all the information which the G (Ops) staff are likely to want to know about a battle group—such as locations, attachments and detachments, AFV strengths and combat effectiveness. An example of this format is shown at fig 5. There is also a format for Enemy Contact Reports. The G (Int) staff can call for this to be displayed on the VDU as a straight forward list of contacts in time sequence, or they can tell the system to sort the list and present only those contacts which occurred in a given area, or face a particular battle group, or in which a certain type of equipment has been sighted. The computer will work all this out for them. Other formats deal with such subjects as nicknames, codewords and reserved demolitions.

To look at a format, all a staff user has to do is to type in a two figure number on his keyboard, and the format will appear on the VDU within a few seconds. He can then type in any changes (for example a change in a unit's location) using his keyboard. If he wants a hard copy of the format on paper, he simply presses the "print" key on his keyboard and the print-out will come zipping out of the thermal printer in a matter of seconds. It can then be used for map-marking, briefing or passing to an LO. The author always takes up-to-date print-outs of important formats with him whenever

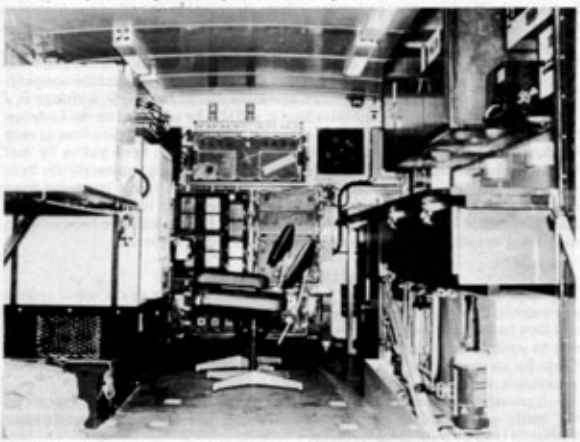

Figure 2. The interior of a Terminal Equipment Vehicle (WAVELL). The magnetic disc store is on the shelf on the left-hand side of the vehicle, with the Central Processor Unit beyond it

Wavel - The Army's New Command and Control System (2)

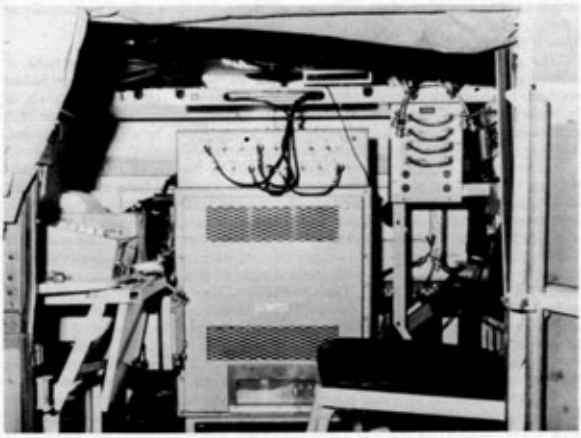

Figure 3. The interior of a task force WAVELL terminal. The Central Processor Unit is in the centre of the picture, with a keyboard and thermal printer to the left of it. The magnetic disc store is located in the place normally occupied by the front seat passenger. The Isolator Unit is almost identical but has no magnetic disc store

he leaves the headquarters, and updates them on arrival at any other headquarters that he visits.

Any changes made to data as described above will automatically be transferred to the terminals of all the other headquarters using the system. Furthermore the information put in under one format may well affect other formats, and the computer is programmed to change these formats automatically. For example, a change in a unit's location put in on the Unit Data format will also be amended on the Location State (Locstat) format, and on several other formats as well. The data-base at each headquarters will therefore contain information which has been put in by that headquarters, probably rather more which has been transmitted automatically from other headquarters, and a considerable amount compiled by the computer from other formats. The headquarters thus has immediate access to considerably more information than is normally available to it, and a lot of time will have been saved in not having to call up such information by radio and then collate it.

RESULTS OF THE TRIALS

The Stage 1 trials had a number of limitations, caused mainly by the use of civilian equipments; they were too fragile for field use, they required too much maintenance and they had insufficient storage capacity. Nevertheless the aim of the trials, which was to confirm that the WAVELL concept meets the requirements of 1st British Corps for an operational ADP system, was met in full. Among the many significant advantages of the system are the following:

—It provides commanders and staff with accurate and up-to-date information on the battle which enables them to exercise command and control much more efficiently than by traditional methods.

—It eliminates the requirement for updating state boards manually, since all the information can be obtained from a print-out.

Wavel - The Army's New Command and Control System (3)

—It eliminates the need for many periodic returns and reports.

—It enables a headquarters to change command much more quickly, because all the information required at change of command is already stored in the terminal at step-up headquarters.

—It significantly reduces the incidence of errors in passing information which are introduced by the various human links in the normal communications chain.

—It reduces the amount of net radio traffic needed to obtain basic information, such as changes of location.

Not surprisingly the system proved of immense value for controlling engineer operations, and a number of special engineer formats were trialled and developed for incorporation in Stage 2. These included an Engineer Grouping and Tasks format, Minefield and Demolition schedules, various formats concerned with vehicles, equipment and resources, and a free text format for sending confirmatory orders and

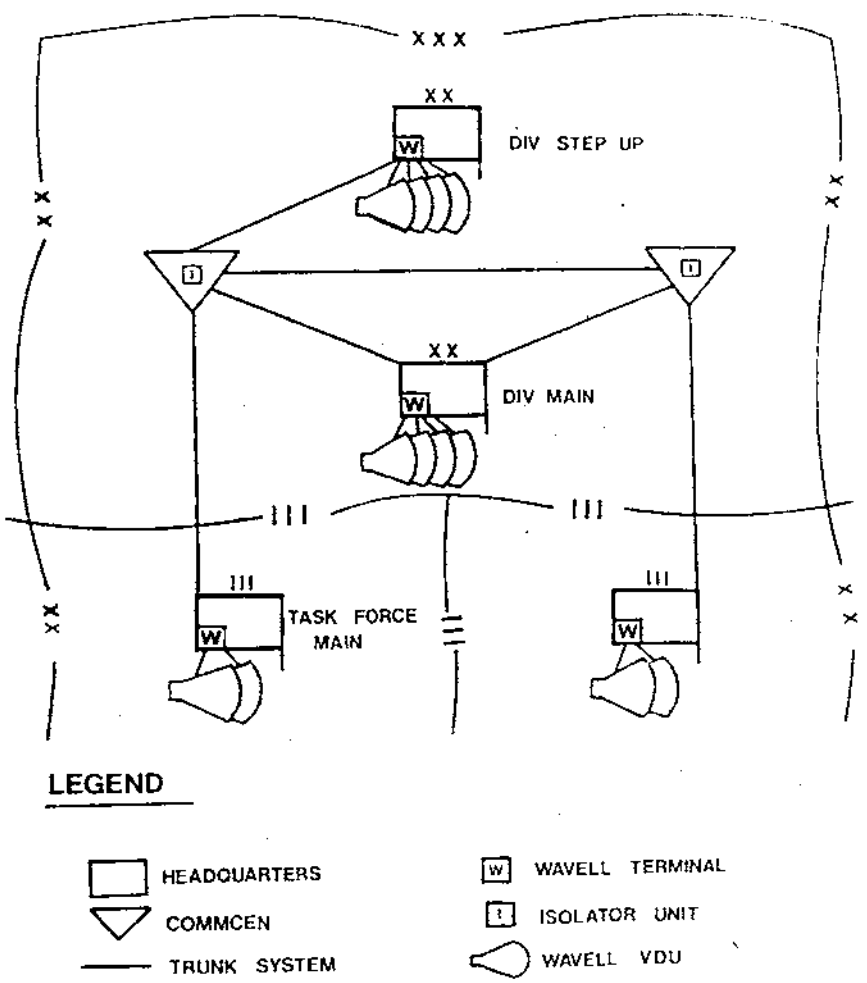

Figure 4. Schematic diagram of Stage 1 Wavell deployment. Wavell will also be deployed at Corps level during 1979.

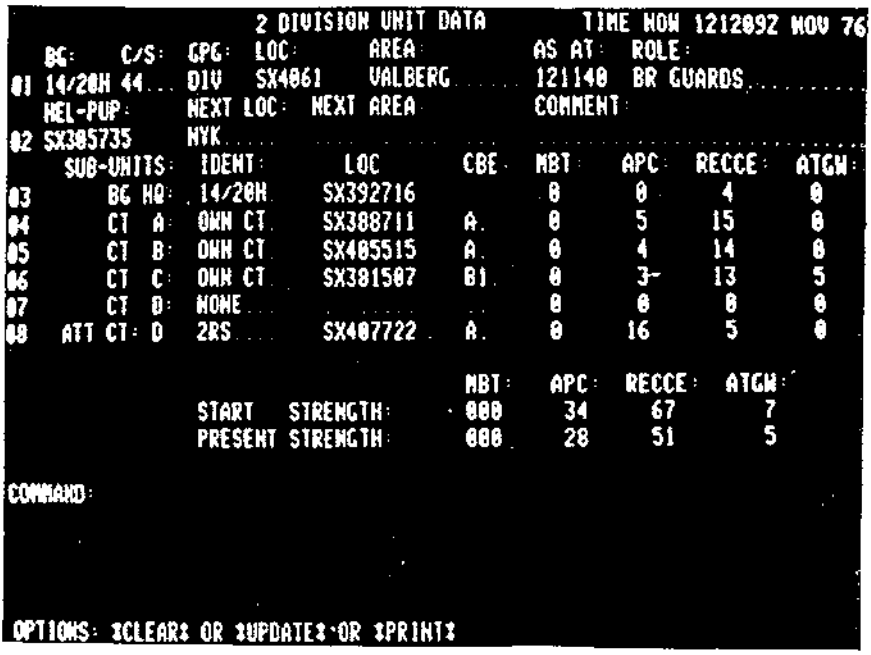

Figure 5. A typical format. The information shown is entirely fictional

sitreps. In the final version of the resources and equipment formats, all the addition, subtraction and totalling will be done automatically by the computer. On a recent command post exercise, print outs of the various formats were sent to HQ RE at Corps headquarters in lieu of all the states and reports currently required. They were found to be a great advance on previous methods of passing information. In Stage 2 all such information will be continuously available at Corps headquarters, and will be collated automatically by its computer. Engineers at Corps headquarters will be able to see at a glance where engineers in the Corps are operating and what they are doing, which minefields and demolitions have been completed, and how much stores and equipment are available in each location; all information which is time-consuming to obtain and laborious to collate using current methods.

