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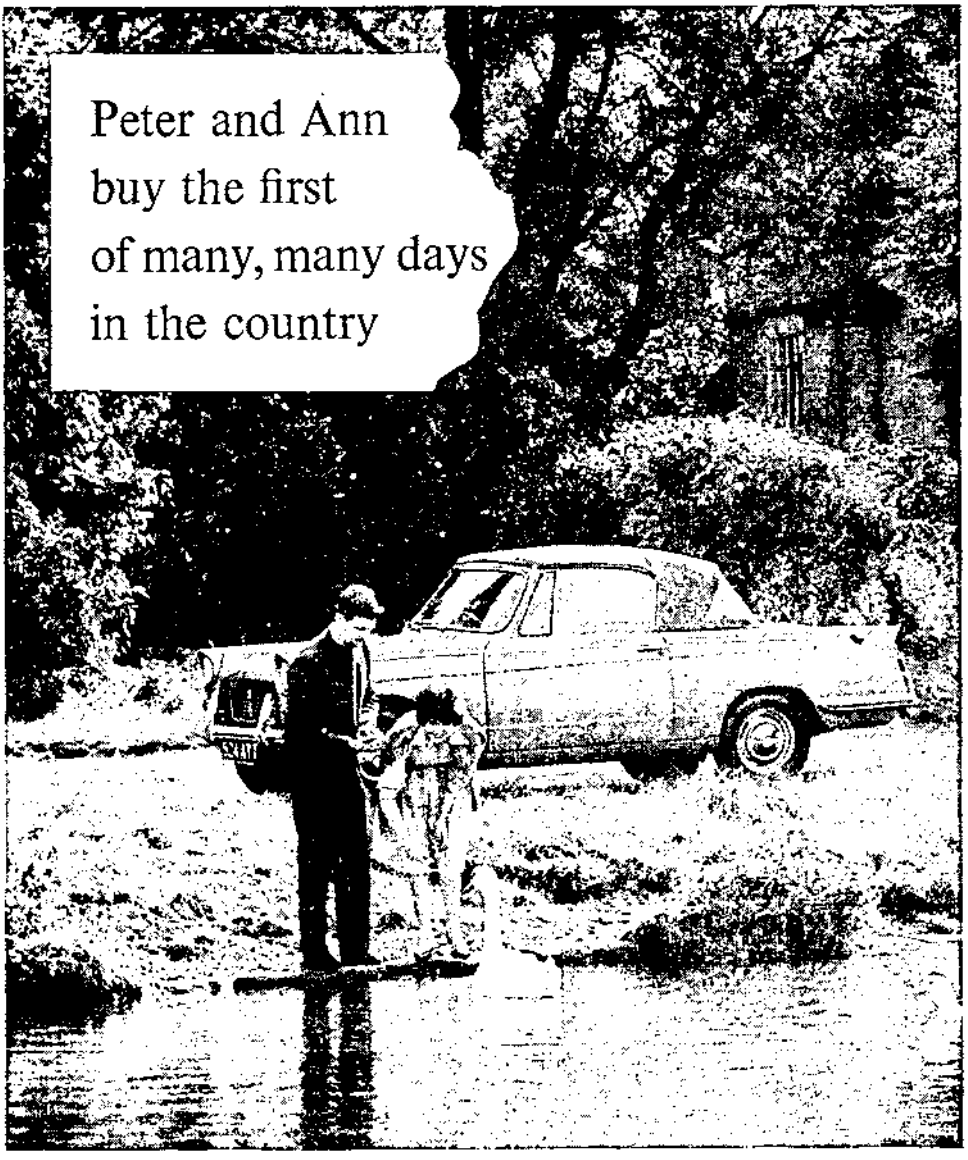

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Corps Notes

It is with deepest regret that we have to announce that General Sir Kenneth Crawford, KCB, MC, Chief Royal Engineer, died on 5 March 1961.

* * * * *

On 1 January 1961 Lieut-General Sir John Cowley, KBE, CB, Master General of the Ordnance, became Colonel Commandant the Royal Pioneer Corps in place of General Sir Frank Simpson, GBE, KCB, DSO, whose tenure of office had expired.

* * * * *

Brigadier H. E. Hopthrow, CBE, ERD, has been elected Secretary of the Royal Institution in succession to the late Sir Harold Spencer Jones.

* * * * *

In the past six months of 1960 the War Office, assisted by the Air Ministry and Arms Schools, conducted a Staff Study, called "Barebones", for the Quartermaster General. The conclusions of the Study which dealt with the mounting, deployment, and maintenance of a limited war force were presented at the SME, Chatham.

* * * * *

The Engineer-in-Chief's Exercise "Young Marcus" was held at the SME, Chatham, last November. It was attended by all Chief Engineers both home and abroad and officers in senior Sapper appointments and Commanding Officers of RE Units serving in this country and in Europe. Colonel D. W. Cunnington, GM, CD, Chief Engineer the Canadian Army, and Brigadier-General R. B. Warren, representing the Chief of Engineers the United States Army, were also present. The address given by the Engineer-in-Chief to the senior RE Officers is printed in this edition of the *Journal*.

* * * * *

On 6 December last 23 Independent Field Squadron RE undertook the emergency task of building a 150-ft Bailey Bridge across the River Taff at Radyr, near Cardiff, to carry an 18-in water main, the previous pipe and its supporting bridge having been swept away by flood water. The task was greatly assisted by the co-operation and help forthcoming from the City Engineer's Department, the CRE and staff of 109 (Glamorgan) Field Engineer Regiment (TA) and from 1 Engineer Stores Depot, Long Marston; in spite of difficult approaches and an awkward site the task was compleeed in 21 hours.

* * * * *

The annual relief of the Independent (Arabian Peninsula) Troop RE at Aden was carried out by air last November by another troop from 38 Corps Engineer Regiment stationed at Ripon. During November also 3 Independent Field Squadron RE of the Strategic Reserve in the United Kingdom replaced its troop, serving in Kenya, by another troop. 59 Field Squadron RE re-

mains in the Southern Cameroons in engineer support of the Infantry battalion group there. 160 Works Section RE, having completed its task in providing accommodation, returned home and disbanded.

* * * * *

38 (Berlin) Field Squadron recently presented to "B" Squadron 14/20 King's Hussars a silver model of the Brandenburg Gate, to mark the latter's departure from Berlin. For three years the two Squadrons had shared the same barracks and run joint messes. The model, a photograph of which is published with these Notes, is 5½-in high and it was specially commissioned to commemorate the close association between the two units. "B" Squadron 14/20 King's Hussars presented 38 (Berlin) Field Squadron RE with a large framed hunting print.

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The Queen's Commendation for Brave Conduct was bestowed last December upon Sapper M. Sheevan RE for his gallant conduct in rescuing a child from drowning in a rough sea at Bridlington.

* * * * *

Lieut-Colonel R. L. Clutterbuck, OBE, RE is to be congratulated on winning the 1960 Bertrand Stewart Prize Essay Competition.

* * * * *

The reorganization of the Territorial Army has resulted in an overall reduction in all Arms of the Service. The position of the Corps, however, compares favourably with most other Arms. Seventy-five per cent of RE (TA) units have been retained which reflects the importance of Sappers in a modern streamlined Army. Nevertheless two Lieut-Colonels' commands

have unhappily been lost and some twenty-five RE Squadrons have unfortunately had to lose their identity, their volunteers being absorbed by remaining engineer units.

* * * * *

We are glad to publish in this edition of the *Journal* accounts of the award of the Freedom of Birkenhead bestowed upon 113 (Cheshire) Army Engineer Regiment (TA) to mark the centenary of the formation of the Cheshire Royal Engineers Volunteers from whom the unit is descended, and the award of the Freedom of Wallasey to the 624 (1st Cheshire and Carnarvon Artillery Volunteers) Crane Operating Squadron Royal Engineers (TA), formed on 31 January 1860 as the 4th Cheshire Company of Artillery Volunteers, to mark the granting of a Charter last year to the County Borough of Wallasey. The Corps will wish to congratulate both these historic Territorial Sapper units on the honour bestowed upon them. Congratulations are also extended to 506 Field Squadron RE (TA) who were recently presented with the Freedom of the Borough of Wallsend.

* * * * *

Telegrams of greetings were exchanged between the Corps of Indian Engineers and the Institution of Royal Engineers to mark the India Day Celebrations. This edition of the *Journal* contains an account of the activities of past and present members of the Gurkha Engineers during the recent visit to this country of Their Majesties the King and Queen of Nepal.

* * * * *

1 April 1961 will mark the 50th Anniversary of the formation of the Air Battalion Royal Engineers. On 1 April 1911 the RE Balloon School was reorganized as the Air Battalion RE with an establishment of fourteen officers and 176 other ranks. The final phase of the responsibility of the Royal Engineers for military aeronautics had begun, namely that of training officers and men in the handling of all types of aircraft and providing a small body of expert airmen from which air units for war could be formed. The history of this unit was short but eventful and saw a remarkable advance in power-driven aircraft.

On 13 May 1912 the Royal Flying Corps was officially inaugurated and took over from the Air Battalion RE, absorbing most of its personnel. The Sappers' responsibility for military aviation which the Corps had sponsored since 1878 from pioneer work with kites, balloons, airships and flying machines had come to an end. *Quo fas et gloria ducunt: Per ardua ad astra.*

* * * * *

The first Joint Professional Meeting of the Institutions of Royal Engineers and Civil Engineers was held at the London Headquarters of the Institution of Civil Engineers on the evening of Thursday 2 February.

In the absence of Sir Herbert Manzoni, President of the Institution of Civil Engineers, who was unable to be present, the chair was taken by Sir George McNaughton, the senior Vice-President of the Institution. After some preliminary Institution business he asked Major-General Sir Douglas Campbell, President of the Institution of Royal Engineers, to take the chair and to conduct the Meeting.

Brigadier R. B. Muir presented his paper "Engineer Support to the Christmas Island Nuclear Tests of 1958" to a large audience composed of Members of both Institutions. A discussion of his paper followed during which a number of Royal Engineers officers spoke as well as civilian officers of the Admiralty Engineering Department and the War Department Works Organization. The Chief Royal Engineer, General Sir Kenneth Crawford, expressed our thanks to Sir George McNaughton for opening the Meeting and to the President and Council of the Institution of Civil Engineers for making the Joint Meeting possible, and for so kindly making available all the necessary facilities for it. He also expressed the wish that the meeting might be the forerunner of other similar Joint Meetings.

It is hoped to publish in a future edition of the *RE Journal* details of the discussion that took place on Brigadier Muir's paper.

It is most appropriate that we are able to publish in this edition of the *Journal* an article written by Major D. H. de T. Reade, the Information Officer of the Institution of Civil Engineers, entitled "Unbroken Links between Civil and Military Engineers" which describes the historic and long-established association between the Institution of Civil Engineers and our own Institution.

* * * * *

This edition of the *Journal* contains an article setting out the Council's views on altering the present membership structure of our Institution. The changes they recommend are designed to improve the professional status of the Institution of Royal Engineers in relation to other professional Chartered Institutions by introducing a graduated system of membership comparable to the various types of membership in force in other Chartered Institutions. The Council's proposals will be submitted in the form of a Special Resolution at this year's Annual General Meeting. The actual wording of the Resolution will be published in the *Supplement*. The purpose of the article is to give background information and to let all Members know why the Council proposes these changes which they consider to be in the best interests of the Institution.

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Lieut-Colonel A. R. Currie, DSO, OBE, AMNZIE, RNZE, formerly Chief Engineer, New Zealand Army, and a Corresponding Member of the Council of the Institution of Royal Engineers since 1 January 1949, has retired.

His place as a Corresponding Member is being taken by Lieut-Colonel P. H. G. Hamilton, BSc, AOSM, RNZE, the new Chief Engineer New Zealand Army.

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Sign-post for Royal Engineers

By Major-General T. H. F. Foulkes, OBE
The Engineer-in-Chief, the War Office

The following address was given by the Engineer-in-Chief to Chief Engineers and other senior Royal Engineer officers assembled for his Conference, held at Chatham during the last week of November 1960.

Gentlemen,

The general nature of our duties towards the Army has always remained so much of a kind that a review of our functions and how we have performed them in the past will give some indication of what we can expect in the future.

In using this retrospective approach I am not ignoring the fundamental changes that are taking place in the conduct of war through a vast increase of fire-power, the advent of radiological hazards and, to a lesser extent, improvements in machines and instruments. But as engineers we have always to deal with realities, in terms of solid matter, and I am not aware of any recent change in the laws of gravity, the width of the world's rivers, the sliminess of mud, or even the Principle of Archimedes. And as for radiation and this phenomenal fire-power, they are likely to do far more to enlarge our tasks as engineers, and hinder our efforts, than help us with our work.

When I remind you of who we are and what the Corps is I shall be saying things that were so well known to many of our predecessors that they took them for granted. But they need to be stated afresh because some Sappers, through specializing in one department of military engineering or another, have found it hard to retain a broad enough view of the Corps; besides which, the drastic changes occurring in the Army as a whole have made it less easy to see clearly where the Corps stands within it.

It is not one of my objects today to beat the Corps drum, though I believe it does no harm to give it a thump now and then; but we can all take some comfort from most of the things I am going to say.

I am not offering you anything in the nature of a large-scale map showing in detail the routes to follow, but more of a signpost, a "Signpost for Royal Engineers", and the Royal Engineers to whom I refer are the combatant and fully trained officers of the Corps, not the other ranks, nor, with some exceptions, the officers who are commissioned from warrant rank.

I am very well aware that the overall achievement of the Corps has been no less due to the military and technical quality of its other ranks than to any other factor. I know that, as the level of the education of the Country has gone up so the capabilities of our ORs have risen, and must continue to rise, with it. I also know how very much the Quartermasters of the Corps, of all categories, contribute to its efficiency.

The other ranks follow where the officers lead, and their own skills must of course be related to the qualifications of their officers: but it is of the officers that I am now going to talk.

Let us first glance at the background to my subject.

In 1904, a Royal Engineer, Colonel Capper, later Major-General Sir John

Capper, Colonel Commandant of the Royal Tank Corps, met the Wright brothers in the United States and received from them a proposal to spend four years in England working solely for the British Government. The remuneration suggested was £20,000; but the War Office turned this down as it had no belief in military aviation, and declined, even in 1906, to buy one of their flying machines.

Since it was only eight years later, in 1914, that Von Kluck's strategic moves were disclosed, just in time, by aerial reconnaissance, one is led to suspect that the authorities had been somewhat stupid and short-sighted. But in reality, occurrences of this kind do more to demonstrate the difficulty of peering through the veil than to expose the blindness of those whose vision fails to penetrate it; and no doubt this decision was influenced by the unquestionable efficiency of our Cavalry in their ground reconnaissance duties.

Fifty years ago the fire-power of the machine gun was obvious; so, too, was the value of barbed wire as an easily manufactured and portable obstacle; but very few foresaw their decisive influence when used in conjunction, or the static nature of the war they were going to produce.

Again, as late as 1909 the Army, acting on the best civilian technical advice, decided that petrol was too inflammable for use on active service. There was little difficulty in forming a mental picture, accurate as far as it went, of vehicles getting "brewed up", but it is given to the very few to be able to hold in mind a total and perhaps distant situation, and it was too hard to foresee that, in the two world wars that followed, petrol-driven vehicles would be in common use in the field and the risk of their catching fire had been wrongly assessed.

These, and other military developments that now look obvious in retrospect, proved to be generally unpredictable at the time.

The problems that confront the soldier today are far more complicated and speculative. The Secretary of State, in a speech to RE officers of the Army Emergency Reserve in February 1960, said it had become just about as easy for the layman to understand strategy and tactics as to master the intricacies of the gold standard. Liddell Hart himself admits he does not know the answers to our defence problems in the nuclear age, though he did know most of the old ones, and published them, before the war. And the CIGS, at his Autumn Exercise, found it necessary to utter a warning against the all-too-easy fun of debunking and what he called the "military agnosticism" that it can lead to.

But if only one thing is obvious in all this it is that, to come to terms at all with military problems in the present age, a combination of military and scientific judgement is required, which can be obtained only by aptitude, training and experience.

In December 1958, Brigadier J. B. Brown set a lot of Sappers thinking when he published his article, "Whither the Corps?" in which he deplored what he believed to be our technical decline, taken in conjunction with loss of experience in Works.

In one of the many published replies I said I felt that while his warning was timely, and that technical training of officers had suffered as a result of the war and subsequent emergencies, the real and perennial problem was one of balance between the military and technical sides of the RE officer's training and that, to understand this, one must appreciate the true nature of the profession of the military engineer.

I wrote a good deal more than this and have not changed my mind in the meantime ; but I was cautious enough to use the pseudonym of "Fabius" in case the future Engineer-in-Chief should subsequently find himself in open disagreement with the former CE Southern Command.

It was not because he was the Stonewall Jackson of antiquity that I was attracted to this Roman Consul, in fact I have always felt somewhat disillusioned by the inability of the warlike Romans to give the Carthaginians a proper battle, but because I believe he said, at a time of grave emergency; "By taking thought we may save the State"—a theme to which I shall return.

Last year, after lunch at an All-Arms Exercise, I was in danger of dozing when I heard the speaker say with some wit, "We, too, have our Latin motto: *Ubentum—vimendum.*" I dreamily asked myself, "Mend what?" Guns, vehicles, wireless sets, electronic equipment and missiles, of course. Mend, and maintain. "And in former times?" Dented armour, part-worn axes, notched sword-blades and blunted arrows, forsooth!

And then I began to see what that officer really was: an Armourer, a member of one of the most ancient, indispensable and respected trades known to war. A specialist: at different periods of history specializing in one vital activity or another according to the current needs of the fighting man; sometimes overlapping or amalgamating in his duties with other functions such as those of the Farrier, the Wheelwright or the Custodian of Warlike Stores; but always a specialist with definite limits to his functions: in modern parlance, an equipment engineer.

Who then was that engineer in Shakespearian times who had such notorious bad luck with his petard? Was he, and is he still, a technical specialist?

In some ways, yes. In the making of obstacles, such as ditches, pallisades and castle walls; or minefields at the present time, and of course in the destruction of routes across existing obstacles. And on the opposite side, a specialist in the surmounting of obstacles, both natural and artificial, by the undermining of walls, by breaching, blasting and bridging; and, today, by the gapping of minefields and the demolition and dozing away of obstructions to movement. Hence, by long experience, a professional specialist in all the defensive arts of war, as well as in the tactical passage of enemy obstacles: much too closely mixed up in the battle, moreover, to be able to do his duty at all without himself being a good soldier.

A specialist in carving out routes and roads, usually through series of topographical obstructions. A specialist in survey which he, more than anyone else, has raised from the ancient arts of laying out buildings and fortifications to its present state of scientific refinement.

A specialist in building accommodation for troops in the field with all the engineer services the human body demands; and in the construction of logistic installations needed to support fighting units, not omitting oil for the Army and the Royal Air Force, or the generation of electrical and mechanical power. A specialist at airfield work in all its aspects; in handling cargoes and moving stores through waterways, ports and beaches; in building and operating military railways; and hence well qualified to control military movement. A specialist in the provision and handling of his own "ammunition": that is, the engineer stores required for all such work. A specialist in bomb disposal and the use of explosives.

Finally, in a small but important way, and through an early technical alliance with the Post Office, a specialist "postman".

Quite a lot of specific tasks, quite a lot to learn and quite a lot of engineering science to acquire; but by no means the end of his liabilities.

So what else beyond these duties? Clearly, the application of engineering science, so necessary to his own specific functions, to war in general. In fact, the whole of that large region of responsibility which extends from the province of the fighting soldier with a weapon in his hand to that of the unarmed man of science; excluding only those well-fenced fields definitely allotted to some such specialist as the Signaller and the Armourer; a largely unmapped country where the military engineer has always held the mineral rights and which has produced, so far, such things as Greek fire, battering rams, oil-boilers, catapults, dare I say guns and gunnery? mines, petards, hellburners, smokes and gases, mechanical transport, telegraphy, balloons, flying machines, tanks, and photography in ground and air survey and in astronomy; and no doubt still holds many hidden treasures.

Such thoughts recall an address by Sir Eustace Tickell at the Royal United Service Institution in 1949, when he said of the military engineer: "He stands in the place of the residuary after all specific legacies have been allocated, and he never quite knows until the time comes what he is going to get. Although so much engineering is now the duty of others, an ever-increasing amount seems to be left over for the residuary legatee."

Here is another quotation, from a different source: "The present age is pre-eminently a mechanical one, using the word in its broadest sense to cover the entire range of engineering. . . . The nation which is best prepared in engineering matters will gain an immense initial and, perhaps, final advantage. . . . It is, therefore, of the first importance that a careful study of the manner in which engineering resources can be utilized in war should form one of the paramount duties of the higher direction of the army, both in peace and war, and that there should exist an organization by which such matters can be definitely brought to the notice of the responsible authorities together with a machinery by which the whole resources of the engineering professions of civil life can be brought to bear on the solution of military problems and made available in war for the service of the army."

True enough; and in case you suppose it to be something which has just been thought up, let me tell you that that is an extract from the report of the Rawlinson Committee, written in 1919, no less than forty-one years ago.

Before I turn to the technical half, I shall add a little about the military side of our duties. The greatest practical problem that always confronts the military engineer in the field is to complete all the essential processes, in the way of reconnaissance and survey, the assessment of engineer intelligence, design and calculation, and the provision of stores, that must be done before the real work can begin; and to do so quickly enough to keep pace with operations, the tempo of which is getting faster all the time. Hence the necessity for good engineer communications, and for engineer reconnaissance and the movement of small stores by air; hence also the need to collect engineer intelligence and make plans, whenever possible, far in advance of operations. Unlike other arms, who can rely on their first-line ammunition to see them through any short battle, we cannot standardise all our stores, our engineer ammunition, and carry with our forward units the wherewithal to do every task that might confront us at short notice. We must either be given time, or make it somehow.

It has been written of the late Brigadier Kisch, Chief Engineer, Eighth

Army: "The skill of a Chief Engineer lies not so much in technical brilliance (though Kisch had this to the full) but in correct and timely military appreciation and its reactions to engineer commitments, before he is given any orders. Only thus can he hope to make adequate arrangements to keep pace with operations."

That is why it is so exasperating for any resolute Sapper ever to be kept in the dark; but even when the staff understand this, and the more experienced of them do, the military engineer needs a power of anticipation verging on second sight.

It is a peculiarity of the Corps that every RE officer, however junior, is liable to find himself in the position of trusted engineer adviser to some commander in the field, and it is essential for the advice he gives to be good. Should any Sapper, through personality and military qualities, become adviser to a higher commander and yet be unable to offer sound advice on the wide field of engineering problems that might come his way, it would be a very unsatisfactory situation, and one that I would not be prepared to tolerate.

For this reason the Corps has always, at least since Peninsular days, paid very serious attention to the technical training of its officers, beginning by giving them an engineering education on the broadest foundations, and including when possible, a University Course, reinforced with instruction at the School of Military Engineering and, in modern times, at other RE schools. This has been followed at a later stage by practical experience in many fields of engineering, but especially in Works Services at home and overseas. By these means it has usually been found possible to fill appointments in war, including senior ones, with officers who have been well equipped with the necessary technical knowledge and experience.

Here you will expect me to say something about the recent civilianization of Works, but let me start by reminding you of two things: first, that this is the result of a deliberate decision by the Government; and, second, that we still have great responsibilities for works in war and in certain kinds of emergency.

I have little patience with people who declare that the loss of Works in peace is either an unmitigated disaster or an unqualified blessing. The subject is far more complicated than that and I cannot cover it here. But I believe that such opinions usually stem from too narrow a view of the Corps and an inability, or disinclination, to see it as a whole and appreciate this essential need for a proper balance between our military and technical functions. So I would ask those who do express their views to make sure they are detached and objective.

It is a fact that in the past we were purposely given these Works duties to train us for our tasks in war, and it is quite true that we are now losing much of the benefit of that experience, as well as many opportunities of holding responsibility and earning promotion on the building and construction side of the Corps. It is also regrettable and sad, that many officers, 312 regulars to be exact, should have to leave the Army prematurely.

As a Sapper, I am very proud of what we have done in Works; but there can be no doubt that the mounting size of the task, including the huge war-time back-log and extra work caused by violent changes in accommodation policy at home and overseas, had become too much for an essentially small Corps to handle properly. The Works tail not only wagged the Sapper dog and detracted, by the manning difficulties it caused, from the over-all

efficiency of the Corps, but, even worse, it absorbed much of that energy, initiative and enthusiasm which we must always direct in fields of thought and action to the general support and assistance of the Army as a whole. Nor did Works always provide the sort of experience we needed, though many officers got better training from it than they realized at the time.

So, when the manpower of the Army, and with it the strength of the Corps, was drastically reduced, this at least became clear: the old system could not continue unaltered.

The new Engineer Special Service Establishment, ESSE, consisting of 118 officers and 242 other ranks, received official approval on 19 September 1960, and will give officers and senior other ranks outside the normal establishment of the Corps practical engineering experience to prepare them for their duties in war and emergencies. It will include those who are on the Long Civil and Long Electrical and Mechanical Courses, with which we are familiar, and others on attachments at later stages of their service, as well as some quartermasters, ex-clerks of works. A number will be with the Works organization to provide a pool of Works-trained officers in all Commands. Some will be with contractors and some with consultants, and I shall endeavour to ensure that these attachments are as interesting and useful as possible. Compared with the numbers previously employed on Works, the strength of ESSE is small, but the Army and the Corps are also shrinking, and I hope to make up for quantity by the quality and variety of the experience that will be gained.

It is important to understand that ESSE could never be justified on grounds of compensating us for loss of senior appointments in Works. All the same, I regard its formation as a milestone in our history, because it officially reaffirms our status as a Corps of Engineers, and not mere pioneers. Whatever its size and shape, the really important fact is that ESSE now exists. I hope it will be as keenly supported as it deserves to be by all officers and other ranks.

Outside ESSE, I want to see individuals and units doing a lot of practical engineering, and this should become easier to arrange as units become all-Regular again and can have a longer training cycle than one year.

