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SEPTEMBER, 1972

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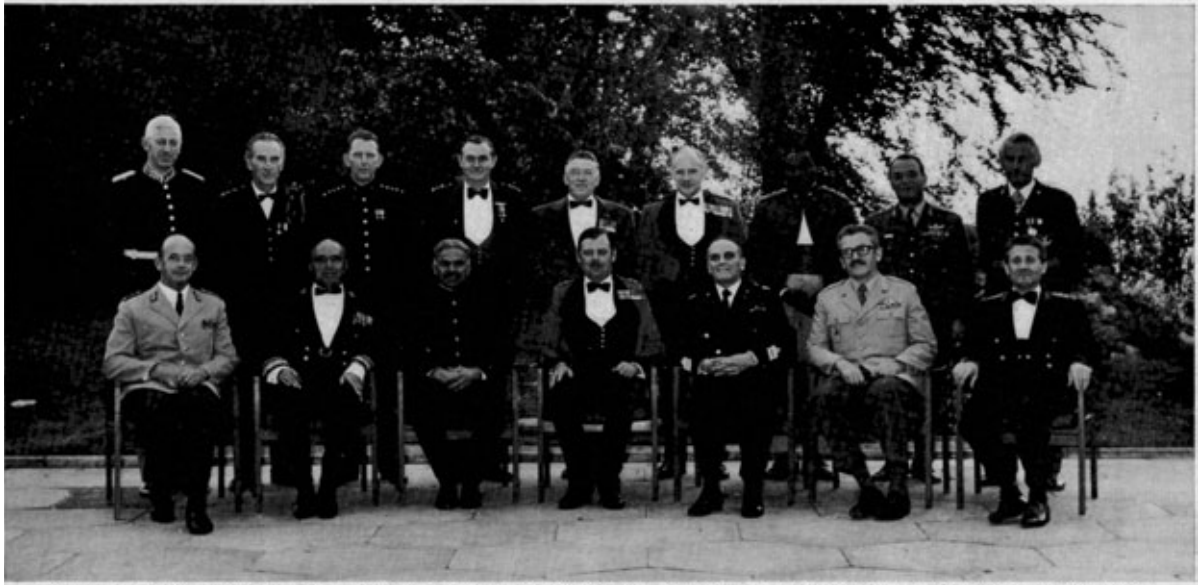
ENGINEERS IN CHIEF AND CHIEF ENGINEERS WHO DINED
IN THE ROYAL ENGINEERS HEADQUARTERS OFFICERS MESS
ON WEDNESDAY 7 JUNE 1972
ON THE OCCASION OF THE ARMY ENGINEERING EQUIPMENT SYMPOSIUM 1972



Standing. Colonel O. A. Ø. Tveten (Norway); Colonel J. Cooney (Ireland); Colonel L. Breure (Netherlands); Brigadier I. Lemmer (South Africa); Brigadier General N. C. Brown (Canada); Brigadier C. F. Flint (Australia); Brigadier O. Obasanjo (Nigeria); Brigadier M. Polykandriotos (Greece); Brigadier A. Ke Bernstrom (Sweden).

Seated. Brigadier General Stephani (Germany); Major General Mir Hassan Atefi (Iran); Lieutenant General B. N. Das (India); Major General F. G. Caldwell (UK); Lieutenant General G. Pironne (Italy); Lieutenant Colonel General Milvoje Gluhak (Yugoslavia); Brigadier General Nesimi Tanyeli (Turkey).

Engineers In Chief And Chief Engineers who dined in the RE HQ Officers Mess

Editorial

"THERE is nothing like a good disaster to raise the morale of the Royal Engineers." So said some cynic whose origins are best left undisclosed. There is however reason in the thought. The military engineer can play a part in peace and need not restrict his activities to training for a war which may never come. It is this thought that has led countries in the past to use their military engineers for some aspects of construction engineering to support national requirements.

From 6 to 9 June 1972, a Military Engineering Symposium was held in London and at the Royal School of Military Engineering. This Symposium attracted the attention of seventy countries, twenty of which sent their Engineers-in-Chief or equivalent. The principal topics discussed were the roles of Military Engineers in the world today and their organization and equipment. Papers were read by members of the RSME staff and senior officers from India, Nigeria, Australia and the United States. Such an international gathering of military men must be almost unique (at least outside the auspices of the United Nations) and it is certainly the first time that as many as sixteen "Chef du Genie" have sat down together in the Royal Engineers Headquarters Officers Mess. The photograph shows those who were able to attend and reflects the vast amount of goodwill that still exists in our imperfect world.

Last year a Northern Army Group Study period was held at the RSME and was reported on in this *Journal* in June 1971. This year, on the initiative of British Military Engineers and their Engineer-in-Chief, Major-General F. G. Caldwell, the co-operation of Military Engineers has been extended still further.

It was a previous Engineer-in-Chief who coined the phrase "Engineering for Peace" and he envisaged the part that Military Engineers could play throughout the world. The African and Asian speakers at the Symposium all stressed the important role which their military engineers have in helping to build the infrastructure of their countries. A more up to date paraphrase might therefore now be "Engineering in Peace"; everyone agreed that the military engineer has certain characteristics which readily lend themselves for use in peace in many different situations. By virtue of these military characteristics—mobility, both tactical and strategic; readiness and availability to react quickly to any given situation, excellent communications and impartiality—the military engineers can respond in time and space to a degree beyond the scope of most, if not all, civilian organizations. Such needs do not arise because of military or political upheavals, but because in an increasingly sophisticated world the threat of disasters becomes more apparent. Man's continual striving for improved standards of living leads to ever increasing interference with the natural course of nature. There is no knowing how these changes are affecting or will affect the environment in which we live or the delicate balance of the crust of the earth on which we live. An ever-expanding world population and an ever-accelerating technology create situations where the possibility of disaster becomes steadily more real. Even if military forces were disbanded entirely, there would appear to remain a need for a disciplined force of Engineers capable of moving anywhere at short notice when required.

Cost or lack of international agreement currently prevent the formation of such a force under the auspices of the United Nations. But such thoughts were discussed at Chatham in June 1972 and appeared to be received with generous acclaim. The British Sapper, forbear of the Royal Air Force and of the Royal Corps of Signals, may feel that complexity and specialization will prevent the birth of any more such protégés. However, the world is his oyster and June 1972 may perhaps come to be recognized as the date when the idea of the use of engineers in peace in the way described above found fruitful ground.

* * * * *

Engineer Equipment Symposium (5-9 June 1972)

LIEUT-COLONEL D. J. N. GENET, RE

INTRODUCTION

THE Engineer Equipment Symposium was jointly sponsored by the Director of Defence Sales and the Engineer-in-Chief. Presentations and discussions were held at the Royal Commonwealth Society's Commonwealth Hall in London and at the Royal School of Military Engineering, where military equipment displays and exhibitions by civil firms also formed part of the programme.

In his address of welcome to a large audience representing sixty-seven countries, on 6 June 1972, General Caldwell emphasized that the purpose of the Symposium was to discuss some of the common problems which confront military engineers in the 1970s, at the same time affording opportunities for our guests to see some of the engineer equipment which enable the Royal Engineers to carry out their tasks.

ROLES AND ORGANIZATION OF ARMY ENGINEERS

In the first of a series of presentations, Brigadier S. E. M. Goodall, the Commandant RSME, set the scene for the Symposium by presenting a European view of the roles of military engineers in the world. After mentioning some significant early examples of military engineering work, Brigadier Goodall traced the development of the military engineering art down the ages to the major wars of the twentieth century. In conclusion he suggested that the roles of military engineers in the 1970s should be regarded in four categories:

a. Tactical support for the Army in the Field.
b. Logistic support for Navy, Army and Air Force.
c. Ancillary support, such as Survey and Bomb Disposal.
d. Additional tasks for which military engineers are well qualified by their characteristics of quick reaction, good communications and flexibility.

Colonel C. A. Landale, the Colonel GS RSME completed the European view of this part of the proceedings with his presentation on the Roles and Organization of Military Engineers, in which he highlighted the British organization of standard field squadrons in engineer regiments and the great flexibility which is conferred by our system of dual trade training.

Distinguished engineer officers from India and Nigeria presented their views on the roles and organization of engineers in Asia and Africa. Brigadier S. C. L. Malik discussed the complicating effects of climate and geography on all engineer operations in Asia and stressed the need for Indian Army Engineers to play their full part in peacetime development projects. This view was supported by Brigadier O. Obasanjo, who after outlining the organization and roles of the Nigerian Army Engineers in peace and war since independence, emphasized that few newly developing countries can afford to allow their engineers to concentrate exclusively on combat engineer training in peace. The Army Engineers' contribution to national development, through constructional projects of all kinds, undoubtedly helps to overcome many national economic problems.

In general discussion on this subject, Brigadier Malik referred to the advantages of the Indian Border Roads organization which is a civil works organization controlled by the Engineer Corps and which is capable of undertaking valuable constructional development work on its own. Brigadier Obasanjo described the system of financing rural development projects in Nigeria.

Plate 1. Display by civil firms

Plate 2. Display by civil firms

Engineer Equipment Symposium
5-9 June 1972

COUNTER MOBILITY

The Symposium then turned its attention to questions of counter mobility. The subject was introduced by Lieut-Colonel B. S. Read, who reviewed the principles governing the siting, design and composition of tactical barriers, and the engineering techniques involved in producing them in conditions of general war in Europe. Guerilla war aspects of mine warfare, both from the Insurgent and Security Forces points of view were presented in an interesting paper by Brigadier C. F. Flint, which was based on recent Australian operational experience in Vietnam. Brigadier Flint stressed the importance of hindering guerilla mine production by a proper system of denial of all natures of ordnance to a resourceful and ingenious enemy. He also pointed to the need for development of an entirely new barrier system and to solution of the seemingly intractable problem of mine detection and clearance. British Army developments in mine warfare and demolition equipment were reviewed in a paper by Colonel J. N. Elderkin, the Colonel GS GS(OR)7, who outlined the principles on which the British Army is seeking to improve its demolition capability and described in some detail two mine systems currently under development in the United Kingdom.

In the discussion which followed, it was obvious that many overseas countries had a keen interest in the Barmine system. In answer to questions, Colonel Elderkin re-emphasized some of the main characteristics which will make this new mine such a flexible and effective equipment. Brigadier Goodall said that we were still investigating the best system for recording minefields when the new scatterable mine systems (such as project Ranger) come into service. He said that at present the best solution appears to be a combination of self sterlizing mines and a marked "no-go" area into which they will be scattered.

MOBILITY

The Symposium reassembled at the RSME Study Centre at Chattenden on Wednesday 7 June, to study the problems arising from the military engineers responsibility for providing tactical and strategic mobility. Lieut-Colonel B. S. Read presented the British view in a paper which, after considering the importance of maps as aids to mobility, discussed current methods of minefield breaching and indicated their general inadequacy. Colonel Read then outlined British doctrine for gap crossing by means of amphibian assistance, three categories of tactical bridging, AVLB, MGB and M2 and trackway laying. He mentioned the concept of the Combat Engineer Tractor, which has been designed to make such a useful contribution to the British Army's general mobility on the battlefield of the late 1970s.

The United States Army view of mobility was presented by Brigadier General Wayne S. Nichols, who first outlined the comprehensive responsibilities of the Corps of Engineers. Turning specifically to tactical mobility, General Nichols' main theme was that improved firepower has always created a greater requirement for dispersion, and more mobility than the tactical commander ever really has. Army engineers can therefore never afford to cease looking for ways to improve the efficiency of this particular aspect of combat engineer work. New mobility equipments such as helicopters and amphibians confer great tactical advantages, but they also increase the bill for engineer support. Roads and airfields must be completed more quickly, perhaps with the new family of Engineer Construction Equipment (FAMECE), the helicopter emplacement of bridges should be further developed, and the problem of mine detection and breaching must be solved.

A number of interesting points were raised in the discussion on mobility which followed these two presentations. Brigadier General Nichols emphasized that the Fuel Air Explosive (FAE) technique of minefield breaching was still under evaluation but indications were that most mines buried as much as 20 cms down would be detonated. This system would not be effective against the more sophisticated double pressure fused or command detonated mines. General Caldwell said that we were

Plate 3. Display by civil firms

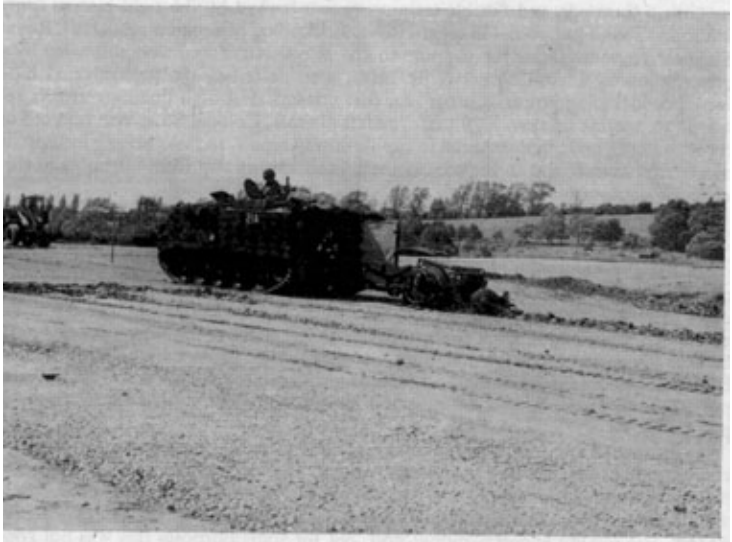


Plate 4. Display by civil firms

Engineer Equipment Symposium
5-9 June 1972 (3 & 4)

never likely to achieve one system for clearing all mines but would probably always require a family of complementary equipments, for example mine ploughs, explosives in various forms and hand detectors. He emphasized the problem of the escalating cost of all equipments and warned of the dangers of military engineers pricing themselves out of the market by trying to develop mines which are too sophisticated.

Although such mines posed great problems for those who have to breach the minefield, the UK would prefer mines which were a little less complicated but which we could afford in sufficient quantities.

Brigadier Mackay questioned the validity of the FAMECE concept of modular earthmoving equipments built up of interchangeable power units, chassis and working equipment. Since these equipments would probably have to work continuously, modules could not be changed and it would therefore be as effective and certainly cheaper to have purpose built light equipments to start construction.

General Ploger emphasized that, if successful, FAMECE would optimize the work output of engineer plant by relating the size and weight of equipment modules to the available lift of helicopters which may be used to bring the plant to the site. In addition it would increase the flexibility with which equipments and spares could be moved around the battlefield.

Finally General Caldwell asked for views on the most effective balance between spending money on development of Amphibious vehicles or Bridging Equipment. He explained the UK view that bridging will always be needed for tanks and logistic support and that we therefore concentrate our resources on developing bridging. American and Indian views corresponded very closely with this policy.

STRATEGIC SUPPORT

On Thursday 8 June the Symposium turned its attention to questions of logistic engineering, including Air Force Support. Lieut-Colonel J. F. Otten's presentation described the wide variety of engineer construction work which may be required to maintain military forces in operations and the principles which affect design and execution. Maintenance of an effective general capability to meet these obligations requires a thorough and flexible training system backed by the right reserve army units, and sound judgement in regard to the stockpiling of engineer resources. Royal Engineer responsibilities for support to the Royal Air Force were discussed in a presentation by Lieut-Colonel N. R. Sturt, who described the sophisticated base facilities, including power, storage and fuel systems, and high quality runways required to operate modern high performance aircraft. Colonel Sturt also referred to the techniques and plant required in rapid runway repair, to tasks arising in support of Harrier aircraft and to the concealment problems arising from advances in surveillance equipment.

MECHANICAL AIDS TO MILITARY ENGINEERING

In a final presentation to the Symposium, Brigadier Goodall suggested a number of ways in which military engineers should seek to improve their effectiveness. Rising costs of new engineer equipment should realistically be justified according to the cost of the related equipment being supported. The effective life of equipments must be kept under careful review to ensure that they do not become militarily ineffective before successors can be available. Machine must replace manpower to improve output whenever possible, and the selection and procurement system for all forms of plant must be carefully planned.

In discussion on Strategic Support tasks, Lieut-General Das raised the problem of responsibility for stabilizing the voltage required for all service use of power in the field. It was stated that the quality of electric power for the British Army conforms to standards laid down in international agreements. Power for normal use was generally of the same quality as the National grid, but for some purposes this was not good enough, and special arrangements have to be made to control voltage and related

Plate 5. The Armoured Vehicle launched bridge

Plate 6. Hicyle tools

Engineer Equipment Symposium
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characteristics. A joint RE/R Signals Working Party is at present looking at the future requirements for electrical power for the Army in the field.

Colonel Powell (Canada) raised the question of engineer participation in major oil pollution emergencies such as occurred after the Torrey Canyon shipwreck. In the United Kingdom clearance was undertaken by the Department of the Environment and RE were not directly involved.

After some discussion about disaster relief, General Caldwell said that although the time may not yet be ripe to consider an international disaster relief task force, there is a need for military engineers to discuss ways and means of reacting quickly and effectively in emergency.

EQUIPMENT DISPLAYS

British Military engineering equipment was displayed to the symposium in two ways. Sixty-five civil firms, Royal Ordnance Factories and Research Establishments established stands and equipment displays which remained open for the benefit of potential customers throughout 7, 8 and 9 June. A large area was allotted for this purpose at Lodge Hill to enable firms to demonstrate plant, cranes and other equipment and to discuss business with visitors from overseas. A mock up Combat Engineer Tractor was displayed by the Military Vehicles and Engineering Establishment.

In addition, the RSME staged three formal military equipment displays, in which troops of 20 Field Squadron and 24 Field Squadron demonstrated a selection of current and future British engineer equipments. On the afternoon of 7 June, a countermobility display included mine warfare and demolition equipments and the light mobile digger. After an interval to enable visitors to inspect equipment, a second display demonstrated equipments designed to provide mobility which included the full range of bridging and the more important amphibian aids and trackways. A selection of the logistic engineer equipment more commonly used in strategic support tasks, including earthmoving plant, ancillary airfield equipment and mechanical handling equipments was demonstrated on the afternoon of 8 June.

CONCLUSIONS

The Symposium provided an unprecedented opportunity for exchange of views between military engineers of many countries and for seeing British military equipment. Additionally a large number of officers were able to see something of the training facilities available at the Royal School of Military Engineering.

On 7 June the Engineer-in-Chief presided at a dinner in the Headquarter Mess of the Royal Engineers. There was a large gathering of Military and Civilian guests, including General Sir Noel Thomas, the Master General of the Ordnance and sixteen Chiefs-of-Engineers. This was a splendid international military engineering occasion.

It was most noticeable at the discussions, both during the working hours of the Symposium and afterwards, sometimes late at night, that the problems facing military engineers, whether in peace or war are very similar although the conditions in which the problems arise may be very different. It was also noticeable that there is much to be gained from such international discussions and it was hoped by many that the "fund of goodwill" and understanding created will not be allowed to wither away.

* * * * *

Engineer-in-Chief's talk on the Corps Annual General Meeting

AT the Annual General Meeting of the Corps, held on 21 June 1972, the Engineer-in-Chief, Major-General F. G. Caldwell, OBE, MC*, gave a talk on the State of the Corps. He said:—

As you will see later on a great deal of what we do or propose as a Corps depends on our having a healthy recruiting position and this, as far as I can see, will always be the case. I therefore make no apology for starting with this subject.

OFFICE RECRUITING

First, to deal with officers. Last year was generally a disappointing year for officer recruiting in the Army as a whole. The Corps, in fact, did better than the Army generally by recruiting a greater proportion of officers direct from University. However, Sandhurst was particularly disappointing both in quality and in quantity. This was partly because of changes in the timing of the Sandhurst courses resulting in only one batch of officers being commissioned. Their general standard was below that we would have wished to see. The course length and syllabus for Sandhurst will change again this September in a further attempt to attract young men of the right calibre. When I took over, I instructed the Engineer Recruiting Liaison Officer to go all out for University entrants either direct or through the medium of cadetships. As can be seen from the diagram we did well in 1971 and it looks likely that we shall do well again in 1972.

Type of Commission	1970	1971	1972 (Estimates)
Permanent Regular Commission			
a. from Sandhurst	24	13	32
b. from SRC/SSC	6	11	10
c. University Direct entry	nil	13	10
d. University Cadetships	2	4	5
e. Transfer from other arms	nil	1	nil
Total Regulars	32	42	57
Special Regular Commission	8	3	7
Short Service Commission	16	14	9
Ex WO's SRC/SSC	25	20	20
Total SRC/SSC	49	37	36
Grand Total	81	79	93

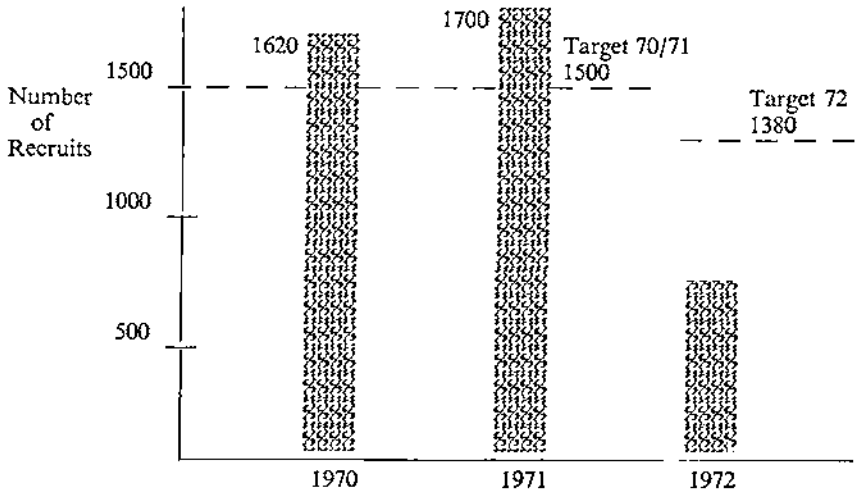
RE OFFICER RECRUITING

On the last YO Course about half the students were University Entrants and the Commandant at Chatham was extremely pleased with their generally high standard. In the future it is possible that we could reach a position where competition to get into the Corps as an officer begins to increase. This makes life a bit complicated as of course with three entries a year from Sandhurst and graduates coming in throughout the year, selection is not easy to arrange. However, I believe that the University

method of entry will continue to be of increased importance and so we are examining the whole problem with a view to instituting some sort of selection system if necessary.

SOLDIER-RECRUITING

1971 was also a boom year for Soldier Recruiting. As can be seen from the diagram we had over 1,700 adult recruits in addition to the 970 juniors.



Total RE Adult Recruits

The overall quality has been good and it is fair to say that we are not simply benefiting from the overall high unemployment level in the country, but genuinely attracting soldiers to an interesting, demanding and well paid profession. This year we are expecting a slight drop in the total number of recruits, and this is consistent with the overall drop in the size of the Army.

All recruits now go for a two-day briefing at one of the two Recruit Selection Centres, either Sutton Coldfield in the Midlands or Glencoarse in Scotland. The Director of Army Recruiting (DAR) allots each Centre a proportion of recruits to be allocated to each Arm/Corps, in our case between 6 and 7 per cent of the total. Any recruit who comes to the briefing committed to a particular Corps and determined to serve in that Corps may not be unduly pressed to change his mind. Some 30 per cent of our recruits are so committed. But DAR still has ample scope with the uncommitted proportion to meet the Director of Manning's target for each Arm/Corps. The Corps is at present some 400 above the target strength of 13,300 This is a healthy state and I believe we probably do slightly better out of the Central Recruit Selection System than we did before as the standard of young man we get is higher. However, we must never be complacent about this since the forecasters, as you well know, are predicting there is going to be tough competition with Industry to attract the best quality of our young men in the next few years.

However, we as a Corps have much to offer the young man of today. The important thing is to tell the potential recruit, both officer and soldier, about it and in my view we must never let up in our attempt to ensure that through the medium of Television, Radio and the Press, our activities are known to as wide an audience as possible.

NORTHERN IRELAND

Now I am going to turn to another important subject: Northern Ireland, where we have a CRE with a small staff to control Engineer tasks. To provide Engineer support we maintain three field squadrons, two from UK and one from BAOR who

do a four month tour before being relieved. They are deployed under command of the CRE, one in support of each Infantry Brigade. We often have additional squadrons over there for specific tasks as, for example, Long Kesh Internment Camp or the closing of border roads. We were given the task of border road closure towards the end of 1971. It took us a little time to discover the most effective way of blocking these, bearing in mind the political constraints which rule out mining craters. We now use a combination of cratering and rooting as this seems to give the best results. Sappers working on these tasks have often been given Infantry protection and have come under fire on a number of occasions.

The brigade field squadrons have all been involved in numerous small, often isolated, engineer construction tasks in support of operations, in improving accommodation and other facilities. They have been improving local defences with sandbag sangars and sentry boxes. Other tasks have included building security fences, security lighting, putting up road blocks using knife rests, barbed wire and putting ox-humps in the roads. There is little sophisticated engineering in many of these tasks, but they require careful organization and have often exposed sappers, working generally in sections, to the very real danger of being shot at by IRA snipers. Indeed it was in just this situation that a Sapper from 50 Field Squadron was killed last month, and a Lance Corporal was wounded. All this work has greatly increased the protection afforded to unit sentries and vulnerable points.

A major problem in everyday operations is barricade clearance. This is dangerous work for which the Muirhill Light Wheeled Tractor and the Allis Chalmers Medium Wheeled Tractor with their armoured cabs have proved invaluable. A plant operator was recently awarded a Military Medal for gallantry and a Lance Corporal received a GOC's Commendation for this work.