The trials were sufficiently promising to enable the divisional commander to be able to recommend that Stage 2 should go ahead on the same lines as Stage 1, but must have full military specification equipment. Perhaps the only notable recommendation was that the system should be extended down to battle group level; task force headquarters are currently having to spend too much effort in obtaining basic data from battle groups over net radio and feeding it into the system. One answer to this would be for battle groups to be equipped with a simple, hand-held message entry device which would operate on normal net radio communications. One desirable improvement would be a map display facility, but this is unfortunately beyond the state of current technology.

THE FUTURE

In the longer term the possibilities are limitless and fascinating. The pace of development is such that a computer chip processor unit (a silicon chip with printed circuitry measuring 2mm by 2mm) costs about £5 today. Ten years ago a machine of this power would have occupied the space of an averaged-sized room and cost well over £100,000. In a couple of years time the cost of such a chip will be down to 50p. In five or ten years time, enough solid state "bubble" memory (information is stored in

tiny magnetic "bubbles") to store a full page of text can be expected to cost less than a penny. It is easy to envisage the day—not many years hence—when every staff officer both at home and abroad will have a WAVELL-type VDU on his desk, each with its own internal computer on a chip. These will have access to terminals in every other office, as well as to more specialized and powerful computers in places like the Ministry of Defence and Record Offices. Mail will be sent electronically—with the staff officer doing his own typing—and will be filed electronically on a magnetic filing system at the terminal instead of on conventional files as we know them. Clerks and typists will become a thing of the past except in a supervisory and personal assistant capacity—but before RE Manning and Record Office let out a cheer, it is only fair to point out that the majority of their clerks will become redundant also! New technology is making ADP information and transmission systems cheaper, lighter and more efficient every year. It is only a matter of a few years before they will completely replace traditional office systems as we know them.

The Defence of Rorke's Drift 22 January 1879 The Commemoration of the Centenary

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IT is said that fortune favours the brave; that was certainly the case at Hatch Beauchamp in Somerset on Sunday 21 January 1979. On that day many serving and retired members of the Corps of Royal Engineers, led by the Chief Royal Engineer, Lieutenant General Sir David Willison KCB OBE MC, and others joined together to commemorate the defence of Rorke's Drift, and to remember in particular Lieutenant (later Colonel) J R M Chard RE, who was awarded the Victoria Cross for his part in the action. Despite the appalling weather which gripped the country as a whole, the day was fine and sunny, and by contemporary standards warm.

The ceremony was a culmination of months of planning. It was inspired by the desire of Mrs Dorothy Phillips, a niece of Colonel Chard, to present to the Corps certain relics connected with her famous uncle. Originally Mrs Phillips, whose 94th birthday would have coincided with the anniversary, was to have made the presentation herself, but very sadly she died in March 1978. It was left to her son, Mr Donald Phillips, to fulfil her wishes. On behalf of the Corps, Major General R C A Edge CB MBE, a retired Colonel Commandant, formed a committee to plan and organise the commemoration.

As Colonel Chard is buried in the churchyard of the Church of St John the Baptist, Hatch Beauchamp, his grave was to be the focus of the events. A further family connection was that at the time of Colonel Chard's death the Rector of this church was his brother. Commander and Mrs Barry Nation very kindly offered the use of their nearby home, Hatch Court, for the parade.

It was here, in front of the impressive Georgian mansion looking out over a wide sweep of gravel and lawn, that the Chief Royal Engineer was received with a General Salute at 11.00 am on 21 January 1979. On the right were the Royal Engineers Aldershot Band and the Corps of Drums of the Royal Monmouthshire Royal Engineers (Militia) resplendent in scarlet. Next to them were over a hundred Members of the Royal Engineers Association from South Wales, Taunton and Plymouth together with members of the Royal British Legion led by fifteen standards. Then came contingents from the Army Apprentices College Chepstow, 100 Field Squadron the Royal Monmouthshire Royal Engineers (Militia), and the Somerset Army Cadet Force. The parade was commanded by Major J W Quin RE

Photo 1. The Chief Royal Engineer, Mr Donald Phillips and the bust of Colonel Chard

Photo 2. The Chief Royal Engineer addressing the Parade

The Defence of Rorke's Drift 22 January 1879 (1 & 2)

from the Army Apprentices College. There were many spectators including a large number of distinguished guests who were seated on the steps below the imposing portico of Hatch Court.

After the General Salute the Chief Royal Engineer inspected the parade and spoke to many members of the Association. Mr Donald Phillips, then presented to the Chief Royal Engineer a splendid marble bust of Colonel Chard and the sword which he carried at Rorke's Drift. In his speech Mr Phillips emphasised Colonel Chard's qualities of courage, calmness, resolution and modesty. He said that his family thought it only right that these valued possessions, which had been in their care for nearly a hundred years, should be made available to a wider public through the Royal Engineers Museum. Lieutenant General Sir David Willison accepted the bust and sword and thanked Mr Phillips and his family for their great generosity in

Photo 3. The Chief Royal Engineer lays the wreath on behalf of the Corps

The Defence of Rorke's Drift 22 January 1879 (3)

presenting them to the Corps. He said that Colonel Chard's deeds were a very good illustration of the fact that Sappers are soldiers first and engineers afterwards. The heroic defence of Rorke's Drift had altered the whole course of the Zulu war, redeeming in a single night the British Army's earlier disastrous defeat at Isandhlwana. The Chief Royal Engineer also said that he had exchanged greetings with the Royal Regiment of Wales, who were holding their own celebrations at Brecon.

To the strains of "Wings" and with a proud "swing" the Parade then marched off to the church where the Rector of Hatch Beauchamp, the Reverend K B Edwards B Sc, assisted by the Reverend J C R Webb FCA CF, conducted the appropriate and dignified Memorial Service. The lesson was read by Lieutenant Colonel (Retd) W W M Chard, late of the Royal Regiment Fusiliers, and a collection was taken for the Charles Johnson Hospital, Ngutu, Zululand. The singing was led by the North Curry Choral Society who had very kindly volunteered their services.

After the Service the parade formed up in a hollow square about the plain marble headstone which bears the inscription:–

In Memorium
Colonel J R M Chard VC RE
"The Hero of Rorke's Drift"

The Buglers of the Royal Monmouthshire Royal Engineers (Militia) sounded the Last Post and the Royal Engineers Association Standards were dipped. The sounding of Reveille ended the two minutes silence. Wreaths were then laid upon the grave of Colonel Chard, by Lieutenant Colonel W W M Chard on behalf of the family, by the Chief Royal Engineer on behalf of the Corps, by Her Majesty's Lieutenant for Somerset on behalf of the County of Somerset, by Captain W Bailey RE, on behalf of 5 Field Squadron (in which Colonel Chard was serving at the time of Rorke's Drift), by the Chairman of the Royal Engineers Association on behalf of the Association and by Colonel Welchman DSO on behalf of the Royal Regiment of Wales. This simple yet moving ceremony in the country churchyard on a sunny winter's day was a fitting tribute to the officer of whom the Chief Royal Engineer said that his deeds stand out even in the illustrious company of the Sapper officers and soldiers who have won forty-six Victoria Crosses for deeds of great valour and gallantry.

All those on Parade then returned to the Village Hall for lunch. The guests of the Corps, who included Her Majesty's Lieutenant for Somerset and Mrs Luttrell, the Chairman of the Somerset County Council and Mrs Leonard Williams, Colonel the Right Honourable E D L du Cann PC MP and Mrs du Cann, the Lord Mayor and Lady Mayoress of Plymouth, the Mayor and Mayoress of Taunton, and members of the family of Colonel Chard had lunch at Hatch Court. After lunch there was an opportunity to inspect an excellent display of items connected with Rorke's Drift, including the Sword of Honour presented to Colonel Chard by the City of Plymouth. The display had been prepared by the Curator of Taunton Museum.

The Corps is indebted to Commander and Mrs Nation for offering the use of their splendid house and grounds for the ceremony.

It was a great delight to all those who had been involved in planning the ceremony that General Edge, who had unfortunately suffered a stroke in December, had recovered sufficiently to attend. General Edge was responsible for the concept of the ceremony and its success was very largely due to his drive and enthusiasm.

* * * *

AutomoBilly

COLONEL E H IEVERS

Eyre Ievers grew up in Ireland and joined RMA in 1922. Served in the days of horses in Field and Training units RE and Bengal S & M. Leave in the mountains and jungles. 1938 E & M Course. 1939 Cadet Trg. Late 1940 to Greece—flame defences—Fd Coy in the retreat—picked up at night from a rowing boat by HMS Kimberley. *Fd Sqn in Egypt before Cadet Trg in Roorkee from Sept 1941. Four years of staff jobs including officiating DDMT in New Delhi. CRE Quetta. CRE Colchester. In 1950—retired with family to Australia. 1973 moved to England. A jobbing gardener. Interested in metaphysics. This is his fifth article to be published in the* RE Journal.

BILLY, n (Austral). Tin can used as a kettle etc. in camping out . . .

Concise Oxford Dictionary

A Hillman Station Wagon with a 1500cc engine, having a 7psi radiator cap was to be our transport and our home on a tour of unspoilt Tasmania.

A standard plywood house door, 6ft 8in × 2ft 8in, formed the base for a top bunk on the roof rack and a roll-up bed below left little spare room inside the vehicle.

A Billy which could be boiled in the automobile to produce hot tea and food, whilst on the move and even while raining (without carrying a stove and its fuel), was a very attractive idea. My companion for the tour was interested in the project, he was a Master of Science and had the use of a workshop.

Could we do it? We could and did!

The billy was an inexpensive aluminium cooking vessel, with a lid held on by three clips. A heating loop made of ¼in copper tubing was taken through the lid. The lid of the assembly was fixed to a bracket bolted to the engine and connected with washing-machine plastic hose to the car heater outlets. The billy had to be clipped up to the lid, and its removal *downwards*, enclosed by its insulating cosy, was a bit tricky. A cord operated a spring-roller blind which could be pulled up in front of the radiator while its temperature was raised above the 212°F required to boil the billy. A knob on the dashboard operated a push/pull cock which controlled the hot water from cylinder head to the heating loop. Three pints of drinking water could be boiled in the AutomoBilly (A–B) while driving about five miles on the level.