The transfer of Works to the Civil Service must obviously cause a great change in the planning of officers' careers, but it is too soon to say exactly how things will be done or just what will be the effects of the change. However, there are two principles on which I shall work. First: the best appointments will continue to be given to the best available officers; and second, technical ability and experience will count as an asset to an officer when he is being considered for any Corps appointment, including the command of a squadron or regiment, for the reasons I have already given.

I may add that I shall do all I can to see that RE officers are selected to serve in senior appointments up to the limit of their merits and abilities, whether inside or outside the Corps, and that I hope we will in future take a larger part in our traditional functions of invention, research and development, for which as a Corps we are so well suited.

In referring to technical ability and experience I do not necessarily mean degrees and letters after one's name, because many officers have had no chance of getting them; but I shall look for signs of aptitude early in an officer's service and a lively and continuing interest in all the forms of engineering connected with our duties later on, however he may be employed at the time.

As for letters indicating membership of Chartered Institutions, I am keen on as many Sappers as possible earning these through their early training and subsequent work in ESSE and elsewhere. The fact that they will be valuable to an officer in later life is his own business. What interests me is the outward and visible sign of his connexion with the civilian engineering world, a connexion which has always been important to the Corps. Not only is it to the advantage of the Army and all concerned that we should retain a close and friendly relationship with the civilian Works Organization, but we must also keep up our old and valued alliances and liaison with the various Engineering Institutions, in the formative period of which Sappers have in fact played a prominent part.

From early times, civilian and military engineers have worked together in peace, while in war of course they combine their efforts; and it is mainly through the Corps, Regular, Army Emergency Reserve and Territorial Army, that, in the words of the old Rawlinson Report, which I have already quoted, "the whole resources of the engineering professions of civil life can be brought to bear."

Nevertheless, I believe there is some danger of such letters coming to mean more than they should, of the qualification meaning more than the man; and I shall continue to judge an officer by his proved abilities, including of course, his technical qualifications.

The excellence of the appointments that Sappers fill when they retire, whether with letters after their names or not, is evidence that my views on this subject are widely shared. In fact, the proper military engineer is highly valued in industry and commerce, where time is usually money, because his training has taught him to put a high premium on time. "Calculate and measure everything" is one of the basic tenets of engineering, and it is not that the military engineer is addicted to guessing, but he is taught to be eager to make decisions on *adequate* information, and, by clear analysis of the problem and quick deployment, to press on with the work. The breadth of his education, his knowledge of his materials and his practical experience often enable him to improvise where others might be held up. And to all this he can usually add some gift of leadership, sometimes lacking in civil life, which he has developed at regimental duty.

This brings me to the description of the military engineer that I offered at the Corps General Meeting in June 1960: "Not a mere pioneer, nor a poor imitation of an infantryman and apology for some civilian specialist, but a member of a distinct and time-honoured profession. A good soldier, able and ready to make sound military appreciations, and earning the respect of the best soldiers as a *military engineer*, and at the same time a versatile engineer, valued by the best engineers, again as a *military engineer*."

As life is short the RE officer needs to be well grounded at school to give him a flying start; and from that time on he must not only be a quick learner but he must be helped to learn quickly. Once he has got his basic engineering education he must rapidly become a sound regimental officer understanding the art of getting the best from his men. Thus, not only must we have a high standard of entrant, but having got him, must spare no effort to train, help, and inspire him.

Later, he must extend his military knowledge, learn the mechanics of war and, in particular, understand what is and is not militarily feasible, so that he can act with the intuition of a trained soldier. He should also expand

his engineering knowledge by attending courses and getting all the practical experience he can. He should try to follow his own professional tastes, work hard, play hard, read, travel and learn languages.

This is a lot to undertake, but it has been achieved often enough in the past, and I do not believe that many of our most distinguished officers have really had their careers planned in detail for them by the Military Secretary or the AAG RE. Their success has been more often due to their own ability, and to private study, drive and initiative. But if any Sapper ever thinks he has nothing to do, he had better visit a psychiatrist.

When Sir William Denison returned to England in 1866, after being Governor of the Madras Presidency and acting for a time as Viceroy of India, and was then appointed CRE Portsmouth, there were those who thought the posting not entirely appropriate; but Denison protested that he had "done his best to qualify himself for the various duties which, as an officer of Engineers, he might be called on to perform", and said he was eager to rejoin the Corps as a Colonel. Unlikely as such situations are to recur with any frequency, I would commend this attitude to all Sappers, and remark in passing that there are officers today who have been a long time away from the Corps but would acquit themselves very well if they returned to it, provided they had maintained a real pride in being Sappers and taken a lively interest in their possible employment as such.

There is a thread of military engineering which runs right through the history of the Country. To cover his disembarkation near Hastings, William the Conquerer put up a dismountable timber castle which he had brought across the Channel. His Chief Engineer was Humprey de Tilleul, the names of whose successors are to be seen on my office wall. King Edward III, in his Crécy campaign, like Montgomery 600 years later, did not march from Normandy to Holland, across the grain of the French rivers, without good engineer organization and equipment.

It has recently been written of the Duke of Parma, that Spaniard who came so near to invading England: "His powers of intellectual analysis and organization lifted the art of war to a level that the sixteenth century saw but rarely", and it is certain that his prowess as a military engineer did much to earn him that compliment. Nor would Queen Elizabeth's Earl of Leicester face him in the Low Countries until he had with him, as Marshal of the Army and his second-in-command, the tough old Engineer and military genius, Sir William Pelham. Of such soldiers more anon.

This ends my exposition of the military engineer and there is no need to enlarge to a gathering like this on his past services to the country. But a good corps of military engineers is bound to throw up, as by-products, engineers on the one hand, and soldiers, on the other, who are second to none.

Though the many solid volumes of the history of the British military engineer at home and overseas give only a slight impression of his achievements in the wider fields of engineering, especially in India, Africa and the North American continent, I think their magnitude is appreciated by most of us.

But what is not so generally known is the astounding variety of the distinctions gained by individual Sappers in science, engineering and public administration, as outlined in the short biographies appended to the various volumes; for instance, that no less than sixteen have become Fellows of the Royal Society. Nor, I think, do many of us realize that Sappers have held at

least fifty Governorships of overseas territories, including Van Dieman's Land, Hong Kong, and North Carolina.

On the purely military side which, I repeat, is a by-product of our normal functions we have usually had to carry a heavy handicap. Until the abolition of the Board of Ordnance in 1855, RE officers were seldom allowed to hold staff appointments, and were hardly ever given command. Thus we find Lieutenants Jesse and Stokes being deprived of their administrative appointments in 1851 simply because "the C-in-C disapproved of RE officers being appointed to the staff". Almost throughout World War I, there were strict orders against employing Royal Engineers on the staff and on other non-technical duties, though some did manage to break through. And between the wars, admission of Sappers to the Staff College was very limited.

In spite of such obstacles, no less than five Sappers have become field marshals, including the first CIGS. Nearly sixty have reached the rank of full general and more than sixty others, lieut-general; and major-generals have been, like the caterpillar, innumerable.

In September 1939, we had 565 officers of field rank or above. They produced eighty general officers by the end of the war, or nearly one in seven, who held forty-five staff appointments at these levels in spite of the pre-war restrictions on entry to the Staff College. But an eminent infantry soldier, when he heard of these figures, said he thought it even more significant that, during the war, scattered about in key staff appointments at lower levels, one was only too likely to find a Sapper, "the sort of chap", he said, "who could see right into a problem and out the other side."

Statistics like these would be less interesting if applied to the Royal Armoured Corps, Gunners or Infantry, because the majority of their officers presumably join their regiments in the hope of eventually reaching high rank in command or on the staff; but the average Sapper, I should say, has joined the Army to be a military engineer, and such figures therefore provide some indication of the value to the Army, quite apart from its military engineering needs, of having as part of it an efficient Corps of Royal Engineers.

And so it is that capable officers who have been attracted to the Corps by the prospect of being military engineers, and trained within it to develop their faculties, have hitherto done more than a little *to lift the art of war*, and may, like Fabius, having taken thought, still help to *save the State*.

From my reading of Corps history, I believe that, in spite of all its past achievements, there has never been a time when the majority of its officers would have said that everything in the garden was lovely. They have usually had to contend with incredible difficulties. Today I feel no complacency at all: I know that everything is not lovely. We have, as always, great problems to surmount, but I doubt if the Corps has ever been in better shape so long after a great war, or if its prospects have been brighter, and the two things that give me most encouragement are: the quality of so many of its officers and the Army's imperative need to make the fullest use of them in the present age.

As for problems, I shall always welcome constructive suggestions. Thirty-two years ago, and not very far from this spot, I was told by the Commandant SME and Inspector of Royal Engineers: "When you're my age you'll be entitled to your own opinion". No doubt I invited the rebuke, but I notice he was sixty at the time. Things have changed since then, not only as regards the retiring age of senior officers, but also in our attitude to the views of

others; and while I dislike the over-confident assertion of plausible opinions based on ignorance of the facts, I shall always welcome fresh thought and helpful ideas, whether they come from the Regular or Reserve Army, military or civilian engineers, the last-joined boy-soldier or the eldest retired officer.

I hope Sappers will continue to think big and let their ideas range far and wide, and that what I have said today will provide a sign-post that you can read.

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113 (Cheshire) Army Engineer Regiment (TA) Centenary Celebrations

By Captain G. W. A. Napier, RE

It may take a hundred years for a regiment to reach its centenary, but to those responsible for the planning of the celebrations it arrives with amazing suddenness.

The occasion in question was the Centenary of the Cheshire Royal Engineer Volunteers who have had their Headquarters in Birkenhead since they were founded in 1860. They are now represented by 113 (Cheshire) Army Engineer Regiment (TA) and to mark the occasion the County Borough of Birkenhead granted the regiment the Freedom of Entry at a ceremony held on 15 October 1960. No other unit has served 100 years in Birkenhead and the Council were determined to do the Regiment well. Many Birkenhead men had been associated with the unit almost since its foundation. They first saw active service in South Africa where two contingents served from 1900–2. In 1914 the then 2nd Cheshire Field Company was the first Territorial Sapper unit to go to France where they served with distinction. The Second World War found them in Palestine, North Africa and Italy, and after the war, when the Territorial Army was re-formed, they became 113 Assault Engineer Regiment (TA) which they remained until the present 113 Army Engineer Regiment (TA) came into being in 1956.

Plans were laid early and we decided to take the opportunity to use the Centenary for recruiting purposes. Many elaborate schemes were suggested not all of which reached fruition, and the events finally decided upon, in addition to the main parade, were an Officers' Dinner, a WO & Sgts Ball, an All Ranks Ball and a Service of Thanksgiving in the Parish Church. There were also individual squadron parties, and by way of propaganda static displays of equipment, models and photographs both on the ground, in shop windows and in the foyer of a cinema.

In the planning stages many unexpected problems presented themselves. The parade and march past were to take place along the main bus route, How to choose a suitable forming up point and reconcile the demands of Military procedure with the vagaries of the Birkenhead Saturday afternoon shopping crowd was no small matter. The problem was solved by the Birken-

head police who rose to the occasion and met all our requirements as if it were a matter of routine. What would the attendance be like? It was whispered by the pessimists that the men would not risk the embarrassment of parading before the public, and on the day would not appear. After all, were not Tranmere Rovers at home that afternoon? The Adjutant began to have a nightmare of the Commanding Officer and Officers lined up before a non-existent parade.

As the time approached a sense of urgency began to prevail and little groups of men could be seen at any time practising drill, working on the displays or cleaning and pressing uniforms. One PSI volunteered in a rash moment to blanco the entire webbing for his squadron. Notices had been put in the press to try and make contact with any old members of the regiment. It was an important principle that all past members of the units which have made up the Cheshire Royal Engineer Volunteers would be invited to all events. Frequently old gentlemen would appear at the Drill Hall in response to this and the permanent staff would politely listen to interminable stories of experiences from as far back as the days of the South African War.

If it is true that a bad Dress Rehearsal means a good First Night, then our Parade should certainly be a success. It poured with rain throughout the day and made an outside parade impossible. So much for hopes of co-ordinating the timings of the arrivals and departures of the units and the VIPs.

Mercifully the actual day was fine and dry and the wet weather programme duly consigned to the waste paper basket. The Regiment turned out in its maximum strength and the *pièce de résistance* was the contingent of past members of the unit, eighty strong, and led by a former OC 2nd Cheshire Field Squadron. The parade was attended by Major-General Sir A. Douglas Campbell as Representative Colonel Commandant and the guests included Brigadier E. C. W. Myers—a former OC 2nd Cheshire Field Squadron—and the Chief Engineer Western Command Brigadier W. H. Aylwin. The Corps Band, under the Director of Music, provided the music at all the functions.

Also present at the parade was the Commander 24 Engineer Group, Colonel A. J. Le Seeleur, and the GOC-in-C Western Command was represented by Brigadier D. Meynell, his Chief of Staff. The Regiment was represented on the rostrum by the Honorary Colonel, Brigadier C. C. Parkman who received the Scroll and Casket and made a presentation on behalf of the Regiment. The parade was commanded by the Commanding Officer Lieut.-Colonel P. F. Gooding.

It soon became apparent that we had underestimated the crowds of spectators, other than official guests. They turned out in force and even became an embarrassment by swamping the road in the area where the band was to form up. The police were equal to the situation and the band performed an intricate manoeuvre and succeeded in gaining their right position.

The Mayor, Alderman H. D. Shakeshaft, JP, arrived to a fanfare of trumpets and was led to the front of the parade to take the salute. Led, because he has been blind since he was a young man, but in spite of this disability he manages to combine a minute knowledge of local affairs with a ready wit that produces the *mot juste*. The Mayor inspected the parade and then presented the Scroll and Casket. The speeches accompanying the presentations lasted for forty minutes, but the citizens of Birkenhead took it all with admirable fortitude. An impressive part of the ceremony was the trooping of the casket along the front ranks, and it was perhaps a happy

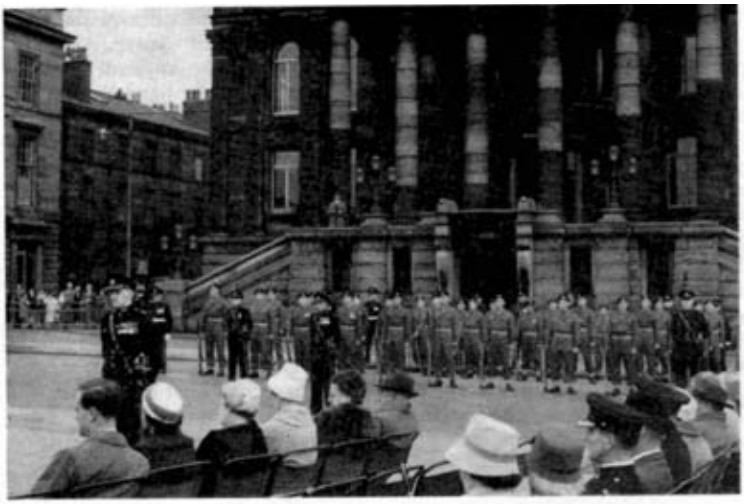


Photo 1. 113 (Ches) Army Engineer Regiment (TA) parade before Birkenhead Town Hall before being granted the Freedom of the County Borough.

Photo 2. The Presentation Silver Casket in which the Scroll will finally rest, is trooped past the front rank of 113 (Ches) Army Engineer Regiment (TA) on the occasion of the granting of the Freedom of Birkenhead.

Army Engineer Regiment Celebrations 1, 2

Photo 3. The Mayor of Birkenhead, Ald H. D. Shakeshaft, JP, inspects the Old Comrades contingent. In the inspection party are left to right, The Commanding Officer Lieut.-Colonel P. F. Gooding, TD, RE (TA), the Hon Colonel, Colonel C. C. Parkman, OBE, TD, ERD (TA), The Mayor, Major-General Sir A. Douglas Campbell, KBE, CB, DSO, MC.

Photo 4. The Mayor of Birkenhead, Ald H. D. Shakeshaft, JP, talks to Major J. F. M. Perrott, MC, who led the Old Comrades contingent. Also in the picture are (left to right) Major-General Sir A. Douglas Campbell, KBE, CB, DSO, MC, and Lieut-Colonel P. F. Gooding, TD, RE (TA).

Army Engineer Regiment Celebrations 3 & 4

coincidence that the slow march "Scripio" is also the tune for the hymn "Toll for the Brave" which was written to mark the occasion of the sinking of HMS *Birkenhead*. Finally the Regiment fixed bayonets, marched past with the Mayor taking the salute, and headed through the town to exercise their privilege and demonstrate their dual citizenship.

The Corps Band led the march through the streets of the town with such *élan* that most of the Regiment did not realize how exhausted they were until they reached the end of the march. The only mishap was to the tuba player who was forced to stop playing for a few moments because of the number of applecores and other articles that were being discarded into his instrument by the inevitable train of small boys that accompanied us.

The All Ranks Ball in the evening provided relaxation from this activity, and the following morning the past and present members of the Regiment gathered in the Parish Church of St Mary and St Paul for a Service of Thanksgiving led by the Vicar and the Regimental Chaplain. The Rev. C. J. H. W. A. Bradley, Warden of Bagshot, and an old friend of Sappers, who preached, reminded us that the good old days may not have been all they seem and that greater potential exists among the young men of today for enterprise and adventure than ever before.

A final march through the town brought us back to the Drill Hall and the closing party for All Ranks. And so it was in a spirit of relaxed cordiality that the Cheshire Royal Engineer Volunteers embarked upon their second hundred years.

Presentation of the Freedom of Entry of Wallasey to the 624th (1st Cheshire and Carnarvon Artillery Volunteers) Crane Operating Squadron Royal Engineers (TA)

By MAJOR C. DALY, TD, RE (TA)

THE County Borough of Wallasey covers the north-west corner of the Wirral Peninsula in Cheshire. 1960 was its Charter Year and amongst the many events held in the district to celebrate this achievement none was more enthusiastically received by the townspeople than that of the Freedom Ceremony for the Borough's TA unit. The Squadron had already celebrated its centenary earlier in the year, having been formed on 31 January 1860 as the 4th Cheshire Company of Artillery Volunteers.

COUNTY BOROUGH OF WALLASEY

TO THE COMMANDING OFFICER OF THE 624 (1st C.S.CAV.) CRANE OPERATING SQUADRON, R.E.(T.A.) WALLASEY, AND ALL RANKS

GREETINGS

THESE PRESENTS HEREBY WITNESS That at a Meeting of the Council of the County Borough of Wallasey held on the 3rd day of March, 1960, the following resolution was passed unanimously:

That in appreciation of the fine traditions of the 624 (1st C.S.CAV.) Crane Operating Squadron, R.E.(T.A.) Wallasey, and in recognition of the attainment of their centenary and intimate association with this Borough, where they have been continuously stationed, the Council confer upon the Squadron the right, privilege and honour of marching through the streets of Wallasey on all ceremonial occasions with bayonets fixed, drums beating and colours flying

Given under the Common Seal of the Mayor Aldermen and Burgesses of the County Borough of Wallasey this Eighth day of September 1960

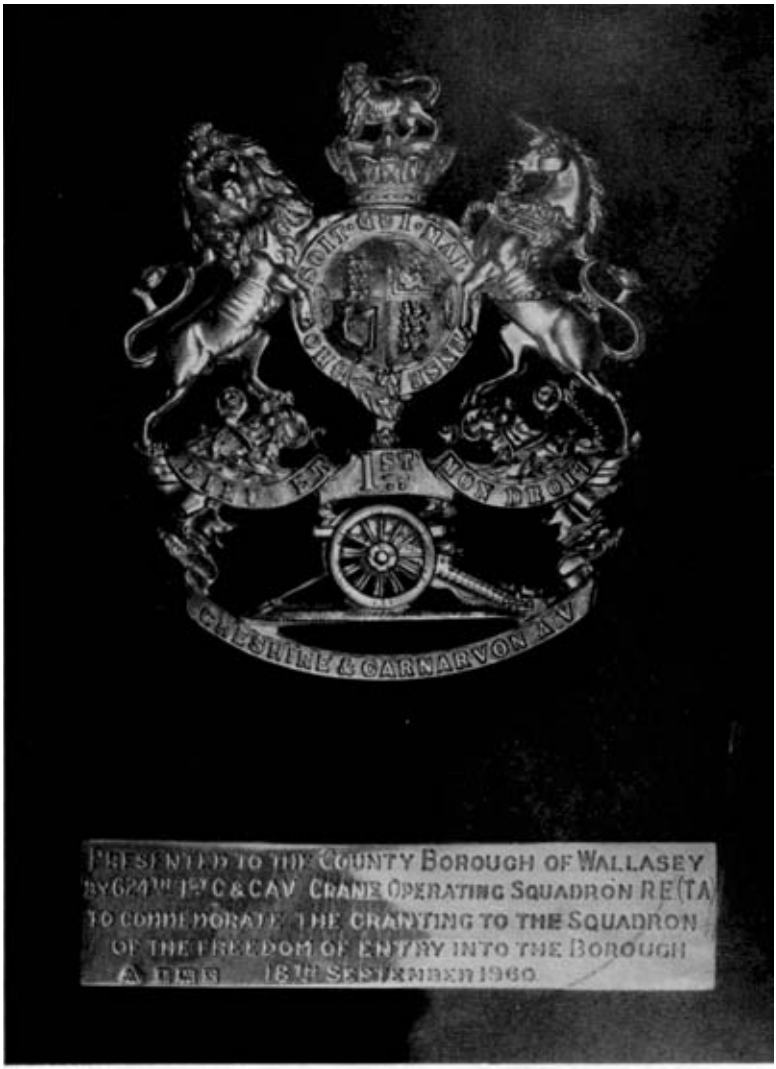
Mayor

Town Clerk

The Scroll Conferring the Freedom of Entry into the Borough to the Squadron.

(By kind permission of the Wallasey Borough Council)

Presentation Of The Freedom of Entry Of Wallasey 1



Silver Framed Cap Badge presented to the Wallasey County Borough Council.

(By kind permission of the Wallasey Borough Council)

Presentation Of The Freedom of Entry Of Wallasey 2

For ninety-six years the unit remained Artillery. Its title, but not its role, changed several times before 1956 when it was converted to the 624 Crane Operating Squadron of the Corps of Royal Engineers. To perpetuate its long and distinguished history as Gunners permission was granted by War Office for one of its oldest titles, namely the 1st Cheshire and Carnarvonshire Artillery Volunteers, to be incorporated in its present title.

In the period between the two great wars the unit was fortunate in having the services of many fine officers of whom two Commanding Officers deserve special mention. One of them afterwards became Major-General Sir Claude Liardet, KBE, CB, DSO, TD, DL. After being CRA London Division he was promoted Major-General and given command of a Division in 1938, a rare, if not unique, distinction for a TA officer in peacetime. He subsequently became Commandant of the RAF Regiment. The other was the late Colonel John Sandeman Allen, OBE, MC, TD, who was for many years Member of Parliament for Birkenhead (West).

Sunday, 18 September 1960 had been fixed as the date for the Freedom Ceremony as far back as March. With the Squadron already heavily committed to participate in the Charter Celebrations with both indoor and outdoor military displays, weekend exercises, fifteen days annual camp with 1 Port Task Force and the usual annual civic ceremonies, it was agreed that the autumn would be the best time for this important parade. As an example of long-range weather forecasting the choice of date was exemplary. In a dismal summer with monsoon-type rain the weather relented for just a few hours to give a blue sky and a warm sun.

The ceremony was held in front of the Town Hall on the Seacombe Promenade, the site overlooking the River Mersey. By a happy coincidence there was a full tide.

The river frontage of the Town Hall with its wide steps sweeping down to the river, and flanked by grass verges facing a broad stretch of the promenade, was a natural auditorium which added much to the dignity of the occasion.

Headed by the band of the 123 (East Lancs) Field Engineer Regiment RE (TA) the Squadron with a representative contingent of Old Comrades moved to the parade area at 1120 hrs. Owing to clothing problems which had proved insuperable the troops wore battle-dress, but the drab colour of khaki was somewhat relieved by the No 1 dress of the officers and the band.

While the SSM dressed the parade before handing over to the OC, Major C. Daly TD RE (TA), visitors were taking up their positions near to the dais or in the enclosures. Among the many military guests were Brigadier W. H. Aylwin, Chief Engineer Western Command, Colonel A. J. le Seelleur OBE, Commander 24 Engineer Group (TA), Colonel G. McFarlane, TD, Commander, 1 Port Task Force and Lieut-Colonel W. Vivian Jones, MBE, TD, DL, Chairman of the Cheshire Territorial and Auxiliary Forces Association.

At 1129 hrs the mayoral procession emerged from the great doors of the Town Hall, led by the civic Mace Bearer, splendidly top-hatted, and the Mayor's Chaplain. At the foot of the Town Hall steps His Worship the Mayor of Wallasey, accompanied by the Town Clerk and Brigadier Aylwin, took his place on the dais.

After receiving a General Salute the Mayor inspected the parade, pausing several times to speak to members of the Squadron and to Old Comrades. On returning to the dais the Mayor called upon the Town Clerk to read the

Scroll conferring the Freedom of Entry into the Borough upon the Squadron. It read:—

"To the Commanding Officer of the 624 (1st C & CAV) Crane Operating Squadron RE (TA), Wallasey, and All Ranks, Greetings.

"These presents hereby witness that at a Meeting of the Council of the County Borough of Wallasey held on the 3rd day of March 1960, the following resolution was passed unanimously:—

"That in appreciation of the fine traditions of the 624 (1st C & CAV) Crane Operating Squadron RE (TA), Wallasey, and in recognition of the attainment of their centenary and intimate association with this Borough, where they have been continuously stationed, the Council confer upon the Squadron the right, privilege and honour of marching through the streets of Wallasey on all ceremonial occasions with bayonets fixed, drums beating and colours flying.

"Given under the Common Seal of the Mayor, Aldermen and Burgesses of the County Borough of Wallasey this eighth day of September, 1960.

CYRIL G. E. DINGLE, Mayor
A. G. HARRISON, Town Clerk"

His Worship the Mayor then addressed the Squadron. After expressing the Borough's pride in the long and honourable association between the Town and the Squadron, he added that it was a happy coincidence that the Squadron's centenary should fall in the same year as the Town's Charter celebrations.