At the same time as we have to deal with barricades there is the problem of the bomb. Although the RAOC have the prime responsibility for dealing with bombs in Ireland, we support them on many operations, particularly where blast walls have to be constructed to muffle the explosions. Similarly, we are responsible for all search training in the Army and the RSME runs courses for unit search teams of all arms operating in Ireland.

Last, but by no means least, we have done a good deal of construction work. This has involved converting existing buildings for accommodation, building Twynham and Nissen huts for accommodation and office blocks and generally improving the pretty cramped living conditions of all units in the province.

Our second major role has been to operate as Infantry. Each year from BAOR we have to produce regiments of sappers to take a turn in helping to meet the shortage of Infantry. Last year a four squadron regiment was in Ireland and currently we have a three squadron regiment there. Staff Sergeant Banks, one of the last casualties before the IRA cease-fire on 26 June, was serving with 16 Field Squadron in this role. I believe that they have done the job extremely well and that it has provided us with very good training.

One of the most fundamental ingredients for success in Northern Ireland is providing the right equipment at the right time. The Corps is very much concerned with the procurement of equipment for engineer tasks, explosive ordnance detection and disposal, armoured protection for plant and sentry boxes and all forms of search equipment.

As I said, we are very much in the search business and are employing a number of new experimental techniques for searching cars and individual men who may be carrying weapons, ammunition and explosives. We are also working to develop new improvised bomb clearing equipment. The IRA bombs get progressively more sophisticated (although they still succeed in blowing themselves up fairly regularly) and we must try and keep one jump ahead. As an example, we now have an effective explosive "sniffer" which detects the vapour given off by gelignite explosives and the Erdector which detects anyone who has been handling explosives. We are also working on a soil de-stabilizer which will hinder the repair of craters and rooted

ground and a liquid known generally as "instant banana peel" which when spread on the ground makes it extremely difficult for anyone throwing stones to remain standing. Put together, all these tasks and responsibilities add up to a contribution to operations in Northern Ireland of which the Corps can, I believe, be justifiably proud.

ORGANIZATIONAL CHANGES

Before I deal with the rest of the world, I think I should mention one or two organizational changes which have taken, or are about to take place. Most of you will not be directly aware of a problem we have in my own Headquarters. This stems from the fact that we are split between London and Chatham. I hope that we shall shortly get permission to move Engineer Training up to London to join the rest of us in the Empress State Building. This will bring the whole of the HQ E-in-C together back in London where it should be.

Within my own Headquarters the Brigadier Engineer Plans has been re-designated the Director of Engineer Services and in addition to his normal tasks of control of Professional Engineer activities in the Corps, Airfield work in support of the RAF and Provision of Resources, he has now taken over the sponsorship and in-Service management for the Army of Engineer "C" Vehicles and Plant. This means that we now have direct control over all our own plant including implementing the recommendations of the Lindsell report in building up the families of plant and equipment which we require.

Turning to the UK itself, I should mention the formation of Headquarters United Kingdom Land Forces (UKLF). On 1 January this year we began implementing the recommendation of the well-known Stainforth Committee and by January 1973 we shall have HQ UKLF and nine Independent District Headquarters, in England, Scotland and Wales. The operational part of UKLF is virtually unchanged from the old Strategic Command. The principle change is that the Chief Engineer UKLF becomes responsible for the control of all engineer matters except individual training in the UK including Scotland. Northern Ireland is expected while the current emergency continues.

You will recall that during the 1968 Defence Cuts when four infantry battalions were reduced to representative company strength, 10 Field Squadron, which is now part of 37 Engineer Regiment at Longmoor, was also put on a reduced establishment of two troops. Last August the Army Board agreed that 10 Field Squadron along with the four infantry battalions should be put back on to a full establishment. We have now proposed that this squadron should go next year to an RAF station in Germany to provide permanent support for the RAF in peace, to be primarily concerned with Harrier Support and Rapid Runway Repair.

During the course of 1971, 59 Field Squadron which had been supporting the Commando Brigade based in Singapore, moved back to UK. It is based in Plymouth and has been placed under the command of 3 Commando Brigade for support of all Commando operations. The squadron has a troop permanently based in Arbroath in support of a Commando Committed to operations on the northern flank of NATO. It is converting to Green Berets and is now just over 75 per cent fully Commando trained. This is the first time we have had a Sapper Unit fully integrated into the Commando Force and they have been very well accepted.

TAVR

Now I want to say a word about the TAVR. You can see from this diagram that on the whole our units are well up to strength.

29 Engineer Brigade (V)		% *Recruited*
HQ 29 Engr Bde	Newcastle	72
71 Engr Regt	Glasgow. Sqns in Scotland	95·5
72 Engr Regt	Gateshead. Sqns in North East	91·3

73 Engr Regt	Nottingham. Sqns in N Midlands	94
117 Sp Sqn	Dundee	97·5
105 Plant Sqn	South Shields	92
873 Mov Lt Sqn	London	100
30 Engineer Brigade (V)		
HQ 30 Engr Bde	Stafford	102·5
R Mon RE	Monmouth. Sqns in Wales and West Midlands	96
74 Engr Regt	Belfast	65·5
75 Engr Regt	Manchester. Sqns in North West	102
125 Sp Sqn	Stoke on Trent	72
143 Plant Sqn	Walsall	96

TAVR Recruiting

They have their own special recruiting problems, the greatest of which is the constant average of 15–20 per cent per year turnover of manpower. This imposes a great strain on unit administration and greatly increases the annual training load. To help cope with this training problem we continue to run TAVR Officer and Senior NCO Courses at RSME and Basic Recruit and Combat Engineering Training in the Training Brigade.

I am very happy to be able to tell you that the general morale and efficiency of our TAVR Units continues to be of the very highest order. Their training, which includes one year in three in BAOR, is tough, realistic, interesting and is tackled with great enthusiasm. Having an operational role, they have a strong sense of purpose. I consider them to be a most valuable addition to our order of battle and as much a part of the Corps as anyone else. I also believe that they now have closer links with the Regular Army than they ever did before.

WORLD TOUR

The Engineer-in-Chief then took his audience on a short tour of the world in which he mentioned:

New Zealand. The appointment of Lieut-Colonel J. M. Harman, RE as the Director of Engineers, New Zealand Army.

British Solomon Islands Protectorate. The work of a Specialist Team in the Islands.

Hong Kong. The assistance given by the Sappers in the June 1972 flooding and in particular the rescue of Mr Henry Dutton QC by Lance Corporal Pavey and Sapper Prowse both of 54 (Hong Kong) Support Squadron in difficult and dangerous conditions.

Singapore. The progress made by the Sapper troop in the ANZUK Brigade Field Squadron.

Bangladesh. The work of the detachment from 12 Engineer Brigade giving advice on the restoration of communications under the United Nations.

Arabia. The work of the Sappers, notably the Field Survey Squadron, in the Gulf and Oman.

Africa. In Zaire the help being given by the detachment supervising the repair of bridges and Lieut-Colonel D. E. R. Cameron, RE and his team in assisting in the training of Zaire Engineers. In Kenya, Ethiopia and Malawi, the exercises which have taken place there.

Cyprus. The work of the Sappers in Cyprus.

Malta. The work of the Specialist Team in Malta.

Gibraltar. The work of the Sappers in Gibraltar.

BAOR. Activities in BAOR notably the bringing of 28 Amphibious Engineer Regiment to full operational capability.

British Honduras. The despatch of a troop of Sappers plus 10 Field Squadron to British Honduras.

Canada. Exercises in British Columbia and Quebec.
Scotland. The airfield in Skye.
He also mentioned the work of the Survey Service around the world.

EQUIPMENT

Now for a few words about equipment. I want to mention two items which I regard as being particularly important. First the Combat Engineer Tractor which will have a four-in-one bucket and the Vinycombe anchor for use in exiting from obstacles particularly river banks. The first seven prototypes are nearing completion and should be ready for trials next year. During the past year we have been seeking approval for the full buy and these should start coming into service in 1977. I believe the project is progressing very satisfactorily and that this machine will prove to be a winner.

In the more immediate future, in fact between now and the end of the year, we take over the manning and operation of the Armoured Bridge Layers from the Armoured Regiments. This coincides with the bringing into Service of the new AVLB Chieftain Bridge Layer with its 80 ft bridge. We are also nearing the completion of the user trial of a shorter 45 ft span bridge for AVLB. These two bridges form part of our family of bridging for the 1970s and 1980s.

I am, of course, most concerned with the future and I am very pleased to say that the various long term studies, notably Demolitions in the 80s, Barrier Systems in the 80s and Bridging in the 80s for which we have a joint UK/American/German team resident at Christchurch, are all progressing well.

ENGINEER EQUIPMENT SYMPOSIUM (JUNE 1972)

Three weeks ago we held an Engineer Equipment Symposium, which lasted for most of a week and was held at the RSME and in London. The aims of the Symposium were two-fold:

a. To discuss military engineering problems of common interest with our friends and allies.
b. To interest military engineers from overseas in our equipment.

The Symposium was jointly sponsored by the Director of Sales and myself, as the result of which we were able to pool our individual resources to great mutual advantage.

After the usual reception at Lancaster House we held the first day of presentations and discussions in the Royal Commonwealth Society Lecture Hall. The next two days we spent at the RSME, where in general mornings were devoted to presentations and discussions, and the afternoons to watching military displays or touring the many stands and static displays established by civilian firms. Apart from papers by ourselves, the Indians, the Nigerians, the Australians and the Americans all presented Papers.

The general standard of presentations, displays and administrative arrangements laid on by the RSME were excellent, and I know our guests were very impressed. Altogether fifty-three British Civil firms participated, in addition to twelve Royal Ordnance Factories and R and D Establishments.

A total of sixty-seven foreign countries accepted invitations to attend, twenty of these were in fact represented by their Chief of Engineers or its equivalent. I cannot believe that so many National Chiefs of Engineers have ever gathered in one country before. It was a great pleasure to meet them all, and I am sure they all enjoyed visiting Chatham. Furthermore our fund of goodwill and understanding has been much enhanced in the military engineering world. We should also have done much to promote sales of military engineering equipment abroad, with resultant benefits for all concerned.

I believe we may have started something as a result of this Symposium and that

some form of world association of military engineers may eventually develop. Certainly there was much talk of engineering for peace and of co-operation in disaster relief and I believe that such discussion between the engineers of different nations can only do good.

CORPS AFFAIRS

Now to conclude, I should like to say a word about what can loosely be described as Corps Affairs. As many of you will be aware we are becoming increasingly involved in a way which brings publicity on a National scale in such activities as exploration, climbing and sailing. I believe such activities will increase and that we shall play an increasingly important part in them. John Blashford-Snell is already planning a very large expedition down the Niger in Central Africa in 1974 and Henry Day is likely to lead the Army sponsored climb of Mount Everest in 1975.

Similarly, in sport, we are beginning to compete at a National level, particularly in sailing, canoeing and swimming. I hope we shall have one or two sailors competing in this year's Olympics and with luck we can improve on this in 1976. The RE Free Fall Club is going great guns and I hope it will make a name for itself in the next year or two. On a completely different tack we are examining the possibility of setting up a Museum of Military Engineering Equipment at Fort Amherst in Chatham. This is a big project which will naturally take many years to complete.

All these activities are good for the Corps in every sense of the word but they need money and support. There is no doubt that under the energetic and enthusiastic direction of the Corps Committee the management of the finances of the Corps have greatly improved over the last five years and of course we hope for great things from the series of first-day covers which we are currently promoting. However, if we are to support the various activities in which we are likely to be engaged in the future we shall need money and enthusiastic support from members of the Corps both serving and retired. In addition we shall need, if we are to reap full benefit from them, to publicize these activities to the utmost.

The Engineer-in-Chief then concluded by paying a short tribute to the Chief Royal Engineer, General Sir Charles P. Jones, GCB, CBE, MC, who was due to hand over the appointment to General Sir Charles L. Richardson, GBE, CBE, DSO, on 1 July 1972.

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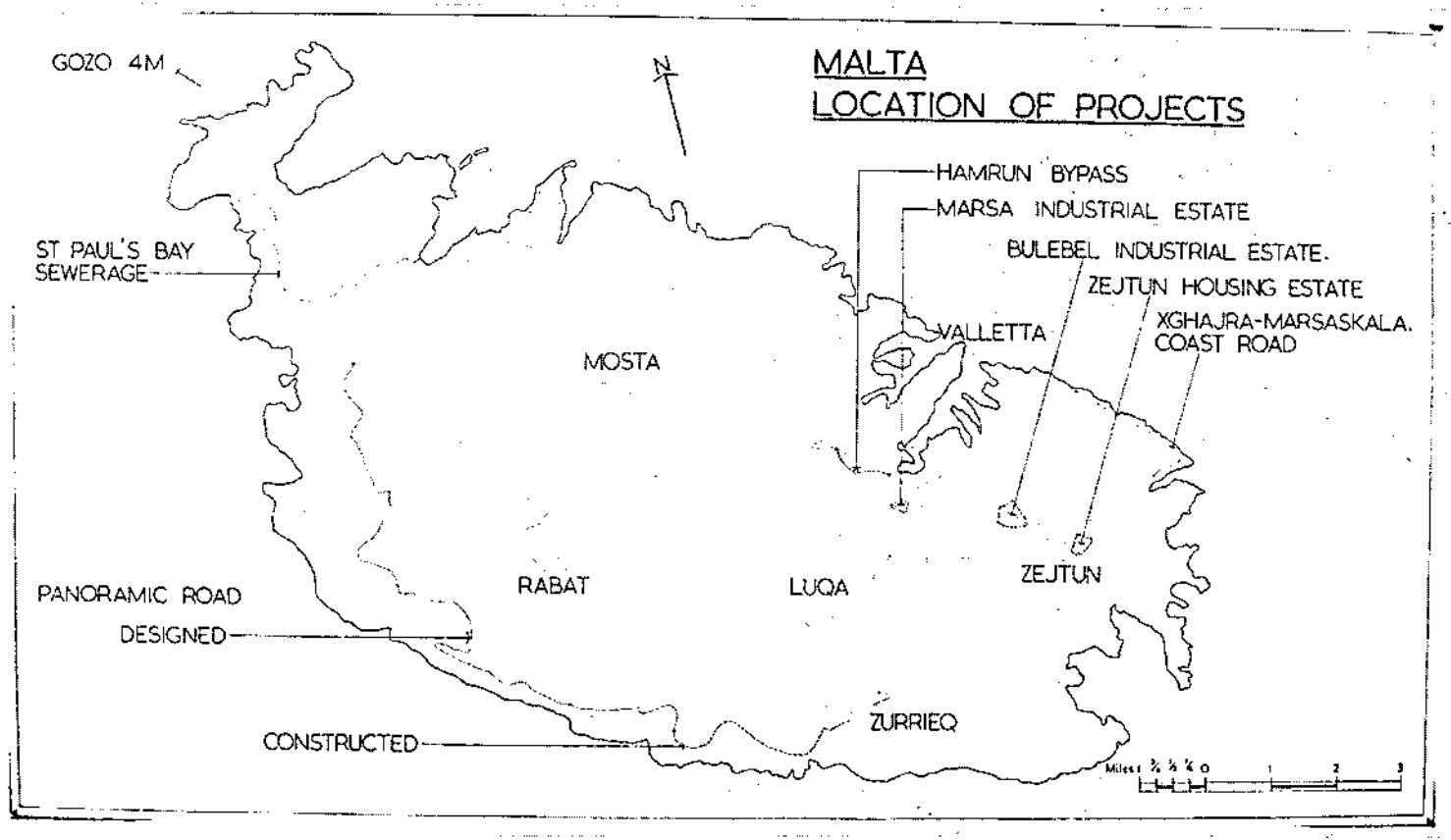
MALTA
LOCATION OF PROJECTS
GOZO 4M
N
HAMRUN BYPASS
MARSA INDUSTRIAL ESTATE
BULEBEL INDUSTRIAL ESTATE.
ZEJTUN HOUSING ESTATE
XGHAJRA-MARSASKALA. COAST ROAD
ST PAUL'S BAY SEWERAGE
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Engineering for Peace. A Recent Project in Malta

LIEUT-COLONEL R. M. HUTTON, MBE, RE

BACKGROUND

FOR its size Malta has always had a profound influence, in peace and war, on the affairs of the Central Mediterranean. In turn she has been blessed and cursed through being situated at a cross-roads of the traffic of war and a cul-de-sac for the histories of several peoples. The race that built the massive Neolithic temples on the Island disappeared suddenly without trace; the Knights of St John were banished by the French almost to extinction; and now the British, who have had an unbeaten influence in Malta as a Colony and a newly independent nation for 170 years, are now on their way out.

The Defence White Paper of 1967 announced a final withdrawal of all British Services because of the Island's reduced strategic value. As a result of concern in both countries, the withdrawal was extended to cover a four year period until 1971 and a Joint Mission to Malta, composed of British and Maltese industrialists under the Chairmanship of Lord Robens, reported that 15,000 new jobs must be provided by 1972 to compensate for the severe reduction in Service spending. In 1971 the new British Government, besides continuing financial aid to Malta that had been stopped in 1969 by the previous Government, reappraised the local Defence scene and, aware of the swift rise in Russian sea power in the Mediterranean, decided to maintain a base on Malta under the existing Defence Agreement due to expire in 1974.

At the time of the Robens Report in 1967, it was realized by the Corps that good opportunities would exist for construction work to assist the Maltese to broaden their economic base. An agreement was reached to place a Specialist Team R.E. (Construction) on the Island for two years and a Team was detached from 62 CRE in May 1968. In 1970 the agreement was renewed for a further two years and a request for a larger sized Team was partly met by establishing a Specialist Team RE (Malta) in July 1970. At the same time a chapter in the Corps' association with Malta was closing: Royal Engineers Malta, who had had an unbroken link with the Island since 1798 when Captain William Gordon RE was landed to aid the Maltese irregulars rise against the French, disbanded leaving behind the newly formed Specialist Team and a Postal Unit as the only Sappers in Malta.

A fresh chapter opened in June 1971 with a General Election followed by a change of Government. The consequent eruption from a long smouldering political volcano shook Malta to its very limestone foundations. One of the first casualties was the Defence Agreement; the flow of lava looked as if it would quickly obliterate all memory of the friendship and achievements of the two countries until it was diverted at the twelfth hour by an acceptance, on 26th March 1972, of a long standing offer of increased financial aid by Britain acting for her NATO Allies. What was left by that time was little—all Service units and valuable equipment had left the Island—and the painfully slow process of rebuilding a Service presence had to begin. The Specialist Team, whilst not exactly part of the Defence Agreement, had felt the tremors of the local eruptions and was inevitably bound to a Service withdrawal; it finally left by 21 March 1972 after having handed over its work, in this case "the Project", to the Maltese on 13 March 1972.

THE PROJECT

From the first, the charter of the Team was "to assist the Director of Public Works Department, Government of Malta, to plan and implement projects recommended by the Robens Report"; although the type and size of the Project grew with

a gradually established reputation of the Team, the charter remained the same for four years. Principally the role of the Team was to execute building and civil engineering tasks of Public Works but later some electrical and mechanical work was undertaken. The choice of tasks was agreed with Director of Public Works Department (PWD) by OC Specialist Team with subsequent confirmatory approval of the Engineer-in-Chief (Brigadier Engineer Plans) and locally of Commander British Troops Malta. At first the tasks were to plan Panoramic Roads round the coast of parts of Malta and Gozo. Actual construction works were then accepted on the Panoramic Road, a by-pass at Hamrun and a new industrial estate at Marsa. Later a larger industrial estate at Bulebel was taken on and a housing estate near Zejtun (see map). In the office, a considerable amount of investigation and design work was accepted.

The "Panoramic Road" concept has already been described by Major R. Jukes-Hughes, RE and Major D. A. Johnson, RE in an article in the December 1969 *Journal*. An exciting idea, it never had any great political support and it was always doomed to be a long term venture. However, the survey at 1/500 scale and design of the 15 mile of road progressed steadily and the construction of the first 3½ miles was nearly finished by the time of withdrawal of the Team. Wherever possible Malta maintains a labour intensive tradition requiring work to be done by hand and not by machine. Roadmaking fell under the same misguided technique and so the construction of this road, with a hard-bitten gang of PWD direct labour, a little worn plant and with no official support, dragged on tediously. However, the contribution from the Team was modest: one officer employed part-time, one surveyor and one draughtsman on survey and one Clerk of Works full-time on site was sufficient. The effect was to provide the Clerk of Works with a real challenge to obtain progress and a useful opportunity to develop his skill at the management of direct labour. No Maltese road was ever built by the Romans and most seem to go nowhere, therefore the result of a well aligned, wisely planned and soundly built new road was welcome to tourists and Maltese as a stylish access to an attractive coast-line (see photo 1).

Hamrun By-pass forms part of a Regional Road complex which by-passes the built-up areas of Marsa, Hamrun, Valletta and Sliema. The by-pass consisted of ¾ mile of dual carriageway and an eleven span reinforced concrete flyover at an interchange in the centre of this section. A safe and unadventurous design had already been prepared by PWD engineers and site work had just started when the Team was asked to take it over. Direct labour was employed also on this task with some minor contracts for excavation, kerbing and so on; no direct labour had previously been employed on a structural job of this kind. Consequently, as well as designing formwork, safety barriers and temporary scaffolding, Team personnel of one officer (part-time) and two Clerks of Works (full-time on site) had to organize, instruct and control the variable work force in placing roughly 4,000 cu yds of concrete and 300 tons of reinforcing steel. The result is a well finished but heavy structure that will form a viable part of an important road network when the remaining links of the Regional Road are completed (photo 2).

Factory construction is right in line with the recommendations of the Robens Report, therefore it was natural that one of the earlier tasks was to supervise the construction by contractors of nine factories, totalling 135,000 sq ft in area, at Marsa. A site staff of one officer and two Clerks of Works covered this task until completion one year later; they also designed some roadworks and services necessary for the estate. This first introduction to Maltese contracting and standards was to be useful for a much larger task, also in the construction of factories, later at Bulebel.

To provide factories from scratch for 7,000 new jobs, as recommended by the Robens Report, needs a comparatively large expenditure on the Public Sector. Norman and Dawbarn, Consultants of London, were commissioned to design a suitable estate for 3,500 new jobs on a well chosen site at Bulebel, south of Grand Harbour, and the Team had the rare opportunity of undertaking all aspects of site supervision. Principals from the Consultants visited periodically and relations with

Photo 1. Panoramic Road Construction above Ghar Lapsi.

them were close and fruitful; otherwise all features of engineering, standards, alterations to factories to meet tenants' needs, quality of work and administration of contracts were the prerogative of the Team on behalf of Director of Public Works. For two years this was the biggest commitment of the Team; a general strength on site was two officers (one Resident Engineer and one Site Engineer) and five Clerks of Works supported by some PWD Office Staff. The solution adopted by the Consultants was to split the forty-two factories, totalling 500,000 sq ft floor area, into three major contracts and to put the considerable site works into one civil engineering contract. There are only two Maltese contractors of any size and they shared the contracts which totalled £2·2 m, resulting in a cheap cost for factories only

Photo 2. Flyover on Hamrun By-pass.

of £3 per sq ft floor space or, inclusive of all site works and offices, of £4 per sq ft floor space. The type of factory construction may be appreciated from the photograph following (photo 3) being of masonry walls with either pitched and sheeted roofs or North-light roofs; space for future extensions was allowed behind each factory, except for the small terrace type. Separate offices were built next to each factory and a central administrative building was provided for the communal estate facilities. In spite of a good well-drained site with no foundation problems, the civil engineering works were not straightforward: provision of services, particularly electricity, was difficult to co-ordinate and final extensive landscaping and clearing of site presented difficulties towards the end. An unusual provision for water conservancy was made by the collection of rainwater in two separate systems—roof-water being piped to underground reservoirs (four each of 1 m gallon capacity) and water from roads and ground being drained to smaller reservoirs for agricultural and fire-fighting uses. The roof-water was re-circulated to a central water tower for toilet and industrial use. As well as the satisfaction of seeing a well planned and attractively designed estate take shape, there was added reward in the end of seeing many of the factories brought into use. Due to the withdrawal, it was necessary to hand over the last part of the civil engineering works and a quarter of the last factory contract to PWD to complete but by March 1972 the final accounts had been prepared for two factory contracts and measurement of the other two contracts was well advanced. In the absence of any qualified Quantity Surveying staff within PWD, measurement of work formed an essential commitment and the equivalent of one officer and two Clerks of Works were fully occupied thus for the whole period. The contracts themselves over-ran time, for various reasons, yet the Authority was not prepared to grant time extensions as recommended by the Resident Engineer. The contractual climate was worsened too by non-payment of interim valuations apparently because of a lack of funds during the latter half of 1971. Despite this, factories are now available for use and they form one of the most attractive industrial estates ever built.

Different contractual peculiarities affected another time-consuming task—a housing estate for 113 houses near the town of Zejtun which was one of nine new Government housing estates hurriedly started to solve a chronic housing shortage. PWD architects had prepared a layout for the site and outline house designs which were developed by the Team into full working drawings for three types of three-bedroomed houses together with full site works of roads and services. For political reasons it was at first decreed that construction should be executed by direct labour; later, after a shortage of building tradesmen had been proved to all, it was agreed to go to contract. Various contracts of different sizes were prepared by the Team and eventually one for the construction of house shells was let for £208,000. Separate contracts for finishing trades, as is the Maltese custom, and for a mile long sewage outfall were also prepared; several were let before handover of works on site to PWD in March 1972 by which time the estate was at last well advanced. A site staff of one officer and two Clerks of Works was generally maintained from the start of work in early 1970. When complete the estate will provide large houses of good construction which will stand well in comparison with other Government housing. The cost of a two storey masonry house of 1,700 sq ft indoor floor area was £2,800, giving a rate per sq ft very comparable with estates designed by other consultants (see photo 4).