Reserve drinking water was carried under the bonnet in two quart-size plastic bottles which we refilled from mountain streams. The last boiling of the billy before stopping for the night went into thermos flasks for the next morning's early tea. The A–B was next used before the breakfast stop to boil the eggs.

(*To the tune of Australia's "Waltzing Matilda"*) . . . . . .

"And we sang as we drove and waited while the engine heat
boil'd up our Au-to-mo-Bil-ly for tea
Au-to-mo-Bil-ly Au-to-mo-Bil-ly
Yes please an Au-to-mo-Bil-ly for me"

AutomoBilly Mk II, developed for the next summer tour, used a ½ gallon enamelled utensil (price 69 cents). This was just the right size to fit in a wire lettuce basket (price 75 cents), the handles and top of which folded down and kept the lid firmly in

Colonel E H Ievers

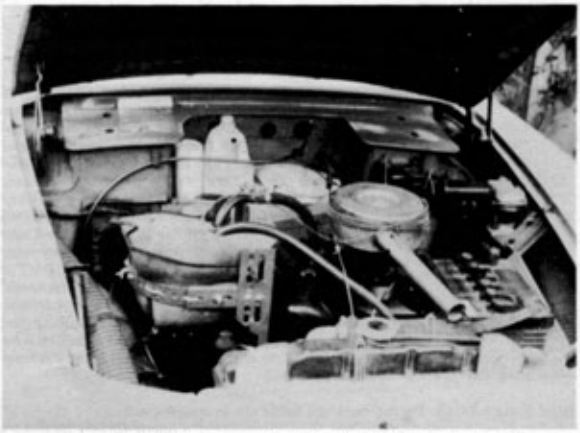


Photo 1. A–B Mk II in its mounting which is bolted to the cylinder block

place. The billy in its wire basket sat in its mounting fixed to the cylinder block and the lid with its flexible hoses attached could be lifted off *upwards*. (See photos).

More thought had been given both to A–B cookery and the use of an insulated wide flask in which to keep one lot of food hot while another was being cooked. Besides the boiling of water for tea, 1 pound cans of soup, Pork & Beans and Meat & Veg were heated up in the billy, eggs were poached and potatoes boiled.

A dial thermometer was added to the instrument panel so that the temperature inside the billy could be watched. This cost about $10 and was the only expensive item purchased but was simpler than arranging a visible steam outlet in the top of the bonnet to show when the billy boiled. This A–B Mk II was used on subsequent tours and remained installed until the vehicle was about to be sold nearly four years later.

An electrically heated AutomoBilly was tried in a motor car with an alternator. The battery was mounted close to the front with the cradle bolts coming through abaft the headlamp. Slightly longer bolts enabled an identical cradle to be fixed under the wing ahead of the wheel, and an expanding wire secured a kettle in a cosy. This A–B could be used at any time, including when the car was parked, or coasting downhill, but it was feeble compared with a water heated A–B. It could be useful for warming up food for an infant. (We didn't have one then!)

DEVELOPMENT POSSIBILITIES

Few motor cars nowadays have enough room under the bonnet to accommodate a water-heated A–B. In addition no accessory manufacturer could consider producing and marketing the many different designs which would be required to fit under different bonnets. For several years, nearly all cars (except "Beetle" Volkswagens) have had flat-topped front wings extending all the way from the bulkhead right to the front. Underneath the wings there is much covered space which is generally entirely unutilised. If the tops of wings could be hinged to open to give access to the space below, this might be developed to be useful. Hot and cold foods in flasks could stand in the deeper spaces close to the headlamp and bulkhead, and other picnic case contents could be accomodated in the shallower space above the wheel. Perhaps

Automobilly (1)

some wealthy car buyers have specified such development to their coachbuilders, and perhaps more humble enthusiasts may have bought second-hand wings for DIY experimenting, but I have not yet seen any front wings with visible hinges and locks.

When the use of space under the wings becomes common, the way will be clear for manufacturers of A–B's, because there will be somewhere in which they can be installed conveniently. (Preferably under the kerbside wing, so that user does not have to stand on the road.) The hoses to carry the very hot water, under pressure, would be safely away under the bonnet which could remain closed down. Some A–B's might be designed merely to produce boiling water from a bibcock, others might be water jackets within which saucepans could be heated. One can imagine some car-wives wanting more that one A–B, and possibly a small sink for the washing-up!

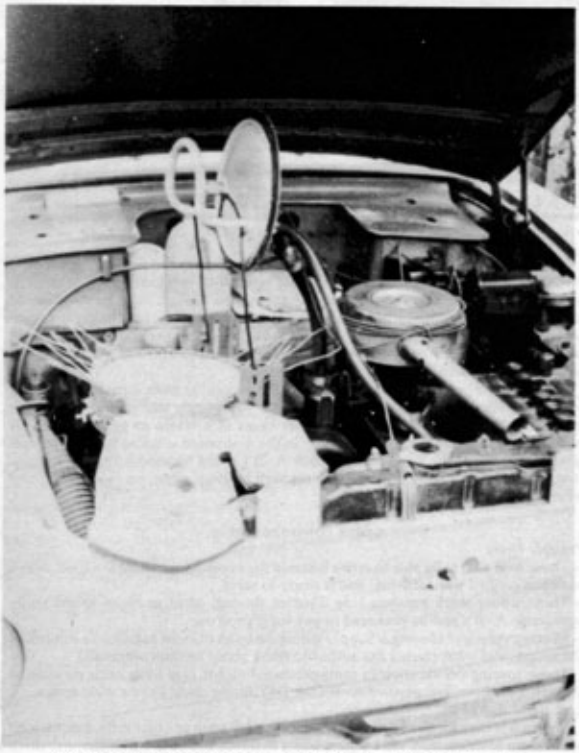


Photo 2. Lid with heater loop has been raised and rests on its wire support

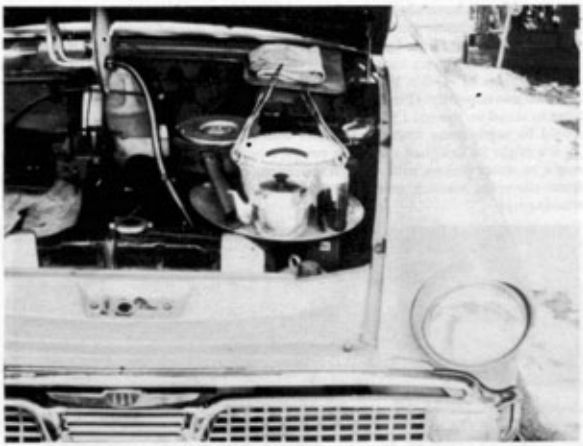


Photo 3. Tea is ready to be served

Another development to be considered is a swollen-headed radiator. A cavity in this, surrounded by radiator hot water, could be an A–B in which liquids or cans, or indeed any other vessels and their contents, could be heated. Such an A–B would involve the vehicle manufacturer and not be just an accessory, but the great advantage would be the abolition of the need for A–B hose connections. Vehicles with transversely mounted engines, having the radiator at the kerbside of the bonnet, would have an advantage.

Because of emphasis on safety, only A–B's accessible from outside the vehicle when it is stationary have so far been discussed. Few people worry about the danger of scalding water from a car heater in the event of a crash, so perhaps an A–B accessible by opening the glove box door in the dashboard will also become acceptable. Just think of the convenience! Such A–B's could be used without having to stop, they could be used while driving through built-up areas, on motorways, and when driving in convoy.

OTHER CONSIDERATIONS

Possible Users

— Those who wish to be able to arrive home in the evening with some hot food, which has been cooked while driving, and is ready to serve.

— Those whose work involves long distance driving, often at night, might really appreciate A–B's and be prepared to pay for a good one.

— Military vehicles? (Seeing a Sapper wiring on to an exhaust manifold a can out of the rations was what started the author to think about an improvement!)

— Those touring on vacation in mass-produced motor cars have been mentioned already. For them, inexpensive A–B's for DIY fitting could have a wide appeal.

Less Road Accidents

When it is easy for tired drivers to have some hot soup or other refreshment, with a minimum of delay, they will be more likely to do so, and be in better shape to drive more safely.

Less Fires

When motorists are able to brew up without lighting fires, or even striking a match, they may cause less grass fires, bush fires, and forest fires when driving through countries where these are a serious hazard.

Warning

The fact that an extremely simple A–B can be improvised, could tempt amateurs to experiment. They should remember that water from an engine cylinder head might be at over 240°F, and at over 10psi pressure, and is NOT to be trifled with.

Gentlemen—The Corps

COLONEL P L NEWTH OBE, MA

In recent years Col Newth has served as 21C, Junior Leaders Regiment RE and then as MA to the Chief of Staff BAOR. He commanded 3 Training Regiment RE and then went to HQ Northern Ireland as GSO1 SD and Training. In 1974 he returned to MOD for his first venture into the Weapons Staff as PM Weapons 4 responsible for the development and productions of mines, demolition and related equipment. He attended the last Senior Officers War Course in 1977 before taking up his present appointment as BLO Engineers in the USA.

"WHITHER THE CORPS". It was about 20 years ago that the original article under that title appeared in this Journal. No doubt before and certainly since the arguments have waxed and waned. Essentially they have been "Engineers" versus "Sappers", "Real" versus "Royal", PQEs against the rest, whether we are a Corps of Sappers leavened with engineers or a Corps of Engineers leavened with soldiers and, however it may be, what proportion of which do we need and how s hould the rest be trained. The most recent thought-provoking exercise was Major Mike Sims' excellent paper "Sapper Influence in the Army" and discussion on it at last year's E-in-C's Conference and since. (Both are summarised elsewhere in this Edition of the Journal). In this article a slightly different diagnosis is attempted.