The scroll was placed in an oak casket made specially by the Ferries Department. The casket was decorated with enamelled miniatures of the Corps Badge and the Borough Coat-of-Arms, and a silver plate on the lid was inscribed with details of the occasion.

The Mayor then presented the casket containing the scroll to the OC who received them on behalf of the Squadron, and acknowledged the honour conferred upon his unit.

Descending the lower steps to the promenade, the OC handed the casket to the scroll party consisting of a Sergeant, Corporal and Sapper. Carried by the Sapper, with the armed NCOs as escort, the casket and scroll were trooped along the ranks. During the trooping the band played the Royal Artillery slow march—a touching tribute to the Squadron's forebears.

After the trooping the OC called for three cheers for the Mayor and Corporation. By now the excitement had spread to the hundreds of spectators, many of whom joined in the cheering.

The OC then marched to the foot of the steps and addressed the Mayor: "Sir. May the 624 (1st C & CAV) Crane Operating Squadron RE (TA) exercise their right to march through the streets of Wallasey with bayonets fixed and drums beating?"

Permission having been granted, bayonets were fixed, swords were drawn, and the parade moved off in column of route with the band playing. The scroll party, bearing the casket and scroll, marched at the head of No 1 Troop.

Meanwhile the civic party, guests and spectators were making their way to Brighton Street, a main road at the rear of the Town Hall, where another dais had been erected. After a short march "around the houses" the parade approached the dais. Twenty yards short of the saluting base the band broke

into "Wings". And so the Squadron proudly saluted the town's first citizen before marching through the streets back to their TA centre.

The Mayor and Corporation entertained the troops and their relatives and friends at a buffet luncheon in the Civic Cafe inside the Town Hall. Telegrams of congratulation from the Engineer-in-Chief and the Commandant Transportation Centre RE were read.

At a luncheon for officers and their guests, also held in the Town Hall, Major Daly presented the Mayor with a 1st C & CAV cap badge, dating from 1880, mounted in a silver frame and inscribed. In acknowledging this souvenir of a happy day, the Mayor suggested as the Squadron's unofficial motto: "Per Ballistas ad Machinas".

Foundation Stone Ceremony at Kahawa

By K.R.H.

At Kahawa near Nairobi in Kenya, a cantonment for two infantry battalions is under construction. This project is of considerable interest to the Corps as site supervision is in the hands of a CRE (Works) with an almost entirely military staff; also the senior representative of the main contractor has only recently retired from the Corps. We reproduce below an article which has appeared in the Kenya magazine "Twiga" describing the ceremonial laying of a foundation stone for this cantonment.

On Monday the 18 July, 1960, another milestone was reached in the construction of Templer Barracks at Kahawa.

Late on a very dull afternoon with rain threatening almost at any moment, the foundation stone for the Barracks was laid in the gymnasium by the General Officer Commanding, East Africa Command, Major-General Sir Nigel Tapp, KBE, CB, DSO. From 5 o'clock onwards guests invited to the ceremony arrived in a steady stream and took their seats facing the gymnasium where the stone was to be laid. A Union Jack was draped over the stone itself concealing it from view. On either side a soldier from the 1st Battalion, The Royal Inniskilling Fusiliers stood on guard. A large number of the African workmen employed on the site were assembled in a special enclosure, while many others found points of vantage on the surrounding half-completed buildings. On the road running alongside the gymnasium behind the spectators' seats, a guard-of-honour was drawn up of fifty-two men from the 1st Battalion, The Royal Inniskilling Fusiliers and to one side were the band and pipes of the same regiment.

Promptly at 5.30 p.m. Major-General Sir Nigel Tapp arrived, accompanied by Lady Tapp. The General, who was in full ceremonial dress, took the salute and inspected the guard-of-honour. He then joined Lady Tapp and was greeted by Mr. Gibson, Director-General of Works, Mr. Geraghty, Assistant Under-Secretary of State for Works, both from the War Office, Sir John Howard and Mr. Leishman, Chairman and Managing Director

respectively, of John Howard & Co. Ltd., the main contractors for the Kahawa project. The party proceeded down the pathway, between the guests, to take their seats immediately facing the gymnasium. As they arrived Miss Karen Fish, eight-year-old daughter of the Site Agent, stepped forward, curtsied and presented Lady Tapp with a bouquet. Lt. Col. J. R. de G. Pilkington, MC, Commander, Royal Engineers at Kahawa, then mounted the steps of the verandah to the gymnasium and speaking into the microphones, which were placed just to one side of the foundation stone, welcomed Mr. Gibson and Mr. Geraghty and asked Mr. Gibson to say a few words on the Kahawa project.

After referring to the historical background to foundation stone ceremonies, Mr. Gibson explained the directions which he had received when he had assumed his appointment at the War Office and how the Kahawa project formed part of the fulfilment of those directions. He stressed that the technical requirements of the Army were growing almost every day and that soldiers were necessarily, therefore, very much more intelligent persons than in the past. In these circumstances it was incumbent on the War Department to provide soldiers with living accommodation comparable with that available to their counterparts in civilian life. He expressed his conviction that when Templer Barracks was completed and the soldiers and their families moved into the site, it would be found that this standard had been achieved. He explained that the planners, army and civilian, working in close co-operation over the past two years, had largely finished their task and that the stage of fulfilment had now been reached. This final step had been entrusted to John Howard & Co. whose firm had many achievements and had built up a very good reputation for performance, organization and finish. He expressed his confidence that these same things would be enjoyed on the Kahawa Contract.

Sir John Howard in reply thanked Mr. Gibson for his kind remarks and assured him that his firm would do everything it possibly could to merit the confidence expressed. He referred to the Kahawa project as a great challenge to his firm's experience and to the skilled African workmanship which would go towards its accomplishment.

Colonel Hasildon (Resident Director at Kahawa) and his team, he said, were doing an excellent job and he thanked Colonel Pilkington and his staff for their co-operation. It was very fitting that the foundation stone should be laid by General Sir Nigel Tapp, and, addressing Sir Nigel, he added "We cannot allow this occasion to pass without saying how pleased and delighted we are that you, Sir, should have recently been honoured with your knighthood".

After referring to Sir Nigel's distinguished career and, in lighter vein, warning him that the stone had to be very carefully laid, Sir John Howard went on "It therefore gives me very great pleasure indeed Sir, to ask you to perform this ceremony, to hand you this trowel, which is your tool of office and also to present to you on behalf of my Directors and my Company this Salver which I hope will remind you of this happy occasion". Handing over the Salver, Sir John Howard expressed the wish that Sir Nigel and Lady Tapp would enjoy every happiness in the future.

Major-General Sir Nigel Tapp thanked Sir John for his gift which he said would always be a tangible reminder of the very pleasant duty which he had been called upon to perform.

Photo 1. Major-General Sir Nigel Tapp, KBE, CB, DSO, lays the foundation stone (photograph by courtesy of Army Public Relations)

"Templer Barracks", he said "the name which has been given to this project, with the blessing of the last Chief of the Imperial General Staff, Field Marshal Sir Gerald Templer, is more of a town than a barracks in the old fashioned sense. And surely the project that it is arising here at Kahawa upon what was empty grass land a few months ago, should be well qualified to be called a town. The site itself is over a mile long and it is half a mile wide. When completed it will have seven miles of tarmac road, serving apart from

Foundation Stone Ceremony at Kahawa 1

anything else, three hundred new houses. It will contain at first, two infantry battalions and their families, and about two thousand people in all will live here. But there is more to all this than roads, houses and people. At the heart of Templer Barracks will be its community centre—the church, schools, cinema, clubs, swimming pool, gymnasium and sports fields". He expressed his appreciation of the work done by the planners and referred particularly to the co-operation of the Kenya Forestry Department in the planting of thousands of trees which would be well established by the time the first occupants moved in. Templer Barracks, he thought, should be a pleasant place to live in and it was his hope that with all the planning, John Howard's skill and Nature's aid, there would be created a place of character worthy of the British Army and of Kenya itself.

Referring to more mundane matters, he spoke of the three and a half million pounds which were being spent on the project. Together with that being spent on refurbishing old camps, building at Gilgil, rations and supplies, etc., for the British Army and the King's African Rifles, the British Government was spending between four and five million pounds a year in Kenya. "This is, to my mind", he said "evidence of faith in the Colony's future".

Turning to the practical side of the occasion, he went on "Now despite what Sir John said, I do actually, like most of us, a little home decorating—it's not quite on this line—but I can now honestly say that whilst the greatest of our Elder Statesmen is an expert with stone and cement, I don't think anyone is in danger of losing his job as a brick-layer because of my efficiency with the trowel". "You might ask," he continued "why it was decided that this foundation stone should be laid in the walls of the gymnasium. It is because this building will not only be used as a gymnasium but it has also been designed to serve as a centre of social activities and a common meeting place for all. Now it is my sincere hope that those who use this building and live in Templer Barracks will do so in peace and happiness and that Templer Barracks will take a worthy and respected place as an integral part of Kenya.

And now, with a humble awareness of the honour that is mine today, I will lay this stone".

With these words, Major-General Sir Nigel Tapp turned towards the gymnasium, the Union Jack was removed and he carefully spread mortar beneath the foundation stone. Slowly it was lowered into position, with his left hand resting on it, and with due solemnity, he pronounced the words "I declare this stone well and truly laid".

As Major-General Sir Nigel Tapp stepped aside, the Deputy Assistant Chaplain General, Padre Claxton moved forward and conducted a short service of dedication.

The ceremony ended with another general salute from the guard-of-honour after which the guests proceeded for refreshments to an area not far from the gymnasium where they were received by Sir John Howard and Major-General Sir Nigel and Lady Tapp.

The rain which had so miraculously held off during the ceremony now made a brief attempt to mar the occasion driving the guests into the already crowded tents. As darkness fell and the guests departed, the half-constructed buildings covering the site, stood out against a stormy skyline, a vivid reminder of man's effort to provide protection for himself against the fury of

the elements. Silence fell until the morrow when it would once again be broken by the sound of the masons chipping their stone and the roar of machines carrying on with the task so well symbolized by the laying of a foundation stone on which were inscribed the words of the Psalmist "Except the Lord build the house, they labour in vain that build it".

The Gurkha Engineers and the State Visit of TM The King and Queen of Nepal

By "GURKHA SAPPER"

THE State Visit of Their Majesties The King and Queen of Nepal was very fully reported in the Press, but it is thought that it might be of interest to give a brief account of how this visit affected the Brigade of Gurkhas and, more particularly, the Gurkha Engineers.

It should be explained that the Gurkha Brigade Association which is referred to herein embraces the Regimental Associations of the ten Gurkha Rifle Regiments. It is no small honour that the newly formed Gurkha Engineers Association has been admitted to membership of this distinguished body. The Gurkha Engineers endeavour to show their appreciation by supporting Gurkha Brigade Association activities to the fullest extent.

On the 19 October 1960, HM The Queen reviewed a parade in the garden of Buckingham Palace, accompanied by HM The King of Nepal. The parade was drawn up on three sides of a square on the lawn facing the terrace. On the right was the Combined Military and Pipe Band of the Brigade of Gurkhas. Gurkha Engineers were represented by the Pipe Major of the Gurkha Engineers Pipe Band, four other pipers and one drummer. In the centre was the representative Infantry Company Contingent, Gurkha Engineers being represented by four drivers, and on the left was a Contingent of retired officers of the Gurkha Brigade Association: Lieut-Colonel J. H. Carver, RE (retd), was on parade with this party.

After The Sovereigns had inspected both ranks of the parade, there was a short recital by the band and then the contingents marched past Their Majesties at a sharp rifle pace.

Many other members of The Royal Family witnessed the parade from the terrace as did the following officers of the Gurkha Engineers Association and their guests:—

Major-General L. E. C. M. Perowne, CB, CBE, Colonel, The Gurkha Engineers, Brigadier Sir Mark Henniker, Bt, CBE, DSO, MC, Colonel J. H. S. Bowring, OBE, MC, Colonel W. G. F. Jackson, OBE, MC, Major W. W. Branford, RE, Major G. N. Ritchie, RE, Major J. D. Orange-Bromhead, RE, Captain T. le M. Spring-Smyth, RE, Captain P. P. Rich, RE, Captain D. H. Bowen, MBE, RE, and J. R. M. Kennedy, Esq.

In addition to the Royal Review and Gurkha Brigade Association dinner, Major-General Perowne, in his capacity as Colonel, The Gurkha Engineers, attended the following functions:—

The State Banquet at Buckingham Palace on 17 October, the reception at the Guildhall on 18 October, the reception given by the Nepalese Embassy at Claridges on 18 October, the dinner given by the Army Council on 20 October and an official lunch for HM The King of Nepal at the School of Infantry, Warminster, on 30 October.

On 21 October, Their Majesties the King and Queen of Nepal visited the RMA Sandhurst where they witnessed a special parade held in their honour and had lunch. They also met the Gurkha Cadets at Sandhurst informally. Lieut-Colonel and Mrs Carver and Captain Bowen had the honour of being presented to Their Majesties on this occasion.

On 31 October, HM The King of Nepal was guest of honour at the annual dinner of the Gurkha Brigade Association at the Savoy Hotel. Major-General Sir Douglas Campbell, KBE, CB, DSO, MC, representative Colonel Commandant RE, attended the dinner as guest of the Gurkha Engineers. It is perhaps noteworthy that all previous Commanding Officers of Gurkha Engineers were present on this occasion, i.e. Colonel F. M. Hill, CBE, 1951–2, Lieut-Colonel J. H. Carver, 1952–5; Colonel J. H. S. Bowring, OBE, MC, 1955–8, and Colonel W. G. F. Jackson, OBE, MC, 1958–60.

In all twenty RE officers attended and several were presented to His Majesty during the course of the evening, which was a most enjoyable occasion.

It need hardly be emphasized that this state visit provided a unique opportunity for both Sovereigns to acknowledge the service of the Gurkhas and it is the good fortune of the Corps to be associated, so early in the history of Gurkha Engineers, with such memorable events.

Unbroken Links Between Civil and Military Engineers

By Major D. H. de T. Reade

The Institution of Civil Engineers was established on 2 January 1818 by a group of seven far-sighted young men. Their meeting took place at the Kendal Coffee House, Fleet Street, London. Attendances, however, waned after a time until two years later Thomas Telford, one of the most illustrious engineers of the time, was invited to become the first President. Under his guidance the Institution's prestige grew and membership increased and in 1828 a Royal Charter was granted. Today the Institution of Civil Engineers has the proud distinction of being the senior professional engineering society in the Commonwealth.

Since its earliest years the Institution has always maintained a close link with the military engineer. The list of Members and Associates for 1824 (earlier records are not available) shows the names of a number of honorary

military members including Lieut-Colonel C. W. Pasley (later General Sir Charles William Pasley, KCB, FRS, DCL, first Director of the RE Establishment Chatham 1812–41, and Inspector of Railways 1842–6) and Major T. F. Colby (later Major-General Thomas Frederick Colby, LLD, FRS, Director of Ordnance Survey 1820–46) and two professors in mathematics at the Royal Military Academy, Woolwich, Peter Barlow, FRS and Doctor Olynthus Gilbert Gregory, LLD. From that first list until the present day there have always been Sappers on the Roll of the Institution.

Telford Medal Winners

The Telford Gold Medal is the highest award of the Institution of Civil Engineers. Since its inception in 1838 it has been awarded on six occasions to Royal Engineer officers, namely:—

1849 Colonel H. D. Jones, RE, for his paper "Description and drawings of the bridge at Athlone". Colonel Jones became Lieut-General Sir Harry D. Jones, GCB. He served in the Peninsular War and he was the Commanding Royal Engineer of the British Army before Sebastopol. He later became Governor of the Royal Military College and Staff College at Sandhurst.

1865 Captain H. W. Tyler for his paper "On the Festiniog Railway for passengers as a two-feet gauge with sharp curves and worked by locomotive engines." Captain Tyler left the Corps with the rank of Captain. He later became Sir Henry Whatley Tyler, Kt, the Chairman of the English Channel Tunnel Commission and Chief Inspector of Railways.

1868 Lieut-Colonel P. P. L. O'Connell for his paper "On the relation of the freshwater floods of rivers to the areas and physical features of their basins". O'Connell was originally a Madras Engineer. He rose to the rank of Major-General and he was Consulting Engineer for Madras Railways 1862–5.

1873 Colonel W. H. Greathead, CB, for his paper "Account of the practice and results of irrigation in Northern India". Greathead was originally a Bengal Engineer. He served in the Punjab, in the Indian Mutiny and in China. He became a Major-General and he was Chief Engineer of Irrigation of the North West Provinces 1861 to 1876.

1897 Colonel John Pennycuick, CSI, for his paper "The diversion of the Periyar". Pennycuick was originally a Madras Engineer, he was in charge of the Periyar River irrigation project and from 1896 to 1899 he was President of the Royal Indian Engineering College, Coopers Hill.

1920 Major-General Sir Gerrard Moore Heath, KCMG, CB, DSO for his paper "Royal Engineer work in the Great War 1914–18". Major-General Heath served in the South African War. In 1915 he was Chief Engineer II Corps and later Chief Engineer 1st Army. From 1917 until the end of the war he was Engineer-in-Chief in France. After retirement in 1919 he became Chairman of the Building Research Board, DSIR.

First World War

Early in the First World War the President of the Institution of Civil Engineers was appointed by the War Office to consider applications for temporary commissions in the Royal Engineers (Regular Army) from persons who were not attached to Officers Training Corps. In addition, the President continued his action as hitherto in connexion with appointments to the Special Reserve of Officers, Royal Engineers. He was also asked to make

Charles Manby—Secretary of the Institution of Civil Engineers—in the uniform of the Engineer and Volunteer Staff Corps, the creation of which was originally suggested by him. He was, till his death in 1884, Adjutant, with the rank of Lieut-Colonel.

certain recommendations for commissions in the Royal Garrison Artillery as well as for other special services.

The following extract from correspondence with the Army Council affords gratifying testimony to the appreciation which civil engineers gained during the 1914–18 war:—

"The (Army) Council are well aware of the very considerable part which civil engineers have played in the operations of the present war, and of the

Unbroken Links Between Civil and Military Engineers

patriotic spirit that has actuated them. Many who have held very responsible positions in civil life have been, and are, content to serve in a subordinate capacity, on small pay and with great exposure to climatic conditions and to the enemy. This public spirit is most admirable, and the Council are glad of this opportunity of placing their appreciation of it on record.

"Moreover, in many cases the special knowledge and skill of civil engineers have been of the utmost military value. The problems of engineering which have presented themselves have been in many cases of exceptional magnitude and difficulty, and it has been very largely due to the professional knowledge of the field engineers with the Armies that these have been successfully overcome. The scheme inaugurated some years ago of giving Special Reserve Commissions to young civil engineers and training them at Chatham, etc., has borne admirable fruit. Some of these young men have fallen in their country's service; others have been badly wounded, but it may be said that all have upheld the splendid traditions of their profession in fearlessness of danger, while showing that their military training has, added to their technical knowledge, fitted them admirably for work with their comrades of the regular Royal Engineers."

Record of War Works

The Civil Engineer in War is the title of three volumes containing sixty-eight papers relating to the Second World War. Among them are "The Mulberry Harbour", "The Pluto Pipeline", and "The Bailey Bridge".

"It will be evident on reading the papers," wrote the late Sir William Halcrow, Past President of the Institution of Civil Engineers and Colonel-Commandant Engineer and Railway Staff Corps, Royal Engineers (TA) 1948–9, in the foreword "that the war gave rise to many novel engineering problems and to the exercise of considerable ingenuity in their solution. Whilst these arose from military necessity, the results are by no means peculiar to military engineering, but are often of wider application to civil engineering practice. During the war the technical branches of the services were naturally expanded widely by the appointment of temporary officers, many of whom were members of our Institution. The papers give evidence of the close collaboration that existed between the regular and temporary members of the services, and it is to be hoped that this collaboration will continue no less strongly in times of peace."

All Passed Examination

In their own interests, Royal Engineer officers should ascertain, at an early stage in their military careers, what steps are necessary in order to become Corporate Members of the Institution of Civil Engineers. For the experienced regular Royal Engineers officer there is little difficulty in his being absorbed into civil life in his professional career. For instance, over the past few years the overwhelming majority of Royal Engineer officers who have taken the Institution of Civil Engineers' "Professional Interview" passed at the first attempt to become duly elected Associate Members of the Institution of Civil Engineers.

Officers of the rank of Lieut-Colonel and above should invite the Council of the Institution of Civil Engineers to give a decision as to their eligibility of being elected to Corporate Membership. For others, special regulations have been agreed with the War Office.

The Secretary of the Institution invites all Royal Engineer officers who are not on the Institution's Roll to attend general meetings, and take part in the discussions on papers.

Last February, the Institution of Royal Engineers held its first Joint Meeting with the Institution of Civil Engineers at the latter's building in Westminster, when the paper, "The development of the nuclear experimental base on Christmas Island" by Brigadier R. B. Muir, was discussed.

Strategic Reserve Regiment

By LIEUT-COLONEL R. L. CLUTTERBUCK, OBE, RE

No Strategic Reserve Sapper unit has ever spent more than a year or so in UK before being partially or wholly committed to a shooting war—or at least to a theatre where shooting seems imminent. On arrival there, they find themselves in strange terrain faced by strange enemies, and usually unacclimatized. Their first weeks and months are their most difficult, and yet, because of the political effects and world publicity aroused by troop movements, these weeks are often amongst the most vital ones in the cavalcade of the cold war. The training and employment of Strategic Reserve units in UK is, therefore, very important. Little has been written about it in the *Journal* and that is one reason why I think it worth describing and commenting on the employment of one such unit—38 Corps Engineer Regiment—in 1959 and 1960.

Another reason is that field units doing a tour in UK have a particular responsibility to the rest of the Army for public relations and recruiting. The moulding of a civilian recruit into a soldier in a training unit is always something of a strain, and this is understood by most people, including the recruit himself. In deciding to join the Army, he projects his thoughts beyond the training regiment to the "adult" units in which he will spend his working life. If these give him promise of happy days, he will join. Though he will hear indirectly about service overseas, he will see and hear a great deal more of the units in UK, particularly those in his own part of the country. It is important, therefore, that such units be employed, not only to fit them best for their cold war crises, but also to present a living image which will appeal to the potential recruit and to the teachers and parents who advise him.

Fortunately these requirements coincide. The cold war, unlike much of the two world wars, requires Royal Engineers to be real engineers; and by its absence of front lines it gives them more than an average chance of being shot at and of shooting back. Real engineering with a spice of adventure provides the draw for the best type of officer and sapper.

Real engineering, shooting and adventure training should, therefore, be the basis of the daily life of a Strategic Reserve unit. We have been lucky, for this has been our lot—and we have the added stimulus of a detachment in the Arabian Peninsula. In this article I shall describe in outline the tasks we have been given, assess their value, and say how we have set about the duty of trying to present the Corps in a favourable light to the people of Yorkshire and the North.

At the same time, I hope to reassure officers who may find themselves posted to Strategic Reserve units. Regimental soldiering in UK has had a bad name, with good reason, but those days are past, and we have found that it has provided a rewarding life, with more than an even chance of a sudden operational call overseas within a two-year tour. For no Strategic Reserve unit ever feels far away from active service. We train and stand by, not for a hypothetical war, but to join in a real and actual war, whose progress and techniques we can follow in the Press, since scarcely a day passes without a clash somewhere in the world between soldiers supporting law and order and dissidents, guerillas or rioting mobs. We are always at some kind of notice, often for a specific place or operation, which sometimes doesn't come off, but—as a study of the last twelve years will show—very often does. We were only in UK for a few months before our first call came, and we now have the finest captain's job in the Corps—the command of our independent troop in the Arabian Peninsula.

After Christmas Island

We spent 1958 on Christmas Island, where we took part in several nuclear tests, and had in every way a most stimulating time. We returned to UK at the beginning of 1959, where we reorganized. Apart from our reunion with our families, our arrival in Ripon had all the seeds of a crashing anti-climax.

For the first three months we all felt it. Our first task, after a year of solid engineering in the Pacific, far away from any shooting war, was to retrain ourselves as soldiers and field engineers, and this we did. This was normal stuff and merits no description or comment other than to say that both for infantry and sapper training, facilities in Northern Command, and in Ripon in particular, are excellent.

Outline of Events

Our employment in outline from our return from Christmas Island leave (February 1959) to date (October 1960) has been as follows:—

1959	
February–April	Troop Training—Infantry and Field Engineering.
May–June	Heavy girder floating bridge trials, Hawley, rafting training, Goole.
July	RE Week Ripon (displays, ceremonial parades, etc.)
August–November	2½ miles of road at Otterburn—temporary (water bound macadam) surface and temporary bridge. (Crash action—a 200-ft pontoon bridge was built to meet a traffic crisis in York).
November	Indep Fd Tp despatched to Aden.
December	Adm inspection
1960	
January–March	Individual courses (trades, plant, cadres, etc). Junior NCOs Cadre Course to Cairngorms (ski training).
April	Tp Trg–Infantry, range, field firing.
May–July	130-ft permanent bridge for Forestry Commission (Plashetts, Northumberland). Permanent (prestressed) bridge at Otterburn. Tarmac surface on road at Otterburn.

	Outward bound training culminating in canoe crossing of English Channel (twenty-four men).
August	RE Week Ripon.
September	Relief troop for Aden goes to train in the West Highlands.
	CIGS opens Plashetts bridge.
October	Junior NCOs Cadre Course to West Highlands. Individual courses (trades, plant, etc.—209 men.)

I will not attempt to describe every operation in detail. The many technical lessons from such projects as the road and bridges at Otterburn and Plashetts merit separate articles which are being submitted by the officers who did the work. I will describe them only as far as is necessary to assess their value as training for the cold war, as a means of furthering public relations and recruiting and, in the longer term, as education for long-service officers, NCOs and sappers. In all these respects, if one includes Christmas Island, we have been remarkably lucky in our tasks in the past three years.

Heavy Girder Floating Bridge Trials

The heavy floating bridge trials at Hawley provided a squadron task *par excellence*—250 miles from RHQ—and it fell to 63 Field Squadron. It involved receiving by rail 400 tons of bridging equipment, constructing a 539 ft. class 100 floating bridge using various experimental construction drills, carrying out technical tests with MEXE experts, and finally mounting a demonstration of the construction and capabilities of the bridge to a large gathering of officers and Ministry of Supply officials.