In addition to this site work, a part of the Team's potential was always engaged on various office engineering tasks. Hydrographic surveys were frequent requests, for surveyors were short in Malta—particularly, it seems, those who were prepared to bob around in boats sounding the bottom of bays for new jetties or piers. The Zejtun Housing Estate caused a lengthy work load in design and in the preparation of contract documents. After this, investigation work for a new 10,000 line telephone exchange building was started and later designed in detail. Full contract documents were prepared for the building works and for the air-conditioning of the apparatus room by packaged type roof-mounted units. The whole was estimated at £62,000 but

Photo 3. Bulebel Industrial Estate from the completed part on the East. Factory construction can be seen at the other side of the Estate.

Photo 4. Zejtun Housing Estate on the slope beyond the fifteenth-century Church St Girgor.

no work has yet been started. A large scale sewerage scheme for St Paul's Bay area in North Malta was also investigated and designs were being prepared for gravity and high rise pumping mains and sea outfalls. The total cost of this scheme was estimated at £¼ m, spread over a number of years, and it was likely to produce more engineering problems than any task hitherto of the Team. Later another road 1 mile long was designed for north east Malta and an investigation was started for a new town to house 5,000 people in the same area. Smaller studies were made on such diverse subjects as precast yard, workshops, road overbridges and traffic congestion; an extensive design was also prepared for the central heating and hot water system for a 900 bed hospital by E & M staff from 62 CRE (later 64 CRE (E & M)).

Other Specialist Teams from T & AVR and individual officers from Engineer Specialist Pool visited Malta for training each year, during which they did work for Malta Government and the Services. They also gave much assistance to the Project and advice to the Team which, from genuine specialists, was invaluable.

THE BENEFITS

In the end, what was achieved and who was the ultimate beneficiary? Certainly the Malta Government benefited by being able to use a Management Team of engineers and technicians on an "extra cost" basis and, in spite of the chilly political climate at the time of withdrawal, they expressed their ready appreciation of the Team's work. It is likely that most of the Team's work would not have otherwise been started and the remainder of it would probably have been completed at greater expense and with lower standards. During 1971 construction work to the value of nearly £1 m was handled by the Team and about £¼ m of work was designed. But the absolute beneficiary is really the Corps for, by taking advantage of an opportunity to employ some of its construction potential within a formed unit on interesting and challenging tasks abroad, experience has been gained in the management of direct labour and supervision of contracts (in short, the production of finished construction tasks) and an amount of job satisfaction has been earned. The scope of the work, including particularly the quantity surveying content, contributed to the technical benefit which can not, at present, be obtained elsewhere within the Corps.

Of course, it was all "Engineering for Peace". Malta may not be as under-developed as she claims but the Project helped to improve the Service-orientated Maltese economy. In the past, Sappers in Malta have been heavily involved in the construction of massive defences, tunnelling and repairs to the fortifications erected by the Knights. Now they have turned from fortifications to factories, from "Engineering for War" to "Engineering for Peace" thereby helping to establish a different reputation for the Service in this modern world.

And yet the Project has really supplied training facilities for war; exercise in the tools of the engineering profession and experience of the problems created by foreign conditions form the knowledge and confidence to undertake engineering construction work in war. Not only in a full war situation but in modern internal security operations, the demand arises for some if not all of the construction work to be taken on by Sappers. There should therefore be sufficient practice in the Corps to meet this demand.

Since the withdrawal of the Team to Chatham, Malta Government has made an official request for the Team's return to continue its previous role. What's past may be a prologue to yet another spell of "Engineering for Peace"—and "Training for War".

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Exercise "WATERLEAP" 1971

MAJOR D. W. WILLIAMS, RE

BRITISH field squadrons have visited Canada on training exercises for a number of years, each exercise being called Waterleap and designated by the exercise year. 1971 was no exception with 50 Field Squadron carrying out Exercise Waterleap 71 between June and September. What was exceptionable was the exercise location; the squadron spending its time camped at 2,000 feet on the shores of Lake Chilliwack amongst beautiful natural forests and mountain peaks in the province of British Columbia, close to the Canadian Pacific coast line. The reason for this choice of exercise location is worth explaining.

First however it should be understood that Exercise Waterleap 71 was concerned with the practice of combat engineering and the bridges, roads and other works constructed by the Squadron were of an unsophisticated type. This narrative is more a story of the Exercise than an article on engineering profundities.

Until the middle of the nineteenth century the future province of British Columbia was largely unknown and uninhabited except for the indigenous Indian tribes. Intrepid explorers such as MacKenzie and Fraser had made their way along the impressive rivers which bisect the province and which now bear their names, and fur trappers, mostly accredited to the Hudson Bay Company, earned their hard living in the enormous primaeval forests. The only European habitation of any size was the town of Victoria on Vancouver Island, at that time a British Colony on the Pacific shoreline and the headquarters of the Hudson Bay Company which was to play a conspicuous part in establishing British sovereignty over the future province. At the time the expansive United States of America had reached its western boundary, that is the Pacific Ocean, it had recently been involved in a war with Mexico on its southern border and elements living in Oregon Territory were pressing north along the Pacific shore towards Canada whose international border with the USA was very badly defined. The Hudson Bay Company was clamorous in its pressure on a distant and reluctant British Government to define the boundaries of British Columbia, or New Caledonia as it was then called, and prevent its appropriation by settlers from the USA. The pressure was successful with the border being defined by the 1847 Anglo-American treaty of Washington. The agreed border was surveyed by a joint border survey team in which Royal Engineers played a leading part, between 1857 and 1861.

The respite however was temporary. In 1857 gold was discovered at various locations in British Columbia. A gold rush started and the provincial European population rose very rapidly from tens to thousands. By 1858 there was estimated to be over twenty-five thousand living in the Province at a time when government control over places and people was virtually nil. The Province was in danger of becoming an area of extreme lawlessness. Again the Hudson Bay Company was prominent in establishing sovereignty; its head on Vancouver Island, Governor James Douglas, placed the vast mainland Province under his own authority, raising taxes and policing it to the best of his ability. He also solicited the British Government for the despatch of an armed body of men. These men, 154 in number, started arriving in British Columbia in late 1858. They were Royal Engineers. In sending them the then Secretary of State for the Colonies paid them a pretty compliment which seems worth repeating:

"The superior discipline and intelligence of this force, which afford grounds for expecting that they will be far less likely than ordinary soldiers of the line, to yield to the temptation of desertion offered by the gold fields, and their capacity at once to provide for themselves in a country without habitation, appear to me to render them especially suited for this duty; whilst by their services as pioneers in the work of

civilization, in opening the resources of the country, by the construction of roads and bridges, in laying the foundation of a future city or seaport, and in carrying out the numerous engineering works which in the earlier stages of colonization are so essential to the progress and welfare of the community they will probably not only be preserved from idleness which may corrupt the discipline of ordinary soldiers, but establish themselves in the popular goodwill of the emigrants by the civil benefits it will be in the regular nature of their occupation to bestow."

The next five years were to prove the perspicacity of the Secretary of State. The Sappers were the first organized body of men the new Province had seen. Gold seekers apart, they represented a significant portion of the population. Their discipline, military authority, relatively sophisticated social and cultural background, and above all their abilities as engineers fitted them for their role as community leaders. Their presence sufficed to restore and maintain law and order amongst the gold seekers and consequently left them free to carry out engineering works of great variation. They constructed many roads, tracks and associated bridges throughout the Province, they created the basis of many towns including the construction of schools and churches, they surveyed large areas of the Province and produced and printed many maps. They created government printing presses, mints, libraries and they designed the first postage stamp, the colony's coat of arms and, equally important, they played a full and leading part in the social life of the colonial community and participated in all its cultural and material developments. In all, this team of Sappers played a major part in creating the basis of a provincial society which in 1871 was able to negotiate entry into the Canadian Confederation as an equal with other provinces.

In 1971 British Columbia was celebrating the centenary of this event. 50 Field Squadron was scheduled to exercise in the Province instead of in the usual and more easterly Canadian training areas as a concomitant of the centenary celebrations and in particular to mark the extensive efforts of their predecessors of 1858. Of these predecessors, all but a handful eventually settled in the Province. Their reasons for doing so are soon made evident to the visitor.

All North American car number plates seem to bear a motif appropriate to the state. Thus one learns that Texas is big, very big, that California is sunny, and that British Columbia is beautiful. In general these motifs seem to be accurate, certainly in the case of the last one: British Columbia is beautiful. The land is consistently rugged, criss-crossed by mountain ranges with peaks of over 12,000 feet, snow-covered in winter, snow-capped and majestically and crushingly barren and rugged in summer. The Province is covered in primaeval forests of magnificent trees which climb straight and true and have girths measured in up to tens of feet. Lakes abound, nestling between the mountain chains and well filled with fish, the forests which rise from them are full of deer, black bear and countless other varieties of animal life and the rivers which stem from them, such as the River Fraser, are breathtakingly beautiful as they pound their way down steep inclines to the Pacific Ocean. The province is vast, it seems to be an unconquerable redoubt of nature and constantly feeds the eye wherever one goes with a grandeur which is awe inspiring.

The Squadron reconnaissance party departed for this paradise in early June 1971 to be met at the far end by wet, cold and foggy weather in what should have been summer. Their discomforture was increased when their first look at the intended camp and works site was through five feet of clear water viewed from a boat. The problems had started, brought on in this case by an unusually late thaw of the mountain snow causing excessive run off into Lake Chilliwack at about the time of the exercise. The camp site was re-located but the primary works site remained inundated during more than half the exercise.

The Squadron's task was to complete access routes into a wilderness area around Lake Chilliwack, the area was to be called Sapper Park and was intended as a recreational area for the people of British Columbia. The park was located 35 miles away from the town of Chilliwack at the head of a very rough road and included

part of the lake itself, surrounding mountains, other lakes and creeks, and an area, adjacent to the United States border, which was particularly rich in samples of primaeval timber and abounding in wild life. The lake itself was five miles long by one mile wide and provided good sailing and fishing. The idea of creating Sapper Park had been born in the Canadian Armed Forces Base (CFB), Chilliwack, home of the Canadian Military Engineers, formerly the Royal Canadian Engineers. Since the autumn of 1970 Canadian Sappers had been hard at work on the project and, by the time of arrival of the Squadron, had bridged one creek using Bailey Bridging and had hacked and blasted their way through 1¼ miles of timber and rock along the lake shore to provide rudimentary access to another creek on its southern shore. This creek had to be bridged. Squadron participation in the project evolved as four fold, firstly to replace the Bailey Bridge over the first creek (Depot Creek) with a 60 feet improvised timber bridge. Secondly to complete the road started by the Canadian Sappers and extend it a further ½ mile to the second creek (Chilliwack Creek) where, as the third task, a 120 feet improvised timber bridge was to be constructed to take the road to a car park and picnic area at the start of the wilderness area proper. This last was the fourth task. Whilst still dealing with generalities it is worth recording the enthusiasm exuded by all Canadians in discussing the "great out-doors". All Canadians seem to hunt, fish and go boating and all seem to love being out and about in their beautiful country. The enthusiasm reaches Provincial Government level which, through a Ministry of Recreation, pays commendable attention to the orderly development of recreational areas and the necessary public facilities which go with them. The overall interest and attention paid to the provision of popular recreational areas and facilities as instanced by the creation of Sapper Park, was impressive.

The reconnaissance party arrived back in UK with its news of frosty weather and inundated works sites but, apart from much repetition of the battle cry flexibility, planning went on unimpeded; OG remained the exercise dress and, hopefully, teams from the Squadron spent what few days were available to it for training, at Lodge Hill thumping piles into the ground. This training was very necessary as the level of pile driving knowledge and experience within the Squadron was extremely low.

On 27 June the advance party left England. For various reasons the advance party was a strong one, consisting of 88 men out of the 200 participating in the exercise and 14,000 lbs of the 20,000 lbs of airlifted freight allocated to the Squadron. The freight included a Paterson water trailer which developed faults in Canada which made it useless after the first day, a circular saw trailer which was extremely useful, and a Mighty Midget man portable welding trailer which, fortunately, was offered at the last moment to replace the Squadron's ageing and decrepit welding trailer. These trailers took up 6,000 of the 20,000 lbs allocated. Deciding on the makeup of the balance was an exercise in itself with a surprisingly large quantity of G1098 equipment being left in UK. By good fortune the newly issued high cycle generators and equipment arrived in time to be taken and gave good service although some problems arose, some due to operator inexperience and some caused by failure of items of the equipment after heavy use. The main lesson learned was the need to familiarize almost all field troops personnel with the operation and maintenance of the equipment, a problem which also arose in running almost 20 generators, pumps and chain saws etc. which were drawn from the Canadians; all had different starting systems, maintenance schedules and, most importantly two stroke fuel mixture ratios. Ensuring that no misuse took place was a constant headache. The need for a basic mechanical awareness amongst field troop personnel seems to be becoming increasingly essential.

The advance party flew by RAF Britannia and Hercules to Vancouver airport, spent a few days at CFB Chilliwack sorting itself out and then moved to Lake Chilliwack with vast quantities of Canadian Army stores, equipment, vehicles and plant. Its task was to set up camp at Depot Greek, so named after the establishment of a Royal Engineers Survey Base Camp in 1859, and to make an immediate start on project work so that by the time the main body arrived each aspect of project

could be proceeded with simultaneously with the aim of completing all by 17 September, the date already set aside as the Park Inauguration Day.

The new camp area, carefully selected so as to be above all possible flood levels, lay in a valley which had been logged by the local lumber company whose custom it was to burn off all slashed branches, dead trees and tree roots etc, after vacating the area. These burn offs produce quite intense fires and the effect in this case was to create in the valley the sort of scene one would expect to find if by chance a nuclear device had been let off in the same area; all around was bare earth ripped up by dozer tracks and piled with blackened and scarred heaps of burnt timber with here and there the gaunt skeleton of a giant dead tree casually left there by the lumber men and now pointing, blackened and scarred, silently and alone into the sky. Into this Hades the Squadron descended with its equipment and plant which was soon busy ripping out roots and levelling off an area on which a tent city could be erected. Living accommodation was to be tented with beds, blankets and sheets provided by the Canadians. Camp Structures were erected for cookhouse, ablutions including showers, canteen, and Officers' and Sergeants' Messes. Piped water was laid on to all cookhouses and ablutions. After 3 weeks of work by mixed elements of the advance party the camp site could be said to be habitable by field (if not by Butlin) standards and all effort could be devoted to the project itself.

Project work had in fact progressed well by this time. Canadian effort on the road had run down to ten men primarily concerned with continued rock blasting of the side hill cut which clung to the edge of the mountain forming the lake shore in this area. The Canadian rock blasting equipment, hired from civilian firms, was most impressive: For some months the drilling teams had used drills mounted on a reworked Sherman tank chassis which provided powerful drilling rigs on a tracked vehicle suitable to the very rough terrain over which they operated. Latterly the rigs used were much smaller tracked machines which derived their motive and drilling power from accompanying compressors. These rigs were very mobile and could, drive a drill head at 60 feet radius from the base machine, they were easy to operate, were robust and required little maintenance. Squadron teams gained valuable experience operating them on a shift basis with Canadian supervision. Meantime, also on the road, the Squadron fleet of tippers which included 2½ and 5 ton Standard Military Pattern (SMP) vehicles together with civilian pattern Fords, Chevrolets and a Sicard, were busy operating over the extremely rough access road leading to Chilliwack Creek whilst the drilling teams and Squadron plant was busy widening the road. By necessity the road had to be used as a haul road to Chilliwack Creek despite its very substandard condition. The resulting slow turn round times and poor serviceability rates of the vehicles provided an object lesson on the value of good tote roads. An interesting statistic from this period was that the daily average puncture rate for the vehicle fleet was ten.

The bridge over Chilliwack Creek was a substantial structure designed for Cl 60 one way or Cl 30 two way traffic and involving the driving of 60 piles along a total span of 120 feet. At the time the site was approachable only by water and was itself largely under water. There was therefore an anxiety to get at the task as soon as possible so that snags could be revealed early. In fact the task went surprisingly well. The equivalent of a 10 RB was rigged as a pile driver and was taken across Lake Chilliwack by Class 30 ferry to the only piece of dry land available close to the home abutment. From this point the home abutment piles were driven with ease into the sand/silt creek bank. The sets obtained on the piles gave, by Morgans formula, which provided the lowest values, a resistance to penetration lower than the design figure. This led to the decision to form a double bent abutment wall, but otherwise the abutment piles were well driven with a great deal of satisfaction by the team which had trained at the RSME. By the time the home abutment piles were driven the far bank was just appearing above water and it was therefore decided to proceed immediately and drive the far abutment piles. The rig was reloaded on to the ferry which was warped across the creek and finally, after much manoeuvring including

bogging and unbogging drills, was put into a position from which the piles were driven. Again the resistance to penetration was inadequate but this time this was overcome by including more piles in the designed single bent. By the time the last abutment pile was driven the water level had risen to the extent that continued occupation of the far bank seemed unwise and the rig and accompanying plant was evacuated on to the ferry. It had originally been intended to drive both instream piers by constructing ramps from each bank to within piling distance of the pier positions. The flood condition of the creek made this patently impossible and it was decided instead to drive from the rig mounted on the floating ferry. This proved to be an interesting and not too difficult an operation once initial difficulties had been overcome and team experience obtained. The first difficulty was that of anchoring the raft to the bank securely and by such means that allowed the raft to be located correctly in relation to the intended pile position. The second difficulty was the practical one of actually manipulating the raft under the control of surveyors on two obtusely angled instruments. For purely local reasons anchorages were of poor quality and badly spaced so that some difficulty was experienced in placing the first pile. Thereafter however work progressed smoothly with the raft tethered to the first driven pile which provided a datum from then on. The limited reach of the driving rig meant that the raft had to be located on either side of each instream pier at some stage or other to allow all piles to be driven. In one way therefore the flood condition was fortunate as without it there would not have been sufficient water to allow the raft to float at all these locations. Throughout this period the Devil or the deep blue sea option of either too little water to allow a floating rig or too much to allow driving from land was always near, but the piling team was just able to keep abreast of the rises and falls in water level and all pier piles were driven successfully. It was also fortunate (by redesign) that the clear distance between piers was precisely two inches greater than the raft width so that the raft was able to shake itself free from the piles at the end of the operation. By the end of July, as the water level in the creek sank to an unworkable level for pile driving from afloat, the last pile was driven, the rig was ferried away for other duties and the advance party took a well earned four day leave to await the arrival of the main body.

A break of four days was sufficient to induce most of the advance party to leave camp and explore British Columbia. Some stayed in the Chilliwack area going on local treks into the hills either on foot or on horseback, a popular local method suited to exploration of the rough but acceptable trails which crossed the mountains. By this time a large number of local friendships had been made and Canadian hospitality was extended to many over the break. Those who had not made personal arrangements were given the opportunity of joining a Squadron coach party which was setting off to see as much as possible of the country. Approximately forty set out in a coach which covered nearly 1,000 miles in the next four days: Seattle in the State of Washington was visited on the first day with the night being spent under canvas in an American town called Wenatchee which claimed itself to be the fruit centre of the world! The mayor of this town had got to hear of the visit, turned out in welcome accompanied by the local police chief and pressman and ceremoniously opened up the municipal gardens for the travellers use as a campsite. The remainder of the trip included a drive through the 250,000 square miles of coulee (lava bed) country in Washington State which seemed to epitomize the "Bad Country" of Western films, to the Grand Coulee Dam and the Columbia River, and then back into Canada with an evening spent at a colourful Red Indian War Dance competition and a final drive through the scenic valleys of the Rivers Thompson and Fraser in British Columbia. On return to camp it was found that the camp guard had been involved in the Squadron's first skirmish with the local black bears about ten of which had provided constant company since the advance party's first arrival: Every evening at sunset the swill vehicle departed camp for its short journey to the swill tip. For an hour beforehand the bears, which probably weighed up to a maximum of 300 lbs, would have been emerging from the tree line and assembling at a discreet distance from the

swill pit from which they regularly obtained their evening meal. As the days went by the bears became more self assured to the extent that they were eventually climbing into the rear of the swill vehicle before the swill bins could be emptied. This was too much even for the nonchalant Sappers and swill thereafter had to be emptied into the pit from a tipper. During the four day break there was little or no swill because of the small numbers living in camp. This upset the bears used to having an evening feast and on the second night they invaded the camp. The duty officer imagined that the movement of his tent was caused by a passing friendly Sapper, but on peering out of the tent flaps he found himself being peered at with equal surprise by a rather fierce looking bear. Another Sapper was rather put off at finding strange company in the desert rose tent and a cook was alarmed at finding a bear in the kitchen playfully tearing the place apart. The bears were invited to go but refused, became rather recalcitrant and were only persuaded to depart by the regrettable action of shooting two of them. There were no more major incursions into the camp but the swill ritual lasted to the end of the exercise and individual bears often strolled leisurely through the camp whilst one young one adopted the officers mess where he appeared every morning at about 11 o'clock for his morning break which normally consisted of a pot of honey. Others, normally young ones, appeared regularly at work sites in search of titbits, and a grizzly bear was spotted within two miles of the camp, but on the whole the bears were a friendly and acceptable part of the local scene.

On 1 August the remainder of the Squadron manpower and freight arrived and were quickly deployed to work which now divided into troop tasks; one troop on the Depot Creek Bridge which was now started, one troop plus most of support troop on the road and the third troop continuing with its task of building the Chilliwack Creek Bridge and starting work on the car park and wilderness area.

The Depot Creek bridge was designed within the Squadron again for Cl 60 one way or Cl 30 two way traffic and was a relatively simple structure consisting of two 30 feet spans using RSJ's as road bearers spanning between a central double bent timber piled pier of 12 inch diameter piles and bankseats located behind piled abutment walls. By this stage the piling rig operator was well practised but the correct location of piles proved difficult at this site because of the rocky nature of the ground which frequently had to be blasted before piles could be driven. All components were easily manageable by hand or crane and after the piles had been driven, the task became a straightforward one although for the troop concerned a very novel and worthwhile one which gave much practise in the skills involved and a great feeling of satisfaction on seeing the bridge completed. This bridge had been designed and built at short notice and the ordering and aquisition of materials was an exercise in itself. It therefore seems worth digressing at this point to describe some of the problems encountered in this field.

50 Squadron had obtained experience in stores handling during the construction of Victoria Stadium Gibraltar where £100,000 worth of materials passed through its hands. For Exercise Waterleap the stores accounting section therefore included an officer, SNCO and junior NCO's in addition to the normal SQMS staff. The carriage of administrative stores concerned with the setting up and running of the camp required over 60 vehicle loads and this sort of quantity set the tone for the exercise; the procurement of the large quantities of timber required for both bridges required constant negotiation and chasing, much liaison had to be carried out with production departments at CFB Chilliwack and constant changes in vehicle and plant requirement required organizing and arranging. All of this had to take place over a line of communication of 35 miles of poor roads without telephone communication except for an emergency line. Stores procurement was often a problem but never caused a works delay, the worth of the elaborate set-up was thus proven.

As described earlier construction of the Chilliwack Creek Bridge which had been originally designed at CFB Chilliwack had progressed well by this time and although much work remained, completion was not seen to be a problem. Driving piles for this

bridge had been a very interesting task and its completion continued to arouse great interest. The road bearers for the bridge, 40 feet in length, were of Douglas Fir taken from the surrounding forest. Minimum roadbearer diameter was 2 feet which generally meant a diameter of 3 feet at one end and an original tree which might be anything up to 5 feet diameter at its base. Each span was carried on 9 of these logs, a total of 27 in the bridge. Some of the timber in this and the Depot Creek Bridge and most of the piles, was felled and shaped by the troop concerned, but in the case of these giant trees it was thought best to employ experts from the local lumber company who were able to fell the trees with remarkable accuracy of direction and later strip and cut into sections at an extraordinary speed.

The lumber camp was within 1½ miles of the Squadron camp, roads and tracks were in common use by both organizations and for this and other reasons liaison turned into friendly relationship with many members of the Squadron becoming familiar with the workings of the lumber industry which provides British Columbia with a large part of its wealth. The Squadron also became familiar with vehicles hauling cut lumber and weighing up to 90,000 lbs which roared past the camp at high speed and in swirling clouds of dust at fifteen minute intervals throughout the day. The road used by both lumber and Squadron vehicles continued for five miles as a side hill cut up to 100 feet above the edge of Lake Chilliwack, it was very narrow and had a number of blind corners and negotiating it against the flow of lumber vehicles was rather like going around a helter skelter the wrong way. Fortunately there were no serious accidents, although there was one head on collision between a lumber vehicle and a jeep which, in view of the disparty of size, might have been rather unfortunate.

The roadbearers produced by the lumber company weighed about five to six tons each and placing them would have been quite a task were it not for the 20 ton crane kindly provided by the Canadians. This machine had a lift and reach which was beyond the normal experience of the Squadron and was a most welcome experience which saw the bridge further on its way. Much work remained with vast quantities of timber pouring into the bridge to make up decking, footwalks and approaches but again, as for the Depot Creek Bridge, the task now became a novel, and fascinating but straightforward job whose completion by the target date of 17 September was not in doubt.

One side benefit of working on either of the bridges was to be able to watch the salmon runs in both creeks. British Columbia exports large quantities of salmon caught in the lower reaches of the big rivers, but controlled numbers are allowed to reach their spawning grounds and many were to be seen in both creeks. In particular Depot Creek was a breeding ground for a land-locked breed of salmon called Kokinee which weighed up to 2 lbs, were bright red in colour and for about a month were frequently seen to be gracing the table of officers and sergeants messes, mostly by courtesy of members of the sergeants mess who seemed to catch most of them by means associated with "tickling" although some seniors were seen in the Creek carrying trident forks and looking like rather damp versions of Britannia. The soldiers mess was not devoid of salmon which appeared on the menu as frequently as commoner fish does in the UK and almost in as large a quantity as the peanut butter which was ration scaled to the extent that almost required a separate ration truck to deliver the issue. Canadians are apparently rather fond of peanut butter!