If we have lost influence, and there is some doubt about this, is it because we are failing to make our voice heard in the All-Arms community or is it, perhaps, because we as military engineers have less to offer than had our predecessors? Surely it is our job to make the tasks of other arms easier, or indeed even possible, by applying the skills and techniques of the engineer to the requirements of the battlefield. Taking this idea forward a little, it is not enough to respond to requirements or to devise answers to problems as they emerge. If we do this, then this is all we will be expected to do. We may be considered efficient *reactors*, but we shall not be seen as the likely source of the flash of genius that will turn the impossible into the possible. No, to be effective we must be, and be seen to be, *innovators*, the source of ideas and techniques that allow others, almost more than ourselves, to do whatever it is they have to

Colonel P L Newth OBE MA

do. For this to be possible there are two requirements. We must be knowledgeable soldiers, otherwise we may well not see the problems clearly enough and no one else is going to bring them to us. But quite as much we must be engineers who include in our skills a knowledge of the state of the art across the whole field of engineering. Only then can we be in a position to propose engineering solutions to the problems of soldiers with authority and a high chance of success.

This is not the place to trace the history of Sapper officers' training, but we can lay a respectable claim to being amongst the first to introduce logical and systematic training for engineers. For the better part of 200 years and until quite recently we have trained our officers to be all-round engineers. In the years between the wars a majority read for the Mechanical Sciences Tripos at Cambridge, itself perhaps the finest grounding in engineering yet devised. All attended several months of training in applied military engineering as senior lieutenants or junior captains on courses variously known as Supplementary, JO, YO Stage Two, etc. For a number this early training led to life long interest in some particular branch or sub-branch of engineering, often without formal qualification. So, historically, the Corps has contained a broad base of engineering knowledge with many peaks of learning in specialised topics. We need not look far for the results. Military aviation born out of the Sapper balloon and kite units of the turn of the century, modern signalling and all it has lead to, the tank itself, the land mine, PLUTO (Pipe Line Under The Ocean) and the Mulberry Harbour of World War II. A better historian than I could add to the list.

But in the generation that has perfected the computer, flown to the Moon, and perhaps developed the art of engineering further in thirty years than in all its previous history, it is difficult to find a single area where Sappers have presented the Army with some startling leap forward in capability. Perhaps two examples of "might have beens" will illustrate the point. As the years go by we must become more and more concerned with urban areas which grow inexorably across the potential battlefield. Every urban area is equipped with a latent demolition system in its gas supply system, as we nearly discovered by courtesy of the Ulster Workers Council in East Belfast in 1974. Are there Sapper officers who are capable of sketching out a scheme to make use of this potential? Do they have friends in the world of municipal engineering who could help convert the sketch into a workable plan? A second example. A ditch remains a very effective component of an obstacle system. Specialist earthmoving machines of gigantic size and huge output are now commonplace on construction sites across the world. Who knows enough about such machines to harness them to the obstacle plan? Could even a small number of such monsters so change the face of the FEBA (Forward Edge Battle Area) as to allow the Corps Commander to fight his battle in a different and more effective manner? Surely it is to questions such as these that we should be applying ourselves. When we have the answers we shall be in a position to make a real contribution to the All-Arms Group and our voice will be heard. But to get to those answers we need a great deal more up-to-date engineering knowledge in the heads of our field Sappers

This then becomes a matter of training. In recent years we seem to have gone astray in two ways. Firstly, under many well known pressures, we have reduced the level of training for young officers to little beyond the day-to-day needs of a field troop commander. Secondly, we reserve full professional training for a small minority. Because time away from troops can prove such an over-riding disadvantage not many of our best officers opt for this training. Those who do tend to be diverted from the main stream to appointments where they cannot acquire the military experience which should be the catalyst to the application of their engineering skill to military problems. So we find ourselves without the breadth or depth of engineering knowledge that we need.

To put this right will hurt, for it means that we must spend more time in training our officers and this must mean less time with units. A first step has been taken in the reintroduction of a form of Stage Two training for young officers. This is a start, but it is not enough. We need something akin to the old Supplementary Course, with

updated content. Junior officers should return to Chatham after a couple of years with a unit to learn about the state of the art and how to apply it. This training will fall short of chartered engineer standard but at least all Sapper Officers should know enough to be able to plan the sort of projects that we are invited to undertake. We must get away from the attitude, "this is not combat engineering—send it to Barton Stacey". With this background for all, we could well find that the number who need formal higher qualifications falls considerably and that their training could be achieved by attachment outside the Corps with some savings to set against the load imposed by a Supplementary course for all.

It is worth pondering for a moment on how degree training would impinge on the arrangement outlined above. In the future we expect to recruit a majority of our officers as graduates. Of these it is fair to assume that most will have an engineering degree. The last thing that we should do is to waste the time of these officers by repeating on a Supplementary course what they have already learnt as undergraduates. Hence, it would be necessary to design the Supplementary course to include a great deal of flexibility. It is of interest that the US Army Engineer School is encountering exactly this problem now in its Engineer Officers Advanced Course. They are tackling it by dividing the course into a great number of modules, some compulsory, some selective. Each student is, therefore, able to take a course that matches his needs and fills the gap in his knowledge (in case this article ends up in US hands I must hasten to add his or her). We could well learn from this technique of course design.

What of degree training itself. It should continue to be our policy that any officer who is capable of obtaining a degree should have the opportunity of doing so. But no existing degree course is entirely appropriate for a military engineer. I have already suggested the old Mechanical Sciences Tripos course came somewhere near the ideal, especially if taken in two years, but alas this possibility no longer exists. So let us invent a new one, to be taken at Shrivenham with active participation by Chatham. Let it be no longer than two years and if need be throw all the other training that a young Sapper officer receives into the balance to make up the time considered necessary to achieve a first degree. Having established such a degree course, it would be worth seeing how many people, who at present take their degrees elsewhere, could be diverted to it, so ensuring as many people as possible with an entirely appropriate training.

If any members of the staff of AG7 or the SD branches have read thus far without degenerating into a state known as the "screaming heebee-jeebees" it will be surprising because the manning implications are substantial. However, it should not be seen as a case of what we can afford to do, but rather of what we cannot afford not to do. If we look seriously at our officer manning we can afford to do it, but the price will be the reasonable one of making much better use of our warrant officer talent than we do at present. We are blessed with the best warrant officers in the world, a fact that is brought home to me forcibly on the all too rare occasions when a Sapper warrant officer has a chance to spend time with the US Army. Yet many are forced to retire in their mid-40s when they are at the peak of their usefulness. We can give these men rewarding extended careers, with some adjustments to terms of service, in many junior regimental officer and staff appointments. Some one else will have to do the sums but a balance can be struck.

The community as a whole expects from its engineers ideas, structures and equipment that will enable it to live more easily and work more effectively. So also, the Army is entitled to expect from its engineers systems that will enable it to do its job more effectively. We can not realise that expectation unless we increase both the breadth and the depth of the engineering knowledge available within the Corps, nor could we apply it if we allowed its acquisition to be at the expense of our military ability. To achieve all this a substantial change in our officer training scheme is needed. The manning implications will not be popular, but they must be accepted.

Escape from Singapore—Part II

MAJOR FRANCIS L ANGELL RE

Part I related the story, Foreword, Chapters 1 and 2, of the departure from Singapore in the *Shu Kwang*, its sinking, the transfer to the *Tanjong Pinang* and the arrival in Sumatra at Tembilahan on the Indragirrie River. *The story continues*:

CHAPTER THREE

Any of you who have made a similar journey to mine will, I feel sure, agree with me that most of us feel a lot happier with both feet on dry land. It certainly was so in our case. We had no idea what lay ahead yet one and all felt, on arrival at Tembilahan, Sumatra, that at least we were back on land, and could, with a certain amount of luck, look after ourselves. At sea we felt completely helpless although on the *Tanjong Pinang* we knew we were in good hands.

I should imagine that no worse place could be found than Tembilahan for starting off on a journey which we knew was a race against time. It was a miserable little village and did anything but inspire confidence. The Japanese were North and South of us and we had to make the trek across Sumatra to the West coast port of Padang before the Japs arrived. However it must be clearly understood that here, as throughout the whole of our journey, the Dutch were most kind and most helpful. We were housed in a school building and provided with bowls of rice for supper. The rice was not particularly palatable, but it was food, and under the circumstances I think we were lucky to be given anything at all. We looked like nothing more than a bunch of tramps and our appearance could not have exactly inspired the Dutch. We of course only had the clothes we stood up in which were filthy and, in many cases, blood stained. Several of us had no boots and only a few of us had tin hats. One of my lads whose uniform had become plastered with filth during the bombing and who simply could not go around smelling like a polecat, was wearing a singlet and blue overalls. Of course we all had several days growth on our chins. During the evening we went into the village and purchased some tinned food for the journey and also bought the only form of headgear available—straw coolie hats. That night was very unpleasant. We slept on the concrete floor of the school house and it was very very hard. There were mosquitoes by the million and of course we had no protection from them. Why everyone didn't go down with malaria I cannot imagine. The result was that when we managed to doze off on the concrete the mosquitoes played merry Hell, so one either tried to sleep and put up with the mosquitoes or one sat with one's back to the wall and fought the little devils.

On the morning of 16 February, things did not look quite so gloomy. We were most surprised to find that escapees from Singapore were expected to get to the Indragirrie River and make the trek across the Island to Padang. Consequently there was some sort of organisation working to assist the journey and we were told that a certain Lieut Colonel was roughly a day ahead of us trying to arrange transport, accommodation, food etc with the Dutch officials. He did extremely well. The journey that followed was very tiring and one seemed to make slow progress, but it worked and the Dutch helped us in every way possible.

It must be remembered that we had left Singapore the day before the capitulation and landed in Tembilahan on the day of the surrender. Whether the journey across Sumatra was as well organized later on I cannot say but I very much doubt it as the Dutch were being hard pressed by the Japanese. In *Singapore to Freedom*, Gilmour says he found certain areas denuded of all transport, as it had been sent to the forward areas, this of course made for great difficulties and delays and I believe, caused certain parties to be caught in Sumatra. This escape corridor across the centre of the Island was free of Japanese after the fall of Singapore, exactly for how long I cannot say, but certainly long enough to get the initial escapees through. It surprises

me that the Japs did not bother to bomb the route but possibly they relied on sinking the escape vessels, in which they were most successful, and did not consider the few that got through as worthy of attention. Of course we had no idea that the route would not be bombed and always kept one eye open for enemy planes. This, together with the fact that we never knew how the Jap was catching up on us, kept us on our toes.