The bridge consisted of normal heavy girder spans on pontoon piers. Though most of the pontoons were of a special military design, a few were standard Storey Uniflote pontoons, which we much preferred. These can be obtained in quantity from industrial production and stock, and would therefore enable the bridge to be added to our standard family of bridges with the manufacture of nothing more than a few special parts (for the superstructure of the floating piers). I very much hope that this will be done.

For cold war use (or on a hot war L of C if we ever have one) such a bridge has an obvious application. It takes normal traffic two-way nose to tail, and can take our heaviest tank on its transporter. It can cope with banks from 0 to 15 ft high, or more with intermediate piers, and can provide navigation spans of up to 56 ft wide, with a normal height of 7 ft which can be raised without difficulty by HGB superstructure on the piers. Based on our trials, we estimated that a field squadron at full strength, with five cranes, working day and night shifts, could build such a bridge (539 ft, Class 100), from equipment delivered in trucks, in 48 hours.

As a point of training interest, the field squadron that did these trials had enough plant operators and drivers within its ranks to man five cranes, two dozers, one road roller, three tugs and ten 10-ton tippers, all surplus to establishment, without calling on the field park squadron for help. This was because, on Christmas Island, we had trained 100 per cent spare plant operators and drivers within the regiment, out of sheer necessity. These trials underlined the value of having this hidden strength, and we have done the same ever since. During the following winter twenty more of our sappers were trained within the regiment to have the additional trade of plant

operator, and they have been a great asset at Plashetts and Otterburn. We are training a further eighteen in the current winter. For a recent cold-war standby (which did not come off) we had no difficulty in including ten surplus plant operators within the complement of a field squadron. It was clear that the task would have needed them, as most cold war tasks do.

Goole

The site we selected for our advanced watermanship at Goole was the one that had been used for the war-time training of the special river crossing regiments for North West Europe in 1943–44. It is a challenging stretch of tidal water, 400 ft wide, with a rise and fall of 15 ft, very soft muddy banks and a current at Springs of over five knots.

We navigated two rafts (light assault and close support) 70 miles down the Ouse from Ripon to Goole, and then set every field troop of the regiment to train on them for a week. They had, of course, had preliminary training in still waters at Ripon. This training had been devoted to skill in ferrying with very little emphasis on knocking minutes off construction time. At Goole, the rafts were never dismantled at all and, with an adjacent bridge enabling a stage army of vehicles to flow across, the troops spent all their time on the water. The climax was a challenge to each troop in turn to deliver fifty vehicles on the far bank (using one raft) during ten hours of mixed light and darkness, ebb and flood, with barge traffic roaring through the navigation channels between the shoals. Some troops reached this target and others failed, but every troop ended up with a full team of skilled and confident watermen. And we learned a lot about the ability and the character of the troop officers and NCOs.

The main lesson—apart from the irreplaceable value of training in a strong current and in sustained ferrying—was the utter dependance of such an operation on a strong team of engine fitters under a good NCO. We can hardly have too many men of this trade nowadays, because, whatever the job, we almost always use engines of sorts.

The Otterburn Road

Negotiations for this job began before we left Christmas Island. It sounded ideal as a main summer task for a field unit—2½ miles of road across hilly moorland country, 15 miles from the borders of Scotland, with steep gradients, soft clay and peat bogs. Such a job would clearly involve a massive use of plant, and would, therefore, provide the best possible training, particularly for officers and NCOs. Christmas Island—where we had had 270 pieces of it—had given us a strong appetite for plant.

We had also been asked to carry out troop trials of a 60-ft prestressed Class 100 bridge, and a recce soon revealed that the Durtrees Burn, which the road had to cross, provided a suitably difficult site on bad ground at the foot of an awkward slope. This we thought would be a far better trial than to erect it in cold blood on an easy site in Ripon. And so it proved.

In April 1959 I appointed a Project Officer, and he went up with a team of surveyors and soils testers to align the road. We had a commendably open brief—our task was simply to connect A and B to enable WD traffic on the Otterburn ranges to by-pass the village.

The easiest gradients and the shortest route were to the north, but the range staff (the users) wanted the road as far south as practicable. Here, the

most promising route raised land complications with the Ministry of Agriculture. There were many patches of very boggy ground on the plateau, and local tenant farmers wanted the minimum interference with the best grazing. Balancing soils tests and survey data against discussions with range officers, farmers and land agents, an alignment was agreed which left everyone happy and which—as regards gradients and curves at least—has produced the best road so far built on this range.

The soils tests soon showed that long stretches of the road would inevitably have to be built on a subsoil which had zero CBR value at its natural moisture content, but samples taken from under existing roads showed that, well drained under a waterproof pavement, a minimum CBR value of 4 should be reached after some months (a change from Christmas Island, where well laid lagoon mud gave us CBR values of 70 to 140!). We, therefore, decided to follow the normal civil practice and lay only a temporary surface in the first season, allowing it to settle under traffic before surfacing with tarmac in 1960.

The Project Officer had also to investigate the available limestone seams in order to find one which would provide enough stone (15,000 cu yds) to pave the road for Class 50 traffic on soil of CBR 4. He surveyed the seam stretching back from an old quarry and found that it continued, with an average overburden of 3 ft, for several hundred yards. This gave good hope of meeting our needs—and indeed, by the skin of its teeth, it did.

The alignment and design were drawn out, costed and approved, and plant and resources (the main item being the materials for the twenty culverts and for the abutments for the bridge) were ordered. The date of the start of the work (governed by RE Week in Ripon which was traditionally in July) was 1 August. This left us only about three months in which to do the earthwork and get down a temporary waterbound macadam surface before Northumberland was seized in the grip of winter.

Virtually the whole regiment—two field squadrons and the bulk of the field park squadron, with a large quantity of project plant (we had over sixty pieces in all) deployed during the August Bank Holiday weekend. Most of the culverts had already been built in by the advance party, so the train of scrapers, dozers, graders and wobbly wheel rollers was able to go straight into action, while the quarry, already in action for the concrete for the culverts, stepped up to three blasts a day to build up a stockpile. These tasks were allotted to 48 Field Squadron and the bulk of the plant.

Meanwhile, work was also started by 63 Field Squadron on the embankments and abutments for the prestressed bridge.

Despite low Field Troop working strengths at this time we had—thanks to the usual unfailing support from RE Records—enough plant operators to work shifts from 0500 till 2000 hrs every day. This meant, for example, that the main train of plant producing the road formation—ten to fifteen machines—was served by shifts of eight or nine junior NCOs and sappers, who became remarkably adept at controlling their work with the newly issued Cowley levels. Another pair of shifts of eight blasted up to 400 tons of stone a day from the quarry, and crushed about half of it for the stockpile. Two more such shifts would lay the balance of some 200 tons of uncrushed stone to make a 12-in base course (100 to 150 yds of road a day). The weight of responsibility on the individual sappers can be gauged from these figures.

The technical problems that arose in this project were numerous and

fascinating, and will form the subject of a separate article which will, I hope, be written in due course. They taught us many lessons. For example, our first cut was seldom wide enough—it is hard to believe that, for a 12-ft carriageway with hard shoulders, even on level ground, the peat had to be stripped to a width of 33 ft to leave enough space for ditches of adequate depth and batter. Another mistake we made was in using 24-in or sometimes 36-in pipe culverts; such a cross section was certainly needed to take the flow from the spring thaw on these broad hills, but we should have used multiple culverts, four or nine 12-in pipes, instead, because our deep invert levels gave us a lot of extra work in ditching where the slope of the ground on the downhill side was gentle. A ditch 3½ ft deep needs to be some fifteen feet wide at the top, or to be faced with stone, and either way this takes a lot of work. We were also over-impatient to push on with laying the base—to insure against rain—before the faces of our larger cuttings or side hill cuts had been properly battered and finished. But one learns by experience, and we were getting this experience all the time.

By mid October 1959, after one of the finest summers on record, the main part of the road was complete, with 6 in of wetmix (waterbound macadam) surface to make a total pavement thickness of 18 in, sealed with tar and coated with chippings. But meanwhile a serious flaw had been revealed in the manufacture of the prefabricated concrete sections for the bridge beams—a simple but decisive flaw—the holes were ⅛ in too small for the multiple high-tensile steel prestressing cables which had to be threaded through them! As this was clearly going to require a very big re-think by the War Office designers, by the Ministry of Supply who had bought the beams, and by the factory which made them, it was clear that this bridge could not be completed before the winter weather broke, so we pushed the concrete white elephants to one side and built a Bailey bridge. The road was opened to traffic in December, and for the next five months the soft clay subsoil drained out into the side ditches and was pounded into its final level by the traffic. The wetmix surface assumed undulations up to six inches in places, but bound together into a hard dense layer, ready for dips to be filled and the tarmac surface laid in 1960.

We had originally planned to mix our own tarmac (or asphalt) using our own stone. But the only asphalt mixing plant available in UK proved to be a Starmix 40 which, as Christmas Islanders will know, is more like a factory than a single piece of plant. To dismantle, move 400 miles, and reassemble such a vast plant for 2½ miles of one-way road was clearly uneconomical, and it proved much cheaper to buy hot premix from the local quarry. The British Road Tar Association are campaigning to sell Dense Tar Surfacing as a competitor in durability at lower cost than asphalt. They, therefore, gave us much help and advice. We had saved just enough money on the project to afford this premix in place of the bitumen we had originally budgeted for, and we set the BRTA the task of designing a surface within the money we had. On inspection of our base, they gratifyingly classed it as "well above average", and prescribed a 1¼-in layer of coarse (1-in max) tarmac throughout, topped by ¾-in of fine (½-in max) tarmac (on the level straight stretches) or an inch of dense tar surfacing (on the bends and gradients).

This proved, in fact, too thin a pavement to allow enough scope for levelling out the undulations of the base, but I think it will prove hard and durable. Time will tell.

About the bridge I will not say too much. It was a troop trial, and we have built it, and it has not yet fallen down. But we have, in our report, condemned it all round as a military bridge. The beam sections are too heavy for practical handling by the standard military crane, and too long for the standard low-loader. The assembled beams are too heavy for launching without either a prohibitively huge derrick or falsework—and if falsework is used, the beams could just as well be smaller and more numerous. I had better keep clear of the faults in the detailed design or production of the beams and accessories, as I imagine these will be the subject of discussion between the designers and the manufacturers for some time to come. But for us, the builders, these errors were infuriating and caused endless delays and much travelling to get faults rectified and to get replacement parts.

Not that I would condemn prestressed concrete for military use. In cold war theatres, beams made in local factories using forms shipped from UK will be far more economical in freight charges than ready made beams or steelwork shipped out instead. The idea is fine. But, with so many proved civil designs to choose from, why must the Army try to design its own? In exchange for a few very doubtful advantages in design, we sacrifice all the advantages of using a product which has been proved in the fire of commercial competition. One troop trial may have shaken a few of the rats out, but it cannot shake them all out. I believe that our troop trial may now have helped to convince those responsible that they must stick to a proved civil design; if so it has been worthwhile. It has certainly been worthwhile for us, because the worse the snags the better the experience.

But what a wonderful job it has been—the road and the bridge as a whole. The survey, the soils tests, the alignment, the earthmoving, the quarrying, the surfacing and the drainage; and the technical problems of the bridge; the organization, the plant maintenance, the negotiations and the finance. All these have advanced us on the way of becoming better engineers—and that is surely what the rest of the army wants most of its Sapper officers. And, as always on project work, on things that are built to stay and be used, the sappers further developed the habit they had acquired on Christmas Island, the habit of working flat out in all conditions and all weathers and at all hours.

St. George's Bridge, York

On 7 October 1959, I flew to Aden to arrange the take-over by the regiment of the engineer commitment in BFAP. The Otterburn project was running in top gear and I could have told you, almost to the minute, what the regiment would be doing on any day in the coming week. Or so I thought.

On 15 October, I landed again in UK, and, on opening *The Times* was astonished to see a photograph of a magnificent 205-ft Bailey bridge, on two pontoon piers with superstructure to give 15-ft headroom for river traffic, avowedly built by my regiment over the river Ouse in York.

And so it was. The day after I took off, a main road bridge in York was closed for repair. The resulting traffic jam was such that the Council asked the Army to help. My 2IC, an ex-SME Senior Instructor in Bridging, designed a very fine bridge to suit the difficult launching site and the needs of the busy barge traffic.

His main problem, however, was manpower. We were racing the oncoming winter at Otterburn and this was extending us to the full. So he withdrew only six junior NCOs from the field squadrons at Otterburn, to help our

QMSI to handle seventy clerks, workshop tradesmen, storemen and batmen from the Field Park and RHQ. In true crisis style these enthusiastic amateurs built the bridge, and the Lord Mayor of York opened it, with two minutes to spare before noon on Saturday, when the week-end traffic rush descended upon it. The Police estimated that 10,000 vehicles crossed it in the next 36 hours.

The morals—and the values—are obvious. It was a magnificent test, when we were already straining every nerve at Otterburn. It underlined the hidden strength of a fully committed regiment, and showed that, just as clerks and batmen have often seized rifles and held a breach, they can do just as well when it comes to building a bridge, given an experienced officer and a handful of experienced NCOs to design it and organize the job.

The Bridge at Plashetts

This was another squadron task *par excellence*, over 100 miles from RHQ, requiring a squadron detachment in camp on virgin ground for over two months. I will describe it only briefly, as it is described in a separate article by the officer who designed and built the bridge with 48 Field Squadron.

It was clear that Otterburn in 1960 would require only one squadron, plus the bulk of the plant. We were, therefore, put in touch by the Chief Engineer Northern Command with the Forestry Commission, who had twenty-two old Bailey bridges in Northumberland which they wanted replaced by permanent bridges. They offered us the choice. The largest was the 130 ft bridge across the Tyne at Plashetts, a remote spot in the Kielder Forest in Northwest Northumberland, so we chose this one.

The Forestry Commission obligingly allowed the squadron full rein in designing the bridge—influenced only by the need to incorporate certain RSJs which they already had in stock. The Forestry Commission also negotiated with the Trade Unions. They provided the materials which, with a token charge for our services made by the War Office, cost less than £3,000—a fraction of what a contractor would have to charge to build a bridge in this inaccessible and almost uninhabited area. Thus the Forestry Commission (in other words the taxpayers) were saved tens of thousands of pounds, and we got a really good job to tackle.

The result is a three-span bridge, RC decking on RSJs on pile piers. The piles are BSP cased steel piles, surrounded by 24-in spun RC culvert pipes, the whole filled with concrete and rendered by a special process in which we were assisted by the Cement Marketing Board. The result—and I can say this as it was entirely a squadron task—is a beautiful bridge up to the highest standards of professional finish.

As at Otterburn, the task involved an access Bailey bridge to keep the road open during construction, and there were many other problems, including spates. But it all went with a swing. They had plenty of plant, and every NCO and sapper had a responsible job.

The CIGS, Field Marshal Sir Francis Festing, lives a few miles from the bridge. This led to a situation ripe with possibilities when one day, dressed in civilian clothes, he had a contretemps with a piece of plant on a low-loader in a narrow village street, but God and the GICS were merciful. Later he accepted an invitation from the Forestry Commission to open the bridge. Officers, NCOs and Sappers who had built the bridge were distributed about

it, and the CIGS spent forty-five minutes talking to them as he walked around. We were delighted to find him enthusiastic about the way we have been employed, and in particular about the value of projects such as Plashetts for cold-war training and for public relations and recruiting. So I feel on firm ground in expressing such views in this article.

The Troop in Aden

They call it a troop. It is undoubtedly the finest captain's command in the Corps, and therefore also in the Army.

The troop provides field engineer support for the British Forces in the Arabian Peninsula engaged in maintaining law and order in the frontier area, in Aden itself, and amongst various Sultanates spreading from the Aden Protectorate to Muscat and the Oman.

Their main task, of course, has been making roads and tracks—which is, I think, more than half the field engineer's task in any kind of war. But, by contrast with our 24-ft asphalt carriageway on Christmas Island, and the 12-ft tarmac road at Otterburn, their "roads" are precipitous mountain tracks, blasted through solid granite on the 4,000 to 7,000-ft range of mountains which marks the Yemeni frontier. Sometimes the sappers are shot at—one of them was killed last year—but at the time of writing the frontier is peaceful. During the past six months, the building of the road has had a striking effect on the attitude of the tribesmen, for they realize the extra prosperity it will bring them—an oft recurring theme in the sapper's cold war all over the world. The Kedah Roads project in the Siamese frontier area of Malaya had just the same idea.

But roads and tracks are not their only task. They deal with the tricky problem of mines in the Oman which is no idle task. The troop has also built a tank causeway nearly a mile long over a salt-pan; huts, armouries, and water-towers; and the hundred-and-one other little things that sappers can do for other arms.

But what has all this got to do with soldiering in the Strategic Reserve in UK? The answer is—a lot. We turn this troop over once a year. Into it we pack promising young Officers, NCOs and potential NCOs who we think will develop under the tremendous independence and responsibility which service in this troop provides. And they come back, mature, confident and ready for promotion, to become our junior leaders for the following year.

Training with Other Arms

The Aden Troop provides our finest training ground for practical cold-war soldiering with other arms. The troop is based with a tank squadron, and has dealings in Aden Colony with the RN amphibious Warfare Group and an RM Commando. Up country, they have supported British infantry and armoured cars, SAS in the Oman, Levies in the Aden Protectorate and have worked with Frontier National Guards and other local forces. Not much conventional promotion examination stuff perhaps (divisional boundaries and Corps counter-attacks and so on) but something much more realistic for the real war of today. Many of our best junior Officers and NCOs, and virtually all our long service sappers, can hope to do a spell in Aden during their tour with the regiment.

In Northern Command itself we took part in a demonstration of a rifle company attack supported by half a squadron of tanks, in which, armed

with ripple switches and many miles of cable, we represented 600 rounds of artillery fire, and learned a great deal from doing so. Thereafter, during the summer, we had arranged a series of exercises with a battalion, in which we were to provide both engineer support and an infantry or guerilla enemy, but the battalion was sent overseas. This is one of the snags of serving in the Strategic Reserve. In the coming year we have arranged a similar period of training with an infantry battalion in the Stanford Battle Area, and we are hoping that our plans will not be knocked on the head this time.

For promotion and staff candidates we have sent them on many of the abundance of TEWTS which are run by the TA, and by infantry depots and the RAC Training Brigade—and indeed it has worked, for everyone eligible for a practical examination has taken and passed it, and we have sent one captain to the Staff College each year. In the North there is unrivalled scope for infantry and engineering training, and a blessed freedom from interference, for which we are unendingly grateful.

Adventure Training

The North of England offers tremendous scope for adventure training—notably rock-climbing, hill-walking and canoeing. Throughout May and June 1960 we ran our own training camp in the Outward Bound Mountain School on Ullswater in the Lake District. Fifty men—mainly junior leaders—passed through a week's intensive training here, and twenty-four crossed the English Channel in home-built canoes in July. This has already been the subject of a separate article in the *Journal* for December 1960.

In September 1960, we sent our Aden Troop to train for three weeks at Mallaig and Lochailort (of war-time Commando training fame) in the West Highlands of Scotland—the nearest approach we could find to the mountainous country in the Protectorate. Here, they blasted tracks through rock, chased simulated dissidents through the mountains, and carried out the most hair-raising field firing exercise I ever saw, amongst the rocks and gullies of these 3,000 ft mountains—safe but spectacular. Finally, thanks to the remarkably pro-military attitude of the landowner—the field sections were taken out deer stalking under the expert guidance of a professional stalker. One sapper set a high standard on the first day by killing a 16-stone stag with his SLR at 300 yds. Thereafter, we took part in seven stalks, and killed five beasts; so the troop has some fine trophies to take with it to Aden.

Stalking is probably the best training in patrolling that there could ever be. Right from the start, when the herd is sighted, perhaps two miles away, on a rocky hill side, the problem is to get up to it without being seen and without getting up-wind, pitting one's wits against a live enemy who knows the country. Keen observation is needed, and judgement as to whether a gully or fold in the ground will in fact provide a covered approach on a bare hillside; then, skilful movement and an acute consciousness of skylines; and finally, the stealthy slithering crawl down or along the hillside, into a covered fire position, and the cool, unhurried shot, fired in the knowledge that there is not likely to be a second chance and that the whole result of an exhausting three-hour stalk depends on it. Stags—and more particularly their hinds—are remarkably alert, with nose and ear and eye, and a section which can stalk and kill a stag at Lochailort should have a good chance of dealing with a dissident tribesman escaping along the escarpments after an ambush in the rocky mountains of the Protectorate.

We also sent our junior NCOs cadre courses to Scotland – in 1959 to ski in the Cairngorms, and in 1960 to Lochailort where they too had some stalking, climbed Ben Nevis and three other 4,000 ft peaks, and canoed for many miles through the Lochs and over the sea to Skye.

The Joys of Dispersion

Otterburn, Plashetts, Hawley, Ullswater, Goole, Lochailort, Mallaig and Aden—we are often asked if we don't find it a trial to be so split up. On the contrary, it is a blessing and is the best insurance against the current evil of over supervision, and we look for as many detached tasks as we can.

Our furthest detachment—in Aden—can be reached from Stansted airport in twelve hours. This goes to show that distances are no longer a real barrier against the visits of Superior Officers, but they are an effective filter. The roads to Plashetts and Otterburn (both about 100 miles) are winding switchbacks, and it takes much longer to get to Mallaig than it does to get to Aden.

During 1959, there was no field troop of the regiment in barracks for even a single night in May, June, August, September, and October. (Ripon Week was in July.) In 1960, the same applied in May, June and July. Throughout these months the troops were in camp, for about two months as a regiment (at Otterburn) but otherwise as squadron or troop detachments. None was less than fifty miles from RHQ, and all but one were in the 100 to 300 bracket. My visits rarely occurred more than once in ten days. Only thus are Officers and NCOs really tested, so that the failures are unmasked, the plodders recognized and, above all, the good ones given a chance to develop.

Public Relations and Recruiting

I referred at the start to the particular responsibility of units serving a tour in UK for public relations and recruiting.

Our strongest recruiting card is that sappers do not hang about or do senseless repetitive training, but that they work hard—all over the world—at something useful. Good pay, fair dealing, good food, accommodation, dress, married quarters, welfare, education—all these things play a big part. But in inducing a soldier to sign on or to recruit his younger brother, none of them compare with the question of whether he is, or is not, satisfied with the way in which he spends his working day.

But it is no use claiming that we offer a purposeful life unless we do in fact offer it—otherwise the fraud will quickly be detected and the promise will deservedly bounce back in our faces.

Unanswerable demands for engineer work will ensure that we almost always do offer such a life in cold war theatres overseas. In BAOR there are strong conflicting demands which make it much more difficult, because our primary aim in the NATO army must be to keep our place in the all-arms team, and our military prestige amongst our allies. Whether we really gain more prestige by breaking records with Meccano which we dismantle next day than by solid "built to stay" bridges is arguable—we should do some of each, both in BAOR and in the Strategic Reserve. But, as far as the British public—and I believe enlightened military opinion—is concerned, it is the things that are built to stay that bring the prestige—and the recruits.

We have been lucky to have our story to tell—and we have told it to as wide a public as we can reach—on the BBC and ITV, in the national and local press (we have a weekly "38 Regiment Diary" in our local paper), and at meetings, functions, clubs—wherever we get the chance. But, perhaps most

important of all, we told it, displayed it and recorded it in a brochure to 125 mums, dads, brothers, sisters and fiancées whom we invited to stay for the weekend in RE Week, Ripon.

This last is nothing new, of course, but I do commend it. We accommodated these 125 in barracks, using blocks with small rooms, one room to a family (as in a caravan). The cookhouse fed them. I found them tremendously friendly, both as an audience and as individuals, and appreciative, and I am convinced that they went away firm supporters of the regiment and well pleased with the life their sons lead in its ranks. I hope that some of their younger sons and nephews and cousins and friends will soon be with us.

As well as housing and feeding them exactly as their sons are housed and fed (and their sons would soon tell them if it were otherwise!) we offered them a weekend of military display and entertainment. They saw a regimental parade for the Chief Royal Engineer—the Regiment being armed with the SLR and dressed 100 per cent in blues (for which we borrowed blues and buff belts from all over the country)—and a church parade, also in blues with all the trappings of our Freedom of the City; we had a dance (for which an encouragingly large number of men elected to wear their blues rather than civilian clothes); a fair, with many sideshows including a parachute training fan jump from a 30-ft tower; and—as *pièce de résistance*—a miniature Sapper "Tattoo", with the RE (Aldershot) Band, a silent drill display on grass by the Mayor's Escort, a comic plant relay race, a light bridge-building race (which we hope will enter the Royal Tournament some time), a spectacularly faked demolition of a radar tower by TA parachutists, and, as a historical centrepiece, the blowing and charging of the Kashmir Gate (in which three sapper VCs were won).

In addition to the 125 mums and dads, and some 300 wives and children from the married quarters, over 1,000 of the 10,000 inhabitants of Ripon came to watch this "Tattoo", and afterwards toured the sideshows—which included films, photos and displays showing how the regiment has been employed. The whole performance was well covered in the Press, and given a preview by the BBC.

RE Week Ripon was our biggest single PR and recruiting blast, but the accumulated effects of our day-to-day relationships with the public and the press are no less important. The Freedom of the City is not just a parchment and a catchphrase for pompous functions. It is individually expressed by the friendliness of the citizens towards us, and, on our side, by small practical services which the Army can do for the community; not only the erection of stands and floodlights for local functions, but also by visits and invitations to the forty pensioners at the British Legion Home, and to the thirty-five boys at the Barnardo's home (for whom we have provided workshop tools by voluntary subscription, and whom our sappers visit two or three evenings a week). A year ago we started the "38 Club" in the barracks, run on mixed youth club lines, with membership by election, thrown open to all ranks under 25, and to the girls of the Ripon Teachers Training College, aged 18 to 21. We can claim a success here, not only because of a clear year without any scandals, but also because, after the first few trial evenings, when we invited the college to elect thirty-five members, no less than ninety girls applied—a fair tribute to the behaviour of the sappers. Another such tribute appeared recently in the local press, when the Chairman of the Magistrates Bench was quoted as saying "the behaviour of the Engineers, apart from a

very occasional case, is exemplary. The Royal Engineers are gentlemen in every way, and we in Ripon have something here of which to be very very proud." If we take our recruiting seriously, we should seize on such remarks as these and shout them from the roof tops.