The remaining major task, and the one which from the beginning was seen to represent a problem, was the road. The road specification called for a 20 feet carriageway with 2 feet shoulders either side and V ditches where necessary. Throughout most of its length it was formed by side cutting into the mountain slope which was the easterly shore of Lake Chilliwack. About half the cut ran through low quality granite, part of the remainder through glacial deposits whilst the last half mile to be built up over low lying silt deposits which for much of the exercise period were flooded by up to four feet of water.

Much of the rock blasting had been carried out prior to the Squadrons arrival,

by Canadian Sappers. The results were spectacular with, in places, the inside edge of the road lying against sheer rock faces of up to 60 feet in height. Blasting continued through July and Squadron teams operating the equipment and using ring mains which, on occasion, linked up to 2,000 lbs of Amex explosive. The local rock fissure lines were unfortunately parallel with the side of the hill so that frequently half the mountain side seemed to slide outwards after a blow, leaving rocks of up to 50 tons to be pushed over the edge of the road into the lake below after further blows designed to reduce their size. All this was exciting and interesting work for the men involved including the plant operators. The tractors employed on this work, normally D7's or TD20's, went through a gruelling time: Constant digging into large piles of blown rock, digging to loosen individual pieces and the very effort of traction over the cruel surface caused extremely heavy blade and track wear in particular, whilst the machines themselves frequently seemed on the verge of shaking to pieces. Interesting also was the great superiority of hydraulic over cable operated blades which could do little with the piles of rock. Even a cable operated D8H was a poor second to a hydraulically operated D7 or TD20.

Rock blasting did not finish until early September, more or less coincident with the completion of the cuts through the glacial deposits. Cut and fill calculations were rather difficult because of the unknown final profile caused by rock slip and also because of the vast quantity of fill which was lost into the apparently bottomless lake before any width of road was gained by fill. Nevertheless the final longitudinal profile more or less matched the design profile with, if anything, extra fill being obtained by cutting back further than was strictly necessary into glacial deposits so that in places the mountain road seemed to have the width of a motorway.

Whilst work was going ahead on the side hill cut it also had to proceed on the construction of the final half mile of road over the silt deposits which lead to the Chilliwack Creek bridge. As already described work on this bridge had proceeded during July on the basis of supply by Cl 30 ferry over the lake, access by land not being possible until the roadhead reached it. Construction traffic intended for this section of the road therefore had to make its way through teams working on the side hill cut. Tipper turn around times were slow because of this with resort often having to be made to movement by convoy under radio control. Tipper wear was also very heavy, caused by the need for the vehicles to grind their way forward under heavy load over the rough surface of the cut formation. Tipper maintenance was the biggest single problem during the exercise: The Squadron was initially issued with 13 tippers; by the end of the exercise it had used up to 30 tippers but was seldom successful in operating more than 10 at any one time, the remainder being somewhere in the repair and maintenance cycle. It is however fair to point out that for the last three weeks of the exercise tippers operated a 24 hour day with drivers operating shifts. The tippers therefore gave good value for money but the lessons inherent in the difficulties of operating a working tipper fleet were well learnt by the Squadron.

The final half mile of road reached the Chilliwack bridge at the end of July, happily coincident with the completion of piling and the consequent need for a land based supply chain for road bearers etc. Throughout August a small team of tippers and plant continued to widen and raise the road so that the formation was ready by early September. The Canadian Parks Department had required that the road was constructed on a raft of timbers, not because of any constructional requirement but because the Department required to rid the park area around the road of large numbers of tree trunks which littered the site. These trunks had been blown to this end of the lake over tens of years by the prevailing north wind. The sandy shores of the lake were piled with trunks of up to 6 or 8 feet in diameter, shorn of their branches and bark by wind and water and polished so that they looked rather like grounded whales. These, and their smaller brethren were whenever possible hauled into the intended line of road and then covered over with rocky glacial fill. In the watery conditions prevailing at the time the tractors doing the hauling were often themselves wallowing like whales in the water and mud which formed the subgrade of the road.

The whole operation was very questionable as an engineering exercise but the Parks Department as clients were adamant in their request and at least did seem well pleased with the final result.

By the end of August/early September the road formation was complete from start to finish. The weather had throughout this period provided sweltering sunshine which was a pleasant change from the wet and cold experienced by the advance party. Unfortunately it was so hot that the forest fire hazard grew to disruptive proportions: British Columbia lives by its timber and jealously protects it from the depredations caused by fire which in turn can be caused by either human or natural forces. As the hot rainless weather persisted into August the forests became more and more like tinder boxes and any spark from cigarette or exhaust pipe and certainly any lightning strike, would cause a fire. Despite precautions approximately 50 forest fires were burning throughout the Province at one time during August, the biggest of which consumed 500,000 acres of prime timber. By way of historical digression it is claimed that the smoke from extensive forest fires burning in British Columbia in the seventeenth century could be seen over China. A final precaution taken if necessary by the provincial government was to close down all forestry operations and evacuate everyone from the forest. This did not actually happen during the exercise period but the next worst eventuality did, which was a limitation on work and vehicle and plant movement to a period which prevented work between 1 pm and 7 pm. Thus at a busy exercise period little work could be done during daylight and for a period of three weeks the Squadron operated on night shifts, a system also operated by the local lumber company which was however forced to stop work completely for a short while. Work output was cut but not dramatically. This period also saw a field troop attached to 3 Canadian Field Squadron whilst it was fighting a forest fire; the hard and exhausting work was enjoyed as a novel experience.

By the end of August surfacing of the road could commence. Surfacing material was limited to what could be obtained locally. Supplies of rock were limitless but no rock crusher was available. The alternatives were either river gravel or glacial material of a gravelly nature which was found in pockets throughout the area. This latter material was used with up to three quarries being operated at any one time. Unfortunately the gravel was mixed with rocks of up to 9 inches diameter which required much hard work to clear, and the only rollers available were one sheeps foot and one towed wobbly wheel which was very late in arriving. Notwithstanding these shortcomings the material went down well and although it seemed rather soft immediately after compaction it weathered naturally into a compact and hard surface as was evidenced by the lumber roads which, as a matter of policy, were surfaced with the same material one year before they were required for use, thereafter requiring little maintenance other than grading, the rolling being done by the lumber vehicles themselves.

The road had to be surfaced in approximately 2½ weeks to meet the deadline of 17 September. During this time 8 culverts were being dug into the road, quarries continuously ran out requiring new ones to be opened including the removal of overburdening trees and soil, the weather became inclement with rain always threatening and often falling and finally, the biggest problem of all, the tipper fleet continued to vary in strength between catastrophic and just adequate. Tippers and plant worked around the clock with operators working shifts and *ad hoc* teams removing water and mud from the road with buckets and shovels ahead of the surfacing team. The final loads of surfacing were placed and rolled on the morning of the opening ceremony on 17 September. This example of perfect planning was accompanied by much nail biting, general cliff hanging and a bit of luck and is not recommended as a general aim.

Opening Ceremony does not fully describe the events of the day: There were four opening ceremonies; Lieut-Colonel Hooper, Commanding Officer of 36 Engineer Regiment, 50 Field Squadron's parent Regiment, opened the Depot Creek Bridge, called Invicta Bridge. Colonel Black of the Canadian Military Engineers opened the

road. The Engineer in Chief, Major General Caldwell opened the Chilliwack Creek bridge, called Victoria Bridge, the opening ceremony concluding with a snake conga of sappers over the bridge head by General Caldwell and to the tune of *Hurrah for the CRE.* Finally Sapper Park itself was dedicated and declared open by the Lieutenant Governor of British Columbia, the Honourable J. R. Nicholson. A joint parade of Sappers from 50 Field Squadron and 3 Squadron Royal Canadian Engineers was held, after which everyone feasted on a salmon barbecue, prepared on the shores of the lake, to the accompaniment of a fireworks display. The constructional aspects of the exercise were successfully concluded. Also completed by this time was the reconstruction of the grave of a Sapper who had died in 1861 whilst engaged on road construction and whose grave had been preserved since then by local people, and the construction of a cairn near the town of Chilliwack to commemorate the setting up there of a Royal Engineer Survey Base Camp in 1859. Both of these tasks had been undertaken at the request of the Chilliwack Historical Society. The period since the arrival of the main body was not entirely devoted to work. At the end of August a second four day break was taken with another coach party making a repeat of the 1,000 mile trip carried out by the advance party. A large element spent four days in military accommodation in Vancouver sampling the delights of a city which although architecturally immature has a magnificent setting of mountains, rivers and golden beaches. The Canadian girls were also quite attractive. Sport took its fair share of time with soccer and rugby providing most entertainment. Rugby is a sport which is attracting increasing interest in Canada and the Officer Cadet School at CFB Chilliwack sported a team and challenged the Squadron to a match. A count of heads revealed enough talent, to stretch a word slightly, to form a team from within the Squadron and the match was duly played, being won on a single point margin by the School. Honour however was restored when the two deciding replays went convincingly the way of the Squadron; presumably tradition and experience was telling over the enthusiastic novice. Three games of soccer were played against the local open prison, whose inmates, 40 per cent of whom were Indians, were conventionally employed as forest labour and lead a sheltered and lonely life. All three games were rather easily won but the enthusiasm and friendliness of the inmates, delighted by the contact with the outside world, was rather touching, their general behaviour during the Squadron's visits seemed impeccable and their sportsmanship on the field was particularly impressive, unlike matches they hold against other open prisons which apparently often end up as brawls. The inmates were invited, amongst other groups, to tour the project area. After their visit several expressed a desire to enlist in the sappers. Dissuading them presented a slight problem, but none were enlisted.

Many of the Squadron made individual friends in the area and many female hearts were broken when the Squadron finally departed. Many clubs opened their doors to all ranks and the plethora of invitations to the whole Squadron to attend dances, barbecues and the like was almost embarrassing. CFB Chilliwack had instituted a "Sapper for Supper" programme inviting the people of Chilliwack to have Sappers to their homes for a day or evening; almost every man in the Squadron received and took up at least one such invitation which speaks well for the hospitality of the local people. This hospitality was repaid at the end of the exercise when the Squadron held a number of parties and dances which were eminently successful.

The Squadron returned to UK between 21 and 30 September after a hectic time clearing up and handing back tent city and all the equipment borrowed from the Canadians. The exercise had meant hard work, but work of a fascinating and worthwhile nature in the most beautiful of surroundings and within reach of an affluent society and metropolis. The construction aspects were regarded as entirely successful whilst every man in the Squadron had gained in work and personal experience. This comment applies also to all those who joined the Squadron from without, including those from 20 Field Squadron and 36 Engineer Regiment Workshops, Clerk of Works representation from 62 CRE and others from the RCT, RAMC and last but

not least, 104 PCCU Royal Engineers. Their work was valued and they share in the achievement of a successful exercise.

Exercise Waterleap 71 was conceived at CFB Chilliwack and was supported and sustained by the base throughout. It is fitting to end this narrative first by recording the very large effort put into Sapper Park before the arrival of 50 Field Squadron by Canadian Sappers but not fully recorded here, and second to pay tribute to the support given to 50 Field Squadron by CFB Chilliwack: From the initial reception to the final farewell the base and all its staff who had anything to do with the British Squadron displayed an extreme degree of enthusiasm and co-operation. No requirement which could possibly be met from CFB resources was left wanting and the degree of initiative and interest shown by those involved in the project was a great encouragement to the Squadron. At times, under the stress of completion target dates and requests made by the Squadron must have seemed excessive. It is to the great credit of the Base that patience was never lost. This article therefore ends with a final thank you to all those at CFB Chilliwack who assisted the Squadron through a successful and thoroughly enjoyable Exercise Waterleap 1971.

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A Critical Path to Combat Readiness

MAJOR R. D. GARNETT, RE

INTRODUCTION

LIKE everyone else in BAOR we found ourselves faced with the threat of a combat readiness exercise. For the uninitiated this is an exercise which requires us to be mustered, loaded for war and ready to leave barracks within two hours of alert. We then drive out to various assembly areas and prepare to be checked for combat readiness before returning home.

One important rule, however, is that we are warned when we are vulnerable for a combat readiness exercise. This allows us to take certain necessary precautions.

A natural hazard we had to take into account when planning for the exercise is that the alarm can come at any time day or night. Another is that we have to collect soldiers from three general areas of married quarters and a scattering of private flats after working hours. The biggest problem, however, lies in the fact that our tanks and their petrol stocks are separated from the rest of the unit by some miles. This means that we have to muster and load at two distinct and separate points.

THE PROBLEM

The problem, since we had recently arrived in the garrison, was to produce a suitable plan and orders for this exercise. To try Critical Path Planning methods seemed a useful approach. This article describes how we went about the problem. It also discusses what practical problems and advantages arose from using this method.

THE ACTIVITY LIST

The first task was to produce a list of activities which had to be carried out. From previous experience with paper exercises it was known that over fifty activities would lead to a lot of trouble. Another difficulty was to distinguish what was an activity and what was an event.

To determine what required time and resources to achieve and what was the end result requires a very close analysis. In the end we produced a definition based on time. Less than 5 minutes and an activity becomes an event. Attached at Annex A is the list of activities which was eventually produced. A close look at this will show something of the problem.

ANNEX A

Activity No	*Activity*	*Estimate Duration*	*Actual Duration*
0–1	Receipt of alarm	5	
0–3	REME report to TANK BKS	70	
1–2	Change to Z time	2	
2–3	Alert soldiers in barracks and guard at TANK BKS	10	
3–4	Dressing of soldiers in barracks	20	
3–5	Man Armoury	10	
3–6	Mov vehs to MARRIED QUARTERS "B" & "D"	15	
4–7	Draw pers wpns from armoury	15	
4–8	Draw crew wpns from armoury	10	
5–4	Dummy	0	
6–23	Alert sldrs in "B" & "D"	20	
7–9	Mov of vehs to collect sldrs from qtrs	10	
7–10	Reporting of vehs to load rats + G1098	5	
7–11	Reporting of CVs + Office veh	5	
7–12	Reporting of ammo vehs	5	

Activity No	*Activity*	*Estimate Duration*	*Actual Duration*
7–13	Mov of POL vehs to TANK BKS	15	
7–14	Reporting of vehs to take pers to TANK BKS	5	
8–14	Reporting of tk tp pers alerted & collect Sigs Info	5	
9–15	Alerting of soldiers in qtrs	10	
10–25	Loading of HQ G1098 + rats	30	
11–25	Loading of CVs + Office veh	15	
12–26	Mov of Ammo vehs to dump	15	
13–21	Loading of POL vehs	30	
14–29	Mov of pers from "R" BKS to the TANK BKS	15	
15–16	Dressing of sldrs in qtrs	20	
16–17	Mov of sldrs in qtrs to bks	20	
17–18	Reporting pers state by HQ & MT	5	
17–19	Load weapons to be drawn in Harbour Area	10	
17–20	Mov of Har Party	20	
17–21	Reporting of pers state at TANK BKS	5	
18–22	Report ready to move at "R" BKS	5	
19–18	Dummy	0	
20–38	Dummy	0	
21–36	Report ready to move at TANK BKS	5	
22–29	Mov of HQ & MT to Har areas	20	
23–24	Dressing of soldiers at "B" & "D"	20	
24–17	Mov "B" & "D" to bks	25	
25–17	Line up of HQ & MT	10	
26–27	Load ammo vehs	30	
27–38	Dummy	0	
29–30	Reporting of A veh state	5	
29–31	Tk tps load G1098	15	
29–13	Reporting of POL loading pty	5	
30–32	Decision on vehs to be worked on	5	
31–21	Line up of vehs at TANK BKS	15	
32–33	Work by REME on A vehs	40	
33–21	Dummy	0	
33–35	Dummy	0	
35–37	Report by REME ready to move	5	
36–40	Mov of TANK BKS pkt to Har area	60	
37–41	Mov of REME to Har area	60	
38–39	Setting out Har area	20	
39–40	Dummy	0	
39–41	Dummy	0	
40–43	HQ & MT Harbour up	15	
41–44	TANK BKS group Harbour up	15	
42–44	REME Harbour up	15	
43–44	Dummy	0	
43–45	Prepare warm drink	15	
44–46	Practice alarm positions	15	
45–47	Issue warm drink	10	
46–47	Report readiness	5	
47–48	Issue orders for return	15	

The final list of activities was eventually compiled from a number of sources. The Bde Operation Order set out the results which had to be achieved and the general rules of the game. A conference of the unit "middle management" produced a lot of expertise and highlighted the likely areas of difficulty. Most useful was a copy of an activity list and logic diagram for the complete mobilization of a German army

artillery unit. This last source gave a few minor points only. Its main value lay in the guidance it gave on the distinction between activity and event.

Another source of activities arose from the "refining" of the original plan. This is the term used for the process of splitting out a section of the original plan and considering the logic in more detail. In such a way one hopes to save time by complication of the final plan.

Producing the activity list was very time consuming. In total about 20 hours were spent on this stage. Part can be ascribed to inexperience and part perhaps to day dreaming. Unless you already have an excellent plan, its not a job to be knocked off in a couple of hours.

THE LOGIC NETWORK

Compared with the activity list the logic diagram went together very quickly. The problem was learning to draw it out clearly on paper. The RSME Chatham produce an excellent hand-book on Critical Path Planning. One of the best sections describes how to sit down with pencil and paper and tackle this practical problem.

The first draft looked like the proverbial drunken spider with arrows wandering all over the paper. After about four attempts the network started to look like a logical sequence of events. The trick seems to be to put the longest sequence of events on the bottom of the paper. The next longest goes along the top edge, and the remaining sequences fit in between.

ACTIVITY DURATION

The original logic diagram took no account of timings or resources. The next step was to give each activity an estimated timing based on a common sense allocation of the available resources. Where such timings were uncertain we carried out trials. Drawing weapons from the armoury was a case in point.

Having done this we applied the timings to the logic diagram. After the usual process of working out the Earliest Event Time, Latest Event Time and Float we were able to work out the Critical Path. Needless to say we were over the two hour limit.

Two particular areas appeared critical at this stage. The first involved the loading of reserve POL. We solved this by keeping part of our stocks permanently on wheels. The second involved calling in families from two of the married quarters areas. We solved this by having vehicles on standby with their drivers at the tank barracks out of working hours. This is much closer to the married quarters areas concerned and was an acceptable load during vulnerability periods.

This process of "refining" got us inside the critical times. It also made us look hard at the resources available. In particular we had to be very clear about priorities for loading transport.

PRODUCING THE OPERATION ORDER

A final list of activities with estimated durations was produced along with the final logic diagram. These formed the "General Outline" of the Operation Order and are attached at Annexes A and B. The remainder of the Order gave the detailed instructions necessary to carry out the plan, to provide flexible command and communications, and to produce the necessary administrative support. The production of the Operation Order was easily the simplest and quickest part of the whole project.

THE PLAN IN PRACTICE

A unit practice was held but, due to snow and ice on the roads, finished when ready to move. When the genuine Exercise Alert took place it was during working hours. The fact that HQ and MT Tps were miles away on the ranges added to the excitement.

In both tests the plan appeared to work very well. Two particular advantages seemed to arise from using Critical Path Planning methods. The first was that because

A Critical Path to Combat Readiness

MAJOR R. D. GARNETT, RE

INTRODUCTION

LIKE everyone else in BAOR we found ourselves faced with the threat of a combat readiness exercise. For the uninitiated this is an exercise which requires us to be mustered, loaded for war and ready to leave barracks within two hours of alert. We then drive out to various assembly areas and prepare to be checked for combat readiness before returning home.

One important rule, however, is that we are warned when we are vulnerable for a combat readiness exercise. This allows us to take certain necessary precautions.

A natural hazard we had to take into account when planning for the exercise is that the alarm can come at any time day or night. Another is that we have to collect soldiers from three general areas of married quarters and a scattering of private flats after working hours. The biggest problem, however, lies in the fact that our tanks and their petrol stocks are separated from the rest of the unit by some miles. This means that we have to muster and load at two distinct and separate points.

THE PROBLEM

The problem, since we had recently arrived in the garrison, was to produce a suitable plan and orders for this exercise. To try Critical Path Planning methods seemed a useful approach. This article describes how we went about the problem. It also discusses what practical problems and advantages arose from using this method.

THE ACTIVITY LIST

The first task was to produce a list of activities which had to be carried out. From previous experience with paper exercises it was known that over fifty activities would lead to a lot of trouble. Another difficulty was to distinguish what was an activity and what was an event.

To determine what required time and resources to achieve and what was the end result requires a very close analysis. In the end we produced a definition based on time. Less than 5 minutes and an activity becomes an event. Attached at Annex A is the list of activities which was eventually produced. A close look at this will show something of the problem.

ANNEX A

Activity No	*Activity*	*Estimate Duration*	*Actual Duration*
0–1	Receipt of alarm	5	
0–3	REME report to TANK BKS	70	
1–2	Change to Z time	2	
2–3	Alert soldiers in barracks and guard at TANK BKS	10	
3–4	Dressing of soldiers in barracks	20	
3–5	Man Armoury	10	
3–6	Mov vehs to MARRIED QUARTERS "B" & "D"	15	
4–7	Draw pers wpns from armoury	15	
4–8	Draw crew wpns from armoury	10	
5–4	Dummy	0	
6–23	Alert sldrs in "B" & "D"	20	
7–9	Mov of vehs to collect sldrs from qtrs	10	
7–10	Reporting of vehs to load rats + G1098	5	
7–11	Reporting of CVs + Office veh	5	
7–12	Reporting of ammo vehs	5	

not least, 104 PCCU Royal Engineers. Their work was valued and they share in the achievement of a successful exercise.

Exercise Waterleap 71 was conceived at CFB Chilliwack and was supported and sustained by the base throughout. It is fitting to end this narrative first by recording the very large effort put into Sapper Park before the arrival of 50 Field Squadron by Canadian Sappers but not fully recorded here, and second to pay tribute to the support given to 50 Field Squadron by CFB Chilliwack: From the initial reception to the final farewell the base and all its staff who had anything to do with the British Squadron displayed an extreme degree of enthusiasm and co-operation. No requirement which could possibly be met from CFB resources was left wanting and the degree of initiative and interest shown by those involved in the project was a great encouragement to the Squadron. At times, under the stress of completion target dates and requests made by the Squadron must have seemed excessive. It is to the great credit of the Base that patience was never lost. This article therefore ends with a final thank you to all those at CFB Chilliwack who assisted the Squadron through a successful and thoroughly enjoyable Exercise Waterleap 1971.

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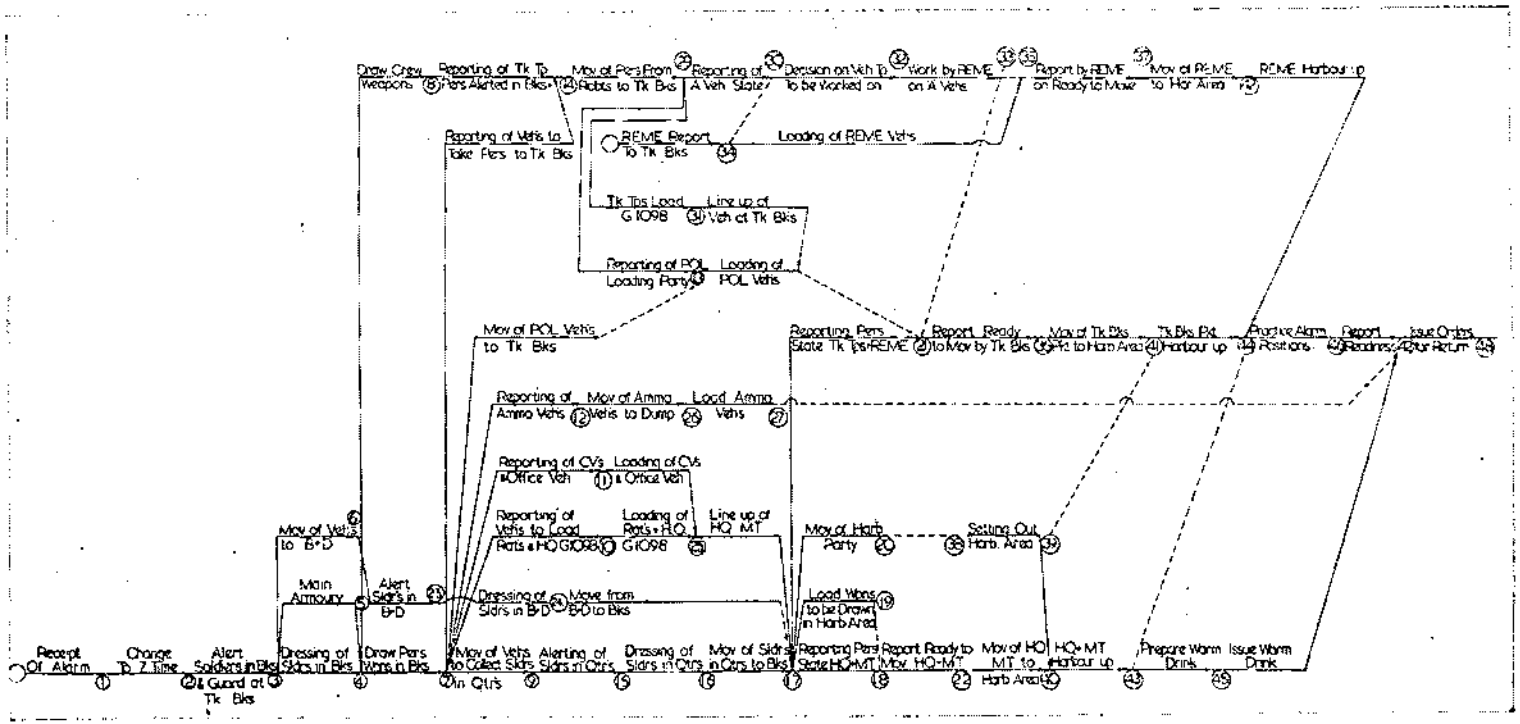
Annex B


Receipt Of Alarm
Change To 2 Time
Alert Soldiers in Bks & Guard at Tk Bks
Dressing of Sldrs in Bks
Draw Pers Wpns in Bks
Main Armoury
Alert Sldrs in B+D
Mov of Vehs to B+D
Draw Crew Weapons
Reporting of Tk To Pers Alerted in Bks
Mov of Pers From Bdes to Tk Bks
Reporting of A Veh State
Decision on Veh To be Worked on
Work by REME on A Veh
Report by REME on Ready to Move
Mov of REME to Har Area
REME Harbour up
Reporting of Vehs to Take Pers to Tk Bks
REME Report To Tk Bks
Loading of REME Vehs
Tk Tps Load G1098
Line up of Veh at Tk Bks
Reporting of POL Loading Party
Loading of POL Vehs
Mov of POL Vehs to Tk Bks
Reporting of Ammo Vehs
Mov of Ammo Vehs to Dump
Load Ammo Vehs
Reporting of CVs in Office Veh
Loading of CVs in Office Veh
Reporting of Vehs to Load Parts + HQ G1098
Loading of Parts + HQ G1098
Line up at HQ MT
Dressing of Sldrs in B+D
Move from B+D to Bks
Mov of Vehs to Collect Sldrs in Qtrs
Alerting of Sldrs in Qtrs
Dressing of Sldrs in Qtrs
Mov of Sldrs in Qtrs to Bks
Reporting Pers State HQ MT
Mov HQ MT
Mov of HQ MT to Harb Area
HQ MT Harbour up
Mov of Harb Party
Setting Out Harb Area
Load Wpns to be Drawn in Harb Area
Reporting Pers State Tk Tps+REME
Report Ready to Mov by Tk Bks
Mov of Tk Bks Pt to Harb Area
Tk Bks Pt Harbour up
Prepare Warm Drink
Issue Warm Drink
Receive Alarm + Restore Readiness
Report Our Return
Issue Orders
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the plan could be visually displayed, the unit "middle management" knew their own particular sequence of events and the critical points where problems might arise. The second advantage was that all members of the unit knew the estimated time to complete each activity. This not only gave a suitable sense of urgency, but also stopped some aimless rushing about.