The first days journey was to be up the Indragirrie to a place called Rangat but only very shallow draft boats could make the whole journey. It was therefore decided to put the wounded, including my wounded Sappers who could not possibly walk far, into a launch, and the rest of us would go up in the *Tengaroh* as far as possible and then walk. We were given to believe that the boat would get within sixteen miles of Rangat. To give some idea of how the Dutch treated us I would like to mention the wounded. Whenever we stopped the womenfolk would take it upon themselves to do what they could in the way of renewing dressings, washing wounds, and in addition, provide and cook their food. I only hope the Dutch women know how much our lads appreciated their kindness.

Well, the wounded were placed in the launch and off they went. After what seemed an age and with everyone getting very impatient, we eventually got away at midday. We sat or lay about on the deck of the *Tengaroh* and sweltered in the tropical sun. The jungle came right down to the water's edge and kept away any breeze that there might have been. We had on board a Malay who said he understood the river and he piloted the craft. He gave us to understand that the river was very treacherous and judging from the way he crossed and recrossed the stream every few hundred yards he was either worth his weight in gold or having a game with us. I prefer to think the former. I was surprised to find on board Mr Rogers, Chairman of the Singapore Harbour Board with the Secretary, Mr Wicks. They had got away with the Harbour Board records. Some of you may have read Mr Rogers' article on the Singapore disaster which was published in the Home newspapers. Unfortunately I have not. I understand it was very outspoken and caused rather a stir. There is nothing to tell of this journey. We merely sat around sweating hard, had some tinned food, and made very slow progress up the river through the jungle.

At 7.30 pm we reached a small *kampong* (village) which was as far as we could go by river, and disembarked. We now expected to start walking but when we reached the main road, to our astonishment, there was a line of trucks awaiting us. We all scrambled in but for one reason or another we did not move off for some considerable time. At last orders were given to proceed and we were rushed at a truly alarming speed towards Rangat which we reached at midnight. We were housed in a school building and this time had a wooden floor to sleep on which was not quite so hard as on the previous nights. We were all rather weary and all getting very smelly, but our beards were definitely improving.

The following morning, 17 February, saw everyone about bright and early as our bones had not yet accustomed themselves to sleeping "hard". We went to the shops but found that Straits dollars were no longer acceptable. Fortunately when I had left Singapore, I had quite a bit of my own money with me but of course it was all in Straits dollars. I sought out a Dutch official and persuaded him to change my dollars into guilders. I then gave each man five guilders and told them that they were to buy essentials in the way of tinned food and, in the case of men whose boots were finished, "rubber sneaks". To one of our officers who seemed to be able to conjure up anything one wanted in the most unexpected places, I gave two hundred guilders and asked him to get emergency rations and anything else he considered would be useful should we get into trouble. In his usual way he turned up trumps. It was here that some kindly Dutchman gave each officer a thousand cigarettes—a small cigarette like a Woodbine—for these we were more than grateful and they kept us and the men going for some little time.

The next stage was to be to a place called Ayer Molek where we were told, we would find accommodation in a rubber factory. Once more we went back to the river

and this time found three lighters which were to be towed by a small launch. It was a blessing that a portion of each lighter was roofed over with *kajang* as this helped to keep the sun off to a certain extent, but jungle rivers are very hot and we were very crowded. If you were lucky you managed to sit on one of the cross members and dangle your feet in space but the majority had to stand and lean against the side of the lighter which being curved was anything but comfortable. We started out at 10.30 am and made very slow but steady progress and reached our destination at 9.00 pm. Once on the way we got tangled up with a tree stump which broke the tow rope and set one lighter adrift. The launch had to take the other two lighters to the bank and tie them up and then chase off down stream to rescue the third. Owing to the heat we drank a lot of tea which was made by the Chinese lighter-man from water supplied by us, but during the afternoon our water supply failed. This worried us not a little but pots of tea still came along from the Chinese and then we spotted his source of supply. He merely dipped his kettle in the river. Now we had remarked on the fact that at each *kampong* a long wooden plant structure was built out over the river and was obviously the village latrine. This no doubt was excellent so far as the villagers were concerned but it rather put us off the tea. There is nothing exciting to tell of this journey. It was just very uncomfortable, very tiring and sweaty under the tropical sun—we were very near the Equator—and the position was aggravated by the constant watch for Jap planes and the uncertainty of everything. However everyone kept more or less cheerful and there were no frayed tempers. At dusk the mosquitoes began in earnest but there was nothing one could do about it. As I have said the journey dragged on through the dusk into the night and we eventually came to Ayer Molek at 9.00 pm, another stage completed. A guide took us from the river bank and we at last came to a rubber factory, in fact a Ford rubber factory. Here we were met by the Dutch manager and his wife standing just inside the gates with hurricane lamps. They gave us a great welcome and, standing on the ground alongside were great buckets of hot tea. They also provided us with food on the spot which I do know went down very well. We were then led to a great building which turned out to be the Latex room. For those of you who do not know what a Latex room is I had better explain. This particular room, which was vast, was filled with concrete tanks roughly eight feet long, four feet wide and two and a half feet high. Into these tanks is poured the Latex to which is added an acid which coagulates the Latex and there you have the first form of rubber. (Planters, please correct me but that, I think, is the general idea.)

So you may take it that this vast room was filled with these concrete tanks, but they did not contain Latex they contained hot water! It was simply magnificent. We all stripped and dived in. The manager's wife had even gone to the extent of providing soap to each bath. Needless to say she couldn't produce towels but our shirts served the purpose. The manager had obviously heard that we were coming through and the hot bath idea really was tremendous. After soaking for some time we dried ourselves with our shirts and were led to a drying shed. Again a vast shed filled with wooden racks covered with sheets of Crepe rubber. The most surprising thing was that the shed was full of troops and RAF. I've no idea where they came from but they were obviously installed. We found a spot for ourselves and put down several layers of Crepe rubber on which to sleep. That night we really did sleep and I was sorry that I had to disturb everybody at 6.00 am on the following morning.

18 February. I had my men out of bed and on parade at 6.30 am. There seemed to be a tremendous number of servicemen and quite a number of officers who were all busy organising something. With great respect I must say that in my experience, when a number of Army officers get together nothing very much happens, but when one officer tackles the job something usually happens. Well this was one of the occasions when delay followed delay and we began to think everything had broken down. Some officers got to the point of suggesting pushing off on their own in order to get on. There was a fleet of "mosquito" buses in the factory and 7.00 am we were detailed off into these and we just sat and waited. If you haven't seen a mosquito bus I

should tell you that they usually have a Ford or Chevrolet 30 HP car chassis complete with driver's cabin. The bus body has seats running lengthwise on each side of the chassis and usually accommodate five passengers to a seat. (All the outlying districts in Singapore Island are served by these buses as they suit winding and hilly roads and can be driven fast.) We packed into the buses like sardines, to which nobody objected if only we could have set off.

However, whatever it was that was causing so much discussion was eventually settled and we set off. We sat or stood up in these buses for eleven and a half hours and got thoroughly irritable. We pulled in at a small *kampong* and I rushed my men into a Malay eating house and made our midday meal off large quantities of curry and rice. At another point on the journey we stopped outside a Dutch house and the fellow and his wife immediately produced fruit and water. I chatted to these people and was very upset when they told me that all Dutch families had had their orders which were to stay put and await the Japanese. It was a horrible thought—they had two lovely children. But they didn't question the order, they were told to stay and were staying like the thousands of other families. I sincerely hope that family is being treated well; they were very brave.

Under different conditions that journey would have been most enjoyable. We passed through magnificent wooded mountainous country, but what with being very cramped, it certainly was not appreciated.

At 6.30 pm we drove into a small town called Sawah Loento. This place was really attractive and is what I imagine a Swiss village to look like, clean, tree lined streets with little houses of distinctive architecture. Those of you who have been to Switzerland would quite likely see no resemblance whatsoever, but I was very impressed. The men were taken by the Dutch officials and given water, soap and food and the officers adjourned to the hotel and revelled in hot baths and dinner. This was our sixth day without a shave and we were still wearing the same clothes that we had in Singapore which by now were really "high". We were still around the Equator and of course were sweating into them day and night. We had to wear clothes at night as they afforded some protection from the mosquitoes, and it's no good anyone saying "No shave, disgraceful" for we had no razors and there were far more important things to do than visit the barber.

At Sawah Loento the wounded were put into hospital and I must say that it was only the kindness of the Dutch housewives that enabled them to get so far.

Cleaned and fed, the party entrained at 10.30 pm that night for Padang arriving at 5.15 am the following morning—19 February. We marched some considerable distance and were eventually housed in yet another school. Two of my sergeants who had been taken to hospital reported here after treatment and I collected two more Sappers who had got away and had managed to catch up with us. We managed to procure a safety razor here and the whole of my party, with one blade, scraped off their beards. It was here that we received our first news of the war in the Far East since leaving Singapore and it was very sad news indeed. Singapore had fallen and the Japanese were making rings round Sumatra and Java.

There was nothing to do temporarily as senior officers present were trying to make the necessary arrangements to get us out of Sumatra, so we endeavoured to clean up, not very successfully I am afraid, and then the Sapper officers adjourned to a hotel for a much longed for beer. We were not very welcome as it appeared that certain Australian gentlemen had passed through Padang and had upset the inhabitants. However, once the Dutch realized that we had no intention of smashing anything and that we were sincerely thankful for all the help they had given us we got on splendidly. The little harbour had been bombed the previous week and this gave us a little food for thought. The Dutch, here as elsewhere, had been told to carry on and they seemed quite resigned to the Japanese occupation which they knew had to come. It must have been rather a strain for them to give us all the help they possibly could with every kindness and yet they could not help themselves. They are a brave people.

On the morning of 20 February, we were told that we were about to make our next sea voyage. Of course we knew this had to come or alternatively that we would be caught by the Japs but we had had rather a bad dose on the *Shu Kwang*, and frankly none of us relished the idea. We wouldn't forget the *Shu Kwang* in a hurry.