In the realm of officer recruiting, we have housed and helped to train 8 CCF and OTC contingents. We also sent Subalterns fresh from Christmas Island to lecture at twenty Public Schools and Grammar Schools to tell them—"I left school five years ago. This is what I have done and where I have been." No direct call for officer recruits—but the best recruiting propaganda there could be.

These are some of the ways in which our outside activities contribute to our relations with the public and thereby to recruiting. But there is no doubt at all that the biggest contribution has been the kind of work the regiment has been given to do—worthwhile tasks for intelligent soldiers. As both the Chief Royal Engineer at Ripon Week and the CIGS at Plashetts commented after talking to individual sappers—our work quite obviously makes sense to the soldiers themselves.

Conclusion

What, then, is our reckoning after a year and a half in the Strategic Reserve? Has it been a worthwhile tour for our Officers, NCOs and Sappers, and has it given them the training that they need? And has it paid a proper dividend in public relations and recruiting?

We think it has.

Above all things, it has offered us a life devoted to preparing for real and not for phoney war—no chinagraph rings on the map (except in TEWTS), but the guerilla ambush in the hills: the ordeals of a handful of soldiers facing a raging mob in a riot ridden town: the dodging pursuit through dark alleys, the bump of bodies in the night and a bullet in the guts; and the engineer work that goes with them—making it possible for the infantry and others to live in inhospitable places: blasting roads through rocky hills: and hunting for single cunningly hidden improvised mines. For those things we train, with the best of the regular Officers, NCOs and Sappers taking turns to have a year of the real thing in our Independent Troop in Arabia.

For training in guerilla warfare, the North of England and Scotland offer full scope. Facilities for shooting and field firing are good and not oversubscribed, and the co-operation offered by the depots and training units is excellent.

The field engineering, workshop and plant training facilities of the wartime SME and of the ETC remain, and there is ample elbow-room to use them.

Finally, we have found unlimited scope for doing engineering projects—roads and bridges that are built to stay and to be used. These offer the best cold war engineer training of all, because cold war roads and bridges *are* built to stay (and not just to take the divisional transport for two days); because they train Officers and NCOs to be practical engineers and not just erectors of Meccano; and because the sappers working on them acquire the habit of hard work. They also produce a sense of deep satisfaction when the job is done, and this is the foundation of a good sapper's morale.

It is this satisfaction in his daily life that induces the six-year man to sign on for twenty-two, and to persuade his brothers and their friends to follow the same career.

Plashetts Bridge

By Major P. R. Harvey, RE

Introduction

In the latter half of 1959 an approach was made by 38 Corps Engineer Regiment to the Chief Engineer of the North-East England Conservancy of the Forestry Commission on the subject of suitable engineering works for 1960. After discussion it was agreed that a bridge over the River North Tyne near the village of Plashetts in the Border Forest Park of Northumberland would do well as a squadron task. In November 1959 the Officer Commanding 48 Field Squadron was warned of the task and told to get on with the preliminary planning.

The Task

The task was to replace a 130-ft triple-single standard Bailey bridge over the river with a permanent bridge using the existing abutments. The Forestry Commission's requirement was for a permanent Class 30, single-carriageway bridge with a minimum of a 12-ft roadway. The most economical design was required and as the Commission already had in stock a number of 24 × 7½ in British Standard Beams these were to be used if possible. An additional requirement was that the completed bridge should need an absolute minimum of maintenance. A reconnaissance of the site revealed that the Bailey bridge, which had been erected by the Forestry Commission's engineers in 1948, was set on concrete abutments on a narrow embankment and was evidently in need of early replacement.

The Design

Three designs were submitted to the Forestry Commission on 9 February 1960. The design that was accepted by them as best meeting their requirements was by 2nd Lieut F. J. Horton RE and consisted of an RSJ and reinforced concrete slab deck bridge in three spans of approximately 40 ft, 50 ft and 40 ft using the Forestry Commission's RSJs, four of them in each end span and five in the centre span. The deck was to be 8-in precast RC slabs in 2 ft 6-in widths. The two piers were each to be formed by three box piles, each pile to be surrounded by 2 ft diameter concrete pipes filled with mass concrete. Plate 1 shows the general outline. We estimated that the whole job would take three months.

In order to keep open a route across the river it was planned to rebuild the Commission's Standard Bailey as a broken span 140-ft bridge with a bridging-crib pier on an existing ford 100 ft downstream. Originally we had planned to put up a massive Extra Widened Bailey in a single span to avoid the use of a pier, as the river, although usually shallow and slow moving, was given to alarming rises of 5 ft or more. However, for a variety of reasons we were told that we could have no EWBB and that we must make do with what was already on the site.

On 29 March 1960 the Forestry Commission gave their final approval to the task being undertaken by 48 Field Squadron and we were off.

Stores Supply

We had already worked out a fairly comprehensive stores list for the project and on 31 March a conference was held at the Forestry Commission's office in York, which the Squadron Commander and 2IC attended, to work out the details of the supply of stores.

The system evolved was simplicity itself. We were given a pad of Forestry Commission demand forms and told to list our requirements on them and send them to York. There the Forestry Commission's excellent organization took over and arranged the supply of stores to us on the site through their usual contractors. For stores outside the Forestry Commission's usual range we suggested the names of various manufacturers from whom it would be possible to buy the items we required. We found *The Engineer Buyers' Guide* published by *The Engineer*, very useful in locating suitable firms. For small stores that were urgently required we were allowed to indent on the Forestry Commission's local engineer who lived near Plashetts and he supplied them from his own stock or ordered them from the local manufacturers for us. Each item of stores was receipted on the Forestry Commission's "Goods Inward Note" which was then used by them to support the payment of the suppliers.

Setting up Camp

The Squadron advance party arrived at Plashetts on 27 April and immediately set to work to make a camp that would keep us fairly comfortable for three months. The camp site was a large field owned by the Forestry Commission about 400 yards from the bridge site on the far side of the river, it had a road running to one side of it and a disused railway on another. The advance party, headed by the Squadron 2IC, was given a week to set up camp. When Squadron Headquarters arrived on 4 May there it was—a tented camp with running water and hot showers, electricity, a corrugated iron cookhouse with a calor gas fish fryer and the promise (subsequently fulfilled) of a television set in the canteen. The advance party having been thoroughly indoctrinated by the local foresters had also established fire points in every vacant space and drunk with power and newly acquired knowledge refused to let anybody into the camp until he had done a fire practice on the Coventry Climax fire trailer. It was a splendid camp, set in a bowl of forested hills, far from civilization (Plashetts village only twenty-five souls), almost on the banks of a river and over 100 miles from Regimental Headquarters. What more could we ask?

The Temporary Bridge

On 5 May we started work preparing grillages and putting rollers in for the 140 ft Bailey on the ford. The crib pier, spiked to 3-in timber, was built on the bank and then taken into the river and placed by the Coles crane in its final position.

On 9 May the Forestry Commission's 130-ft triple-single Bailey was dismantled. As it had been in use for twelve years we anticipated some difficulty in getting it down and we had used a £1's worth of penetrating fluid on the transom clamps and bracing bolts. In the event, the bridge came down without much trouble although there were one or two nasty moments.

On 10 May we rebuilt it as a 140-ft double-single bridge on the ford and by 1830 hrs that day it was carrying traffic across the river and the abutments of the permanent bridge were vacant and waiting.

The Piers

The first job on the permanent bridge was to get the piers in. A great deal of thought had gone into this problem before we arrived at Plashetts and eventually it had been decided that instead of using box piles in the piers we would use cased piles.

These cased piles are a comparatively new idea of the British Steel Piling Company to whom we went for advice. Briefly they are concrete bearing piles with a permanent steel tubular casing. They are formed by welding a flat steel plate to the bottom end of the casing and then driving it into the ground to the required penetration. The pile is completed by filling the casing with concrete. The casing is not withdrawn and remains permanently in the ground to form a shutter which protects the concrete whilst it is setting and hardening, no reinforcement is needed. The casings are made from steel strip formed into a continuous helix with the adjoining longitudinal edges butt-welded together both inside and outside the casing. They are base-driven by filling four or five feet of dry concrete mix into them and using a steel drop hammer weighing 2 tons inside the pile. They come in various gauges and diameters; we used 8 gauge and 14-in diameter. The drop hammer was 12-in in diameter and approximately 9 ft long.

The great advantage of these piles is that they are easily handled, a 35-ft pile weights only 8 cwts and they require no special piling rig to drive them, any crane with a trip release on the rope will do. The casings are supplied in any length, if they prove to be too long when they have been driven the excess length can be cut off. Conversely, those that are too short can be lengthened by welding extensions to them.

The Project Officer had already driven a test pile in the river and reached 21 ft before he got the set he required, so as our bridge was about 14 ft above river-bed level we had ordered six 35-ft piles with shoes on and a spare 30 ft unshod in case one of them disappeared on driving. Throughout the project the British Steel Piling Company was most helpful and their design staff and local representative did all they could to assist us; we are very grateful to them.

A piling frame made up of Bailey panels had been designed to hold the three piles in each pier during driving and a 30-ft single single Bailey was built out from the abutment on to a Bailey pier on the bank to hold the BK 50 excavator which was used as a pile driver. We took great care in the positioning of the piles and even more care to ensure that we drove them absolutely vertical. To do this we set up two theodolites at right angles and sighted each pile on to the vertical stadia hair of the telescopes. After each five blows of the hammer the pile was checked for plumb and corrected if necessary.

We drove our first pile on 19 May with complete success and our second the next day. By this time we had decided that we knew all about cased piles and how to drive them and as we confidently drove our third pile, the last one in the North pier, we lost the hammer. Picture a 35-ft tube 14-in in diameter driven a couple of feet into the river bed and soaring 20 ft above the pier on which the pile driver stands. Inside that tube, 35 ft down, is a 2-ton steel hammer which has become detached from its hauling rope. We felt very downcast as we wondered how to get it out.

We thought first of looking for a sapper with a 13½-in shoulder width or

cutting the pile off to recover the hammer and then welding it up again. We even thought of concreting the hammer in and saying nothing about it until we remembered that it was only on loan from BSP and cost £150. Eventually, on the advice of the local BSP representative we fished for it. The crane operator swarmed up his boom with a SWR strop on the end of his rope and balancing himself on the top of the pile spent two hours trying to hook the hammer 35 ft down in the dark. At last he succeeded and a sadder, wiser Squadron started pile-driving again. However, it is only fair to record that BSP state that on the very few occasions on which internal hammers have been lost down piles they have in every case been retrieved and usually within a matter of minutes.

Having driven the three piles in the North pier we moved the piling frame and the Bailey pier across the river and started work on the South pier and by 29 May the piles in both piers were in. They had been driven to an average depth of 15 ft and to a set of 1-in in five blows at a 4½ ft drop of the hammer.

Whilst the piles in the South pier were being driven we started to case the piles of the North pier with the concrete pipes. One of the Forestry Commission's requirements was that these pipes should be sunk a minimum of 2 ft below the river bed to avoid scour. Even with the river low at the time this proved to be a difficult job and involved four sappers dressed in bathing trunks in excavating round each pile under water. We had tried making a coffer dam round the piers but water seepage through the bed and a flood had forced us to abandon the idea.

Whilst the pipes were going on our welding team fixed the horizontal and diagonal bracing between the piles. This bracing consisted of RSJs cased in concrete, the RSJs passing through the concrete pipes and being welded to the piles.

Capsills and Beams

Having cut off the piles with an oxy-acetylene torch at their correct height and filled them and their surrounding pipes with mass concrete, a steel plate 1-in thick and 16-in square was welded to the top of each to carry the capsill. The capsill consisted of two 10-in by 8-in RSJs welded side by side to form a beam which was placed by crane across each pile and welded in position. This operation was complicated and involved a lot of careful work by the welders in accurate cutting and welding and by the project staff in precise positioning and levelling. However by 6 June the North pier was capped and we were ready to erect the main beams in that span.

These consisted, you will recall, of four 24 × 7½-in British Standard Beams placed at 4-ft centres. On the abutment they were to rest on ¾-in steel bearing plates bolted to the abutment shelf and on the pier to sit on the capsill which had steel locating strips welded to it.

On 7 June the four 40-ft beams were brought on to the site on our 18-ton trailer which was towed into the river by a Size 2 tractor where the 19 RB awaited them. In spite of their size and weight (2 tons each) the beams were placed in position fairly easily and by the end of the day the North gap was spanned. When the beams were in position the welders fastened themselves and their welding trailer on top and started to insert the diaphragms which joined the beams at 10-ft intervals.

The other two spans followed the same pattern and by 13 June we were ready to lay the deck.

Photo 1. The Bailey on the ford.

Photo 2. Piling.

Plashetts Bridge 1,2

Photo 3. Lowering the capsill on the north pier.

Photo 4. Welding the capsill in position.

Plashetts Bridge 3, 4

Photo 5. Erecting the main beams.

Photo 6. Laying the deck slabs.

Plashetts Bridge 5 & 6

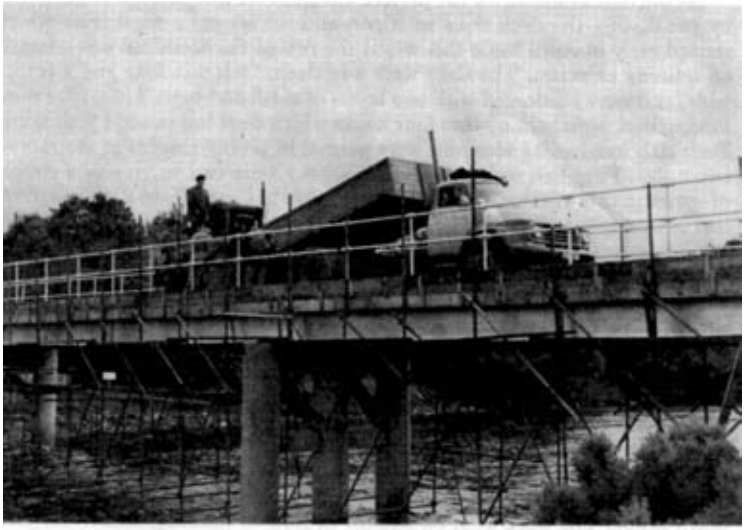


Photo 7. Surfacing the bridge.

Photo 8. The finished bridge.

Plashetts Bridge 7 & 8

The Deck

As the time available for the project was short we had decided to get ahead by pre-casting the deck slabs in Ripon and we set up a small team which started early in April to do this whilst the rest of the Squadron was engaged on training exercises. The slabs were 8-in deep, 13 ft 9-in long and 2 ft 6-in wide, and were reinforced with two layers of mesh and bars. The upper reinforcing bars were bent up into four hooks which were left proud for slinging. Each slab weighed 1½ tons and were poured in timber moulds at the rate of two a day. Fifty-two were required, fifty-four were cast to give us a couple of spares in case of error. From the end of May, 15 Corps Field Park Squadron had been transporting these slabs from Ripon to Plashetts and by now were well ahead of schedule. The story, apocryphal no doubt, is told of the harassed NCO in charge of concreting, planning to cast his last slabs on the move.

On 14 June we laid the first deck slab. Our Coles crane stood on the embankment, picked up a slab, moved forward and lowered it carefully into position on to the cement-sand mortar on the main beams of the North span. After each slab was laid the crane moved over it to lay the succeeding slab. Although it was simple in theory laying the deck turned out to be more complicated in practice. As we had used timber moulds each block was slightly different to its fellows and slight deformations in the top flanges of the main beams meant that each slab had to be given individual treatment to bed it down firmly. The work went on steadily in spite of the snags and by 24 June the last deck slab had been laid.

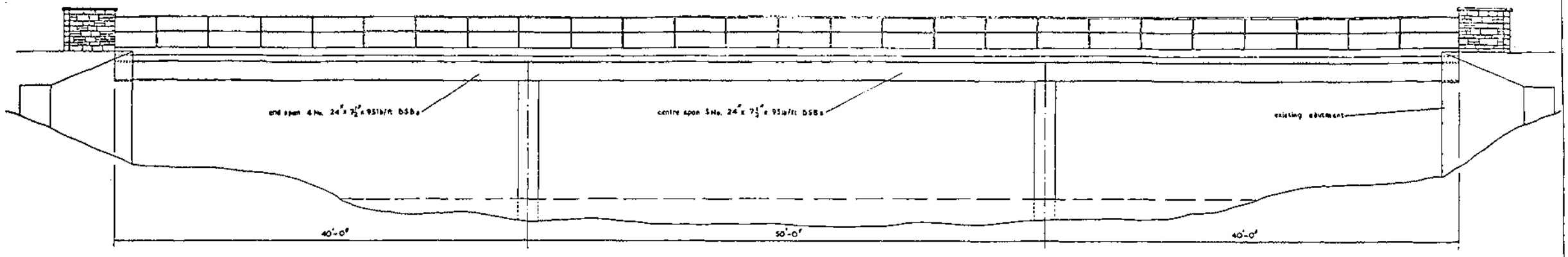
The Approaches

The deck level of our bridge was about 8-in higher than the approach road. We had already poured a mass concrete end-dam 9-in thick and a concrete run-on pad at each end of the bridge and it was now necessary to regrade the approaches. We brought in about 400 tons of 6-in stone from a local quarry, hand-pitched it to the level we required and blinded it with quarry dust. We also constructed a cattle grid some 70 yards down the far approach road. Whilst this was going on the handrails and kerbs on the bridge were being constructed. The rails were 1¼-in galvanized tubular rail clamped to the verticals with a patent Kee-Klamp junction and set in the kerbs. The kerbs which were concrete poured on site were designed to use the deck hooks as part of their reinforcement. We had decided against pre-casting them owing to the difficulty of getting them absolutely straight when laid in sections; our kerbs were lined up with a theodolite. At each end of the bridge two small sandstone parapet walls received the hand rails.

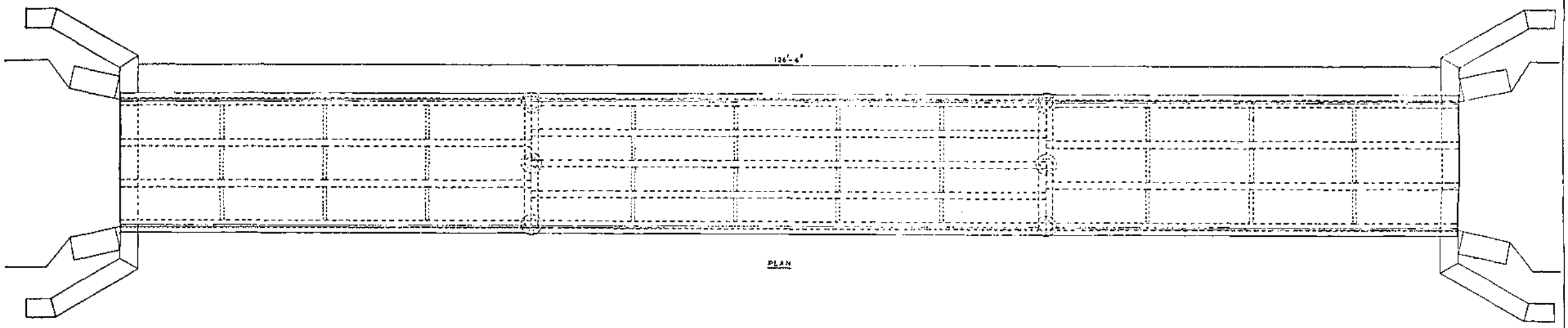
We now had to surface the bridge and the approaches. The designed surface was 3-in of bituminous macadam made up of 2-in of coarse and 1-in of fine. This we had delivered already mixed by a local quarry company straight on to a small Barber-Greene on site. It went down without any trouble in a couple of days.

Rendering and Plastering

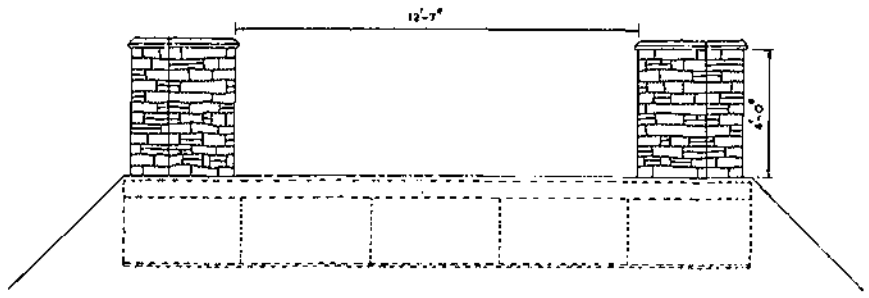
We were anxious that all the concrete in the bridge should look the same, but the abutments were twelve years old, all the joints in the piers were only too evident and our own concrete on the pile bracing and capsills had just been made. Once again we sought expert advice and called on the Cement



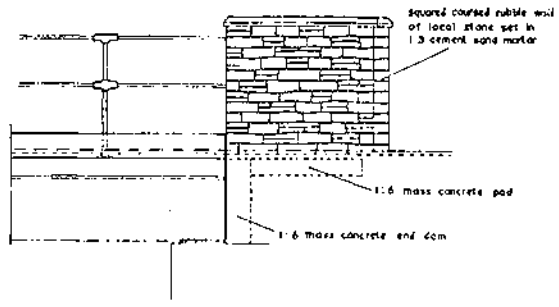
SIDE ELEVATION



PLAN



END ELEVATION



48 FIELD SQUADRON ROYAL ENGINEERS	38 CORPS ENGINEER REGIMENT DEVERELL BARRACKS RIPON
	BELLINGHAM PLASHETTS BRIDGE GENERAL OUTLINE
	MAP REF: ENGLAND & WALES GSGS No 4120 SHEET 76 CARLISLE GR 668896
APPROVED BY	
	SCALES ⅛" & ½" TO A FOOT
	DRAWN / TRACED
	DRAWING No 48/G 7/2
	DATED MARCH 60
	SHEET 1 OF 2

PLATE. 1.

Marketing Company. They not only told us what to do but sent their expert local demonstrator to show us how to do it. The method was to clean the concrete with a detergent to remove all trace of dirt and mould oil and then render it with sand-cement mix to which an adhesive called Cemprover had been added. This was put on with a brush to a stippled finish and provided a key for subsequent plastering.

We had formed another specialist team for this job and they soon got the hang of it. After the stippled key had hardened for three days they were able to start their plastering of all exposed concrete surfaces. They were badly hampered by almost continuous rain which made plastering impossible but they managed it in the end and the result was good. It added just that professional touch to the bridge that was needed.

The Bridge Opens

The date was now the 12 July and the bridge was scheduled to be finished by 19 July. We still had some work to do on the kerbs and parapet walls and the final coat of aluminium paint on the main beams and hand rails was still unfinished. We were badly delayed now by the weather and we were reduced to hiding under the bridge until there was a fine spell and dashing out to paint a couple more feet of steel before the next storm.

On 15 July the bridge was finished and we all went home for a long week-end leaving the picquet to take down the scaffolding. On Tuesday, 19 July at 0800 hrs the bridge was open to traffic and we started to delaunch our temporary Bailey and clear up the site preparatory to moving back to Ripon. On 27 July the last man of the Squadron passed over the Plashetts bridge and the project was at an end.

The Official Opening

The Plashetts bridge was officially opened by the CIGS, Field Marshal Sir Francis Festing GCB, KBE, DSO on Sunday, 18 September 1960.

Conclusion

The Squadron advance party went to Plashetts on 27 April and the rear party left on 27 July. During that period of exactly three months we had erected a semi-permanent tented camp, delaunched and rebuilt a 140-ft Bailey bridge, built a 130-ft permanent Class 30 bridge, recovered the Bailey and packed up the camp. Most of our tradesmen had practised their trades and the Officers and NCOs had had an opportunity to plan a job in detail and see it come to fruition.

It had been a most worthwhile task and as a squadron we were well pleased with it. However none of this would have been possible without the whole-hearted co-operation and encouragement we received from the Forestry Commission whose engineers, mostly ex-Sappers, could not do enough to help us. They were splendid and we are most grateful to them.

A Permanent Way Exhibit at Longmoor

By Major W. Moorhouse, RE

For some years military railway construction has been the responsibility of the Corps of Royal Engineers; there are, however, now no longer any specialized railway construction units in the regular or reserve armies. In a future emergency it might well be the responsibility of field engineer units to assist in the rehabilitation of railways in the United Kingdom, or to undertake track maintenance, and possibly new construction in an overseas theatre.

The aim of this article is to describe the demonstration railway track recently constructed as a training aid and static exhibit at the Transportation Centre, Longmoor, by 16 Railway Training Regiment RE. The track is probably unique in that it contains within an area of 650 sq yds over thirty different types of rail fastenings in recent or current use on Military, British and some Commonwealth railways, combined with a variety of rail sections, sleepers, and other track ancillaries.

The reader may well wonder why so many types of rail fastenings are in use. The principal reason is that the ideal rail fastening does not yet exist, due to a contradiction of desirable characteristics. Briefly, these are:—

(*a*) to hold the rail firmly to the sleeper to prevent lateral spreading of the track, thereby maintaining correct gauge;

(*b*) to hold the rail firmly at a cant of 1 in 20 towards the centre of the track (to correspond with the coning of the locomotive and stock wheels);

(*c*) to provide sufficient vertical loading on the toe of the rail to prevent longitudinal "creeping" of the rail—this being particularly necessary where long-welded rail is installed, when the rail fastenings have to transmit expansion and contraction stresses in the rail to the sleepers and ballast;

(*d*) to be capable of electrical insulation for track circuiting;

(*e*) to have a life of comparable length to its host sleeper;

(*f*) low cost;

(*g*) simplicity, requiring the minimum of special techniques and tools for installation and maintenance;

(*h*) to be easily slackened and tightened when de-stressing long-welded rail, and

(*j*) to maintain its original designed tension after being removed and replaced when re-railing the track.