FINAL THOUGHTS

Well its all over for a while now. Was all the effort worth it?

One of the original aims in using this method was to gain a high degree of control over the many activities. In the event we produced a drill. The only decision which could be made during such a short project would concern major disasters. A revised sequence of events or a major change in resources could only be published after the exercise. Of course we had to produce a new plan in any case and this was an interesting method to try. It probably took no longer to produce than a normal plan. However we did have a fair confidence that the plan was thoroughly worked out.

Hopefully this article and the two Annexes will help anyone trying to produce a similar plan.

Vision or Nightmare—RE Training—AD 2000

"SAM"

IT was a cold, wet Friday in March 1971 and I was visiting the RSME to discuss some vitally important training problem. After the meeting was over we all went over to the Brompton Mess for lunch. Over drinks at the bar we were considering the question of the high rate of wastage which occurred in the first three months of a recruit's training.

"Who can blame a youngster," I said, "asking for his discharge within the first three months. He joins the Modern Army of the advertisements with the idea of getting a trade and what happens to him? He goes to the Recruit Selection Centre where he spends most of three days doing nothing and has his hair cropped. He then goes to COVE where his modern army appears to him as a collection of depressing old huts. He suddenly realizes that he is going to spend four months on military training and field works and then if he is lucky he starts his trade training. To a recruit it seems as if he must wait for ever. They should be here at Chatham and integrate their Trade Training with their Field Engineer training".

I was howled down. "It isn't possible to integrate trades training with Field Engineering." "We couldn't accommodate the numbers at Chatham". "It can't be done. You fellows at the Ministry have wonderful theories." "What do we do with Minley, the Hawley rebuild and all that, you're not practical." I was not convinced and as I went in to lunch I was reflecting on the present unsatisfactory situation. The problems which loomed up were:

a. The lack of co-ordination of training between Junior Leaders, Army Apprentices and the adult recruits.

b. The dispersion of our training establishments.

c. The split responsibility of the Engineer in Chief between Deployment, Manning and Training.

d. The pathological dislike of the Royal Engineers to produce a comprehensive plan for training the Corps and be prepared to work right through it.

e. The problems of time and space within Training Units, time wasted, distances travelled.

f. The inability to allow recruits to learn at their own speed—an individual programme for each man—the use of new methods of teaching, learning machines.

Lunch ended and I was still musing over these things when I sat down in the Ante-Room and looked up at Glubb Pasha's picture.

"You wouldn't stand for that sort of thing," I murmured sleepily. "You knew what you wanted and made sure everyone toed the party line." . . .

I found myself walking into the entrance of Brompton barracks with the Brigade Major. There were men all over the square drilling and carrying on weapon training; there was a bustle of activity everywhere; a party of soldiers marched down to the trades training block and a Hovercraft sat on the car park ready to take a party across to Chattenden on its half hourly return trip.

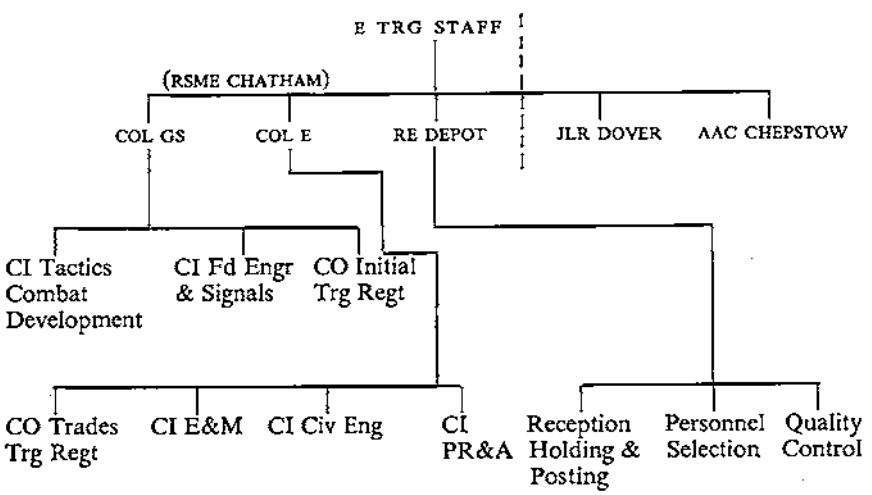
I asked the BM what was going on and he began to explain it all to me.

"You see it all began when they realized that the E in C could not carry out his job of visiting all the Units of the Corps, making training policy, dealing with the directors of the MOD on manning, education, deployment and operations and cover his responsbility for domestic corps policy.

"So it was decided to have a Major General responsible for RE Training and put him at Chatham in command of the RSME and the other units of the old Training Brigade RE. Come on in to my office and I will show you how it is organized now."

I went into his office and realized from the Calendar that it was the year 2000; what a long time it had taken to streamline the training organization. He showed me a chart which was like this:

MAJOR-GENERAL RE TRAINING
BGS RE



"You see," said the BM, "the E in C found that he was expected to deal with all the Directors at the Ministry of Defence and to determine the manning policy, the deployment and employment of engineer units. He had to worry about education as it affected trades training and he was expected to know about Combat Development, Weapons policy and EOD. During all this time he was lucky if he could get a week each month in his office between visits to units around the world.

"So it was decided that he should remain responsible for Manning, deployment and employment of units, inspection of units world wide and the domestic policy and recruiting of the RE. To give training its right impetus and to ensure that wastage of recruits and trained sappers was drastically reduced, it was decided to make the Commandant RSME a Major General RE Training answerable to the

Director of Army Training not to the E in C, and to concentrate all adult sapper training at Chatham, leaving the Junior Leaders' and Apprentices at Dover and Chepstow but under the MGRE Training's command. By doing this the whole of the important aspects affecting training eg,

a. Combat Development and Tactics
b. Weapons and Eqpt Trials and Development
c. Trades Training and Combat Engineer Training
d. Education and Training Technology

could be co-ordinated with continuity. Doctrine could be developed and made mandatory for sapper units world wide.

"The proposal to reorganize had an electric effect. We had only taken over the new Training Brigade Barracks at Hawley in1975 and had settled ourselves comfortably in there and were hoping that the air of new efficiency would impress recruits and reduce the wastage. However, results were disappointing largely because of our inability to achieve a flexible programme to allow recruits to progress at their own speed and because they still felt that they had to wait a long time before they started to train for the trade which they had joined the Sappers to learn. The troubles in Ireland had ended and there was no operation other than floods and disasters and a contribution to various UN forces dotted around the world, so recruiting was slow and wastage climbed to over 25 per cent.

"There was a need to have a very hard look at our training methods. A committee was set up with wide terms of reference charged with cutting recruit wastage and improving the quality of output without an increase in training time. After months of conferring the committee decided that the first step was to centralize all adult recruit and trade training in the Chatham area. It then examined the implications and benefits that followed this decision.

"Many people said that the Sappers had been in Aldershot since the last century and it was unthinkable not to be there. Others said that they could not cope with the large numbers at Chatham. Of course when it was examined in detail we found that we had all the training staff and organization that was required for running the courses at Chatham. There was a need to build extra accommodation and a few basic classrooms, but the space was available to do it, and the savings in administrative staff was worth a regiment of sappers".

What became of Hawley? well the Parachute Regiment moved in there so fast we hardly had time to get out without getting our fingers caught in the door.

There had been much talk of the impossible division by the Medway of Chatham from Chattenden, but by then they had developed a good air cushion load carrier which superseded the clumsy and vulnerable MI bridge. It was quite easy to arrange a route from Chattenden to Upnor, across the river, up the slipway and by an elevated ramp straight into Brompton Barracks. We did it ourselves, it was excellent training in the use of pre-stressed concrete over long spans.

Of course it all took some years to get going and in the meanwhile we had time to study the training of recruits more carefully.

We made sure that when a party formed up its staff remained with it all the time it was at Chatham, up to the end of its basic and field engineer training. There was a normal training time calculated for men to go through this, but if they could complete the programme quicker they were allowed to do so; we were able to do this by using teaching machines so that men could practise whenever they had spare time and they could take their tests at weekly intervals. The subjects were taught by a circus of instructors so that a man could join any course at any stage. Someone was always teaching or supervising each subject from week 1. So instead of taking eighteen weeks to become a Combat Engineer III some of the men were qualifying in ten to twelve weeks, and this provided such an incentive that 50 per cent were beating the norm.

At that time a number of people thought that training men to Combat Engineer II

direct was an excellent idea, but we soon realized that owing to poor selection a large proportion failed to make the grade and many of those that did, really wanted to become Class II tradesmen. So we limited the number of people becoming Combat Engineer II in recruit training to those above average recruits who were not anxious to take Trade Training to Class II initially.

We then considered how we could integrate trades training in the early stages of a recruit's life and we came up with the idea of introducing him to basic trades training during his basic military training and continuing it throughout his Combat Engineering Training based on a three week module of work. By doing this we found that we could turn out a Combat Engineer III and a Class III tradesman in the less sophisticated trades in twenty-six weeks. It also allowed much greater flexibility of programming and full utilization of workshops.

Now all this takes a lot of thought and control of each recruit from the moment he comes into Brompton, but we looked at the practice in many of the more forward looking educational establishments. We found that with more students studying a wider range of subjects they could produce an individual course for each student so we decided to do the same for our recruits.

We decided that the RE Depot should be responsible for receiving recruits and kitting them out. The Depot ensures that each man has a programme prepared and reviewed from time to time in accordance with his ability. They document him, select him for trade training and eventually post him, in accordance with the needs of RE Records. They have the Personnel Selection staff on their establishment for this purpose.

Quality Control has been developed to the extent that a recruit has a two weekly report on how he is doing and he himself can measure how close he is coming to his planned progress. This also provides a digest of information for RE Records and the Recruiting Organization so that they know what trades they should offer to potential recruits and are able to adjust the number of tradesmen to meet the requirements of the Corps monthly. Quality Control also monitors the trade and educational testing of all parts of the training machine, not only at Chatham but also through information cells at Dover and Chepstow. This ensures that a common standard is maintained throughout the Corps.

The Initial Training Regiment receives recruits after they have been documented and kitted and are entirely responsible for their basic military training and for holding the recruits and administering party staffs whilst they do basic trades training and combat engineering training.

The Trades Training Regiment holds and administer all men coming for upgrading training to Class II and I and also the permanent staff of the Trades Training Wing. The documents of everyone in the organization are held by the RE Depot and never leave there until a man is posted out of Chatham. This has taken most of the administrative overheads away from the Training Regiments.

We had always had problems in providing enough Signallers. For some time it had become increasingly obvious that every sapper had to be a basic signaller if he was going to be able to be posted to any field force unit. The problem was to find the time to give a sapper yet another skill. It was found that provided a man was introduced to the subject early in his training he could be given confidence in the use of radio by incorporating voice procedure into his daily Combat Engineer Training. We were then left only with a comparatively small number of RE Signallers to train to be the experts, starting at Class II. So now we expect every sapper to have the ability to use a radio by the time he has qualified as a Combat Engineer Class III.

You will want to know how this was achieved; were our predecessors of 1970 not getting as much training done as we do now? The answer to this is that we were working on a completely different concept; one that had hung on since the 1939–45 War. There was a tendency to tinker with training ideas without anybody undertaking a survey of the whole problem. This resulted in a froth of ideas and total stagnation of action. Too many people had ideas with no real knowledge. Grouping all the RE

training under a single head enabled the problem to be studied in depth and allowed a radical solution to be introduced with some degree of consistency and planning.

We ruthlessly cut out all the non-essentials of the training programmes. We found that the recruits were over-worked, at times bored to tears and overwhelmed by the serious business of becoming a sapper which was far more serious, longer, and more difficult than for any of the other combatant arms. So we introduced training by incentive; at every stage a man could qualify for extra cash benefits ie, when he passed off the square and became a Class I shot, as he completed his various stages of field works and trades training. By starting trade training at the same time as combat engineer training and above all by arranging programmes so that a man could get on faster if he worked hard, we found that the whole quality of recruit and trade training changed. At the same time if a recruit at the end of twelve weeks had no enthusiasm the CO of the Training Regiment was authorized to return him to civilian life or let him transfer to another arm if he so wished and they were prepared to take him. The result of this is that our wastage has dropped to 5 per cent, all in the first twelve weeks of recruit training.

With the reorganization of the Command Structure administrative powers were delegated to lower levels and a CO had very considerable autonomy. We ensured that one of the best officers of his year commanded each of the Training Regiments. They had good officers and WOs under their command because every officer and Senior NCO had to do a tour in the training machine. Normally he would not be brought back to do another tour later. This ensured that the COs and Squadron Commanders came to their command with a very clear idea of what was required of sappers in units world wide. At the same time it ensured that all officers were aware of the training regiments' requirements; they had a much greater understanding when it came to releasing junior NCOs for a tour at Chatham. If any junior officer failed to make the high standard of the Training Organization he was unlikely to get very far in his career and would find it difficult to get command of a field squadron. This concentrated the minds of the young officers in charge of training parties in a wonderful way. It also gave them a chance to prepare for promotion exams in an atmosphere conducive to study.

All this produced a very different outlook in the training organization. It gave recruits the feeling, from their arrival into the Corps to the day they went to their Field Squadron that they were a product of an interesting, lively organization. Field Squadrons benefited too because they were getting men whom they could expect to keep for at least two years before they went off to Higher Trades Training courses and the best ones, who were already Class II tradesmen, for much longer. Most important of all Chatham truly became the centre of the Sapper world where a recruit could see all the options open to him and get a sense of belonging to a single close knit Corps.

I have not touched on the training of Juniors. This too received an impetus from having MGRE Training in command. Their methods and trades training quickly conformed to the same modules as the adults. It was possible for boys from both Chepstow and Dover to qualify as Combat Engineer III and Tradesmen Class II if they were good enough. The best are given a Cadre course plus a Combat Engineer Class II course on arrival at Chatham, with the proviso that they can only qualify as Class II if they pass the Cadre course. They then gain a stripe and go to their field squadron with it and retain it. This gives the really good junior the incentive he needs to get ahead. The standard of this course has been made very high so that only the best are able to succeed.

Trade training in all trades has been aligned with the City and Guilds so that every time a soldier passes an Army Trade Test he qualifies at the same time for a civilian trade certificate. Our standard of tradesmen rose considerably despite the fact that they got little practise with field squadrons, because we undertook to carry out major engineer projects for Government Departments from which contractors were excluded. We did not put field squadrons on to this sort of work; that was grossly

uneconomical with their unsuitable transport, organization and equipment, and we stopped that sort of thing in the late seventies.

A separate Works Group was formed—administered from HQ Resources at Woolwich, with officers as consulting engineers, and site engineers and with military clerks of works and NCOs as foremen of trades. Military tradesmen were used so that their skills were fully employed using the normal range of civil plant and machinery. We built up a great deal of civil engineering skill and experience and at the same time we retained all the attributes of military engineering in the Corps. Our works group has become so well known that it frequently carries out projects for Commonwealth countries as well as in UK. Woolwich has become the centre of civil engineering planning, plant and execution. The roads and airfields group at Waterbeach was retained under the command of the Commander RE Resources.

As a result of all this we find that a great many men leave the Service at the end of nine and twelve years because they are much in demand in civilian life. We are delighted by this as it enables us to improve men's chances of promotion. We still retain those who want to remain soldiers; it is they who fill the senior appointments in the Corps. No pressure is put on men to stay in the Corps, in fact it is rather the other way round. We run an employment exchange, employers register with us for certain tradesmen and men who want to retire have a number of jobs to choose from. So much in demand are our tradesmen that we can never fill all the vacancies offered to us.

There was a roar outside as a hovercraft started up and I leaped to my feet . . .

I awoke in the ante room only to find that everyone had gone back to work. A young officer was revving up his car which obviously had a defective silencer. I looked around and wondered whether I had really been able to see into the future. Everything seemed different to our present day concepts.

Could it be right to encourage men to leave the service at the height of their trade career?

Was it possible to concentrate all our activities around Chatham?

Could we combine combat engineering and trades training in the same establishment?

Could the Trade Training Group cope with basic and Higher Trades training in one place?

Could we treat each recruit as an individual for his training?

Sleepy as I was, I became firmly convinced that the answer to all these questions was YES.

NOTE BY THE EDITOR

If Sam had walked over to the Corps Library after his siesta and consulted an *RE Quarterly List* of the 1930s (*Lists* were published quarterly in those days!) he would have seen a marked similarity between the set up at Chatham then and the organizational Chart explained to him in his after-lunch dream. There was at Chatham a Major-General who carried out, with a skeleton staff, the following duties:—

Commander Chatham Area,
Inspector Royal Engineers,
Commandant SME

Concentrated under him were:—

The SME with a staff of one Brigade Major and two Staff Captains, a GSO II Instructor in Tactics, a Field Works and Bridging School, a Construction School, a Survey School and an E & M School.

The Training Battalion RE (1 TB RE) with a Field Works Major, a HQ Wing and four Companies for recruit training.

The Depot Battalion RE with three Companies, one of which was Boys' Company.

Chatham was a hive of activity and recruits on joining were immediately housed in the Headquarters of the Corps with all the tradition surrounding it.

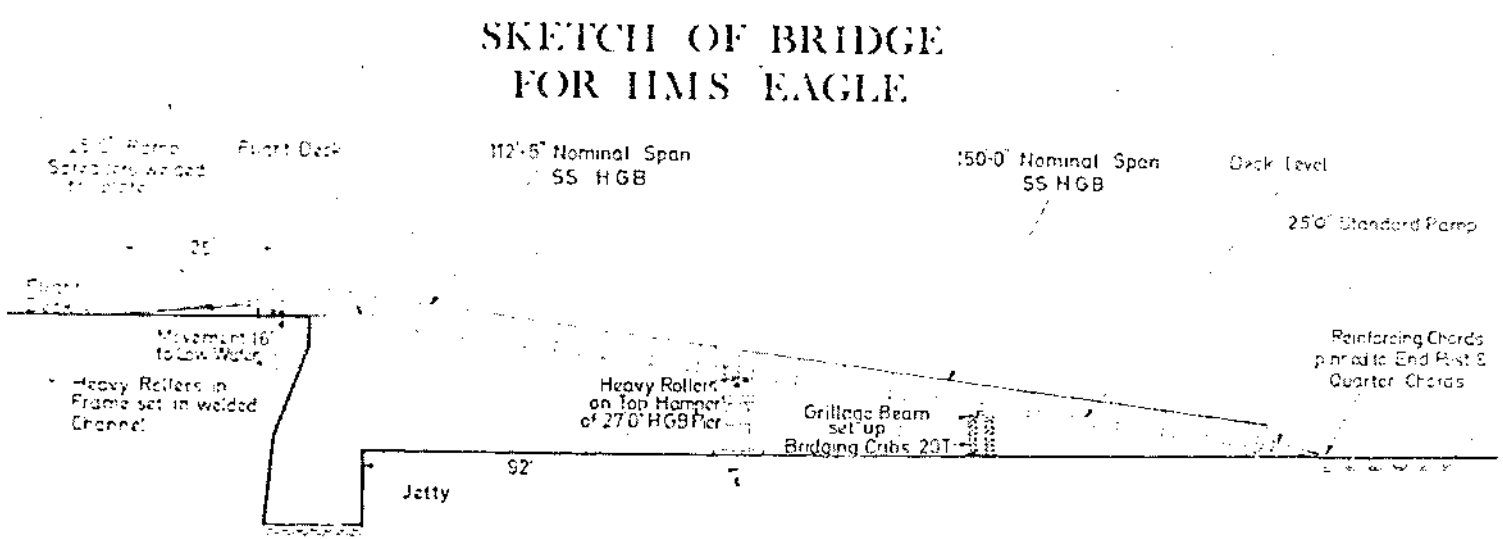


Figure 1. A sketch of the bridge to HMS *Eagle*.

A Kind of Gang Plank

MAJOR C. M. G. DE PLANTA DE WILDENBERG RE AND
CAPTAIN J. D. C. GRANT RE

IT is now some time since the Corps was given the task of providing engineer support for the Royal Navy but with lots of other jobs to keep us occupied, few Sappers have given the idea much thought. The same is apparently not true for the Senior Service, and an increasing number of requests for such support seem to be turning up. This is the story of one of them.

The Navy wanted a kind of gang plank. Ordinary gang planks (apparently called "brows" by the people who know) are little more than an elaborate ladder laid between the dockside and a convenient hole in the ship by which men and light stores can come and go with relative ease. But the Navy wanted something a bit bigger than this and even the most versatile bosun in the Service could not come up with a really acceptable solution. The decision had been made to scrap the aircraft carrier, HMS *Eagle*, and a way had to be found of getting most of the useful bits of equipment out of her, a process known as de-storing. Some of these were quite easy to move, since they would fly, but others were less mobile and most were too big for the "brows". So the Royal Navy, having read and remembered the small print about Engineer Support, decided to see what would happen if they invoked it.

If the Navy was at all impressed by the scale of our response to this request, we were equally impressed by the scale of the request itself. The "plank" had to provide vehicle access from the dockside to the flight deck of HMS *Eagle*. The ship was to be moored in a tidal berth in Portsmouth Dockyard so that the deck would rise and fall an average of 16 ft and at its highest, would be some 50 ft above the quay. In addition, the ship would roll if the weather got bad and despite all the anchors, hawsers, chains and other mooring devices, she would also be likely to move back and forth about 6 ft or 8 ft along her length, parallel to the quay. The maximum load on the bridge would not exceed 20 tons. The Navy was sure that the Sappers could fix it because we had done the same thing—roughly—at Devonport, about a year beforehand. Research showed that the Devonport epic involved a 40 ft SS Bailey. Mathematical analysis ruled out a similar structure for *Eagle* because the gradient would have been too steep!

After some deliberation, Christchurch was called in and Bailey was ruled out. But HGB was quite a different matter and so several designs were worked on. The final one is shown in the illustration, and it is fair to say that had HGB been designed specifically for this particular purpose, it could hardly have been more suited to it and the final result proved to be massively elegant and inspiringly solid. In outline, the design comprised a fixed 150 ft span from the ground to a 27 ft high HGB pier and a second, hinged span of 112 ft 6 in. from the pier to the flight deck. When the ramps were included, this gave an overall length of 312 ft 6 in. and an average slope of about 1:7. It was this last figure which gave the most food for thought; 1:7 is a pretty fair gradient for a launching plane.

Several ideas were worked out for the launching. The only feasible method for the fixed span seemed to be to build it on the ground and lift it into place. For the moveable span, we thought of cantilevering out bay by bay from the pier or of building the span on the flight deck and launching it conventionally from the ship to the pier. Eventually, this second method was dropped because of the problem of the stores which would have to be lifted to the flight deck and also because the launching weight would have required complicated grillages or shoring under the deck. The cantilever system had only one real drawback—it required a "skyhook" of some kind. We were able to provide this by hiring a crane with a 108 ft jib. That made the task simple, if somewhat hair-raising for the pinning party perched on the swaying nose, 40–50 ft above the dockside.