We entrained at 3.30 pm and ran down to the little harbour some way out of Padang. Here, all the British were collecting and we kept out of sight as much as possible in case a spotting plane came over. You can imagine our surprise and delight when we saw, not a hundred yards off the quayside, a British cruiser—HMS *Danae*. She edged her way in and tied up. Immediately, (at 5.00 pm to be precise) a gangway was put down and believe it or believe it not, in thirty minutes, repeat thirty minutes, HMS *Danae* was away with all on board. How I love the Navy, everything seems to go like clockwork. Officers without troops went on board first, and, as I learned afterwards, were parked in the Wardroom. Officers with troops reported in the ship with their troops who were immediately taken to their allotted "quarters". The officers were taken to various parts of the ship and myself and three others were given six feet of good steel decking each in the aft control tower. This was grand as I could look out over the whole ship and any breeze blowing was to be found up there. As we sailed out of the little harbour a plane was spotted making for us. A few seconds worry and then she started signalling and came on. It was a Catalina flying boat returning from patrol and was presumably giving the Captain the latest reports.

The trip across Sumatra was without any excitment and has probably made very dull reading but it gives a brief idea of the journey. Whoever organized the route did his work jolly well and we really crossed the Island in quick time. I hope I haven't over emphasized the little discomforts—and irritabilities encountered; they were really nothing, but we were naturally anxious to beat the Japs to Padang and at the time trivial annoyances magnified themselves a thousandfold.

(To be continued)

A Korean Water Point
The Fickle Finger of Fate

CAPTAIN (QM) G T HAWLEY RE, MISM, MIHM

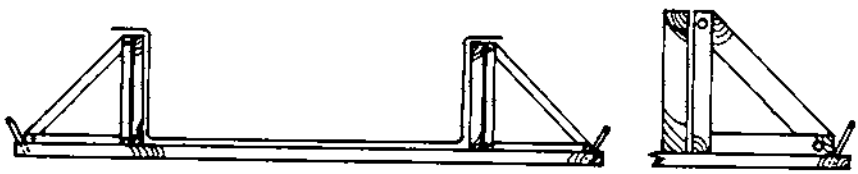
The author joined the Corps at Chepstow in 1946 where he was trained as an Engine Fitter IC and Pumps. He served in Tripoli, Benghazi, Cyprus, Korea, Malaya and BAOR. Commissioned in 1971 he has since been employed in Engineer Resources.

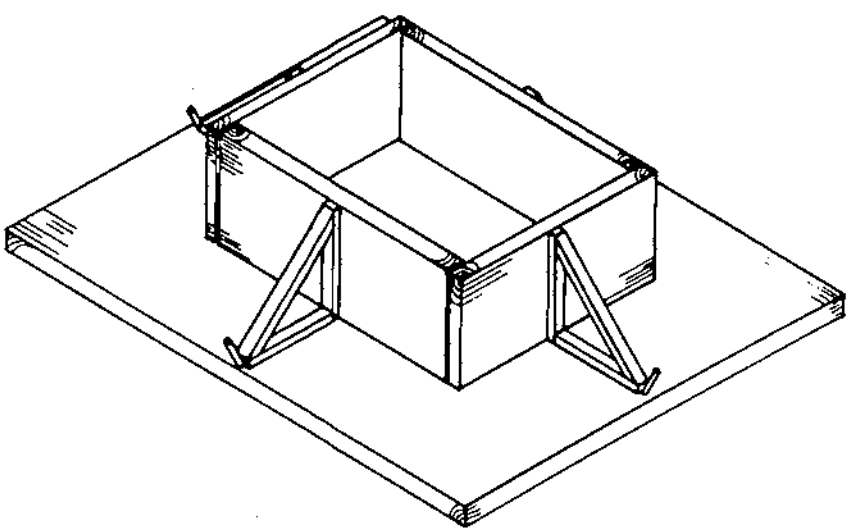
RUNNING a Brigade Water Point was one of the many tasks of 3 Troop 12 Field Squadron RE in Korea during 1951/52.

A serious shortage of "S" tanks led to a temporary tank being designed using a timber deck and frame with a 10 ton vehicle canopy as the skin. Using good

Captain G T Hawley RE

TEMPORARY WATER STORAGE TANK





engineering principles, the timber sides of the frame were slatted to reduce weight but usage soon showed that the exposed edges of the timber "worked" on the canvas skin during filling and soon caused chafing and wear.

My modification of the design was to produce a solid sided timber box (see sketch) with the removable sides wedged into place by triangular supports. To enable the water point section to clean out tanks used for sedimentation, the skin was left with enough slack so that when a support was removed, the corresponding wall could be laid back, thus giving good access for scrubbing out. During a visit from a Senior RE Officer, "official" approval of the modification was given for general use of the tank.

Alas, half promises of recognition of myself—"The Hawley Temporary Water Storage Tank" never came to pass and I faded from the World of Field Engineering without record—or did they change the name of that lake!

* * * *

Early Trials of Modern RE Diving Equipment

LIEUT-COLONEL (Retd) J A COOMBS FIPlantE, AMBIM

The author was commissioned in 1943 and served in India and SEAC with the Royal Bombay Sappers & Miners until 1947, and in 1948 was in Palestine with 6 AB Div. After a Supplementary Course at the SME, he was Adjt 50 Div Engrs, served again at the SME and in BAOR, and attended Staff College. Later service was as a Staff Officer, as a squadron commander in the Malaysian Engineers, and in Aden. He was CO of Depot Regt from 1964–66. He is now Housing & Welfare Commandant, NW Kent, as a RO2.

INTRODUCTION

Reference to the *Army List 1977, Part III, Biographical*, refreshed my memory as to dates. In 1953/54 I was an Assistant Instructor (Bridging) in what was then known as the Field Engineer School, School of Military Engineering (this was before the SME became "Royal"). The FES was then located at Gordon Barracks, Gillingham. As a spare and part time job, I was also the first OC Trials, SME, and had a Sergeant as my Trials Team.

Most of the trials carried out were of a Combat Engineer nature (basically in support of what are now the Wings at Chattenden), although the then E & M School and Civil Engineering School occasionally threw us tit-bits. We were tasked by the GSO 2 (Tech), at HQ SME, then Major Nigel Holmes (now Lieut-Colonel R N B Holmes, BA (Retd).

SHALLOW WATER DIVING

One of the trials we were tasked to do was on "The Shallow Water Diving Kit". We had a pretty sketchy brief: as far as I remember we were told to test the equipment and see whether it was more efficient than the then in-service canvas suit, with copper helmet and air hoses, with air hand pumped from the surface Diving Attendant's boat or raft; I had used one during my Supplementary Course. So "Shallow Water Diving Kit" was added to the list of trials being, or to be, carried out.

Some six months later I received a telephone call from the RE Park to say that a rubber diving suit had arrived, addressed "for the attention of the Trials Officer", and this could be collected from the SME Stores in Brompton Barracks. We collected an MFO box-sized crate, which we unpacked and checked. To our delight, there were some half dozen pages of printed instructions.

The next Wednesday afternoon we decided to go swimming as Recreational Training; we loaded up our kit, and repaired to the SME (heated) Indoor Swimming Pool, which as far as I remember was located somewhere behind the present RE Stables.

With frequent reference to the Instructions, I donned the suit, as I had a memory of a senior officer saying during my early officer training that I should not tell a soldier to do something that I would not do myself!

At last all was ready, and the breathing set and air bottles were harnessed to my back. I could still breathe! Slipping into the shallow end and metaphorically holding my nose, I submerged—and continued to breathe very comfortably. Enjoying

Lieut Colonel J A Coombs

myself, I gambolled around the deep end. Meanwhile, my Trials Sergeant was getting very impatient for his turn, so I had to get out.

The next week we ventured into the Garrison open air pool. This was a large pool, somewhere in the area of the present Brompton Barracks 30yd range. In 1953 it was very murky, as the filtration plant had finally given up the ghost. It provided a good training site for a rubber diving suit, and after an afternoon there, we felt ready to explore the very much larger Gundulph Pool.

This was much more fun, as we could practice some elementary underwater navigation. We were also very popular with the YO course then undergoing wet bridging training as we recovered a lot of stores dropped into the pool by them—and their predecessors—and so saved them money!

We next made a two-day visit to the Royal Navy, at HMS *Vernon*, where we learnt a lot, and later to Siebe-Gormans, where we went down to 70ft, air being supplied by an air line from the surface. We also had voice contact with the surface. We then graduated to the River Medway itself.

In 1953, the Dress Rehearsal for the RE Demonstration took place on the Saturday after the Summer Ball—very bad planning, I felt. I had to enter Gundulph Pool without being seen, cross the pool, and surface just in front of the spectator stand, and wave a small Sapper flag, just to make sure that I was seen. I had taken the precaution of staking out a guide line from the Medway bank, and got myself into the pool. Having thoroughly enjoyed the Ball, returning back to Gordon Barracks at about 5am, I felt very tired crawling across the bottom of the pool, and am sure the pool of sweat in my facepiece was pure Champagne! On reaching my exit point I was a couple of minutes too early to surface, so had a little *zizz* on the bottom, and then surfaced on time, emerged, and answered a lot of questions.

I never managed to get Diving Pay for these trials, as I had not been properly trained, and was therefore unqualified—no doubt readers will agree! But it was tremendous fun, and we learnt a lot by trial and not much error, I hope. Perhaps, in some small way, our report led to the formation of the RE Diving Establishment of to-day.

Protect Your House, Caravan or Workshops with an Earth Leakage Circuit Breaker (ELCB)

E&M CHIPS

THERE have been a few signals floating around stating that military caravans which use mains voltage must have an ELCB. These signals, I gather, were sent out because a child was electrocuted on a military recruiting trailer at an Army display. An ELCB would have prevented this happening. Similarly an ELCB can help prevent the electrically caused fires in the home, and reduce to a safe human level of below 35mA the current felt in an electrocution.

The ELCB will not cure everything but for £20 extra, used instead of the main switch in a distribution box, it can do wonders; especially for the Sapper Officer "rewiring" his new home, usually an 18th-century house with old lead cables and rubber insulation cracking at every bend. The ELCB measures the current arriving on the incoming live line and if it differs by more than 30mA from the neutral line returning the current it trips. If you hold on to a live line you are allowing the current to flow through your body (ooh . . . . . ahh) to earth. The currents in the live and neutral are no longer the same and so the ELCB trips, limiting you to a small current flow, below the level that might have killed you. Likewise a small current in an

Trip Current	Normal Current Flow
30mA	25A
	40A
	60A
300mA	40A
	60A
	80A

Table 1. ELCB Sizes

electrical short, enough to create a fire, will also be isolated. We spend £20,000 on a house and then fail to spend the extra £20 to protect it on the electrical side. Strange? No, it is just the same in the Corps, we expect electrical power, we use it, but we do little to encourage those who provide it!