It will be appreciated that characteristics (*a*) to (*e*) and (*f*) to (*j*) are incompatible, hence the constant research and the multiplicity of rail fastenings available. This also explains the apparent lack of standardization in this matter between the regions of British Railways.

Until December 1959 a demonstration track containing some old military rail fastenings existed at Brimstone Sidings at Longmoor. This was found to be inconvenient for visitors and in consequence was seldom used. It was, therefore, decided to resite the track and to expand its scope to include as many different components as possible. The site finally chosen was as shown in Figure I, as it is near other exhibits frequently visited.

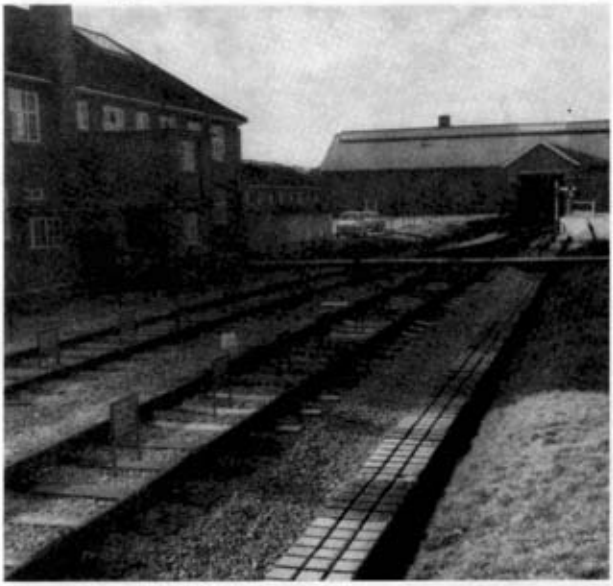


Photo 1. View of track, looking East.

Approval for the construction of the new demonstration track was given in December 1959 on the understanding that it would cost nothing, be carried out by students, and require the minimum of maintenance. The track was completed, in so far as any topical exhibit can be complete, in the autumn of 1960.

Preparatory work included lifting the existing track, and blinding the area bounded by existing concrete lined ditches with a mean of 12-in of ash and local sand to improve drainage. The additional depth of formation was contained by concrete flex-mats, which now serve as a perimeter walkway.

The layout of the new track was controlled by the space available: a main line, turnout and spur were chosen as the most suitable arrangement. A plan of the track and the components it contains is shown in Figure II. In order to include existing fittings, and to allow for future additions, it was necessary to restrict each type to three sleepers, covering approximately seven feet of track. To economize in space a No 6 turnout was chosen rather than the more common No 8, thereby saving about twenty feet of line.

The Chief Civil Engineers of the six regions of British Railways were asked to lend the fittings peculiar to their regions, and the Southern Region was also asked to provide those fittings common to all. In addition, a number of civilian firms kindly gave fittings which were either under private venture tests or not otherwise readily available. The response to all these requests was most generous.

A Permanent Way Exhibit at Longmoor 1

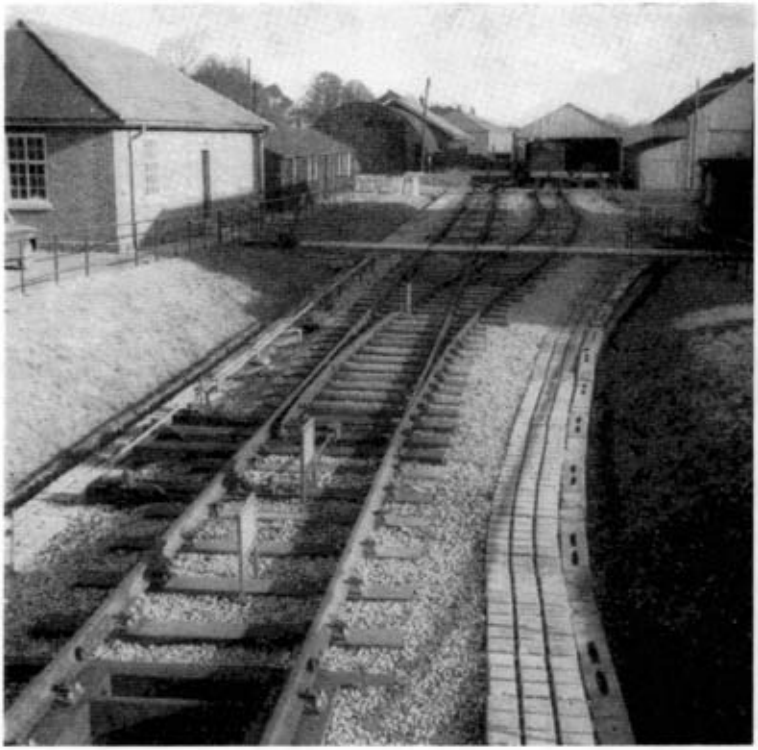
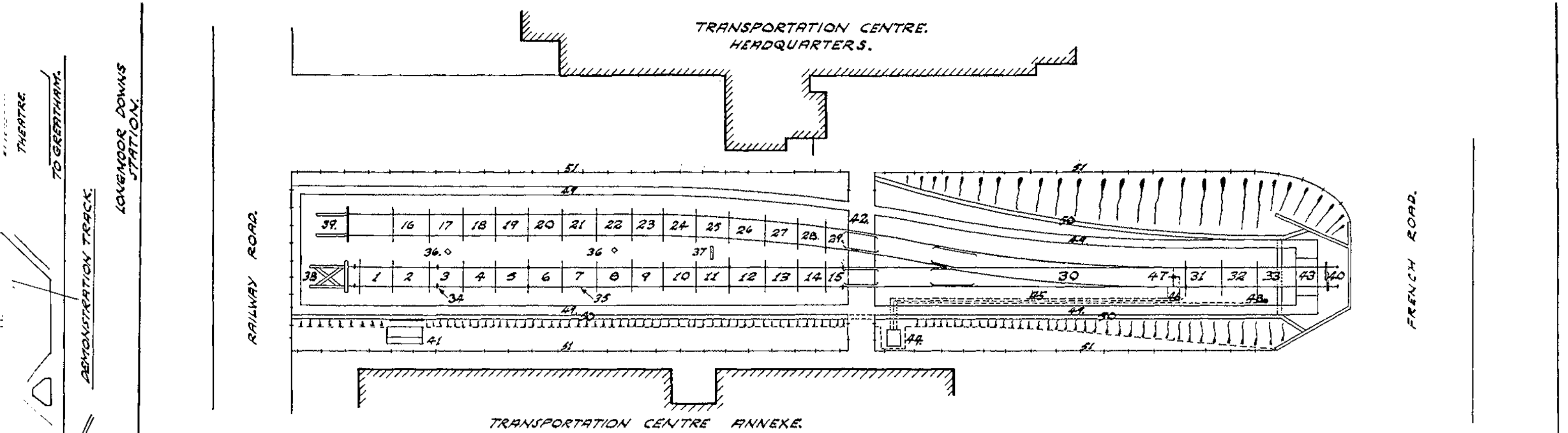


Photo 2. View of track, looking West.

The possible permutations of different fittings, rail sections and sleepers are numerous, and those chosen were a compromise between unnecessary duplication and the desired aesthetic effect. To improve the latter, 2-in nominal limestone ballast was used over-all for "boxing-in", rather than a variation of stone, sand, ash, and soil, and a uniform descriptive sign was placed in the centre of the track at each type of fastening. In addition to the track itself, three types of buffer stops, a signal and signal ground frame, and a concrete platform section were installed. It is intended to add to these ancillaries in the future.

Most of the track items are duplicated in the Regimental model room, but in this case the fittings have been eased to hand tightness to allow the components to be easily dismantled for inspection.

A Permanent Way Exhibit at Longmoor 2



109 lb/YARD F.B. RAIL

1. 'F' TYPE CONCRETE SLEEPERS, 'SHC' ASSEMBLY
2. HARDWOOD SLEEPERS, MACBETH N°2 SPIKES
3. 'F' TYPE CONC. SLEEPERS, 'BJB' ASSEMBLY
4. SOFTWOOD SLEEPERS, BR3 BASEPLATES, MACBETH N°3 SPIKES
5. SOFTWOOD SLEEPERS, 'PANDROL' ASSEMBLY
31. SOFTWOOD SLEEPERS, 'MILLS CLIP' ASSEMBLY
32. SOFTWOOD SLEEPERS, 'WISCLIP' ASSEMBLY
33. WAY BEAMS, ST BASEPLATES, RDI. CLIPS

90 lb/YARD (WD) F.B. RAIL

16. SOFTWOOD SLEEPERS, BASEPLATES, DOGSPIKES
17. HARDWOOD SLEEPERS, DOGSPIKES
18. CONC. SLEEPERS, 'PHILPLUG', DOGSPIKES

98 lb/YARD F.B. RAIL

6. 'F' TYPE CONC. SLEEPERS 'MILLSCLIP' ASSEMBLY
7. SOFTWOOD SLEEPERS, BR1 BASEPLATES, ELASTIC SPIKES
8. SOFTWOOD SLEEPERS, BR2 BASEPLATES, MACBETH N°3 SPIKES
9. 'F' TYPE CONC. SLEEPERS 'AD' ASSEMBLY
10. SOFTWOOD SLEEPERS 'HEYBACK' ASSEMBLY
11. 'F' TYPE CONC. SLEEPERS 'RNB/SB' ASSEMBLY

SIGNAL ACCESSORIES

44. GROUND FRAME 3 LEVERS
45. COMPENSATORS
46. DETECTOR BOX
47. FACING POINT LOCK
48. HOME SIGNAL

TRACK COMPONENTS / ACCESSORIES

34. INSULATED FISHPLATE
35. RAIL ANCHORS
36. MONUMENTS
37. FOULING POINT MARKER
38. STD. WD. TYPE TIMBER BUFFER STOP
39. STD. WD. TYPE OLD RAIL BUFFER STOP
40. CROSSED SLEEPER BUFFER STOP
41. STD PRE-CAST CONCRETE HARP TYPE PLATFORM
42. CONCRETE CROSSING
43. TIMBER CROSSING
49 FLEX-MAT FOOTWALK
50. DRAINAGE CHANNEL
51. TUBULAR STEEL HANDRAIL

95 lb/YARD BH RAIL.

12. SOFTWOOD SLEEPERS CI CHAIRS, WOOD KEYS
13. F TYPE CONC. SLEEPERS CI. CHAIRS, STEEL KEYS
14 SOFTWOOD SLEEPERS CI CHAIRS, THRO' BOLTS, WOODEN KEYS
15. SOFTWOOD SLEEPERS CI CHAIRS, STEEL KEYS

75 lb/YARD (WD) RAIL

19. SOFTWOOD THRO'd POT SLEEPERS, DOGSPIKES
20. SOFTWOOD SLEEPERS BASEPLATES MACBETH N°2 SPIKES
21. SOFTWOOD SLEEPERS, BASEPLATES, ELASTIC SPIKES 'T3'
22. STEEL POT SLEEPERS STEEL KEYS
23. CONC. SLEEPERS, THRO' BOLTS + CLIPS
24. STEEL SLEEPERS, STEEL KEYS
25. CONC. THRO' AND POT SLEEPERS, THRO' BOLTS AND CLIPS
26. STEEL SLEEPERS, THRO' LUGS, STEEL KEYS
27. CONCRETE SLEEPERS, THRO' BOLTS AND CLIPS
28. SOFTWOOD SLEEPERS, BASEPLATES, 'TAFLEX' SPIKES
29. SOFTWOOD SLEEPERS, BASEPLATES, 'RAILOCK' SPIKES
30. STD. W.D. N°6 (1 IN 6) TURNOUT

FIGURE II

P.THOMSON. 24th NOV. 1960.

PERMANENT WAY EXIBIT AT LONGMOOR.

Tumut I Power Station Snowy Mountain Project

By Captain R. M. Hutton, RE

Introduction

On 31 October 1959, Tumut I Power Station in the Snowy Mountains of Australia was officially opened by Dame Pattie Menzies, GBE when she pulled a switch which started one of the four turbo-generators. Originally it was intended that all the turbo-generators should be started at once but it was feared that the noise would affect the success of the ceremony; needlessly so for, apart from the opening clank of the main valve, there was surprisingly little noise from the 110,500 BHP machine.

This ceremony marked the completion of the first major stage of Australia's monumental hydro-electric and irrigation development in the Snowy Mountains. Tumut I Power Station has an installed capacity of 320 megawatts, almost as great as the total generating capacity of New South Wales ten years ago. It is a major engineering achievement in itself as the power station has been built 1,200 ft underground and the same distance in from the right bank of the steep sided valley of the River Tumut.

This article is intended to give a broad outline picture of the construction, drawing attention to a few features of special engineering interest. The background and scope of the whole scheme were given in Colonel M. W. Biggs' article "The Snowy Mountains Scheme" which appeared in the *RE Journal* for December 1958.

The present writer worked on the Tumut I project during its final year as a member of the Resident Engineer's Staff, being one of the two fortunate Sapper Officers referred to by Colonel Biggs in his article.

General Description of Tumut I Project

Tumut I is the first power Station in the Upper Tumut Development of the Snowy Mountains Scheme. The project, consisting of a regulating pondage at Tumut pond dam (fed by tunnel from the storage reservoir Lake Eucumbene) a headrace tunnel and a power station, cost about £(A)60 m. Since later stations on the Tumut Valley (Tumuts 2, 3 and 4) will use the same water as Tumut I, a proportion of the headworks element of this £(A)60 m will be shared between four power stations. An unusual feature in this scheme is that the primary object of diverting water for irrigation from the east to the west of the Great Dividing Range must be financed entirely by the revenue from hydro power. That such a scheme can be constructed economically under these conditions is a result of the imagination of the scheme's originators and the success of the Snowy Mountains Authority.

Schedule of Rates contracts for the power station and nearest headworks were let to the following firms:

(*a*) Tumut Pond Dam to Kaiser—Walsh—Perini—Raymond of the United States of America.

(*b*) Tumut I Headrace Tunnel to the same consortium of contractors; and

(*c*) Tumut I Power Station to Etudes et Entreprises, the initial sponsor of a group of French contractors.

This last contract consisted of the construction of a machine hall, transformer hall, two pressure shafts, lift shaft, access tunnel, tailrace tunnel and tailrace surge chamber underground: and pressure shaft hoist houses, lift house, cable yard, a cable and a road bridge across the Tumut River and a tailrace outlet structure above ground. The contract also included the construction of a mile of access road at 1 in 8 gradient down the 1,000 ft deep valley side to replace a Jeep track built by the authority in the early days for investigation and survey work.

The siting of the power station underground, about two miles downstream of Tumut Pond Dam, was affected mainly by the lack of building space in the narrow, steep-sided valley, by rock conditions at the base of the valley and by the necessity to site the surge tank and pressure shafts in sound rock away from the weathered granite in the valley slopes.

In addition to the civil work, there were many contracts for the supply of electrical and mechanical equipment, the erection of which was done by direct labour employed by the authority with technical assistance from representatives of the supplying firms on the site. The details of these contracts are given in Appendix "A". It is disturbing to see that English Electric and Pirelli General were the only British firms to contract for the project and to know that this situation has not improved on the next Power Station Tumut 2 which is at present being built.

An important aspect of the project was the preliminary investigations work done by the authority's forces, consisting of geological and material investigations and survey. The authority also provided construction power and water supplies, road access, store and some living accommodation to allow the contractor to make a start on the job as quickly as possible. Later, during the construction of the work, authority personnel obtained information on rock behaviour from instruments in the large underground excavations, provided control on all materials used and supervised the contractual work. The headworks were designed by the United States Bureau of Reclamation under an agreement providing for the design of some features, the training of selected authority engineers and the attachment of bureau advisers to the authority. The power station proper, however, was completely designed by the authority at its headquarters in Cooma.

An isometric drawing of Tumut I showing the power station, less head and tailworks, is shown in Figure 1. Facts and figures have been included in Appendix "B" so that the essential statistics can be seen together.

The Power Station Contract

The French contractors, Etudes et Entreprises, were a consortium of six companies headed by Compagnie Industrielle de Travaux and Entreprise Fougerolle pour Travaux Publics, who eventually supplied most of the staff and backing for the consortium.

In the first year of effective operation the contractor got off to a bad start, mainly due to the misplacement of his main effort in driving the access tunnel before he had opened up a satisfactory road down the valley. His camp was at the top of this road 1,400 ft above the access tunnel. Eventually, the contractor changed some of his staff, and, on the advice of the authority, employed six American supervisors. This was a most radical step to take for nearly all the labour and foremen spoke nothing but Italian or French. However, the language difficulties resolved themselves in the Americans' favour

and the system worked quite well, for the delicate French ingenuity and engineering skill was toughened by solid American experience and drive.

Broadly speaking, the bulk of the excavation was done in the first two years of effective work and the structural work in the final two years of the contract. The completion date was 17 September 1960, but the contractor would receive bonus payments if he finished all the contracts work necessary for the running of the turbo-generators earlier. In fact, he was twenty days ahead of time on Nos. 1 and 2 machines and over seven months ahead on Nos. 3 and 4 machines. This was a considerable achievement after falling so badly behind time in the first two years of the contract.

Although temporarily restricted in output because of the construction of a diversion dam for Tumut 2 downstream, Tumut I had been producing peak load power at 330 kV for the New South Wales grid since March 1959 and more recently for the Victorian grid.

The contractor's staff was mainly French and his labour mainly Italian, with, however, many other nationalities represented. Nearly all the labour was migrant. Mining foremen were Italian with a good grasp of their subject, which resulted in careful and exact excavation. The average strength of staff was about forty and labour about 600; rising to a maximum of 760 at the peak of work. The maximum direct labour employed by the Electrical and Mechanical Division of the authority was 340, thus giving a maximum labour force in and around the power station of over 1,000. Working was on a three shift daily basis with generally little work on Sundays.

The final value of the contract was about £(A)8 m which was in excess of the contract price, due to rock conditions which required changes in design and extra tunnel lining. Throughout the contractor had difficulty in equipping the labour effort with suitable and sufficient plant, due to some extent to limitations on the export of capital from France. It is interesting to compare this state of affairs with the comprehensive equipment and plant put into a job by American contractors locally; in fact, these two extremes reflect the difference in mode of working between European and American contractors, and it should be possible in the Snowy Scheme, where the cost of labour is the same for all contractors, to ascertain just how much capital investment in plant and equipment is necessary for the most economical working. Of necessity, the French contractor used considerable ingenuity in invention and improvisation. For instance, the installation of his surface workings (batching plant, compressor house) was done with a minimum of plant, Tournarockers were used for transporting concrete after the excavation had been completed and the placing of concrete in difficult positions was achieved sometimes by original and ingenious methods.

General information about the project would be incomplete without noting some of the principal features of the work which gives an idea of the peculiarities of this type of project.

Principal Features of the Work

Excavation. The major part of the project lay in excavation. This was done in granite or granitic gneiss which ultimately gave satisfactory conditions except where the weathering of the rock was deep at the top of the shafts and at tunnel portals. Airleg drills and stopers were used throughout from various kinds of drilling platforms.

Because of the size of the excavation, the opening up of the machine hall

presented problems that had not been previously encountered by the authority or contractor. After driving the access tunnel, inferior rock at the entrance to the machine hall necessitated a re-siting of the power station 70 ft further along its centre line; this resulted in realignment of the shaft lower branches and the tailrace tunnel but ensured a sounder rock for the machine bays, penstocks and draft tubes. Excavation was by a series of drives (along the crown and abutments of the arch roof) which were opened out sufficiently to place concrete roof ribs before the excavation continued to full depth.

Rockbolts were used extensively for the support of rock by forming a structurally strong arch in the roof and walls of excavations before decompression of the rock started. Initially little faith was placed by the miners in this method of support because of its apparent novelty, but after most of the machine hall roof had been supported with rockbolts, confidence increased and the complete transformer hall roof was adequately supported solely with rockbolts. Steel sets and lagging were used in poor rock conditions in the tailrace tunnel and shafts where it was uneconomical or unsafe to rockbolt. In excavations that were to remain unlined, rockbolts were grouted and the external metalwork treated with a protective paint to prevent corrosion. A description of a rockbolt is given later under "Some particular techniques".

The two pressure shafts and the lift shaft were excavated mainly by raising from three construction adits driven at various levels. The top 70 ft of each shaft was sunk because of the weathered rock that prevented raising. Access to the bottom of the pressure shafts (before the machine hall had been excavated) was obtained through the draft tubes and machine bays through a short inclined adit from the transformer hall.

An impression of the machine hall excavation may be obtained from photograph No 1 which shows excavation in progress at the turbine floor level with an access ramp still in position above the downstream wall. The method of excavation at this stage was by Eimco shovel into crane bucket which discharged into Tournarockers for the removal of muck to the disposal areas. Some rates of excavation are given in Appendix "B".

Concreting. Coarse aggregate for concrete was obtained from crushed tunnel spoil and fine aggregate from the site of some old gold workings 10 miles away. Air entraining agent was invariably used to give 5 per cent entrained air in the concrete. Some of this was lost in the transporting and placing, but improved workability was obtained. Crushed fine aggregate from tunnel spoil was used in the tailrace tunnel concrete up to a maximum of 50 per cent of all fine aggregate. Two batching plants produced a quantity of 57,000 cu yds of concrete, each with maximum output of 20 cu yds per hr. The transport of concrete was either in transit mixers or Tournarockers.

Photograph No 2 is a view of the machine hall looking towards the access tunnel when the final stage concreting was almost complete. Photograph No 3 shows the tailrace outlet structure with a small discharge over an artificial weir of stoplogs which is necessary to maintain a positive head on the draft tubes until the level of Tumut 2 diversion pondage is high enough.

Instrumentation. Because of the lack of detailed knowledge about the behaviour of rock around large underground openings the following various types of instrumentation were used in the machine hall:—

(i) Clinometers were placed on bases in the walls to record angular deflections from a known plane. The results from these frequently proved

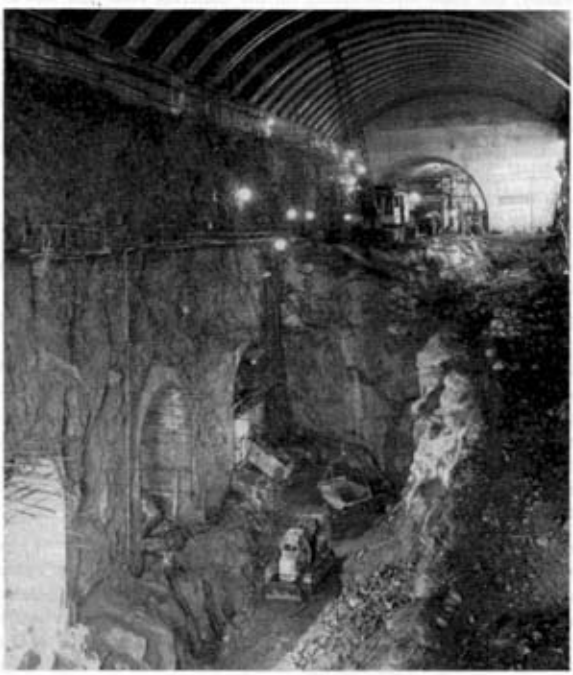


Photo 1. A view towards the Access Tunnel of the Machine Hall during excavation. Penstock portals are on the left of the photograph.

unreliable, probably due to the movement of isolated pieces of rocks in relation to the main wall.

(ii) Strainmeters were placed in the concrete roof ribs, recording reasonably low stresses.

(iii) Direct chainage was made at a number of places across the machine hall from wall to wall. The results of this showed a maximum movement of walls to the centre of ¼-in. This occurred between the concrete rib and abutment and caused some local high stressing.

(iv) Rock noise apparatus (noted in "Some particular techniques") was used to detect excessive movement of rock. Generally, these observations did not forecast any fall-out of rock, nor did any large one occur except for a fall of about ten tons from the roof of the machine hall during the early excavation.

From all these results, it was evident that rock movement occurred around the opening, especially down the deep walls. Previous tests made by the authority on plastic models gave results which were confirmed in practice. An interesting conclusion was that, because of the jointing of the rock, which had a dip of about 60 deg, and the position of the station relative to the side

Tumut 1 power station- snowy mountain project 1

of the valley, the main stress acting on the concrete roof ribs was at about 60 deg to the vertical. This caused the roof ribs to act as arch beams with light vertical and heavy horizontal loadings resulting in some cracking and spalling of concrete abutments.

Pressure shaft lining. The pressure shafts were lined with special alloy steel pipes for the bottom two-thirds of their height and reinforced concrete for the remainder. Pipes were installed in 18 ft lengths and were from $\frac{5}{8}$-in to $1\frac{5}{8}$-in thick. The sub-contractor for this work developed a semi-automatic welding machine for welding the field joints in the vertical part of the shaft.

The space between pipe and rock was backfilled with coarse aggregate and grouted with intrusion grout by the "Prepakt" process. This backfill concrete was very satisfactory since it was easier to place than conventional concrete and did not require any backfill grout to fill voids.

Installation of machinery. Most of the electrical and mechanical equipment of the power station was installed by the authority's direct labour. Its installation had to proceed concurrently with the later structural work of the civil contractor, consequently co-operation and co-ordination was essential. Planning was generally done at combined meetings of the authority's E & M officers and contractors' staff under the resident engineer, who was responsible for co-ordination.

The commissioning of the turbo-generators was done in groups of two machines and lasted about a month for each group.

Main access lift. Personnel access to the power station is by an automatic lift from ground level to the machine hall 1,200 ft vertically below. The installation of this lift, which has the longest travel of any automatic lift in the world, was delayed by many problems, the most serious of which was the failure of trailing control flexes due to kinking and breaking. Cables of such a length had not been satisfactorily made before, but the Australian cable manufacturers have now produced a twist free cable and the lift is in service.

Some Particular Techniques

Three particular engineering techniques are given as examples of the adaptation and development of engineering methods for different conditions. The first two of these have largely been adapted and investigated by the Scientific Services Division of the authority and indicate the amount of research and experimentation that is proceeding along with actual construction in the field.