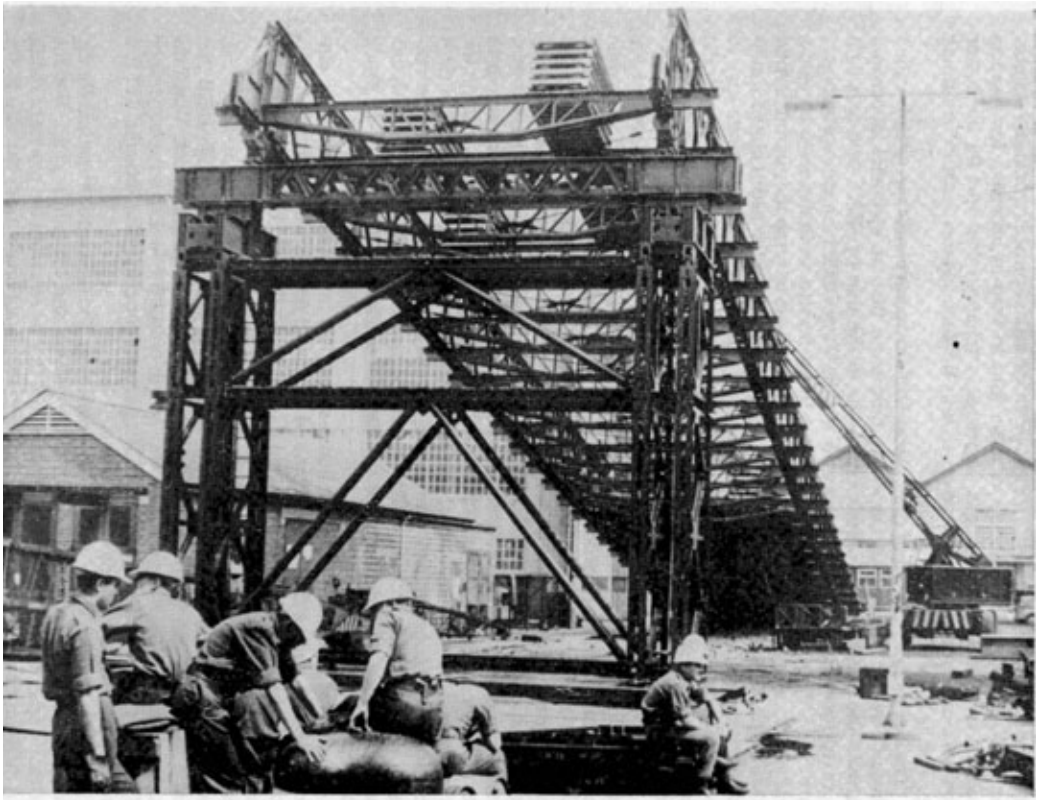


Figure 2. A short pause just after the 150 ft fixed span had been placed.

A Kind Of Gang Plank 2

Before things got to that stage, however, other problems had to be solved. The site was a clutter of tin sheds, welding bays, scrap iron and crane legs. The Yard Services Manager, a very powerful person in the Dockyard hierarchy, decreed this would be cleared and cleared it was, down to a mixture of concrete slabs, rough fill and a concrete-decked jetty. This jetty proved troublesome because its strength was doubtful. Because of this, it was essential for the pier to be built on solid ground but the haphazard laying of concrete wearing surfaces in the past made the exact location of the join very difficult to determine. In addition, the span lengths were critica and if we had had to move the pier more than a few feet, the whole design would have had to be changed. Eventually, the DoE painted an uncertain yellow line on the concrete and declared it to be the boundary of solid Portsmouth. We accepted this as the best we could get and the whole thing stood up under working stresses, so they were probably right. It was also necessary to strengthen the jetty surface to accommodate the loadings to be caused by the crane jacks. This proved simplicity itself; DoE laid large sheets of steel plate, one inch thick, over the whole surface.

Thanks to very effective co-operation from CEP Long Marston, all the heavy stores arrived by train in the dockyard and were shunted in small groups of trucks right on to the site. This shunting operation was a minor miracle in itself, as a plan of the dockyard rail system looked like one of those maze problems found in children's books. A major planning snag was that the ship was still at sea while all the design work was being done and she would not dock until about 10 days before work was due to begin. At the ship end of the bridge, two major problems existed. The first was that the bridge would have to land on rollers placed exactly over the gunwale of the carrier. However, at the point where the bridge would come aboard, there was an overhanging deck which meant that the gunwale was about 16 ft inboard. Since the bridge would be sloping upwards most of the time, it meant that this overhang would need to be removed if the bridge were not to foul it.

So it was removed—a slice about 33 ft long by 16 ft wide was simply cut away by intrepid dockyard workers who looked very much like men sawing off a tree branch while sitting on the branch itself. The second problem has already been mentioned; the longitudinal movement of the ship likely under certain weather conditions. After much discussion with the Naval Construction branch, they designed a roller mounting to be welded to the deck which was basically a channel in which the roller assembly could slide at right angles to the centre line of the bridge. The channel was provided with many grease points, but in practice I am doubtful about how much longitudinal movement it allowed, for the wear on the flanges of the lower chords of the panels suggested some very high side pressures on the bridge.

The movements due to the tide and the rolling of the ship were no real problem as the bridge was left on its rollers. Provision had to be made, however, for the ramp and its supports to move in relation to the deck. This was done by welding the ramp pedestals to a large steel plate and greasing the deck under this plate so that it slid easily in any direction. This simple system worked extremely well but made parts of the deck very slippery.

The final design problems concerned the anchorages at the shore end of the bridge and a means of bracing the pier. The bridge anchorages were taken straight from the book and entailed extending the bottom girder by the use of reinforcing chords and then pinning these to quarter chords set vertically in concrete in the quay. The pier was guyed by attaching cables to the top of it and these were taken to anchorages on the quay along the line of the bridge. In theory, these were unnecessary as the bridge was on rollers on the pier, but as the slope of the bridge was so steep, it was felt wise to use these guys. The overall effect of these various anchorages, plus the weight of the bridge itself, was found to be quite an effective mooring device for the 43,000 ton vessel and kept her steadier than might have been expected.

However, on one particularly blustery Sunday, the bridge watch reported a regular overall movement of about 5 ft 6 in. at the flight deck roller positions, caused by the ship rolling. We had originally allowed for a maximum 6 ft during a full tidal

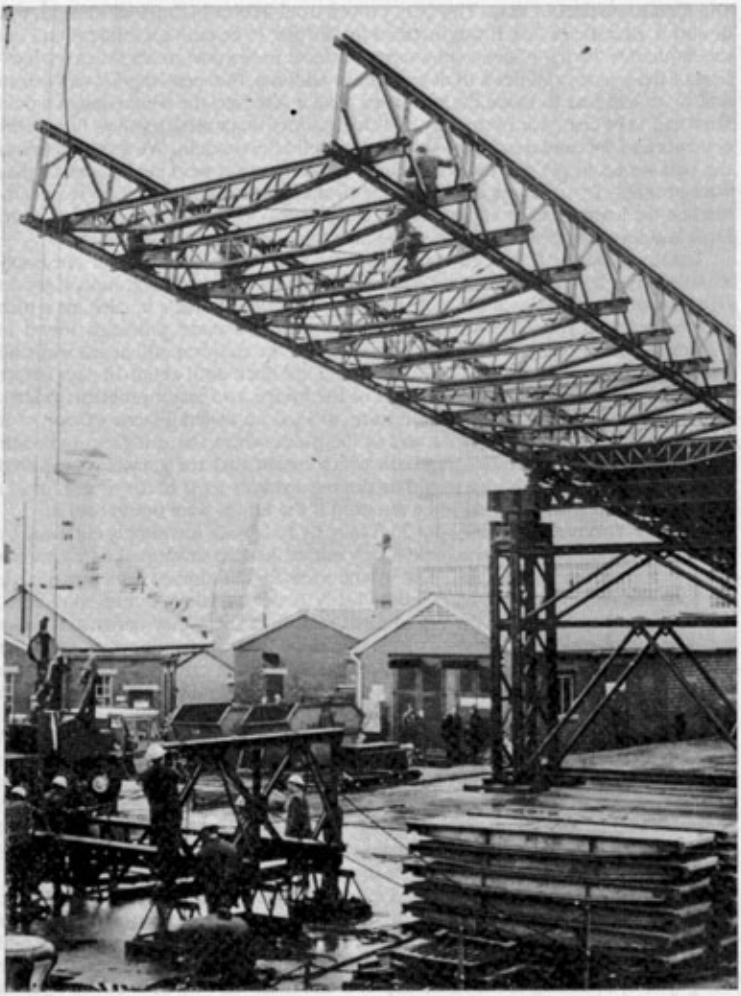


Figure 3. The first half of the cantilever span. Cool heads were assured by cool weather.

A Kind Of Gang Plank 3

cycle, but had added an extra end post in case of something unforeseen. Both the Navy and ourselves were very glad about this on that occasion!

It had been decided that the task would be carried out by 1 Training Regiment, as a "Party Officer's Exercise". This is a phase in the training cycle of a recruit, usually near the end of his time in the unit, when the Party Officer organizes an exercise away from the confines of the Training Regiment. This job was given to 71/15 Party of 28 Training Squadron. They were in their 13th week of training. The Party had a crash course in HGB during the week before the project and a detailed briefing on the methods to be employed on site. The planning and liaison with the Navy, Portsmouth Dockyard, DoE and CEP were done largely by Captain J. D. C. Grant RE and thanks to his efforts, very few snags were met during the construction. The Party Officer was Lieutenant C. I. Rycroft RE and the QMSI was WO 2 Clouter. These, together with the men of 71/15 Party were accommodated on HMS *Eagle*, an excellent arrangement as there was still a quantity of "duty free" on board. The Navy made us all extremely welcome and ran quite a busy book on the exact moment when the bridge would fall down.

Work began on 2 February 1972 with good February weather of rain and cold most of the time. A large dockside crane was used to unload the stores from the railway trucks. Building of the fixed span on the ground was done by a small mobile crane from the Dockyard. Meanwhile, the pier was erected using a hired 25 ton mobile with a 50 ft jib which was later extended to a 108 ft fly jib for the second phase. A second hired crane, of 35 tons capacity, was assembled on the site and when the fixed span was ready, the two hired cranes lifted it smoothly and quickly into position.

This was done by raising the whole span horizontally to the height of the pier, settling that end on the rollers and then lowering the shore end to its prepared seating. During the lowering, heavy strops were used in conjunction with Tirfor jacks, to prevent the bridge from sliding off the rollers.

Once this stage was reached, the cantilever span was started, building outwards bay by bay. The fixed span was decked at the same time. At about mid-span on the cantilever, it was noticed that, due to error, the half-chords between the top pins in the end posts at the hinge position had been left out. There was no lifting capacity available at the time to lift the half completed span to enable the half-chords to be put in place so work was stopped to allow some stress calculations to be made to see how far we could continue while waiting for the heavier crane. The calculations showed that the pins at the hinge point were actually 50 per cent over their safe limit of shear at the time work was stopped! Temporary and probably useless strops were rigged till the heavy crane was available and the odds changed rapidly in the Navy's book. Everything held, however, and once the chords were in position, work continued. One more drama awaited us and I must mention here the great coolness displayed by two recruits who were helping the pin NCOs on the nose of the span. The seventh bay of the cantilever span was being assembled and an NCO and one recruit were working on each side of the bridge. At this stage they were some 45 ft above ground. Each was held by a safety harness and one hand, the recruits passing pins and hammers to the NCO, as the various components arrived by crane. Every movement on the bridge caused the whole thing to vibrate and tremble, but suddenly there was a sharp, resonant bang and the nose of the bridge bounced several feet up and down. The pinning crews hung on and we all waited an instant, expecting to see the cantilever dip and crash to the ground. Nothing happened and as quickly as possible the pin crews came down. The bridge was examined and it was found that a sway brace had parted, causing the bang. As soon as the bridge was considered safe, the pin crews were ordered up again and it is greatly to the credit of the two recruits that they went up at once, with no request to be relieved, and carried on till the task was finished.

Once this span had reached the flight deck, we simply had to wait till the tide came in to raise the ship, settle the bridge on the rollers and lift it till the half-chords

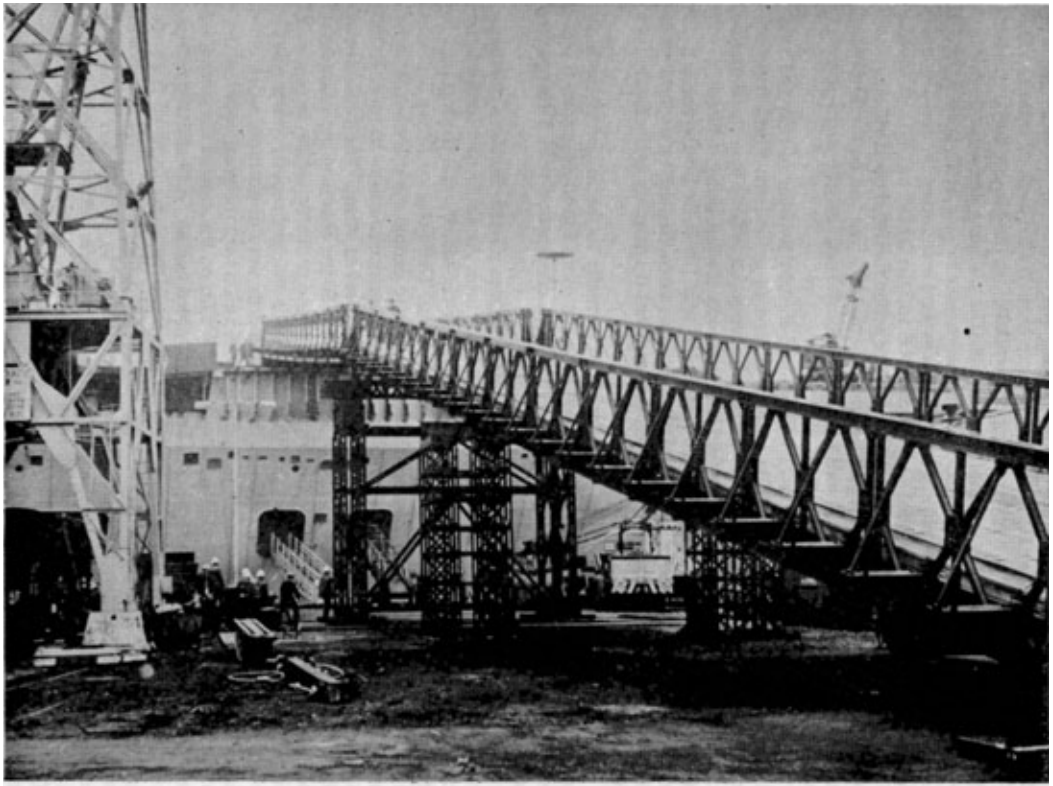


Figure 4. The "gangplank" completed. It would also have made a useful ski-slope!

A Kind Of Gang Plank 4

at the hinge point came free and could be removed. This process was aided by jacks on the flight deck but this proved a hazardous task because of the extreme inclination of the bridge. Indeed, one HGB jack was thrown about 10 ft across the flight deck when the side forces became too great, but no harm was done.

When the half-chords were removed, everyone was delighted to see the hinge system work perfectly and a close watch was kept over a full tidal cycle to study the bridge behaviour. All seemed to work exactly as planned. The ramps were fitted each end and the decking completed and Lieutenant Rycroft gave an impressive demonstration on a dockyard 10-tonner of how to ski in a lorry. Sometime later two bands of naval non-skid paint were applied to the bridge decking panels which gave much improved adhesion for the vehicles using the bridge.

The bridge was officially opened by Rear Admiral P. G. La Niece, Flag Officer Spithead and Brigadier R. S. N. Mans, acting GOC South East District on 14 February 1972. They drove up the bridge on to the flight deck and a signal was sent referring to the first powered landing on an aircraft carrier by a Land Rover. The dockyard drivers soon got used to the techniques required and in the course of the 2½ months it was in use the bridge carried some 700 loaded vehicles. Some idea of its utility can be given when it is realized that had it not existed, all these stores would have had to have been handled by one dockside crane and the ship's derrick. Estimates of the savings of cost vary, but are considered to be between £250,000 and £400,000, a fairly notable result for a "Party Officer's Exercise".

In use, one or two points came to light which are of interest. One was the incredible rigidity of the structure, considering that one end was "floating". Another was more alarming, for it was found that the headless pins on which the second span hinged at the pier were inclined to work themselves outwards very quickly. At first they were simply hammered back in by the naval bridge watch but then heavy gauge safety pins were put in. These safety pins sheared off like tin tacks, so we went back to regular hammering! This phenomenon was undoubtedly caused by the movement of the ship along its length and the side forces on these pins must have been considerable.

The bridge was dismantled in the first week of May by another Party from 28 Squadron, 72/01 under Lieutenant P. J. D. Lamb RE. It came to pieces as smoothly as it had gone up, without any of the heart-stopping dramas that had occurred earlier.

I would like to draw two conclusions from this task. The first is rather obvious, but encouraging to the training organization and also, I hope, to user units. Recruits often have shortcomings when arriving in their units. But with good JNCOs they are capable of putting in an effort which measures up well to any made by their more experienced and better trained companions in a field troop. The second is that HGB is often wrongly written off as something of a stop-gap, out of date equipment. Such tasks as this one may not occur often, but I know of no other equipment in the world which could have been used for this particular job. The ease and simplicity of construction together with the massive strength of the whole structure impressed more than a few people who had not previously seen this equipment in use on a large scale.

* * * * *

Early Days

M.L.C.

In the *Journal* of March 1872 it is noted in an article on the Prussian Engineers, that in the campaign of 1866 the object of the Generals was to get rid of the Engineers as graciously as possible. They were an encumbrance because "the Generals were not sufficiently Engineers, and the Engineers not sufficient tacticians to seize the common point". The author goes on to say that the "true value of the Engineers can only be appreciated when the Commanding Engineer is seen close to the General, grasping the full tactical and strategical importance of each point in a battlefield, and prepared to support and aid the others with his arm of the service".

Having made this point—well familiar to the Engineer today—the Author goes on to point out the difficulties facing the Engineers in achieving their proper status. The reality of the work does not lend itself to "sham fights or blank cartridge". The frustrations of the Royal Engineers in the Autumn manoeuvres (on Salisbury Plain) in both 1871 and 1872 were subjects of acrid comment in the *Journal*. "What could be more provoking when the head of an advancing column, with its engineers, comes to a bridge and a little dirty bit of paper informs them that the bridge was blown up, and must not be crossed for three hours. Three hours! why only let the men use their tools, there are some trees, there is a house and one hour, half an hour, will do the job: but no, the trees must stand and the tools must not be unpacked."

The danger then was that the Engineers got discouraged and, taking the easy way out, concentrated their efforts and skills on peace time building—be it fortifications or other structures. The Prussian Engineers, it seems, avoided this trap and between 1866 and 1870 so perfected their skills as Field Engineers that the complete success over the French in 1870 was largely attributable to the swift Prussian advances often across the grain of the country. The Generals saw to it that the "Engineers were kept well to the front, and not left with their tools in reserve".

The author suggests that since peace time construction has to be done, and the importance of Field Engineering cannot be denied, there was a strong case for dividing the Corps into Field and Garrison companies, after the manner of Field and Garrison Artillery. This was especially so in a short Service Army in which each unit should specialize. For the Field Engineers the priorities must be right. "Let the men's packs be carried in a waggon and let the men carry tools instead".

Despite any good intentions about becoming good field engineers, the 1872 Autumn manoeuvres called forth the following lament "The so called Autumn manoeuvres are over. For two years these practical war games have been played in England—and the country seems satisfied. Yet it cannot but be noticed that a great number of Officers of Engineers, who were eager enough at the onset to take part in them came away at the end with a feeling of disappointment. Is it from a consciousness that as a military body we are somewhat behind the other Arms, who are endeavouring in every way to make themselves equal if not superior to those of foreign powers?"

The blame for not giving the Engineers sufficient opportunity to improve their competence on manoeuvres was apportioned two ways. On the one hand to the Engineers for not pushing their wares sufficiently—from the making of small earthworks, making sure that a pontoon and not a "repaired" bridge was used to cross a river; water supply and so on. On the other to the General Staff, who beyond having assembly camps prepared for the participating troops, did not seem interested in using the engineers on the rest of the exercise. Thus the engineers did not even have a proper opportunity to test their organizations.

A correspondent from India, writing in the August 1872 *Journal* was equally plaintive. Speaking of the "Camp of Exercise, Delhi", it seems that there was no engineer representative on the HQ staff or on any of the other staffs at first. The

consequence of all this was that the Royal Engineers "had a good deal of difficulty in finding out what was going on and the Engineers part of the business was neglected".

This must have been all very sad. Presumably the Corps had much to blame itself for allowing this state of affairs to arise. An article on service in India draws attention to the resentment of some officers at being required to do duty with troops in addition to employment on Works ". . . these Officers volunteered apparently under the impression that their duties would be exclusively civil, the disinclination for duties with the Sappers (that is with one of the Sapper and Miner Units) has become more apparent than heretofore. Officers express themselves surprised and disappointed on the plea that such service was never mentioned . . ." It seems that Officers volunteering had not taken the trouble to read the RE Corps Orders in which the conditions of Indian Service were laid down. All this could show that there was a marked disinterest in field engineering, which could have been reflected in the status of the Corps within the Army. One remembers that after the last war there was a distinct tendency within the Corps for the combat side to apologize for having a connection with the Works side—an attitude which could have contributed to the loss of the responsibility for works services.

In the Staff College entry exam in 1872, Engineer Officers occupied the first three places. Indeed five out of the first seven were Sappers. However, since the Corps was allowed only two vacancies, only the first two gained entry. This was a little galling when there were a total of 32 competitive vacancies. It is perhaps understandable if some Officers decided to make their careers on the "civil" side once they found the military side somewhat restricted.

The pages of the *Journals* of 1872, and the Professional Papers, are liberally sprinkled with accounts of MACC. The use of explosives figured prominently, as indeed it does today. An account of the felling of a 160 ft high chimney in Dublin relates that only 15 lbs of gun cotton were used, and the whole operation clearly gave as much satisfaction to those who carried it out as such operations do now. A rather less satisfactory exercise was the blasting of a large gateway in the walls of Rochester Castle. This was done by recruits and the time taken had clearly been underestimated. The toughness of the Roman mortar, a shortage of gunpowder and lack of recruits to fill the working parties, all seemed to have added to the difficulties. However, the clearing of Martello towers seem to have been more popular than demands to clear pill boxes and other positions from the cliffs of Dover today. And, no wonder, when with one stroke of the 'frictional machine' 200 lbs of gun cotton in one case, and 800 lbs of gun powder in another safely saw to the disintegration of the whole structure. The indefatigable and scientifically inclined Lieutenant Abney being on the spot in both instances, to take photographs and to make "spectroscopic observations".

The only purely historical article published during the year concerned the clearing of the debris of the Old Cathedral from the site of St Pauls in 1666. Parts of the walls were 80 ft high and 5 ft thick. The tower, 200 ft high posed a special problem, but the "Surveyor" (it seems that this was Sir Christopher himself) by the exact use of only 18 lbs of powder lifted the whole 3,000 tons before the tower collapsed in a neat pile. The next blow was delegated to an underling, who, wise in his own conceit "neither went low enough nor sufficiently fortified the mouth of the mine and used too great a quantity of powder. Although the result was effective, some stones were blown into the neighbourhood and further use of powder was forbidden".

The "Surveyor" then decided to use a battering ram and erected a shear legs and a horizontal ram, 40 ft long, with a spike of iron. By vibrating this machine to and fro with a regular rhythm, the wall was brought down. This was not by "any present violence but by the effect of equidistant pulses". No doubt accurately described but a little difficult to believe!

In a General Order issued in 1872 Commanding Officers were bidden not only to discourage, but firmly repress, any tendency on the part of those under their command "to indulge in extravagant and unnecessary habits of luxury, inconsistent with

the military profession. He was to insist upon the Mess being conducted in every particular on strict economy and with due regard to the means of the poorest member of it". Perhaps the Editor of the *Journal* himself had not been amused by the size of his mess bill, when he published a letter to one of his contributors. "We are much obliged for your acrostic. Might we suggest if you really cannot find a better word for No. 6, that innuendo or Idaho might answer—and ask in what country 'Corps' and 'Sure' rhyme?" He then declared his intention not to insert any more acrostics in future numbers.

Scarcely the way to build up the image of being a sympathetic Editor!

Correspondence

Colonel J. L. Nicholson, OBE,
Barleythorpe House,
Oakham, Rutland.
14 June 1972

ROYAL ENGINEERS AT GIBRALTAR

Sir,—In Brigadier Lacey's interesting account of the Corps' connexions with Gibraltar, he stated that Field-Marshal Lord Napier of Magdala was the only Royal Engineer officer to be appointed Governor. There was certainly one other, General Sir Lothian Nicholson, KCB, who became Governor in 1891 and died in 1893 while still holding the appointment. He is buried in Gibraltar.—Yours faithfully, J. L. Nicholson.

Major R. D. Garnett, RE
31 Armoured Engineer Squadron
British Forces Post Office 36
8 May 1972

THE FUTURE OF ARMOURED ENGINEERING IN THE CORPS

Sir,—The replacement of the Centurion Bridgelayer by Chieftain AVLB and the phasing out of the Centurion AVRE are still some way off. The implication of these changes are, however, considerable since the organization of the present armoured engineer squadrons will require considerable changes. To make sure we get it right the role of armoured engineer units requires a lot of thought.

The basic change will be that instead of the present 16 heavy armoured vehicles within the Division the number of engineer tanks will be reduced to 8. The requirement of armoured earth moving plant will be met by the Combat Engineer Tractor (CET) which will replace the Medium Wheeled Tractor, the Light Wheeled Tractor as well as the AVRE.

The present organization of an Armoured Engineer Squadron per Division makes very good sense in that it allows for the economics of REME manpower, spares support and specialized training effort which follow from centralization. It also gains the advantages of integration with the Divisional engineers, of more general training with Divisional units and of quicker response which follow from decentralization.