How do you buy one? MK Sentry make a good line which fits into a distribution box instead of the main switch. The trip sizes are shown in Table 1. The 300mA trip does not give as good protection for the human but is required for old type night storage heaters which can have earth leakage currents. MEM make ELCBs as well. To fit them, the incoming live and neutral from the meter is connected to one set of terminals and the other set is connected to the old distribution box. If on the other hand you are doing the job fully then put in a new Consumer Unit with ELCB switch and MCB (Miniature Circuit Breakers) of 5, 15, 30 or 45 amp ratings instead of

fuses. New? did I hear someone mutter?—rubbish—we have all seen them in Germany, not a fuse that blows but a switch that trips. What if the switch jams through age ?—far less damage than the nails I have found used instead of fuse wire!

Be safety minded in your work and home and remember the E & M Wing, RSME will always give advice and spend your money!

60th Anniversary of the Royal Engineers Presence at Christchurch, Dorset

ON 28 February 1919 Brevet Major G LeQ Martel, DSO, MC, RE (later Lieutenant-General Sir Gifford LeQ Martel, KCB, KBE, DSO, MC) founded the Experimental Bridging Company Royal Engineers, at the Barracks, Barrack Road, Christchurch, and thus established the Sapper presence in Christchurch.

In 1925 the unit was renamed as the Experimental Bridging Establishment, and subsequently became the more familiar Military Engineering Experimental Establishment, or MEXE, in 1946. In 1970 MEXE was amalgamated with the Fighting Vehicles Research and Development Establishment to form the Military Vehicles and Engineering Establishment, or MVEE, and became the Engineer Equipment Division of that Establishment, the Headquarters of which is situated at Chertsey, Surrey.

To mark the 60th Anniversary of the association between the Corps of Royal Engineers and the Borough of Christchurch, a Dinner Night was held in the Officers' Mess, Christchurch, on 28 February 1979. Colonel J H Joiner, Senior Military Officer, presided and a number of past and present members of the Establishment, including Dr P S Bulson, the present head of the Engineer Equipment Division and Mr D G Ainley and Brigadier D E Dunand, both Deputy Directors of MVEE from Chertsey, attended. A number of guests were invited, including His Worship the Mayor of Christchurch, Councillor Michael Hodges, the Town Clerk and Chief Executive, Mr Colin Dewsnap, Lieutenant-General Sir David Willison, Chief Royal Engineer, General Sir Hugh Beach. Master General of the Ordnance, Mr I H Johnston, Chief Scientist to the Army, and Major-General J B Willis. The Band of the Corps of Royal Engineers played during dinner.

In 1969 the 50th Anniversary of the association was marked by the granting of the Freedom of the Borough of Christchurch to MEXE, a privilege which was re-affirmed in 1974 notwithstanding any subsequent changes in name of the Establishment.

60th Anniversary of the Royal Engineers

Correspondence

Lieut Colonel R M S Maude
19 Oakfield Gardens
Dulwich Wood Avenue
London SE19

WHO WILL BE THE LAST?

Sir,—It would be unkind to break it to Colonel I T C Wilson that the activity he saw on the Normandy beaches (his letter in the March issue) when he landed there must have been no more than one of the early Battlefield Tour parties. No doubt the air of general confusion prevailing, or perhaps the high standard of mock realism of those times was confusing, but it must surely have been much quieter than when we were there exactly a year earlier?—Yours faithfully, R M S Maude, (At the time 3 Div RE, but alas no longer serving so I cannot claim to be one of the last.)

Colonel I T C Wilson MBE, MC
Bryony Cottage
Stockbridge Road
Kings Somborne
Hants SO20 6PH

WHO WILL BE THE LAST?

Sir,—Lieut-Colonel R M S Maude is quite right that Normandy 1945 did not have the same cachet as the previous year, nor were campaign medals awarded for battlefield tours however exciting. Had he wished to work it out from my date of birth in the RE List he would have noticed that I was no longer a teenager by then! To protect the good name of the Editor and his proof readers I must confess to missing a year. Nevertheless it would be interesting to identify the last serving sapper to have seen active service in World War II. I know that there are others younger than myself still serving; Lieut-Colonel (QM) G Ramsey MBE landed by glider at Pegasus Bridge in 1944. The Army is rapidly approaching a situation for the first time since the Crimean War of having no serving soldiers who have taken part in a major war. There are still some Korean veterans around, but less that 3% of the British Army total of the day served there. I hope that the Corps can provide some small ceremony to accompany the departure of their last World War II individual.—Yours faithfully, I T C Wilson.

Lieut-Colonel G W Field MBE, RE
The Royal Military College of Science
Shrivenham
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Wilts SN6 8LA

MERRY-GO-ROUND

Sir,—In his article "Merry-Go-Round", published in the March 1979 *RE Journal* Brigadier Notley put forward some suggestions for speeding up the business of equipment procurement. Few would deny that the development cycle seems, at times, to be unnecessarily protracted. And I am sure that no-one would deny Brigadier Notley the right to express a personal view on a subject which he admits in

his opening remarks is controversial. However, it would be unwise to allow his views to stand unchallenged in our professional journal.

He suggests that the Corps should be "allowed to develop its own equipment which is required in a time frame quite beyond the R & D system." If by "own equipment" Brigadier Notley means specialist engineer equipment which is exclusively for use by the Corps for a purpose which does not impinge on the All-Arms battle then I would be inclined to go along with his ideas. But does any major equipment fall into this category? I doubt it. Equipment which the Corps uses in support of other Arms (and this is our primary role) must meet the operational requirements of these Arms as well as our own. The AVLB, for example, must be capable of giving the battle group commander the mobility, the gap crossing capability, the load carrying capacity and the speed of construction he needs and not the characteristics we, as Sappers, *think* he needs. In drawing up the operational requirements for our equipment, therefore, we must ensure that it meets the needs of all users, including those who have to store it, move it and repair it. How can we do this effectively if we adopt an in-house procurement system? Moreover, do we really have the expertise within the Corps to develop and produce effective equipment?

I would not dispute that the formalized procedures which govern equipment procurement could be streamlined. They have, however, evolved through experience and as a result of studies by Zuckerman, Downey and others simply because we "got it wrong" so often in the past. I am sure that the procedures will continue to evolve along the same lines. The Operational Emergency procedures are just one example of the flexibility in the system for bringing into service in a very much reduced timescale equipment for which there is an urgent operational requirement.

Brigadier Notley's criticism of the GSR (General Staff Requirement) procedure may, in his experience, be justified. If it is true that engineer commanders do not always see important GSRs then there is a fault in the internal administration of the Corps and not, in my view, in the GSR system *per se*. The GSR is simply a formalization by the OR (Operational Requirement) Staffs of the user's views, and if it is not a true reflection of their views then the OR Staffs or the user are to blame, not the system.

In short, the way to the more efficient development of Sapper equipment is through the intelligent application and progressive development of the existing procedures and not by adopting the "do-it-yourself" system which Brigadier Notley suggests.—Yours sincerely, G W Field.

Lieutenant General Sir E Ian C Jacob GBE, CB
The Red House
Woodbridge
Suffolk IP12 4AD

BRIGADIER H F G GREENWOOD CBE MC

Sir,—I feel bound to write a slight correction to the Memoir of Harold Greenwood which you published in the March Journal.

In it there is a reference to "Greenwood's Corner'. I well remember this, as I was Brian Robertson's subaltern in 3 Field Company, and we marched daily past it to our work on other parts of the road whilst it was being built. However, anyone looking for it on the Wana-Razmak road would have a fruitless journey, because it was built, and I hope still exists, not far beyond Razani on the road from Tal-in-Tochi to Razmak.

It would be a pity if this memorial to a fine Sapper should by accident be mislaid!—Yours faithfully, Ian Jacob.

Lieut-Colonel B R Rawlings RE C Eng MICE
Civil Engineering Wing
RSME

SAPPERS FIT FOR WAR

Sir,—Lieut-Colonel Mike Addison's article (March 1979) certainly gives us all food for thought. I entirely support his basic theme although every element of the Corps could point out areas of exaggeration, impracticability or inaccuracy, these do not detract from the basic message. To me the message is; we must train our officers and soldiers to be good military engineers. Civil engineering has been defined as "the art of directing the Great Sources of Power in Nature for the use and convenience of man". The military engineer has a similar responsibility to the tactical commander. The sapper regimental officer should have a basic grounding in engineering and a continuing interest in it so that he will be better placed to recommend the application of modern techniques to change the face of the battlefield. To design to minimal factors of safety requires a much better understanding of the forces involved than normally possessed by the average civil engineer. The constraints of time, manpower and money available for training probably precludes any major changes in our officer training courses. The Corps must therefore convince its officers that the attainment of expertise in military engineering will be recognised as a necessary part of the training of its squadron and regimental commanders having at least equal status with the desirability of undertaking staff training. Younger officers would then be motivated to build on their degree training by maintaining an interest in engineering and could also result in a greater number of the more able officers undertaking long engineer course training. Within units a great deal could be achieved by setting suitable problems to regimental officers during officer training days. Twenty years ago it was commonplace for a CO to train his officers in this way, setting their problems well outside the limited role and standard drills of their particular unit. I believe this was an excellent practice which could be easily reintroduced.

In summary, all Royal Engineer officers should be, *per se*, military engineers, that is all, with common regimental and military engineering background and experience; but many will also have their own specialist training and experience following either a staff college or long engineering course.—Yours sincerely, BR Rawlings.

Brigadier E E Read CBE, MC, CStJ
Whitebean
Middle Bourne Lane
Farnham

TWO INTO ONE DOES GO

Sir,—I would refer to Major Bradbury's charming divagation on the 1st Field Squadron. In my day this was our only "squadron" and worked with the cavalry division. They were normally known as the galloping gasfitters. Most of their tools were carried on pack horses, and the noise on the move was deafening.