The first of these is rockbolts, now widely used in underground works throughout the world but until recently unused in hard rock conditions. In principal, a rockbolt is a steel rod of a length related to the spacing (usually between 5 and 14 ft) with a form of anchorage at one end and a bearing plate and nut at the other. The anchorage is placed in a hole drilled in the rock and is secured by driving or tightening the bolt to a specified torque. In Tumut 1 the anchorage used was a slot and wedge type, but more recent practice is to use a hollow core bolt with expanding shell anchorage. Thus isolated rock may be pinned back or, more important, a structurally strong perimeter can be formed around an opening by sufficient bolting, usually in a definite pattern. A recent development, introduced by the authority, is the grouting of the bolt holes and treatment of exposed metalwork to prevent

Photo 2. Taken from a higher position than Photo 1 and later, during final stages of concreting.

Photo 3. Tailrace Tunnel Outlet Structure with a small discharge to the Tumut River over temporary stoplogs.

Tumut 1 power station- snowy mountain project 2 & 3

Photo 4. The road down to the power station passing underneath the head frame for Pressure Shaft "A", the top of which is behind the "Safety" notice board. Part of the Lift House retaining wall joined up in foreground.

corrosion. The large number of rockbolts that were used on Tumut I can be seen by reference to Appendix "B".

Secondly, an instrument originally developed by the United States Bureau of Mines has been used locally for indications of the stability of rock around openings. The equipment consists of a crystal geophone, an amplifier, earphones and a battery. The geophone is placed in a hole drilled in the rock in tunnels or larger excavations and the number of clicks that are heard are recorded and used as a basis for determining the stability of rock. The clicks are made by pieces of rock moving relatively. From the results it is possible to determine areas of high stressing in rock and to forecast a large fall-out of rock, which fortunately never occurred on Tumut I project.

The third technique was an old one remembered in time to effect a solution to a small but difficult problem where other remedies had been tried without success. Stoplogs at the tailrace outlet had to be water-proofed to a certain height to maintain a minimum tailwater level. Tarpaulins were fastened to the upstream side of the stoplogs but leakage still occurred through the bottom and sides of the stoplogs. After attempts had failed to stop the leakages, a load of sand was thrown into the water upstream of the leaks. The sand was carried into the leaks by the water and built up plugs sufficient to reduce the leakages to negligible proportions. This cheap remedy was easy and quick to do. Ashes, sawdust, clay and gravel can also be used for leak stopping, either separately or combined, in different structures such as pipelines or dams.

The Future

This article is not detailed enough to allow many conclusions to be drawn, it is more a statement of the facts about a fairly unusual project. Better value can be obtained by concluding with an impression of the future of the Snowy Scheme, for the completion of Tumut I marked the end of one stage, and only a small one, of the whole scheme. The next stage will be the completion of Tumut 2 Power Station in 1961. Then the emphasis swings to the Snowy-Murray Development further south where there will be built first a 15 miles long tunnel from Island Bend to Lake Eucumbene. From Island Bend in the other direction, westward, there will be a further 15 miles of tunnelling, four dams and two large power stations which will be the first part of the more powerful half of the scheme. The first of these, Murray I will generate 750 MW in a surface station and will be commenced in 1962. Finally, the effort will swing back to the Snowy-Tumut Development for the construction of three more dams and power stations downstream for Tumut 2.

At the end of this colossal scheme about twenty years ahead, Australia will have an extra 2 million acre feet of water for irrigation and 3 million kW of power produced during the redistribution of the irrigation water. This irrigational and hydro-electric power will be of immense benefit to the country and will assist a greater rate of immigration. An important benefit of a less direct nature will be gained from the formation of an organization, in the authority, trained and experienced in the development of a large engineering scheme. Such an organization could eventually be used on similar schemes elsewhere in Australia, and is at present being used on an investigation of the Mekong River in South-East Asia. The future looks bright.

Acknowledgement is made to the Snowy Mountains Authority for permission to print this article and to use the authority's photographs and drawing of the Tumut I Power Station.

APPENDIX "A"

The Main Contractors—Tumut I

Civil Works
Tumut Pond Dam and Headrace Tunnel: Kaiser-Walsh-Perini-Raymond
Tumut I Power Station: Etudes et Entreprises

Generators
ASEA of Sweden

Turbines
English Electric Company

Transformers
ACEC of Belgium

Cables
Pirelli-General

APPENDIX "B"

Some Facts—Tumut I

Equipment

Four No 80 MW Francis turbines with output of 110,000 bhp at 375 rpm. under a net head of 960 ft. Specific speed is 23.4

Four No 12, 5 KV 50 cps generators with rated output of 80 MW at 0.95 power factor

Seven single phase transformers with output voltageof 330 KV

Sizes

Tumut pond dam: 283 ft high concrete gravity arch

Headrace tunnel: 8,200 ft long, 21 ft diameter concrete lined

Pressure shafts: twin 12 ft diameter shafts 1,200 ft deep

Machine hall: 306 ft long, 59 ft wide and 111 ft high

Transformer hall: 128 ft long, 56 ft wide and 45 ft high

Access tunnel: 1,400 ft long at 1 in 8 downgrade

Tailrace tunnel: 4,200 ft long, 25 ft diameter partially concrete lined

Lift shaft: 1,200 ft deep from a four-storey lift house to the control building in the machine hall.

Headrace surge tank: 131 ft high, 50 ft diameter chamber

Tailrace surge chamber: 230 ft long, 26 ft diameter chamber with an enlarged tailrace tunnel for 1,000 ft

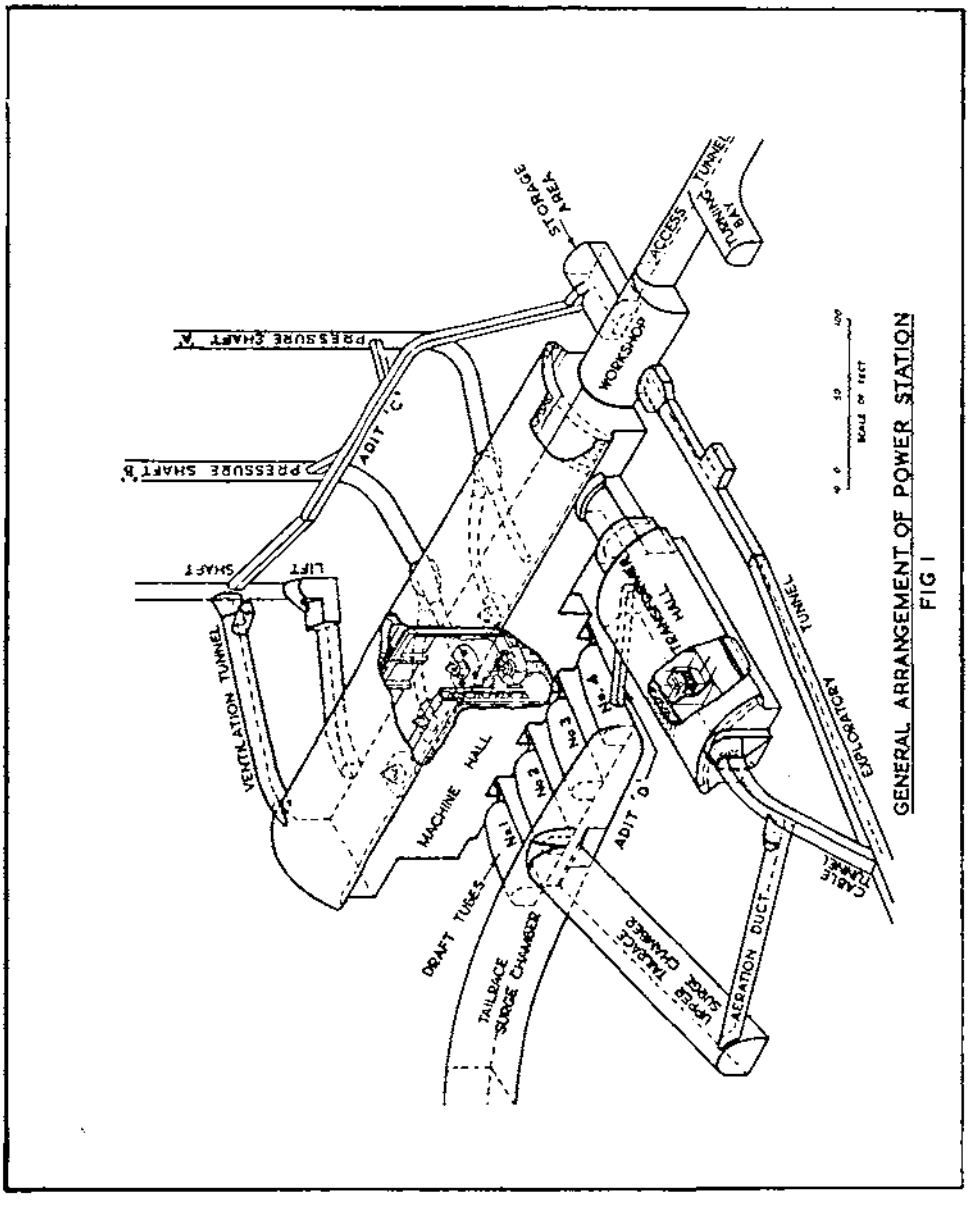
Quantities

Total excavation: Headrace—138,000 cu yd Power station 250,000 cu yd

Total concrete: Dam—178,000 cu yd. Power station 57,000 cu yd

Total rockbolts: 150,000 linear ft

Rate of excavation progress: Shafts—5.25 ft per day. Tailrace—13.8 ft per day



GENERAL ARRANGEMENT OF POWER STATION
FIG 1

Management for War

By Colonel M. B. Adams, BA, AMICE

Introduction

The art of controlling work in the most efficient way is one of the more fascinating of problems with which we are faced. Perhaps many members of the former Works Services wondered why the organization had taken the form it had. Changes in a heavily committed working organization can only be gradual—there is always very little free time to initiate them and one can never be certain what effect they will have in the future both on the organization itself and its supporting training structure. The present time when we have handed over responsibility for the peace-time works services seems to be a particularly apt one to consider how we should run the war-time works services for which we might be responsible. Such an opportunity to plan an organization freed of the usual ties whilst the merits and snags of the old system are still fresh in our mind cannot re-occur.

It is of course useless to plan an organization unless it has some setting to fit into. Settings are, however, unstable—military thought is ever on the move and the concept of future operations today is often ridiculous and forgotten tomorrow. It occurred to the author that as this was not an immediate problem it might be more worth while to re-examine the principles on which such an organization is based. If the principles are sound, correct and well understood they will change slowly, if ever, over the years and there is no problem in adapting them to meet the special set of circumstances which any future operations might throw up. With this thought in mind and looking back a few years, one wonders if constant adaptations to local conditions had not blurred the principles and left only a muddled organization. It, therefore, seems worth while to start again from the beginning and the rest of this article will, therefore, only attempt to deal with problems free of their immediate, sophisticated background.

As some assumptions must be made it will be merely assumed that some Engineer HQ exists to control the activities of a number of units, possibly assisted by unskilled military labour and either directly employed or contract civilian labour, with conditions near to or actual war. Further it is only proposed to deal with constructional activities—it is realized that there is another very real problem, namely the operation and maintenance of utilities such as water supplies, electricity, railways, etc. This type of work needs a different type of organization and the principles will stand out clearer if they are considered separately. Admittedly most organizations will be faced with both problems and compromises will be needed to control both types of activities, but such problems will have to be faced later.

Background

It is interesting at this stage to consider some of the major changes that have taken place over a period of say twenty years, a period chosen on purpose more or less to cover World War II.

Firstly and most marked have been the advances made in electrical and mechanical engineering. It was rare in 1939 to see a bulldozer and very few officers had experience of their control. In 1960 there is so much mechanical plant that it is normal to consider the horsepower available per man. In fact as a recent writer to the *Journal* has pointed out this concept itself is clearly wrong and for many tasks it is the amount of plant that is the controlling factor and labour is merely an adjunct to such plant.[1] During the same period the advances in electrical engineering have been equally striking—to take one example a new science, that of electronics, has advanced out of all recognition with its countless applications to modern warfare.

It is slightly frightening to consider that many of these advances have apparently made no mark on the Corps and it is good to see that a new interest in E & M matters is being stimulated.[2]

There have of course been striking advances also in civil engineering. New materials, such as light alloys and plastics, have opened up new fields, whilst improved techniques, such as prestressed concrete, have added to the applications of the traditional materials. It is difficult, however, to compare the progress in this field with that in the electrical and mechanical where the effects have been of a revolutionary nature. These changes have been reflected in industry. In a mixed project the traditional role of the civil engineer to control and co-ordinate is dying out and such activities now often fall to one or other of the main branches of the profession. But there is one further tendency which is perhaps of more basic importance—engineers have begun to realize that their profession is one and indivisible and that, though specialization is necessary, an over-all picture as an engineer is more important. A particularly welcome sign is the proposed amalgamation of the Institutions of Civil and Municipal Engineers. So many of the functions of the military engineer are linked with those of his civil engineering colleague that all this has considerable interest to us.

Secondly, the art of management itself has begun to receive serious study. The management consultant is now an important member of the industrial world, the services rendered by such people as the Cost Accountant, the Production Controller etc, are highly developed and techniques such as O & M and Works Study are now commonplace and in universal usage. Other branches and Arms of the Service have taken these developments perhaps more seriously than we have and it is possible that they have more applications than we have yet considered.

Military Factors

It is now necessary to turn to purely military factors which will influence the solution to our problem though in most cases they are well known and need little amplification.

Firstly, we must conform to military organizations and methods. The Commander of a force or formation has a G, A & Q Staff who provide the machinery for him to exercise his command and obviously the military works organization must fit into this staff system.

Secondly, even in war we must conform to whatever accounting system

[1]Estimating Plant required for Major Military Engineering Projects by Colonel C. E. Warth. *RE Journal*, September 1959.

[2]The Engineer-in-Chief's address to the Annual General Meeting, 1960. *RE Journal*, September 1960.

(both of stores and money) the Treasury devises. To the good we have the chance to break free from the ponderous system devised to control peacetime works services and let us hope that, now we have the opportunity, we can devise a system that provides a service which can give us yardsticks of efficiency rather than just dead hand control.

Lastly, time is a more important factor in war than quality or cost. Though this fact is well known it must regretfully be said that we often only pay lip service to it. Not only do we need the will to save time but we need the most skilful machinery we can devise to find out where we are wasting it so that the necessary remedial measures can be applied. The will is there, but every improvement we can make in our methods of controlling time needs detailed study—the science of work measurement is still very much in its infancy in the Services.

The Problem

Sufficient has now been said to explain the title of this article. Industry would recognize the problem as a managerial one and, reduced to words, it would run "How can one man (the Chief Engineer) control in the most effective way the activities of the many (ie the units, civilian labour, plant etc)". To do so he will clearly need a staff.

It is unnecessary to quote Professor Parkinson's law dealing with the growth of staff. It is well known, however, that unless the purpose of a staff is frequently examined critically many of its functions become useless and redundant. No doubt exercises have been held to examine the purpose of an engineer staff—the author however cannot remember attending one. It is suggested that over the passage of time the aim and purpose of Engineer Staff has become muddled, hence making it more and more difficult for a Commander to exercise his command effectively.

The Breakdown

To arrive at a solution to the method of controlling work it is necessary to analyse the basic operations which take place in arriving at a completed item of Engineer work. Clearly then if each of these operations can be separated out a staff branch or appointment will be needed to control it and, if the operations and branches correspond, it is obvious that the staff must work with maximum efficiency as they will have singleness of purpose. If the staff divisions are made in other ways there is bound to be overlap with only muddle ensuing.

Two points should be borne in mind however. Firstly, the relative importance between each operation will vary considerably and this will effect the solution. Secondly, the staff needed to control each operation may have little resemblance to traditional staff. These aspects will be discussed later.

What are these basic operations? The first one is a background one, namely *Research*. Research must come first however much it may be forgotten later. Basically it aims to improve existing techniques, equipment or materials and is of course fundamental to progress. Whilst it obviously is outside the scope of a field HQ it is still part of the process and has been included so that it will not be forgotten. It will be referred to briefly later.

The next operation is *Design* and allied closely with it so that the two operations are inseparable is *Development*. Design produces all the information necessary for the construction organization to make, build or construct

what is required. In a narrow sense this entails the production of the necessary drawings and specifications but in the fullest sense it means such adaption, modification and testing necessary to satisfy the requirement especially when a standard answer is insufficient to meet it.

The next operation is *Construction*. Construction takes the design and hands over the completed project to the user. The process of construction subdivides into very clear stages and these will be analysed later.

There is one last, very important operation on the technical side. This operation is a co-ordinating one. For want of a better name it will be referred to here as *Technical Administration*. It is necessary to find out what work the force or formation Commander requires; to translate these requirements as necessary to the correct technical branch and to satisfy the user that the proposed solution is the one he wants. In industry this function is known as Sales Engineering.

The Solution

It is suggested that the branches of an Engineer staff must coincide exactly with operations as above; their charter is hence as simple and straightforward as it is possible to be. Putting aside research, the basic branches will be:—

Design
Construction
Technical Administration

Military staff will of course be needed in the usual way to deal with such functions as personnel administration, training, and other military activities. This aspect is outside the scope of this article and such activities will be referred to collectively as *Personnel*.

The next point is perhaps a fundamental one. Each branch must cover the complete field of work, undertaken by the force or formation. Sub-divisions of work in an idealized case are then basically into the three main branches of engineering, viz: Civil, Mechanical and Electrical. This does not imply such divisions are obligatory or necessary. Obviously divisions are made to fit the load; whilst in one area it might be necessary to split Mechanical into Water, Refrigeration, POL etc: in another Electrical and Mechanical might be handled as the familiar E & M.

It is possible in very large HQs that further subdivisions might be necessary, especially if a large amount of design work is envisaged. There are various ways of dealing with this such as forming project *teams* or separating future work from work in hand. To deal with the merits of the various methods a more detailed background is required and hence this aspect will have to be side-tracked for the moment.

The number of divisions and subdivisions should of course conform to the usual rules of span of control; but it is hoped that staffs of this magnitude will be a rarity.

Design

The amount of design work that is required in a military organization in the field is usually limited and probably restricted to work of a layout nature rather than original design. It has also been found that military officers cannot hope to compete in this field with their civilian counterparts—though they start on a par and can remain on level terms to Long Engineering

Course with the civilian, as a result of specialization the civilian then completely outpaces the senior officer.[1] If senior design staff should be wanted in war it is hence clear that they should be earmarked from the Reserve Army.

Development work, however, takes on a special importance. Standard equipment and techniques rarely fill the special conditions imposed and the rapid solution of these new problems will often be vital to the success of operations. This type of design is more important in many cases than the usual concept.

Construction

This branch is perhaps the most vital to the work of the Corps and it is hence important to consider how to organize it. Fundamentally it splits into two stages; before construction dealt with by the *Planning Section* and during construction by the *Progress Section*. It is perhaps easier to consider plant, tools and material in detail separate from over-all planning and progressing and it is hence convenient to have a third supply, or *Resources Section*. Planning act as the senior section and determine how the job will be done and how much engineer effort it will take in time, men, plant and materials. Progress see the plan is carried out by the target date and Resources organize the procurement of tools, plant and materials and progress their supply. All this is straightforward but now certain features, not present in existing organizations, will be considered.

First it is essential that planning is split from progress and never combined as is usual in present practice. The planner's task, besides producing the method statement as to how the task will be carried out, is to produce the programmes showing the units, men, plant and time required and to keep these amended to fit changing circumstances. In other words they are responsible for producing the targets to be achieved. For this reason they must have no connexions, except in an advisory capacity, with the people who do the job represented at HQ by the Progress Section. Much of their work is inspired crystal gazing—if they are going to carry it out they must be free of other distractions especially of a routine nature, otherwise only planning can suffer. Their job is to keep a target (which will probably need constant revising) for their Commander so that he has a real control of time.

The Progress Section has two main functions. Firstly it must advise the Chief Engineer on the state of completion of a project in relation to target. This function is vital to the exercise of command and needs no further explanation. It depends of course for a constantly up-to-date programme so that the remedial action to deal with the snags as they arise can be decided on facts and not surmises. Without such a programme command will depend entirely on hit and miss methods. The second function is to act as a progress chaser to units. The concept of "progress chasing" for constructional work is slightly novel. The idea is to anticipate the bottlenecks of the man on the ground and see they are sorted out before they arise. They naturally must enjoy the confidence of units with good over-all knowledge of all the resources of the theatre. Their skilled use pays large dividends—unit officers are able to get on with their job instead of chasing round HQs and Store Parks to gather information or stores.

The Resources Section will bear little resemblance to the present organization.

[1] A Report on No. 1 Special Long Civil Engineering Course by Colonel R. A. G. Binny, OBE, AMICE, Professional Papers of the Corps of Royal Engineers (Fifth Series) 1956.

Bearing in mind the importance of singleness of aim the technical work must be separated from the usual administrative work allied with it. Its task is to get the stores, plant and tools to the people who require them but not to hold, account, indent for them, services of a purely routine nature which are carried out elsewhere. Their duties will include such functions as surveys of engineering materials (stone, cement, timber, etc), and plans for their development; the organization of flow to and from Engineer parks though it will not concern itself with the detailed running of such parks or paperwork; the organization and progressing of Workshop production and the output of producer units such as quarrying, forestry, etc, the organization of stores from other arms such as Ordnance, Supplies and Transport, etc. The flow of paperwork connected with carrying out the directives of this section fall into another channel though naturally the resources officer and the paper passer must often work closely together. In a large HQ this section may need subdivision; obviously civil, mechanical and electrical subdivisions will not fit and the subdivisions will be similar to those already in the Resources organization.

Technical Administration

The main purpose of this section has already been made clear. Its task is to find out the Army's requirements and to interpret them to the design and construction branches. It frees the technical branches completely from the negotiation and manoeuvring necessary in dealing with outside staff most of it irrelevant to producing a finished article. For this reason it will act as the channel of communication between formations and units and the HQ.

Supporting services to the Technical branches can of course be considered independently. It is suggested, however, that they should all be coordinated by one branch (and hence the name Technical Administration) so that all paperwork stays in one channel. A second very important function of this section is hence to provide such services as may be required: financial accounting, stores accounting, arrangement of contracts are typical examples. Which services are required depends on the particular circumstances of each case.

Effects of the Suggested Organization

A complete organization developed on the lines suggested is shown in the Appendix. It is hoped the main point brought out is that each Staff Branch and Division has singleness of purpose. Further technical branches are freed from administrative routine which is channelled into one branch.

It might be interesting at this stage to compare a post in the old Works Organization with the method similar work would be tackled in the suggested organization. Taking the former Staff Officer (E & M) he was expected to be responsible for the design, construction, inspection, operation, maintenance and technical administration of such plant and installations which lay in his Commander's field of responsibility. It is inconceivable in the 1960s that one branch could handle such a wide technical field—even worse, it separated E & M work from other constructional activities when the two are interdependent. It is suggested the whole concept was wrong; design, construction, technical administration must all be considered separately and civil, mechanical and electrical engineering must be integrated at each stage. The results of the old system have been frankly disastrous—the type of

work has been unpopular and the Corps is ill prepared for the responsibilities of the 1970s.

It cannot be too strongly emphasized that this article only deals with principles and not with specific cases. It is not visualized that any HQ will need an organization as shown in the Appendix. The important point is that if the principles are understood it will be perfectly safe to strain them to meet some particular case. The muddle arises after constant improvisations and adaptions have been carried out; the basic principles having long been submerged and forgotten. To give a simple example; a small HQ controlling units trained basically to use standard equipment is unlikely to need a design branch and if design tasks arose they would have to be tackled by the construction branch. Normal design has in fact been carried out by a UK agency and the principles are still the same.

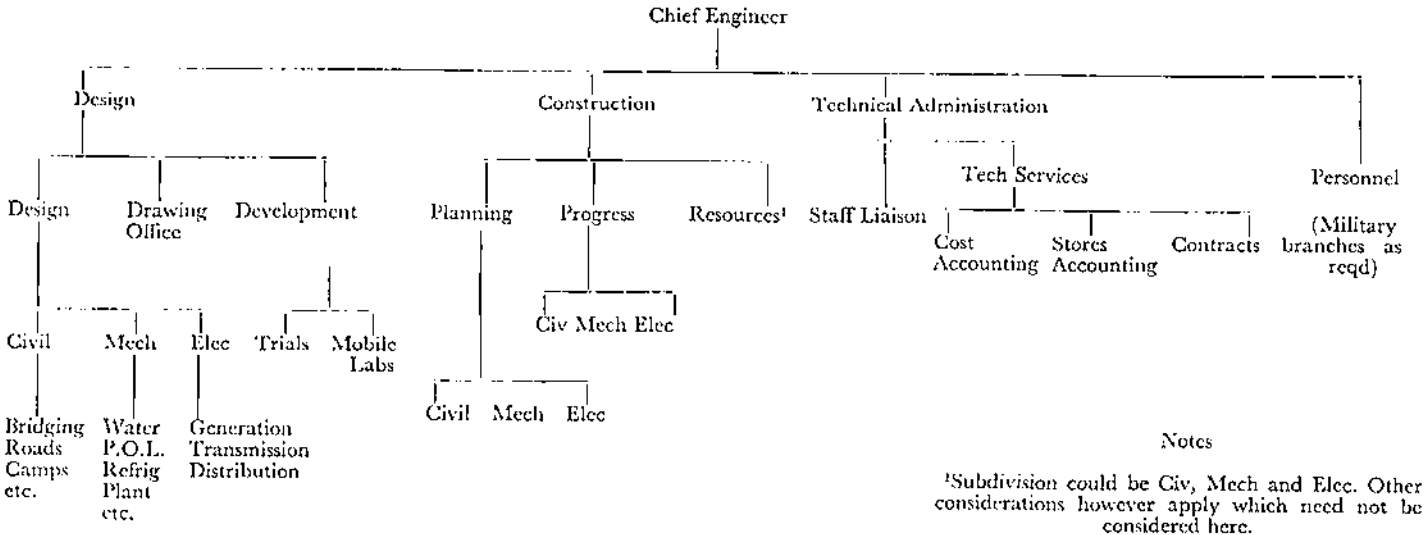
One last point not yet mentioned is Research. Research cannot be carried out in the field and yet if progress is to be made the army's equivalent of research organizations must be aware rapidly of problems in the field so that they can be solved in a quieter atmosphere. It is suggested that direct two-way communications between the field and such organizations is required not only for problems as above but so that the field can use such weapons as computers which would otherwise be unavailable.