Whether 8 AVLB's is a viable number of vehicles to absorb the overheads of centralization is another matter. Unfortunately, we will still be faced with the same problems since the Chieftain AVLB is no less complicated, than the Centurion armoured engineer equipment and is also subject to the same need for a wide variety of spares. Any further decentralization might seriously affect the reliability of the equipment quite apart from the inevitable "bricks and motar" problem in BAOR.

Apart from the changes in the number of vehicles there is also the question of manpower. The present armoured engineers train very closely with their affiliated armoured regiments

within the Division. Frequently more time is spent training with other arms than with the rest of the Divisonal engineers. This is possible because the armoured squadrons at present have the ability to carry out a lot of low level pioneering such as nuisance mine laying, and clearing, reserve demolition parties, construction and laying of Class 60 trackway, battle noise simulation and so on. In fact the squadrons are viable engineer units to support Battle Group level requirements, in addition to the use of their own equipment. This level of support is only practicable with the present equipment since the AVRE contains at least two crew more than necessary. The normal organization of an armoured engineer section of one AVRE and one Bridgelayer produces seven working numbers allowing for one to man the radio and be on guard. A large number of drills are laid for such a section and they are practised regularly. The advent of AVLB plus CET and the departure of the AVRE no longer make such a concept practicable. Even if a future section were to consist of one AVLB and one CET there would only be four working numbers.

To summarize so far, the present armoured engineer squadrons hold, maintain and operate armoured engineer equipment within the Division and also provide intimate, quick reaction engineer support for armoured Battle Groups. The advent of AVLB and CET and the departures of the Centurion based vehicles will not allow the present concept to continue.

Changes could be in one of two directions. Either the squadron could become equipment holding units which delivered the necessary equipment to the Brigade field squadrons to employ or an armoured squadron could include a number of sappers carried in APC's thus continuing the present practice of being a balanced unit that can operate alone.

Within the present establishment it would be possible to produce a squadron equipped with AVLB, CET, a bridging troop to look after spare AVLB bridges and the Divisional MGB, and two field sections. The field sections could either support the armoured troops in pioneering or amalgamate to build the MGB if no other sappers were available.

One would be interested to hear other views on this subject. Do we want an Armoured Bridging Support Squadron or an Armoured Engineer Squadron?—Yours faithfully, R. D. Garrett.

Colonel J. N. Elderkin, BSc, MBIM
Ministry of Defence
Old War Office Building,
Whitehall, London S.W.1
28 June 1972

EQUIPPING THE MAN OR MANNING EQUIPMENT

Sir,—Some of those who read Major Wilson's article entitled "Equipping the Man or Manning Equipment", which was published in the June edition of the *Journal*, may have got the impression that nothing at all was being done to improve the capability of the field troops. This is far from true and I would like very briefly to attempt to restore some balance to the picture he has painted.

The Combat Engineer Tractor (CET) is now in an advanced stage of development. The overriding reason for the introduction of the CET is the need to restore the ability of the engineer troop to give effective close support to the battle group. The Corps, along with military engineers of many other nations, has been pressing for such a vehicle for many years. Seven CET prototypes are now being built and the first will leave the factory in October. These seven vehicles will be subjected to technical and user trials at the RSME and in BAOR in 1973 and 1974 and will enable the Corps as a whole to get a much better appreciation of what this extremely promising machine can do.

We see the CET becoming the maid of all work in the Field Troop, because not only is it an excellent earthmover with a road speed of 34 mph, but it can swim, lay trackway, handle mine pallets and bridging stores, winch, provide an anchorage, and launch pontoons. Not least its 2 man crew have armoured protection equivalent to that given by an APC, NBC protection and radio communications. It will also be possible to fire a demolition from inside the vehicle when it is closed down.

Although there are no current plans to give the CET a bridgelaying capability, it has been designed to accept a 20 foot class 30 bridge if any operational requirement for such a capability should ever be agreed. While such a bridge would be no substitute for the Class 60 bridge Major Wilson advocates, his assessment of the need to bridge 20 foot gaps is not endorsed by many who have studied the problem; crossing can often be achieved by dozing and using trackway.

Of the problems mentioned by Major Wilson none are more intractable than those associated with countermine warfare. During 1972 the Weapon and Equipment Policy Committee, which directs Army equipment policy, approved a new series of studies at the Royal Armament Research and Development Establishment designed to lead to a range of mineclearing equipment compatible with the battlefield situation forecast for the 80s. Similar studies are taking place in the USA and on the Continent, but no quick solution is likely, and constructive ideas from Sapper officers with practical knowledge of the problems involved would be very helpful.

I hope Major Wilson agrees that the introduction of the CET will be a very significant advance in the direction he advocates.—Yours faithfully, J. N. Elderkin.

* * * * *

Brigadier L R E Fayle CBE DSO MIMechE MIEE

BRIGADIER LINDLEY ROBERT EDMUNDSON (DAVID) FAYLE a great soldier sapper and seaman, died 3 February 1972.

Born on 31 July 1903, the son of Lieut-Colonel R. J. L. Fayle, DSO, RAMC he was educated at Clifton and the Royal Military Academy, Woolwich where he won the King's Gold Medal and the Pollock Memorial Medal. He was commissioned into the Royal Engineers on 29 August 1923, the top of his large Batch of thirty Young Officers.

After his Chatham Course he was posted to India in 1925, where he joined the Royal Bombay Sappers and Miners at Kirkee and served with them in a variety of appointments until 1930.

On returning to the home establishment he became Garrison Engineer at Woolwich, and in 1932 he joined the School of Military Engineering at Chatham as an Assistant Instructor in the Electrical and Mechanical School. In 1936 he went on a Long Electrical and Mechanical Course after which he became in 1938 an Assistant Inspector of Engineer and Signal Stores at Woolwich.

During the nine consecutive years he spent within fairly easy reach of Chatham and the South Coast he was able to exercise to the full his great skill as a yachtsman and he was for many years Hon Secretary of the Royal Engineers Yacht Club. His name was closely connected with the famous REYC yacht *Ilex*. He was a frequent contributor to the *RE Journal*, among the articles he wrote were '*Ilex* in the 1933 Fastnet Race', '*Ilex* in the 1935 Fastnet Race' and '*Ilex*, REYC, A History of the ship from 1926–1936'. His great watermanship skill was later exercised to the full during the war that was to follow when he became a builder of floating bridges *par excellence*.

In March 1940 he was posted to the Intelligence Branch of the War Office and in October the following year he became SO 1 E (Ops) which appointment he held until August 1942. From then on until the end of the war in North West Europe he served in command of Engineer Troops.

In August 1942 he became CRE III Corps Troops Engineers (later Kent Corps Troops Engineers and 15 (Kent) GHQ Troops Engineers). The two years that followed before D Day were devoted largely to training at Goole in watermanship and the building of high load classification floating bridges under the most exacting conditions and 582, 583, 584 Field Companies and 297 Field Park Company could not have had a better CRE to instruct them and imbue in them a sense of high morale and confidence in their ability to bridge any river at speed, no matter what difficulties would be encountered. Shortly before the invasion of NW Europe the units were specially trained in the construction of Naval Pontoon Causeways for the discharge of cargoes from the Mulberry port. They sailed for France on D Day—6 June 1944—and, in spite of difficulties in towing the Pontoons across the Channel and later storm damage, the Kent RE worked with a will and in the week 11–18 June some 1,400 vehicles, 35,000 personal and 450 tons of stores were disembarked over the Causeways.

In the crossing of the River Seine on 25 August the Kent RE were in the vanguard operating storm boats and close support rafts. They later built a 760 ft Class 40 Bailey Pontoon Bridge across the river at Vernon on 28–29 August 1944. The Seine Crossing was the first major bridging operation in NW Europe. The Kent RE were subsequently engaged in bridging the River Maas at Berg and later at Ravenstein, Mook and Venlo. They were also engaged in the Rhine Crossing—the greatest river crossing operation of the NW Europe Campaign—and built a 2,090 ft Bailey Pontoon Bridge at Xanten. They finally built a Class 40 Bailey Bridge across the River Weser at Bremen in which German river barges were used as pontoons. In an article by David Fayle, published in the December 1948 issue of the *RE Journal*, he described in detail the construction of these seven bridges, and the drama, and often almost superhuman difficulties that had to be overcome in their building and subsequent maintenance when rivers became raging torrents and the bridge approaches seas of mud. For his services in NW Europe he was awarded the DSO.

After VE Day—8 May 1945—Fayle was appointed CRE 5 Infantry Division which formed part of the British Army of the Rhine. He returned to the UK in March 1946 when he was promoted Colonel and appointed Superintendent of the Mechanical and Explosive Wing at MEXE, Christchurch. In 1949 he became Principal Assistant Director DREE Ministry of Supply and, as a Brigadier in 1953 he became Chief Superintendent MEXE—the last Sapper Officer to hold that appointment—his successor being Sir Donald Bailey.

Thus he ended his service with eleven continuous years of helping to formulate and implement Corps policy on the technical development of its fighting equipment. To this task he brought not only his invaluable bridging experience, but also a wealth of commonsense and a thoroughly practical and human approach.

On his retirement on 28 February 1957 he was created CBE and he became the Rating Secretary of the Royal Ocean Racing Club, a post that brought him international recognition.

In 1969 he was elected an Associate of the Royal Institution of Naval Architects—a particular honour indeed for someone unqualified in the Profession.

In 1928, on UK leave from India, he married Rosamonde (daughter of C. F. Bigge of East Brent, Somerset) whom he had known since their schooldays in Bristol. They had one son, now in Australia on a semi-permanent basis, working in Government service as a Chemist, and one daughter, who married Richard Tickell, then a Subaltern in the Corps.

Our deepest sympathies are extended to his widow and family. Among the many messages of condolence received was a telegram from the Duke of Edinburgh on behalf, as it were, of the sailing world in which David Fayle was held in such high regard.

The following tribute by Colonel Ken Wylie was published in the magazine of the RORC—*Seahorse*.

I first met David Fayle when I was a young officer at Chatham and he was instructing in the Electrical and Mechanical School there. As far as I was concerned our relationship would have been an extremely unrewarding one if our contacts had been devoted solely to electrical engineering. However, it soon became clear that we had a common interest in sailing and from that moment onwards we became friends and remained so until the end of his life.

In the early 30s ocean racing was in its infancy but even so it became clear that the sapper yacht *Ilex* would not be a serious competitor much longer if she retained her original gaff rig. It was therefore decided to convert her to a bermudan cutter in the winter of '34/'35 when she was also given a new deck. In those days it seemed a lot of money to spend but somehow David managed to collect it and we started the 1935 season with high hopes.

The first race, which was hardly a fair test for a boat whose windward ability should have been improved by the conversion, was from Burnham to Heligoland. This was downwind all the way and the wind was strong. With his concern for absolute accuracy David reported as we crossed the finishing line that we had averaged 8·37 knots over the ground, which was probably faster than the old lady had ever been before. In the Fastnet there was substantially more windward work and it was very encouraging to find *Ilex* finishing third over all on corrected time. David was one of the crew—a good seaman and navigator as well as a cheerful companion off watch and ashore.

Even in those days he was taking a tremendous interest in the RORC Rule and he was largely instrumental in developing scantling allowance which was very useful to old heavily built yachts and was certainly not abused to the extent that it was in the late 60s as few new yachts were actually built to the rule.

The exigencies of the Service kept us apart for some time and I did not run into him again until the end of the war, when he was CRE of the 5th Infantry Division.

At that time hostilities had ceased and he was busily engaged in trying to extract some of the better German ocean racers from where they had been laid up during the war and get them back to England with prize crews. These windfalls proved to be the foundation of post war Service ocean racing.

Eventually *Ilex* had to be replaced and it was on David's initiative that the REYC had *Right Royal* built. She was a happy choice, and provided excellent sport for the post war intake of sapper sailors.

In the Royal Ocean Racing Club it will be for his work first on the technical sub committee while he was still serving and subsequently as Chief Measurer and Rating Secretary that he will be remembered.

Although he never designed any boats himself he had an extremely keen appreciation of what made them go fast and what made them go slow, and it was largely due to his efforts that the 1957 Rule lasted as long as it did in a reasonably satisfactory form. He always adopted a cautious attitude to change until he was absolutely satisfied that the reasons for the change were well founded.

He was well aware of the weaknesses in the 1957 Rule which became apparent in the late 60s and the adjustments and recommendations for a new rule were already in his mind and had been explained to the Technical Sub-Committee long before the IOR had come into being. It is probably fair to say that unless a man of his integrity and distinction had been in charge of RORC Rating affairs at that time, it would have been extremely difficult to persuade the Americans to adopt those features of the RORC Rule which became fundamental in the new International Offshore Rule.

Perhaps his greatest triumph was to ensure that even with the complications of measurement under the new rule no owner who wanted to start in a RORC race in 1970 failed to have a IOR rating in time for him to do so.

He was transparently honest and his clear mind and patience in explanation were further outstanding qualities of tremendous value when dealing with people less technically equipped than himself. Although the ratings he produced were generally higher than the owners expected, he would always take the trouble to explain why it was so and when he had finished doing this it was impossible not to appreciate the care and trouble which he had taken to see that justice was done.

His military achievements will be recorded elsewhere, for instance in the *Royal Engineers Journal*, but to us he was part and parcel of the ocean racing scene—at sea in his earlier years and subsequently with his slide rule and calculating machine he enabled so many of us to enjoy our racing on an equitable basis.

JRB writes:

To those nearest him in age and to his own batch in particular he was known as "Sapper" Fayle; to most of the Corps he was known as "David" (allegedly because he knew the Psalms by heart). Both these names were used with the utmost affection. He was an outstanding professional sapper who could and did take on every task. I knew him also as a sailor but there are others more qualified to write of his attainments in this field: suffice to say that his advice and skill were always at the disposal of everyone interested in mucking about in boats. It was during the last ten years when he had retired from the Corps and was working for the RORC, and I was at MEXE, that a delightful acquaintance became a real friend as we lived near each other. It was during this period that I really learned how he had come to acquire the names by which he was known to so many, and how well he deserved them both. But neither of these names brings out two of his personal characteristics—the ability to have fun and to enjoy what was going on, and his love of dahlias. No party at which he, and Rosamonde, were present could fail to be a success, and his dahlias were superb. We miss him.

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LIEUT-COLONEL A. C. NEWMAN, VC, OBE, TD, DL

LIEUT-COLONEL A. C. NEWMAN, formerly of the Essex Regiment and The Engineer and Railway Staff Corps T & AVR, died on 26 April 1972, aged 67. He won his Victoria Cross for his heroic part on the raid on St Nazaire on 27/28 March 1942.

St Nazaire was a port of high significance, the only one on the French coast capable of providing a base for the German battleship *Tirpitz*. If the dock could be destroyed a sortie by the *Tirpitz* from Trondheim into the Atlantic would become most hazardous. The main objective of the raid was to block the great dry dock known as the Forme Ecluse which had been specially constructed in 1932 to berth the liner *Normandie*. Newman and his men, mainly drawn from No 2 Commando, were detailed to destroy dock installations, swing bridges and two flak towers. The naval force was commanded by Commander R. E. D. Ryder, also awarded the Victoria Cross for his part in the riad. The destroyer HMS *Campbeltown* (Lieut-Commander S. H. Beattie), with specially stiffened bows filled with high explosive, accompanied by other naval vessels, sailed undetected up the Loire estuary until nearing her goal when all came under fierce fire of all kinds. She rammed the main dry dock "with a grinding crash" and became firmly wedged.

Newman was in the leading craft (MGB 314) steaming up the estuary and stood "coolly and calmly" on the bridge though caught in the glare of searchlights and murderous crossfire, which caused many casualties. Although he did not have to land himself he was one of the first ashore and during the ensuing fighting personally entered several houses and shot up the occupants and supervised the operations in the town regardless of his own safety. He directed fire to put out of action enemy gun positions and to compel an armed trawler in the harbour to withdraw. Under Newman's brilliant leadership the troops held superior enemy forces at bay while the demolition parties got to work.

By this time, however, most of the landing craft had been sunk or set on fire and evacuation by sea was no longer possible. Although the main objective had been achieved, Newman nevertheless was now determined to try to fight his way out into open country and so give all survivors a chance to escape.

The only way out of the harbour area lay across a narrow iron bridge covered by enemy machine-guns and although severely shaken by a German hand grenade, which had burst at his feet, Newman personally led the charge which stormed the position and under his inspiring leadership the small force fought its way through the streets to a point near the open country, when, all ammunition expended, he and his men were finally overpowered by the enemy.

Sergeant T. F. Durrant RE, attached to the Commandos, was also awarded the Victoria Cross for the part he played in the raid. His citation read:

"For great gallantry, skill and devotion to duty when in charge of a Lewis gun in HM Motor Launch 306 in the St Nazaire raid on 28 March 1942.

"Motor Launch 306 came under heavy fire while proceeding up the River Loire towards the port. Durrant, in his position abaft the bridge, where he had no cover or protection, engaged enemy gun positions and searchlights on shore. During this engagement he was severely wounded in the arm but refused to leave his gun.

"The Motor Launch subsequently went down the river and was attacked by a German destroyer at 50–60 yards range and often closer. In this action Durrant continued to fire at the destroyer's bridge with the greatest coolness and with complete disregard of the enemy's fire. The Motor Launch was illuminated by the enemy searchlight and Durrant drew on himself the individual attention of the enemy guns, and was again wounded in many places. Despite these further wounds he stayed in his exposed position, still firing his gun, although after a time only able to support himself by holding on to the gun mounting.

"After a running fight the Commander of the German destroyer called on the Motor Launch to surrender. Durrant's answer was a further burst of fire at the destroyer's bridge. Although now very weak he went on firing, using drums of ammunition as fast as they could be replaced. A renewed attack by the enemy vessel eventually silenced the fire of the Motor Launch but Sergeant Durrant refused to give up until the destroyer came alongside, grappled the Motor Launch and took prisoner those who remained alive.

"Sergeant Durrant's gallant fight was commended by the German Officers on boarding the Motor Launch. This very gallant NCO later died of the many wounds received in action."

Sergeant Durrant's Victoria Cross forms part of the VC display in the Royal Engineer Museum, Chatham, on loan from his family.

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Book Reviews

THE ROYAL MILITARY CANAL

P. A. L. VINE

(Published by David and Charles. £3·25)

The Royal Military Canal, cut from a point just beneath the cliffs at Sandgate in an arc through Hythe and Rye and terminating at the cliff face at Cliff End to the east of Hastings, was designed as a military defence at a time when there was a real threat of invasion by Napoleon's troops. It was built and operated by the military and is a lasting memorial to the engineering skills of Lieut-Colonel (later Major-General) John Brown and to the Royal Staff Corps, who supervised the building and operation of the waterway, and the Royal Wagon Train, who provided the men and horses to haul the barges.

Lieut-Colonel John Brown was directly interested in the waterway from the time he made a survey of the south Kent coast in 1804, and suggested the building of the canal as a second line of defence, until he wrote his last report on it in 1815. He planned the work and supervised the construction of the canal, the military road that ran behind it and the barracks that housed the soldiers who operated it. The author, P. A. L. Vine, gives a comprehensive history of the canal from the planning stage to the present day, when the canal's main claim to fame is that the Venetian Fete is held every other year on its waters. He provides many quotes from official reports and documents and the book is of great interest to canal and waterway enthusiasts. Much information is also given about the Martello Towers erected along the coast in front of the canal as a first line of defence.

This book is of special interest to Sappers as it provides a great deal of information about the Royal Staff Corps, which was formed at the express wish of the Duke of York in 1800 as a result of his difficulty in obtaining the services of field engineers. The Royal Staff Corps provided engineers who were immediately available to the Commander-in-Chief without him having to go begging to the Master-General of the Ordnance. At this particular period in history there were far more engineers in the Royal Staff Corps than in the Sappers and Miners, and at one time Lieut-Colonel Brown had almost 1,000 men of the Royal Staff Corps directly employed cutting the canal.

A well-written book of interest to waterways enthusiasts and students of military history.

H.J.

MAKING AND INTERPRETING MECHANICAL DRAWINGS

GORDON L. GLEGG

(Cambridge University Press. 38 pp. 60p)

When a child begins learning to read it takes a gloomy view, one would imagine, of the possibility of achieving its goal. A beginner faced with a tangle of lines called a mechanical drawing is equally despondent about the possibility of his ever understanding it.

This book is designed to help those who find interpreting drawings an impossible or, at least, a formidable problem. Its purpose is to explain both how to make and how to understand this type of drawing. It does its job with admirable clarity and patience.

It start with how to sharpen your pencil. Then takes us through scales, dimensions, sections, conventions, the need to change from realism to symbolism, 1st angle and 3rd angle projections, and finally leads one from start to finish through the techniques of producing a set of working drawings of a rather nasty looking rack slide assembly.

The book is intended to be regarded as an introduction to British Standard 308 on Engineering Drawing Practice. As such it will mainly be of interest to those who are newly approaching the subject, or perhaps to the mature officer who needs a refresher on the reading of mechanical drawings.

A.H.L.

THE HOME FRONTS. BRITAIN, FRANCE AND GERMANY. 1914–1918

JOHN W. WILLIAMS

(Published by Constable and Co Ltd 10 Orange St London WC2.
362 pages. Price £3 net)

Few readers of Jane Austen would guess that her novels were written during the Napoleonic Wars. Those wars made practically no impact on the lives of ordinary people living in

England at the time. There was no conscription, there were no shortages of food, there were no air raids, and in the idiom of today there was no Home Front. That idiom was coined in the 1914–1918 War. It covers all the aspects of war that impinge daily on the domestic lives of the belligerents; and John Williams in his book, *The Home Fronts. Britain, France and Germany, 1914–1918*, published by *Constable and Company*, describes the course of that war on what we now all understand as the Home Front.

It must be difficult for those who were not even born in 1914 to picture how different life was then from what it is today. In 1914 everyone would dash out of doors if they heard an aeroplane to see it; and the pilot would be clearly visible, waving to all and sundry. Many ladies could not even boil a cabbage—I remember my Mother puzzling over how to make coffee without the cup being full of coffee-grounds—and no Officer would wear a shirt that had not been made by his tailor. If the Hall Porter's whistle did not immediately attract a cab to the Club, a messenger was despatched to fetch one; and a letter, posted in Piccadilly at noon, would produce a reply from the City by the afternoon delivery, written with a quill pen. The reason, of course, was that labour was plentiful and cheap; wealth was in fewer hands than today; and the poor man's wants were simple. The 1914–18 War started a social revolution that is still in progress; and it was on the Home Front that it started all over Europe.

All the belligerents in 1914 felt that God was on their side; all felt their cause was just. "Thrice is he arm'd that hath his quarrel just," said Shakespeare. "But four times he who gets his blow in fust," added Josh Billings. All started that war with clear consciences, high hearts and a conviction that it would be finished by Christmas. How differently it all turned out! The manpower of the nations, their accumulated wealth and their scientific and industrial skills were drawn into the vortex as swiftly as the Governments could organize them; and the lives of the people had to be regulated accordingly. Hardly an aspect of life went on unchanged. Men from all walks of life, rich and poor, joined the Army to face the most unspeakable terrors on a shilling a day; while the demand for munitions brought unparalleled orders to the factories, and unheard of profits and wages to those who worked therein. Women took the place of men in many occupations, then strange but now quite familiar; and gradually two different worlds took shape. One world was peopled by those who fought in the mud and carnage of Flanders, and the other by those who only read doctored versions of it in the newspapers. The one world was never comprehended by the other; this was the same in every country.

The author traces all this in logical sequence. He gives the reader a sufficient view of the wood to understand the pattern of the trees. He divides the book into five parts, one for each year of the War. Each Part has one Chapter on the General Scene and three separate ones on the three countries, Britain, France, and Germany. A Foreword, a Prologue and an Epilogue complete the narrative; and there is a list of References, a Bibliography and an Index. There are some well chosen photographs—the one of *A Soldier Leaving Home* is particularly touching—and there are many notes. Happily the notes are all together at the end of the book, and the pages are not disfigured by innumerable footnotes. If a minor criticism were permitted here, your reviewer wished that each page had the number of the chapter at the head of it, so that if the reader wants to see (say) Note 24 he need not turn back to find which chapter he is reading before finding the note at the end of the book. But that is a detail.

Those who do not remember the period may be surprised to learn how much industrial unrest there was on the Home Fronts, and how much conscientious objection and pacifism were tolerated even in those sterner days. Most military readers will have knowledge of the mutinies of 1917 in the French Army; but it may come as a surprise to read that in Germany too there was a mass meeting of 30,000 workers in Frankfurt in 1916 demanding peace, and as early as 1917 there were hunger strikes in the German Navy. Of the three belligerents it seems that, on the whole, the morale of the British people suffered least; but the strain on them may have also been the least. The British did not have to endure occupation like the French; and although the U-boats threatened seriously in 1917 they were mastered in time, and there was no actual starvation. The sea blockade of Germany was evidently very effective.

Nobody enjoys war, but there seem to be a great many worthy people who feel it their moral duty to hamper those who similarly feel it their patriotic duty to wage the war; and a good deal can be learnt from this book on that subject. One lesson seems to be that if internal unrest can be sufficiently fostered by enemy subversion, then military defeat on the fighting fronts becomes more or less inevitable. There was no war on the Home Front in Jane Austen's day; but it is an important factor now. Your reviewer cannot help feeling that in the future the Home Front may be more important still. A time seems not far distant

when a nation can be so demoralized on the Home Front that military defeat requires little more than a movements exercise by the enemy.