On the presumption that the Royal Engineers, as such, started from the First (something) Company in Gibraltar in 1772, you will recollect that Gibraltar, (backed by Chatham) issued a set of commemorative stamps with pictures of sappers. At this time I had the privilege of being an honorary Ensign in the Life Guard Grenadiers of Sweden. Most Swedish officers are quite mad on stamps. I therefore sent a first day cover to my Colonel, asking that he might give it to some officer. There was apparently such a demand for it that he had to organize a cross country ski race to find the winner.

A year later I was promoted honorary Major!—Yours faithfully, E E Read

Memoirs

COLONEL C M SINGER BA JP

Born 10 January 1900, died 18 December 1978, aged 78

CHARLES MORGAN SINGER, who died in a nursing home near his home in Wrington, Avon, was commissioned into the Royal Engineers on 20 September 1922, antedated to 20 September 1920, after obtaining a First Class Honours Degree in Engineering at Oxford. He was one of the very first officers to enter the Corps by this method. At the SME he showed special interest and aptitude in Survey and Building Construction so, on being posted to India on completion of his training, he found scope for his special talents in the MES on the North-West Frontier, mainly in the Kohat and Kurram Districts.

In the winter of 1925/26 he was selected to join a Political Department team appointed to carry out the survey of an extension of the Khyber Pass road from Landi Khana through Afghan Territory to Kabul. His work involved surveying a very hard and rugged country with a very harsh climate and he earned special commendation for the part he played in the work. On his return to England in 1929 he became an instructor in the Construction School of the SME. During this period he was allowed to accept an invitation of the Oxford University Exploration Club to act as Surveyor to an expedition which was being organised to one of the outpost islands of Greenland. Here his survey work must have been, if possible, bleaker and more difficult than that he had to contend with on the North-West Frontier, but his accomplishment in this difficult land earned for him membership of the Greenland Club of the University.

He drew on his experience here and in India to write a paper on the problems of Road Construction for an army campaigning in an underdeveloped country. This paper won for him the Coopers Hill Memorial Prize in 1932.

Space does not allow details of much of his service; suffice it to say he obtained greater and wider experience of buildings and roads through service in China, the Design Section of the War Office, the launching of the Royal Military College of Science at Shrivenham and the Berlin Air Lift.

With such a wide and varied experience of Works behind him, it is not surprising that he was selected on retirement in 1948, out of very many applicants, for the post of Bursar of Bristol University. He held this post for seventeen years—years during which a vast programme of university expansion and building laid upon the Bursar many outstanding difficulties and responsibilities. On his retirement in 1965 he was granted an honorary degree of Master of Science of the University in recognition—to quote the Citation on the occasion of the presentation—"of the many qualities he brought to his work, qualities such an energy, tenacity, perception, tact and decision, all of which are needed in a job where the reconciliation of conflicting requirements is perhaps the major task."

Truly, Morgan Singer was a great soldier and a great civilian. He leaves a widow and two sons.

JHBL

Colonel C M Singer

BRIGADIER R A GARDINER MBE, MA, FRICS, MIOP

Born 21 June 1911, died 22 November 1978, aged 67

RICHARD AYLMER GARDINER was born at Dalhousie in the Punjab. From Stowe, where he was one of the early alumni, he went to the Shop, and was commissioned into the Corps in January 1931. In July 1934, after Chatham and St John's College Cambridge, he was posted to India as AGE Calcutta. Here an interest in mountains was awakened in him by contacts with prominent members of the Himalayan Club, which he joined, giving valuable assistance in the compilation of its series of Himalayan Route Books.

This new interest attracted him to the Survey of India which had many links with Himalayan mountaineering and exploration. He joined the Department in November 1936 and after training, was selected for No 1 Party engaged in surveying the Garhwal Himalaya. In the spring of 1937, in the course of his work, he established the existence of a pass across the Dhauli-Saraswati watershed to the south of Mount Kamet, which had been suspected by Mumm in 1907, but searched for in vain by Smythe in 1931. A few weeks later he and a brother officer, R C A Edge, made the first crossing of the 19,000 foot pass, later named Gupt Khal.

A period of varied employment followed, mostly upon surveys of the North West Frontier. After war broke out he helped to raise one of the first Indian Field Survey Companies (No 4), and went with it to Iraq in 1941. After a few months he left this unit, but continued to serve in the Middle East in command of RE Field Survey Companies, first 524, a Palestinian unit, and then 525. He returned to India in February 1943 and spent the rest of the war with GHQ in Delhi, first as a DAD and then as an AD Survey.

In 1947 he reverted to the UK and from 1948 until his retirement in 1966 held various appointments in the Ordnance Survey and Military Survey. He was DD Survey Middle East from 1955 to 1958, a period which included the Suez crisis. His final appointment was as Director of Map Production, Ordnance Survey. He was awarded the MBE in 1942.

Gardiner's original strong interest had been in field surveying, but in later years this changed and he became a nationally and internationally acknowledged authority on cartography and map reproduction, working hard to further these branches of the profession. In 1963 he became one of the founders, and an original Council Member, of the British Cartographic Society, becoming President from 1968–1970.

Upon retirement from the Army he was appointed Keeper of the Map Room of the Royal Geographical Society on 1 October 1966, in which capacity he represented the Society on many committees concerned with geography and cartography. He was Chairman of the Royal Society's Cartography Sub-Committee until his retirement in January 1978, and during this period of office became a well known United Kingdom representative at the meetings of the International Cartographic Association, where his opinions were very much respected. He was the principal cartographic reviewer for the Royal Geographical Society's Journal to which he made many distinguished and important contributions.

He was intensely keen on obtaining international co-operation for the maintenance of the 1 : 1,000,000 international map of the world, and also in extending the coverage of the *Tabula Imperi Romani* series.

On retiring from the Royal Geographical Society he was invited to become a

Brigadier R A Gardiner MBE

member of the Royal Society's Ordnance Survey Committee, which at that time was actively engaged in the preparation of evidence for the Government enquiry into the Ordnance Survey and its future activities. Richard applied himself wholeheartedly to this new task and his contribution would undoubtedly have made a lasting impact had it not been for his very untimely death.

One of his many other interests was genealogy and in 1977 was elected to the Council of the Irish Genealogical Research Society.

Richard Gardiner was a man possessed of great enthusiasm who tackled every task with tireless energy. At the same time he was modest and kindly and a man of absolute honesty and integrity.

In 1938 he married Marguerite (Peggy), the daughter of George Flowers of the Indian Civil Service. With their two children they were a most united family to which he was devoted. We offer them our sincere sympathy in their loss.

RCAE, GAH, B St GI, DEOT

JRGF writes:

Richard Gardiner and I were commissioned in the same Young Officer batch and were constant companions during our training and Cambridge course. This included visits to the Lake District and Wales for our introduction to rock climbing. He was more the mountaineer and explorer than rock climber but no doubt regarded these excursions as good training.

We went out to India on the same boat but then separated, he to Bangalore and I to Kirkee. Later he was posted as Assistant Garrison Engineer, at Fort William, Calcutta. One of the perks of the appointment was a visit, every other year, to inspect the Fort at Gyantse in Tibet which was the residence of the British Trade Agent and his escort of Indian Infantry mounted on Tibetan ponies. In 1935 he was due for such a visit and very kindly arranged things so I could go with him. We took the Nathu La route from Gantok, returning via the Jelep La. We then spent a month in Northern Sikkim, around Chomiomo attempting to climb a small peak of some 21,000 feet. However we had chosen the wrong side of it for success.

He was a great companion and I much regret that circumstances never allowed another expedition together. He was made of tough fibre, seemed little affected by such things as altitude or the Tibetan wind and could maintain a good speed uphill almost indefinitely. I will always remember his kindness when I was taken ill with influenza in a Tibetan resthouse and he had to nurse me for three days before we could continue our journey.

AHD writes:

Subsequent to his return to British service after the War, Richard Gardiner filled a number of Survey appointments where I was able to see his sterling qualities; in the Ordnance Survey, the War Office and Middle East. In the last mentioned, he was Colonel in charge of all survey activities, which included operations in East Africa and Iraq. He frequently had to deal with both officers and civilians of other nationalities as well as our own, including those of our NATO allies. He was an admirable choice for these responsibilities, for his charm of manner and consideration for others, as well as his professional skill and balanced judgement, made him an excellent "Ambassador", and a sound Chief also. These same qualities helped him later as DD Svy in the War Office, where his special responsibility was to serve the RAF in its needs for charts and general survey data, often of a bewildering complication. His final appointment was as one of two military Directors in the Ordnance Survey, which gave him control of all map production, wherein he displayed an eagerness for necessary innovation tempered by a practical assessment of real possibilities, which would have been praiseworthy in an even younger man.

Off duty, he was a charming host, interesting and considerate; he will be much missed.

MISS L C EDWARDS

Died 3 January 1978, aged 77

MISS LITA C ("JIMMY") EDWARDS was one of the great characters of the RE Yacht Club. She was the daughter, niece and sister of Royal Engineer officers, her father, Brigadier General R F Edwards, being Hon Secretary of the REYC from 1901 to 1903.

Jimmy Edwards was a superb sailor, who was active in the sport to the end. For the past twenty-seven years she part-owned the 52ft 1902 Fife-built ketch *Sibyl of Cumae*. After a major conversion of the yacht with her own and her partner's hands in the early fifties she fitted *Sibyl* out annually until very recently and sailed her widely from her home port in Argyll, for the most part without the benefit of an engine. She would think nothing of sailing her large vessel through the Crinan Canal with a crew of boys. In 1970 she won the Clyde Cruising Club Seamanship Trophy for a fine feat of seamanship at the Royal Cork YC Bicentenary Regatta, when she beat into the crowded anchorage each evening in all weathers at the end of successive days' racing. She made her last appearance with the REYC by arriving from Ireland with her beloved *Sibyl* at the Club Meet at Lymington in 1976, where she won all hearts. "Unfortunately" she wrote "Sibyl's engine has not worked for the last three years. It was all great fun, even if we did have to break the marina rules by sailing in and out of our berth". Those who know the Lymington Yacht Haven will appreciate this feat—to her a commonplace.

Her friends will long remember her, with her red jelly-bag hat and body-and-soul lashing at her waist. One can but feel assured that she will enjoy fair winds and good sailing now that she has crossed the bar.

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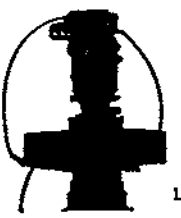

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