The Author does not seek to teach these lessons; they spring to the mind of the reader as he slips easily through the pages of this well-written book. The Author has contrived to avoid heavy-weight work, but a lot of reading has gone into the making. It seems to your reviewer that anyone interested in peering into the future of warfare, would do well to spend a little time reading this book, to see which way the finger was pointing in 1918. It is not hard work, and well worth while.

M.C.A.H.

HISTORY OF THE SECOND WORLD WAR, CIVIL SERIES—OIL

D. J. PAYTON-SMITH

(Published by H.M. Stationery Office. Price £6·75)

This very readable volume deals with the measures taken to maintain the supply of all natures of oil to the civil population and to the armed forces during the war. It describes the difficulties encountered and overcome—difficulties caused by international jealousies, conflicting aims and commercial interests, and above all by the continual shortage of tankers. More than 6,500 were lost world-wide and of these nearly half were British. Moreover, of those operating, it was found that, due to the convoy system, the closure of east-coast ports and wartime harbour restrictions, the turn-round was very disappointing. The book contains much clearly written information on wartime refining problems, high-octane fuels and lubricants, and deals with the many difficulties that were met in attempting to reduce civil demand.

Supply to overseas theatres is dealt with fully and, at any rate in the cases of the Middle east and North-west Europe, with considerable accuracy and understanding. The Author agrees with the present writer that the really enormous loss of petrol on the Western Desert from the 4-gallon "flimsies" was probably as much due to poor manufacture (not a Sapper responsibility) as to unsuitable design. Perhaps we should have been given credit for the local production of more than a million pressed-steel welded containers before the jerrican plants arrived. The cross-channel pipelines, *Pluto* and *Dumbo*, are fully dealt with and written off as almost complete failures. Apparently the Royal Navy (like the Army) pressed unsuccessfully in January 1945 for the closing down of *Dumbo* as it was absorbing as much manpower and effort at sea as it was on land.

A very interesting book with well set-out tables and maps. Its contents are not *only* of historical interest for the problem of oil supply in any future war will be far greater. The civil demand for petrol is now eight times as great as it was in 1939.

E.F.T.

GRAINS OF SAND

EDWARD FURSDON

(Published by Five Feathers Production, Elm Tree Cottage, Ridlands Lane, Oxted RH 8 OTU, Surrey. Price 75p, plus 5p UK postage)

This book of verses from Arabia is a collection of short elegies, written in 1970 and 1972, by Colonel F. W. E. Fursdon when serving with Headquarters Land Forces Gulf, now no more. He writes that he was haunted by the beauty of that proud and ancient land and anyone, who has had sand in his hair and been bitten by the desert, will enjoy this anthology containing a miscellany of verses about the Gulf, its people and their present pursuits and idiosyncracies and what it feels like suddenly to be deposited in swinging London which for one on leave from deserts is something of a test.

J.H.S.L.

ORDNANCE SURVEY PROFESSIONAL PAPERS

(Published by the Ordnance Survey of Great Britain, Southampton, 1971)

The Institution Library has received copies of Ordnance Survey Professional Papers (New Series) Nos 21 and 22, both of which describe geodetic connections across the sea using electronic distance measurement. An internal reorganization has made it possible for the Ordnance Survey to resume publication of its Professional Papers after a lapse of 18 years, and it is understood that further Papers will appear in due course.

Paper No 21 "Geodetic Measurements across the English Channel 1963" describes an important geodetic operation undertaken jointly by the Ordnance Survey of Great Britain and by the Institut Geographique National, France. In addition to strengthening observations either side of the Channel the cross-channel observations between Southern England and the Cotentin Peninsula consisted of 10 long lines measured by microwave (Tellurometer MRA 2) instruments with observed directions along 9 of them. This work has considerably improved the connection of Great Britain to the European Triangulation Network. The paper also describes experimental work in connection with line-crossing techniques, and with meteorological observations on the path, for the measurements of long lines over water.

Paper No 22 "The EDM Connection to the Republic of Ireland 1969" describes a further geodetic operation undertaken by the Ordnance Survey Great Britain and the Ordnance Survey Dublin. Owing to lack of coincidence in Ireland between stations used by the Ordnance Survey Great Britain for the triangulation connection and those subsequently used for the Retriangulation of Ireland the link between the two was weak. Strengthening measurements were made in Ireland using microwave (Tellurometer MRA3) instruments by the Ordnance Survey Dublin and by laser (Geodimeter Model 8) by the Ordnance Survey Great Britain. However the major operation was the joint measurement of 8 long lines across St George's Channel with microwave (Tellurometer MRA2) instruments. This operation was similar in many respects to that described in Paper No 21 but no further directions were observed though 3 of the measured distances were along previously observed directions. It is now possible to include Great Britain, the Republic of Ireland and Northern Ireland as a single block for inclusion in the European Network.

B.St.G.I.

THE SCIENCE OF ROCK MECHANICS PART I. THE STRENGTH PROPERTIES OF ROCKS

PROFESSOR DR W. DREYER

(Published by Trans. Tech. Publications Adolf-ey-Strasse 1d, D 3392, Clausthal-z, Germany)

As bridges, dams, and other structures become larger and are designed more boldly with lower factors of safety, failures, if they occur, are frequently due to mechanical failure in the rocks. The demand for quantitative answers which the disciplines of geology could not, at first, supply led to a new branch of materials science—solid mechanics—following the publication in 1925 of a book by Karl von Terzaghi. Developing alongside as a vital part of geotechnology, rocks mechanics (concerned primarily with the behaviour of harder rocks) was a slightly later starter. The first International Congress was held at Lisbon as recently as 1966.

In what is now a very wide field the most promising lines of research in rock mechanics appear to be directed towards the determination of deformability of fissured or massive rock masses as a function of time; the correlation between the mechanical properties of rock and geological and petrographic data; the remote sensing of rock properties and hydraulic conditions ahead of a working face; the stabilization of rock masses (new grouting media and techniques, rock bolting and anchoring, etc.); porosity and permeability in fissured rock masses; the evaluation of slope failures in practice and the measurement of stress in rock masses before and after excavation and construction. There has been a division into two research groups, one testing rocks in situ and the other concerned with the testing of small samples and the solution of theoretical problems in the laboratory. It would be indivious to compare the merits of the two groups.

In Professor Dreyer's book, the first short section deals with mineral mechanics—a consideration of petrographic parameters such as mineral composition, mineral interlocking, grain density, granulation and porosity. The bulk of the book is concerned with the laboratory investigations on the strenth properties of rocks under defined biaxial and triaxial loads. Some in situ experimental work in mines is included. There is, however, a heavy emphasis on the properties of halite (rock-salt) and other salts which are of widespread occurrence in Germany. With only two working salt mines in the British Isles (Winsford in Cheshire and Kilroot in Northern Ireland) much of this work will not be of interest to British readers. The flowage which occurs in halite is, in any case, atypical of the behaviour or normal indurated rocks.

This is definitely a reference book for the mathematical theorist—it will rarely be consulted by the practical engineer.

P.I.M.

THE OLD FRONT LINE

JOHN MASEFIELD

(with an Introduction by Colonel Howard Green MC)

(Published by Spurbooks Ltd, 88 Blind Lane, Burne End, Bucks. 140 pages. Price £1·95)

AND

THE VICTORIAN ARMY AND THE STAFF COLLEGE. 1854–1914

BRIAN BOND

(Published by Eyre Methuen Ltd, London. 300 pages. Price £5·50)

In the Middle Ages siege warfare was commonplace and the soldiers of that age recognized its extremely costly nature. They therefore devised a civilized convention to limit the casualties. The attackers pounded the fortress walls to make a breach, while the Sappers sapped towards it. When it was thought that the breach was "practicable" the two commanders met to look at it. If it was deemed practicable the defenders were given two options: either, they might march out with arms and honour and civilians spared; or, if they continued resistance, they must expect the fortress to be sacked if surrender became inevitable later. The whole operation was thus a matter of military science and instructed opinion. Slaughter only followed obstinacy or faulty judgement.

On the Western Front in the First World War, however, no such convention was observed. The Germans hurled their well-drilled infantry against the fortress of Verdun; and the Allies (mostly British) poured out their valiant manhood against the barbed wire and machine guns of the Germans on the Somme. Verdun did not fall, and the German position on the Somme was never pierced. Over a million men (half of them from these Islands) were killed or wounded in the Battle of the Somme; and the Germans sustained a quarter of a million casualties at Verdun. Neither Commander had seen the alleged breach; and on the British side, at any rate, any subordinate who reported that the wire was still uncut was told he was "windy" and replaced.

In a former age the attackers would have called their Chief Gunner and Chief Engineer (who might have been one man acting in the two capacities) and told them to renew their efforts till a practicable breach was made. On 1 July 1916, however, in the highest hopes the waves of British Infantry "went over the top" against unbroken defences, held by staunch defenders.

Colonel Howard Green MC, who writes the Introduction to *The Old Front Line* tells the tale of this battle, which he describes as "the most terrible in British history". It lasted officially from 1 July till 18 November; and men from Britain, Australia, Canada, New Zealand, Newfoundland and South Africa (many of whom were fighting against us a few years before in the Boer War) all paid the awful forfeits. The only gleam of success was in the South, where we had heavier artillery and where a young Gunner, a Major Alan Brook, devised a type of barrage never used before. Tanks and Cavalry, both British and Indian, took part and "the flower of the British Empire died on the Somme".

Colonel Green describes it all in detail. The dustcover does not tell us whether he was there himself; but the account is so vivid that one feels he may have been. (The account itself was recently written.) He conjures up the gay, romantic, adventurous spirit of Kitchener's Army; and he describes in simple but moving language how the battle was fought.

The second part of the book was written in 1917, shortly after the Germans withdrew (voluntarily) to the Hindenberg Line. As one might expect from the pen of a War Correspondent destined to become the Poet Laureate, John Masefield wrote with captivating style. He describes the scene rather than the events; and bearing in mind the sensitivity of his wartime readers (and perhaps the Censor too) he spares us the horrors; but he certainly conveys what can best be called the *ethos* of the occasion. It is beautifully done, and the reader must read it for himself.

In spite of the blunders the Battle of the Somme was not entirely without its effect upon the final victory. The continuous pounding of the German trenches shook the defenders, who were the cream of the German Army. Though that army was formidable to the bitter end there was never again (as German writers have told us) the same spirit of heroic sacrifice that animated the men on the Somme.

With hindsight, few doubt that the Generals were right in insisting that victory would only come from the offensive, and that France was the decisive front. The idea was right; the method was wrong; and the continuance of the battle when all hope of victory had vanished deserves severe censure. But the Generals do not deserve all the strictures heaped upon them by some later writers. Divisional Generals were often in the Front Line, and the inevitable

remoteness of Corps and Army Commanders is not the same as callous indifference. Moreover, one must remember the background of doctrine, training and experience to which these Generals were heir; and that brings us to the second book under review, a book about the Staff College.

During the long peace between Waterloo and the Crimean War the cadre of officers who had fought under Wellington faded away. Lord Raglan, who commanded in the Crimea, had only been an ADC at Waterloo; and most of his senior officers had been schoolboys in 1815. Since there was very little formal education of officers during the period, and nothing approaching a General Staff, it is little wonder that many officers were out of their depth when it came to managing a campaign in the far away Black Sea. The many shortcomings in the war direction raised doubts in the minds of persons in authority, both inside and outside Parliament; and measures were taken for improving the state of affairs. The establishment of the Staff College was one of the most important steps taken to raise the whole standard of British Army efficiency.

The Staff College grew from what was known as the Senior Department of the Royal Military College. The Junior (or cadet) Department was at Marlow, the Senior Department was at High Wycombe. Later they moved, respectively, to Sandhurst and Farnham; and the Staff College was opened in Camberley in 1862, the General Staff being formed much later.

A photograph in *The Victorian Army and The Staff College 1854–1914* shows "the Professors. 1864" in which the central seat of honour is occupied by a clergyman who was Professor of Mathematics; while the Commandant, Colonel Lacy, appears to be a less important person. In Plato's Academy mathematics had pride of place in the curriculum for statesmen, and Napoleon was said to have been good at mathematics as a cadet; so the subject certainly has valid credentials as an educational subject for leaders of men. But it is one thing to improve the mind of a youngster and quite another matter to train maturer men to handle troops correctly in the field; or to manage a campaign. Moreover, there must be a "School of Thought" throughout an army, which academic studies and many examinations do little to foster. However, by the establishment of the Staff College a beginning was made.

The emergence of continental General Staffs in the middle of the nineteenth century, and especially the electrical victories of von Moltke, focused attention on what was lacking in Britain and gradual reforms were made. The experiences of the Boer War were not always reassuring, and all the time it was becoming more and more evident that war with Germany was not to be ruled out. The fact that an extremely efficient British Expeditionary Force got to France on time, with all its equipment and a sound doctrine of mobile warfare, stands to the credit of the Staff College and the General Staff which grew from it.

Brian Bond, a Lecturer in War Studies at London University, tells us the story of this development from the time of the Crimean War till the First World War. He tells of the gradual change from purely academic studies at Camberley to a curriculum not unlike that which we know today. When one considers the vast complexity of a national army, and what a formidable task it must be to evolve a staff system from scratch, one is compelled to admire the foresight of soldiers such as Wolseley and Napier or civilians such as Cardwell and Esher.

It may come as a surprise to younger readers to find that French, the C in C of the BEF in 1914, had never been to the Staff College; and that Lord Kitchener, who was certainly the most eminent British soldier of the day, had not been there either. Haig, Commander I Corps, had been at Camberley; and so had most of the other Generals and a few of their staff, but not all. Many officers and men had had active service experience in the Boer War, and many of the senior officers had successfully commanded columns of all arms in South Africa. Annual manoeuvres had given them opportunities of handling modest formations in peacetime; but no one had handled armies as the French and Germans had done. They had studied the withdrawal—largely due to the insistance of Robertson, who had been Commandant and this must have contributed to the skill displayed in the Retreat from Mons. There was apparently little thought given to siege warfare, and General (later Sir James) Edmonds—a Sapper—told your reviewer in later life that he was fiercely rebuffed when he pointed in 1906 to some of the lessons of the Russo-Japanese War. When the Western Front became congealed in 1915, a novel form of siege warfare began; for which neither the minds of the commanders nor the equipment of the armies were prepared. That in large measure applied to both sides; and when one contemplates the immense pressure under which they all had to work, it is not surprising that they did not see at once the answer.

Wars seldom run to a predictable plan and it is essential for some means of keeping military thought, as it were, molten all the time to assimilate change. The Staff College is an

obvious place for this; yet the Staff College was closed down in 1914, and almost every staff-trained officer in the British Army went on Active Service. Many of them were killed and some worked themselves to death in harness. It is not, therefore, fair to blame the High Command in France without some reservations for what happened in the Battle of the Somme.

This book by Mr Bond describes the whole development of the Staff mind, as well as the Staff College, in a scholarly way with many notes suitably grouped at the end of each chapter. Your reviewer is slightly pained by seeing the ICS described as the India [*sic*] Civil Service; but never having been to the Staff College himself he is not too much offended by seeing those who qualified there described as "p.s.cs." The book is eminently readable; dealing, as it does, with personalities as well as events. Taken with the first book under review, the reader gets a balanced—and perhaps more charitable—view of the leadership in the World War of 1914–18 than he may have had before. Both books are well worth reading. They are totally different in every way, except that both are very well written and easily read Your reviewer commends them both.

M.C.A.H.

Technical Notes

CIVIL ENGINEERING

April 1972

CARBON FIBRE CEMENT COMPOSITES. Oscar Faber and Partners, Consulting Engineers have recently initiated a research programme on reinforcement of cement by carbon fibres and the article by J. A. Waller, BSc, CEng, FICE, ACGI, DIC described Faber's experience with the material so far.

The properties of carbon fibres and cements are reviewed in relation to each other. Later the author points out the problems of producing a proper random distribution in two and three dimensions. The current price of carbon fibre is very high but this is inevitable with a total world production in the region of 15 tonnes. A material with the same Young's modulus as steel, an ultimate tensile strength one and a half times that of prestressing strand and a density of less than a quarter that of steel cannot be ignored. It is a most promising structural and non-structural material that invites enthusiastic exploitation.

BRITANNIA BRIDGE, MENAI STRAIT. On 23 May 1970 a disastrous fire very seriously damaged Robert Stephenson's cast iron tube bridge. Urgent remedial work was carried out by the Corps, who erected tall Bailey Bridge trestles from which loads of 200 tons were jacked to relieve stresses on the cast iron tubes. The work carried out was described in the December 1970 issue of the *RE Journal*. The reconstructed bridge is of steel spandrel braced arches with three ribs to each span. The bottom booms of the arches are of welded steel box sections, high yield steel is used where stresses are particularly high and joints are formed with gusset plates and 1¼ inch high strength friction grip bolts. The arches are two-pin and the bearings are of stainless steel weighing 1·5 tons and capable of supporting 2,500 tons per arch rib.

DEMOLITION. In the Corps demolition usually implies the violent destruction of buildings or bridges in war time. In this series of articles civil demolition is discussed from many aspects such as the Code of Practice, hand methods, mechanical methods, explosives and thermic lancing. A point which is considered is the need of the demolition contractor to know how a building is constructed, so that he can contrive a safe demolition method. Also of importance is that "engineers should take account of the fact that a building will not last for ever and to allow for eventual demolition".

W.G.C.

May 1972

WORTHING PUMPING STATION. In this project for dealing with the additional discharge of foul and surface water in connection with a trunk sewer relief scheme, a 3,000 ton concrete caisson 25·6m in diameter and 17m high is being sunk by the Lorenz/Fehlmann method. Skin friction is eliminated by pumping bentonite slurry around the periphery. Excavation is by a front end loader within the caisson filling skips, which are removed by crane. After sinking to the precise depth required the floor of the caisson is reinforced and concreted. The bentonite lubricant is displaced by the injection of cement grout. The sole UK rights for Lorenz/Fehlmann method are held by Foundation Engineering of the Costain Group.

LOWESTOFT BRIDGE. Since 1885 the two parts of Lowestoft split by the Bridge Channel, which connects the inner and outer harbours, have relied on a single leaf swing bridge for communication. This proved inadequate for modern traffic and has become unreliable, resulting in considerable disruption of road traffic. The new structure, designed by J. M. Erde, BA, MICE of Sandford Fawcett, Wilton and Bell is a double leaf trunnion bascule bridge of 100 ft span between trunnion centres. Bridge movement is controlled by two pinions in the tail of each leaf and working against steel racks in the concrete abutments. The bridge is driven by slow speed hydraulic motors, which were adopted instead of the specified electric motors with Ward/Leonard control and a third alternative, hydraulic rams, which were successfully used on a bridge at Lubeck in Germany. When the leaves are in the lowered position they are secured by nose bolts and tail locks to ensure rigidity. The leaf tails move inside a reinforced concrete abutment chamber which is founded on steel H piles, 12 in × 12 in, driven 60–90 ft into the sand subsoil. The cost of the works was around £700,000 and the bridge was formally opened on 24 March 1972.

W.G.C.

THE MILITARY ENGINEER

MARCH–APRIL 1972

The main article of interest in this issue is on Soviet Land Mine Warfare. The text does not deal with the mine hardware, but concentrates more on the Soviet principles of mine warfare. The Soviet approach to this subject is discussed with regard to their engineer organization and offensive and defensive doctrines. Their methods of laying and breaching are also considered in some detail.

Augmenting the above article for the Combat Engineer there are three short pieces on road construction. Two deal with the problems of flooding, one proposing methods to prevent embankment erosion and the other dealing with the construction of a Ford. The third deals with the organization of a clay lime borrow pit for production of a sub base material for road construction. There is also a short review of revetments for protecting combat aircraft.

The computer has been a tool for the design engineer for approximately a decade. In this issue, the American Corps of Engineers' approach to the application of computers in design engineering is discussed, their method of training designers and the computer library are also considered.

Two articles of interest to the engineer with the problem of mooring tankers inshore, are the descriptions of "A Rapid Mooring-construction System" and the use of Sonar for Tanker Mooring site surveys. The former describes a system for mooring tankers, at unprotected offshore locations, of 16,500 and 25,000 DWT, while the latter discussses the use of the Acoustic Underwater Survey Equipment (AUSE). This equipment is capable of profiling sub bottom sediment layers and indicating general sediment composition up to 50 ft below the ocean floor, locating man-made objects and natural features on the ocean floor, and providing a continuous water depth record.

M.F.R.C

Forthcoming Events

2–3 September	RSME Open Day and Veterans Weekend	Brompton
21 September	RESA Regatta	River Medway
22 September	RESA AGM	Brompton
23 September	Mary Cup/Smith and Turner Cup Races	River Medway
5 October	Civil Firms Guest Night	RE HQ Mess
17 October	Band Concert	RE HQ Mess
28 October	SSAFA Ball	RE HQ Mess
7 November	E in Cs' Cocktail Party and Buffet Supper	RE HQ Mess
12 November	Remembrance Parade	Brompton
23 November	49 YO Batch Night	RE HQ Mess
8 December	RSME Winter Ball	RE HQ Mess

SPORTS AND GAMES FIXTURES

RE GOLFING SOCIETY

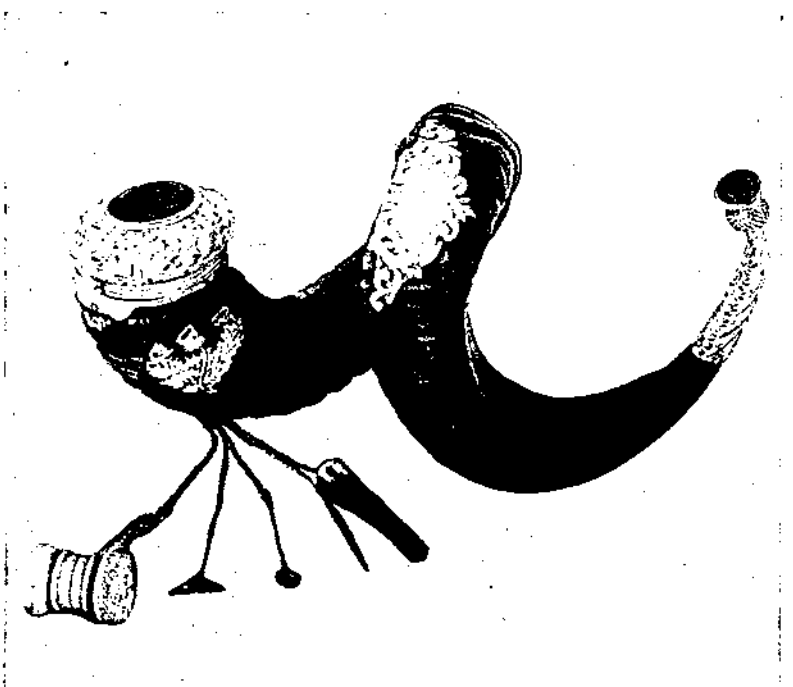
5–6 September	AGS Autumn Meeting	Berkshire
28–29 September	Autumn Meeting	Deal
12–13 October	R St Georges	Sandwich
14 October	RMC GS	Huntercombe
18 October	RMA GS	North Hants
25 October	Serving *v* Retired	Hankley Common

RE HOCKEY CLUB

20 September	Staff College	Minley Manor
23 September	RE Inter Unit 6s	Chatham
24 September	Bournemouth 6s	Bournemouth
6–7 October	Army Inter Corps	
14 October (L)	West Hants	Eastleigh
28 October (L)	Old Tauntonians	Longmoor
4 November (L)	Trojans	Longmoor
11 November	R Sigs	Longmoor
15 November	Oxford University	Oxford
18 November (L)	Fareham	Longmoor
25 November (L)	Bournemouth	Longmoor
2 December	Infantry	London (Burton CT)
9 December (L)	Old Edwardians	Eastleigh
10 December	Blackheath	Chatham
16 December	Hampstead	Chatham

RE RUGBY FOOTBALL CLUB

25 October	RAOC	Chatham
1 November	RMCS	Shrivenham
8 November	RMA	Sandhurst
22 November	RCT	Chatham
29 November	R Sigs	Chatham
6 December	RA	Woolwich
20 December	RM	Deal



This snuff box was presented to the Mess in 1844 by George Sim, Bengal Engineers. It is one of the many historical pieces of the RE HQ Mess collection. Photographs and descriptive details, written by the Late Colonel J. M. Lambert, of fifteen Mess portraits and forty-one pieces of Mess silver are included in a beautifully illustrated booklet entitled

THE PORTRAITS AND SILVER OF THE RE HQ MESS

The book is obtainable from the Secretary, Institution of Royal Engineers, Chatham, Kent. Price £1·50 post free in the United Kingdom.

Articles for the Journal

THE *Journal* depends for its existence on articles submitted for publication on historical, professional and technical subjects of interest to Military Engineers.

They may be of any length, but preferably not more than 6,000 words. They should be typed in duplicate on one side of the paper only, double spaced with one-inch margin. A third copy should be retained by the author for checking with proofs.

Photographs to illustrate an article should be black and white prints on glossy paper. Usually not more than four photographs will be published to illustrate each article. More photographs may, however, be submitted from which the Editor will make a selection. The size of the photographs does not matter as they can be reduced in size for publication. Line drawings, maps, etc must be in black ink, and all lines, lettering, etc must be bold and clear to allow for reduction in size when reproduced. Scales must be drawn and not worded.

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

Payment for articles is at a rate decided by the Publications' and Library Committee. An extra £10 award is made at the discretion of the Committee for articles of particular merit published in each issue of the *Journal*. In addition two prizes, the Montgomerie and Arthur ffolliott Garrett Prizes, are awarded each year for outstanding articles by RE officers, not above the rank of Lieut-Colonel, published in the *Journal*.

Articles may be submitted at any time and correspondence is always welcome. However, the following dates are normally the latest for inclusion in the issues shown:

March issue	1 December	September issue	1 June
June issue	1 March	December issue	1 September

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