Conclusion

It is not proposed to list the disadvantages of this type of organization—they are only too easy to see as our system of training has not been geared to such methods. Staff are never popular with units—the most they can hope for is, if they give an efficient service that they will be tolerated. It is hoped that this article has pointed to some of the action required if our war-time works service staff is to reach maximum efficiency, and to provide discussion points on a neglected subject.

APPENDIX

FUNCTIONAL ORGANIZATION OF AN ENGINEER HEADQUARTERS



Notes

[1]Subdivision could be Civ, Mech and Elec. Other considerations however apply which need not be considered here.

Barrosa

By Colonel R. A. Lindsell, MC

Bear witness bright Barrosa! thou can's't tell
whose were the sons, who bravely fought and fell.
Byron

Introduction

"This should interest you as a Sapper"! so said my host, the late Guy Williams, British Consul at Jerez, as we rose from the table after lunch in his weekend cottage amid the coastal sand dunes south of Cadiz. He led me over to a show case above the open hearth, in which were displayed a great number of badges and buttons of many different regiments. Amongst these he pointed to a worn discoloured badge, on which the inscription "Royal Military Artificers" was clearly decipherable. "All of these" he continued "were picked up on the battlefield of Barrosa just south of here." I was familiar with the battle of Barrosa, as it has become a standard study for the Gibraltar Garrison, but, having failed to read the Corps History carefully, I was until then unaware that the Royal Military Artificers had taken part in it.

From their formation in Gibraltar in 1772, until they were redesignated Royal Sappers & Miners in 1813, there was a natural tendency to regard the Royal Military Artificers as tradesmen rather than as soldiers and to employ them in a garrison rather than in a field role. It is therefore appropriate that on the one hundred and fiftieth anniversary of this famous battle our thoughts should turn to the martial exploits of that small band of Royal Military Artificers, who were the forerunners of our present Corps.

Historical Background

Following the battle of Talavera on 28 July 1809, the British had fallen back into Portugal, and the French armies gradually extended their stranglehold upon the remainder of Spain. One by one the old walled cities capitulated until by March 1810 only the City of Cadiz, standing on its narrow and easily defended peninsula, remained in Spanish hands. Here the provisional Spanish government was established and the remnants of the Spanish armed forces were assembled. In Portugal the relatively weak British forces under the future Duke of Wellington remained on the defensive, whilst work on the famous lines of Torres Vedras was pushed rapidly ahead under Fletcher's inspired direction.

On 24 March 1810, a British military representative arrived in Cadiz. He was Lieut-General Thomas Graham (later Lord Lynedoch), whose portrait, hanging in the coffee room of The United Service Club, must be familiar to many Sapper officers. He was followed by a small force, which he rapidly organized to strengthen the defences of Cadiz.

The early summer of 1810 passed in a virtual stalemate on all fronts. Then in August came the massive French attack in Portugal, the battle of Busaco and the skilful retreat to the lines of Torres Vedras. By the late autumn the starving French were falling back into northern Portugal and Wellington was urging Graham to stage a diversion in the Cadiz theatre.

The Plan

After encountering considerable opposition, Graham secured the approval of the Spanish authorities to a plan to break the investment of Cadiz.

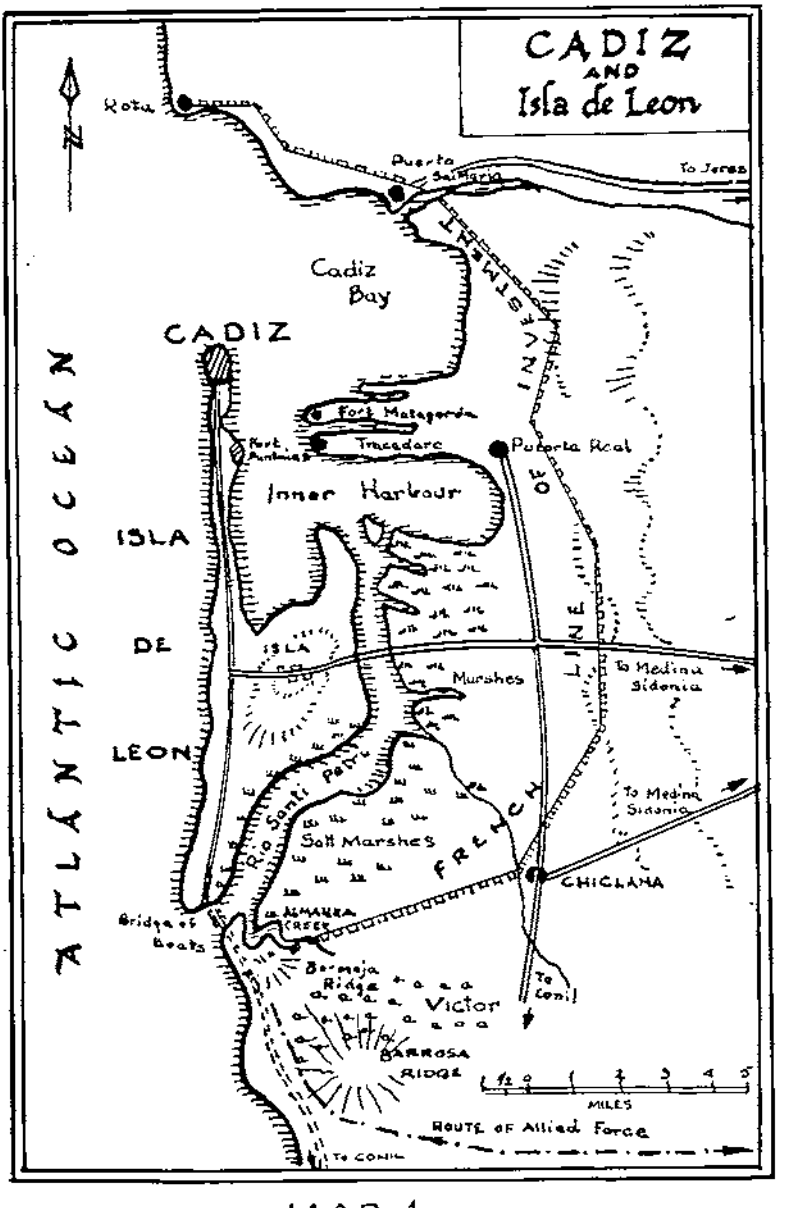
A composite force comprising 14,000 Spanish and 5,000 British troops was to disembark at Tarifa and attack the French forces under Marshal Victor in the area of Chiclana (Map 1). Simultaneously a sortie across a bridge of boats at the mouth of the Santi Petri river would take the French in rear. It was a sound and practical plan, but there was a snag to it. In view of the preponderance of Spanish troops, it was stipulated that the commander should be the Spanish General Manual La Peña, whose lack of ability as a field commander was well known to Graham. On 21 February 1811, the British contingent set sail from Cadiz. They encountered heavy seas and, being unable to enter Tarifa harbour, were carried on to Algeciras bay, where they disembarked on the evening of 22 February.

The Approach March (Map 2)

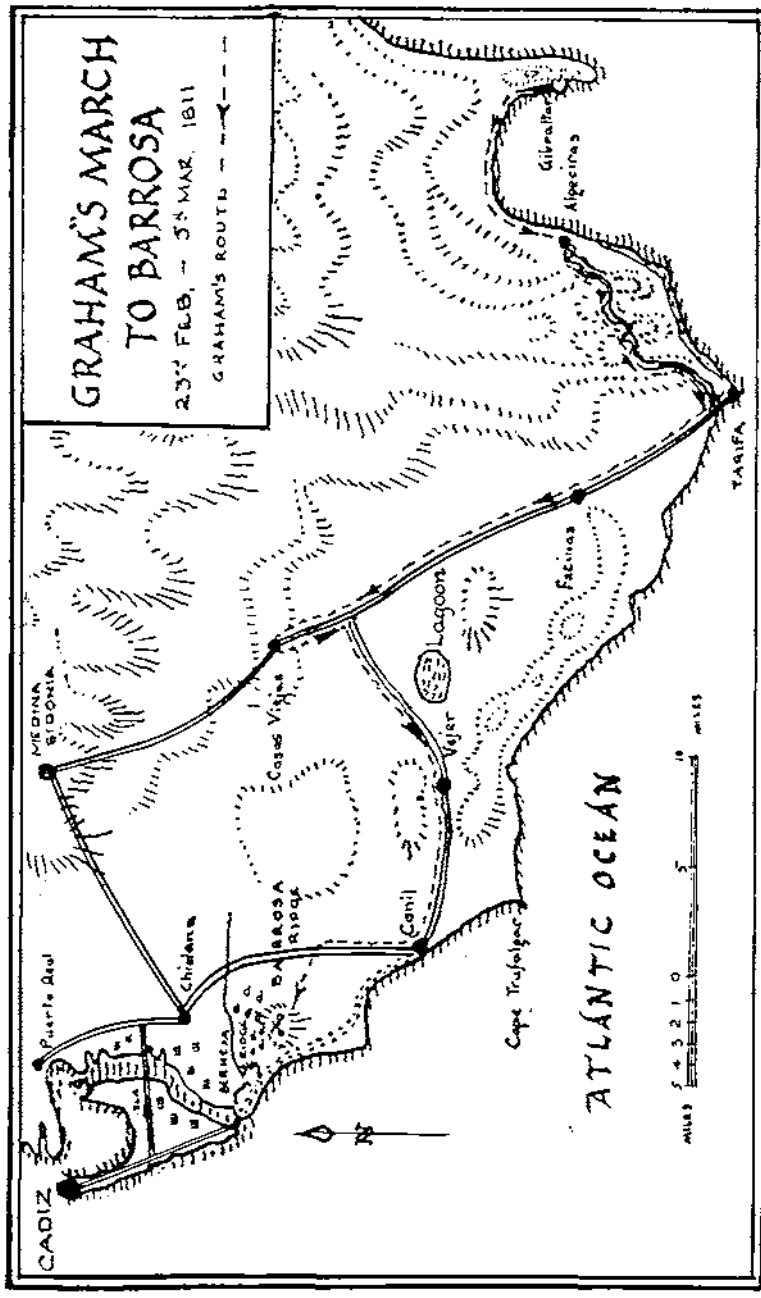
On the morning of 23 February, the British force set out to link up with the Spanish at Tarifa. It comprised the 2nd Hussars of the King's German Legion, ten guns under Major Duncan, fifty men of the Royal Military Artificers under Captain Birch RE and two brigades of infantry, each of four battalions, under Brigadiers Dilkes and Wheatley. The Royal Military Artificers were placed at the head of the column to remove obstacles. Having encountered appalling weather whilst negotiating the difficult hill stretch between Algeciras and Tarifa, they reached the latter place by nightfall on the 24th. Here they waited until the arrival of the Spanish force under La Peña on the 27th.

The following day the combined force moved off amid considerable administrative confusion and after a march over difficult country reached Casas Viejas on the road to Medina Sidonia. Here news reached them that Marshal Victor had despatched a force to intercept them at the latter place. There followed the first of many conflicts of opinion between Graham and La Peña. The former wished to push on and attempt to defeat his adversary in detail, whilst the latter preferred to adhere rigidly to the original plan for a battle in the Chiclana area, where a sortie by the garrison could play a decisive role. Graham's pleas were of no avail, and the force doubled back on to the road leading west to Vejer. Here they encountered a further hazard. A large inland lagoon to the south had flooded a causeway, across which they must pass to reach Vejer. The head of the column was thrown into confusion and Graham riding up found the Spanish troops reluctant to enter the water. Leaping from his horse, he stood waist deep in the centre of the causeway with his staff grouped around him, whilst the whole column passed through. A gallant effort for a sixty-three-year-old! The whole force finally reached Vejer on the evening of 3 March and pitched camp for the night.

Meanwhile General Zayas in Cadiz, knowing nothing of the delays which had occurred, adhered to his original instructions and on the morning of 3 March crossed the mouth of the Santi Petri river and established a bridgehead on the south bank. There he was sharply attacked by the local French commander, Villate, and forced back across the river, his bridge of boats being narrowly saved from capture. At the same time, news of the approach of La Peña's force had reached Marshal Victor and he withdrew the greater


CADIZ
AND
Isla de Leon
N
Rota
Puerto Santa Maria
To Jerez
Cadiz Bay
CADIZ
ATLANTIC OCEAN
ISLA DE LEON
Fort Matagorda
Fort Puntales
Trocadero
Puerto Real
Inner Harbour
ISLA
Murshes
To Medina Sidonia
Salt Marshes
Rio Santi Petri
FRENCH
CHICLANA
Bridge of Boats
Barrosa Ridge
Victor
BARROSA RIDGE
MILES
ROUTE OF Allied Force
To Conil

MAP 1


GRAHAM'S MARCH
TO BARROSA
23rd FEB. – 5th MAR. 1811
GRAHAM'S ROUTE
CADIZ
Puerto Real
Chiclana
BARROSA
Ridge
Canil
Medina Sidonia
Casas Viejas
Vejer
Lagoon
Facinas
Cape Trafalgar
ATLANTIC OCEAN
Gibraltar
Algeciras
TARIFA
miles 5 4 3 2 1 0 5 10 miles

MAP 2

part of his force, comprising two divisions under Generals Ruffin and Leval, from the lines of investment and concentrated them in the pine woods between Chiclana and the Barrosa ridge (Map 1).

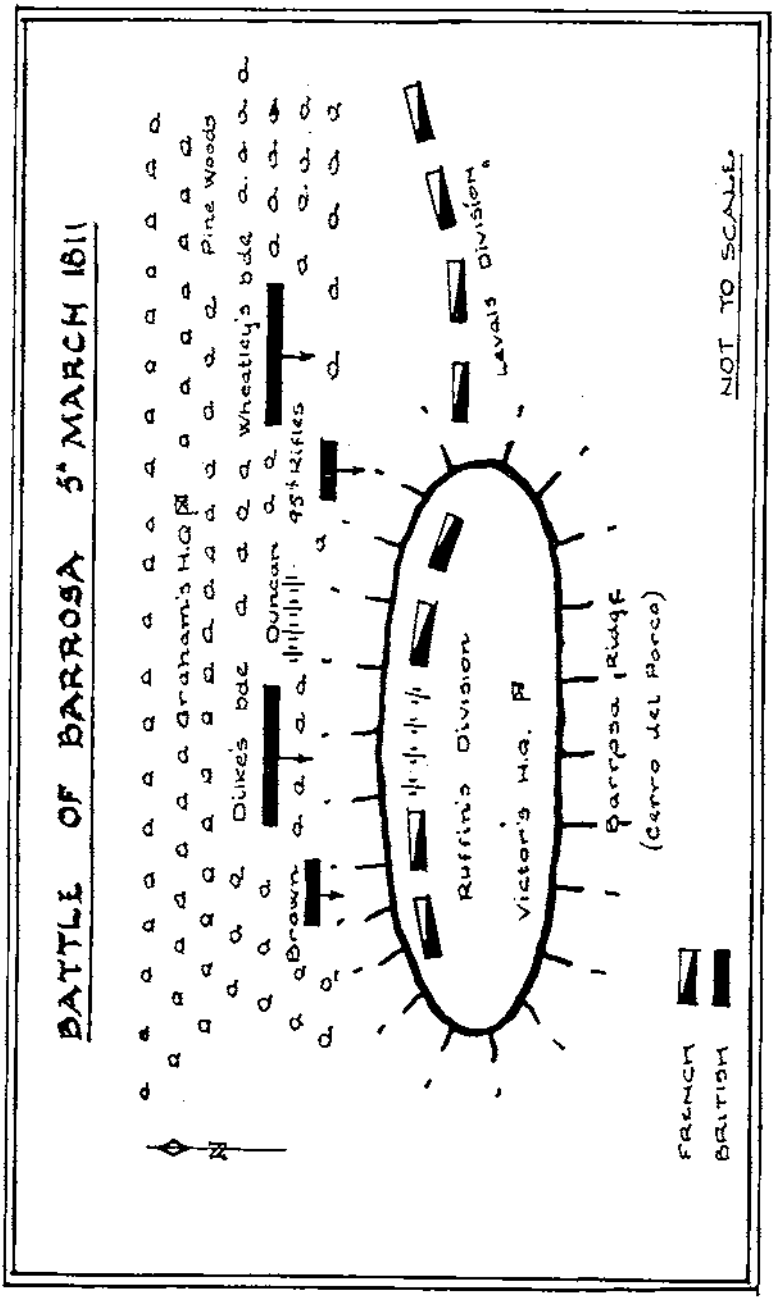
At a council of war at Vejer on 4 March, La Peña against the advice of Graham decided to make an approach march by night via Conil and the coastal track to the Almanza Creek, hoping to catch the French by surprise at dawn on the 5th. The whole force moved off after dark, reaching Conil without mishap, but here the guides missed the way and, as dawn broke, they found themselves half way to Chiclana along the main road. The force then set off westward across the scrub covered plain to join the coastal track, passing immediately to the south of the broad ridge of Barrosa, known locally as the Cerro del Porco (the Hog's Back). During this manoeuvre they passed across the front of Victor's army encamped in the pine wood a mile or so to the north. The French were completely unprepared to meet the Anglo-Spanish force, which appeared so suddenly before their scouts on the fringe of the pinewoods in the early dawn, and, by the time they had stood to arms, the golden opportunity of striking into their enemy's flank had passed. So on went La Peña, unaware of the presence of the French, straight for Bermeja, which was still held by Villate. The British under Graham were held in reserve immediately to the west of the Barrosa ridge, whilst the ridge itself was lightly held by a composite British battalion under Colonel Brown and some Spanish troops. After an initial setback La Peña's troops, aided by a further sortie by General Zayas from Cadiz, captured the Bermeja ridge, forcing Villate back across the Almanza Creek to the east—a neat little tactical operation for which they deserve credit. Graham was then ordered forward to join the Spanish force on the Bermeja ridge, and leaving Brown's battalion on the Barrosa feature as a rear guard, he moved forward into the pinewoods.

In the meantime, Victor was moving slowly forward in two divisional columns towards the Barrosa ridge, which he rightly judged to be the key to the situation. If he could capture this, he would be able to dominate the lower ground and force the allies back upon the Santi Petri River. No sooner therefore had Graham's force disappeared into the trees than Brown saw the whole French force advancing on to the ridge from the east. The Spanish troops fled and the British were rapidly pushed off the feature, which was occupied by one of the French columns.

The Battle (Map 3)

As soon as the news of the French advance reached Graham, he realized the danger, which faced the whole allied force and decided that the ridge must be recaptured at all costs. He turned his force about and set it in motion towards the French. The approximate dispositions of both sides at this stage are shown on map 3, but it must be remembered that the British were at a grave disadvantage. Not only were they outnumbered by about two to one, but they had been on the march continuously for 14 hours, and were then forced to turn about in close column in wooded country and deploy against an enemy, who, confident and fresh after a good night's rest, occupied a position of great natural strength.

Geographically the battlefield was divided into two halves. To the west, the ridge itself held by Ruffin's division, against which Graham directed Dilkes' brigade, and to the east, the slopes held by Leval's division, towards which Wheatley's brigade marched. The main body of the Royal Military


BATTLE OF BARROSA 5th MARCH 1811
Graham's H.Q.
Pine Woods
Dilke's bde
Wheatley's bde
Duncan
95th Rifles
Brown
Ruffin's Division
Victor's H.Q.
Laval's Division
Barrosa Ridge
(Cerro del Puerco)
FRENCH
BRITISH
NOT TO SCALE

MAP 3

Artificers, which had been at the head of the column in the line of march, attached itself to Wheatley's brigade, but a section of seven men under Sergeant Cameron, which had been detached for duty with the rearguard, found itself alongside Brown's battalion in the forefront of the battle.

The battle opened by Brown's battalion, in open skirmishing formation, attacking the flank of Ruffin's division, but they were badly cut up on the exposed slopes of the ridge by the French guns. Sergeant Cameron led a gallant charge of his section against the French, losing one man killed and two wounded. Graham, noting that their blue uniforms, conspicuous amongst the red, were attracting the small arms fire of the French line, ordered their withdrawal into reserve.

Dilkes' brigade then advanced to the attack and by making good use of dead ground managed to reach the upper slopes of the ridge. Here they met a murderous fire from both the French guns and the infantry of Ruffin's division and suffered heavy casualties. At this moment Graham rode up accompanied by several Engineer officers, who had attached themselves to his personal staff. Lifting his hat he cried "Now my lads, spare your powder and give them steel enough" and led them forward against the French line. The French General Ruffin fell mortally wounded and his division streamed off the ridge leaving the guns and an eagle (the first to be taken in the Peninsular campaign) in our hands.

To the left, Wheatley's brigade, screened by a line of skirmishers provided by the 95th Rifles attacked Leval's division. Here the story was the same. The 95th suffered heavily at first, but gallantly hung on to their exposed position on the slopes. Then the 87th and Coldstream Guards dashed forward to the attack and swept the French back in confusion. In addition to their guns, the French left 2,000 killed and wounded and 400 prisoners on the battlefield. The British losses were also heavy—1,200 out of about 4,000 actually taking part in the battle.

Graham realized that his exhausted troops could do no more and sent word to La Peña, asking him to move forward to engage the retiring French troops. La Peña, however, irked by Graham's independent action, declined to co-operate and this golden opportunity of destroying the whole of Victor's force was missed. In disgust, Graham withdrew his forces across the bridge of boats in Cadiz and within a few days the investment was reinstituted by a reinforced French army.

Retrospect

Graham's actions at Barrosa have been the subject of much ill-informed criticism particularly on the part of our Spanish allies. It is asserted that Barrosa was one of those "unnecessary battles", about which we have heard a great deal in recent months in a different context. The critics contend that had Graham obeyed La Peña's order to concentrate at Bermeja, the allied force would have maintained its integrity and could either have renewed the battle in conditions of its own choosing or fallen back into Cadiz. These rather facile criticisms ignore two vital factors. Firstly the great tactical strength of the Barrosa ridge *vis-à-vis* the Bermeja position. From the ridge the French would have dominated the potential battlefield and once firmly established would have been extremely difficult to dislodge. Thus at best the *status quo* would have been re-established, whilst at worst the Allies, hemmed in between the French and the Santi Petri River, might have suffered

a serious reverse. Secondly the over-all strategic situation, which led to the mounting of the operation in the first place. There was an urgent need to strike a decisive and, if possible, mortal blow at Victor's army at a time when victory in Portugal had begun to raise Spanish hopes and morale. Graham showed his true greatness by appreciating both these factors and by his rapid and bold decisions he almost attained unaided at the risk of his professional reputation a complete and overwhelming victory.

Nonetheless, although, as at Corunna, two years earlier, victory on the battlefield could not be exploited, Graham and his little force struck a blow for the Allied cause which, by helping to destroy the myth of invincibility, which had hitherto surrounded the French armies in the Peninsula, had a profound effect on the Peninsula campaign as a whole.

Epilogue

The Corps History relates how after the battle, Graham took by the hand his senior engineer officer Nicholas and the commander of the Royal Military Artificer contingent, Birch, and said to them :"You are fine fellows at work as engineers—you are fine fellows in the field", a tribute, which every Sapper officer may well strive to emulate!

The Field Engineer Officer and Constructional Projects

By "G. S. Sapper"

Introduction

There is nothing technical in this article. It is a brief review of four constructional projects of varying type and magnitude within the experience of the writer but also fairly typical of those in any Sapper officer's experience. With one exception the labour force was built up around one or more field squadrons. For each project a few points of lasting interest have been stressed, but in general the theme is that all these tasks have been within the capacity of a non-specialist field engineer officer. This point is made to encourage those officers who may feel they are only qualified to undertake "meccano" type engineering, whereas in fact they are as capable of success in constructional work as any contractor's engineer. Their work will be done with far greater dispatch and, even if it lacks some of the refinements of skill, a practical result will always be achieved. This paper may also help correct a fairly prevalent impression that the more interesting engineering tasks of the last few years have been carried out solely by the Works Services.

Tunisia 1943

The first project was as a troop commander at Sousse, Tunisia, in 1943 at the conclusion of the North African Campaign and just before the invasion of Pantellaria and Sicily. The field squadron was ordered to assist the Navy in re-opening the port which had been destroyed by our bombing and

by enemy demolitions. The port was required for the mounting of the invasions and the time margin was very short. The whole town was shattered, with the streets blocked by collapsed buildings and craters, and the docks were a shambles. A sunken ship lay across the harbour entrance, the quays were demolished and blocked by the debris of the warehouses, the mole was blown up and the task could hardly have appeared more formidable.

The emergency repairs and new construction, such as LCT hards, were carried out in accordance with priorities laid down by the Naval Officer in charge of the port. Night work was not possible because of air raids, but the maximum use was made of every daylight hour by getting the machines running and the men in position before first light. The squadron's resources were augmented by the engagement of some three hundred Arabs and a large quantity and variety of plant and transport was placed under command. The design work and technical execution of the various tasks were left entirely to the discretion of the squadron.

As they may be of general interest, the clearance of the ship and the repair of the quays and mole are described briefly. Naval divers placed explosives on the ship and it was blown in half. The two ends were then winched clear with two Size 1 dozers, tackles and sunken anchorages. The stalling of one dozer caused the other to take the full strain and the lethal effect of a breaking SWR cable was witnessed in an unforgettable way. Fortunately no one was hurt and in time the ship was cleared away. The filling of the great voids in the quay faces was a major problem made no easier by the voids being some ten feet under water, by the need for the built-up quay to support mobile cranes and by the filthiness of the murky water. There was no one to turn to for guidance and neither the kit nor the experience to adopt normal diving methods or to use sheet piling. The problem was solved by salvaging heavy girders from the stricken town, by placing these across the breach and by windlassing them back to sunken anchorages well away from the face. Oxy-acetylene equipment was needed to clear the debris from the quays and for the salvage work. The bottom of the cavity was then built up level by the hand-placing of concrete filled sandbags. Fondu cement was used to ensure the quick-setting of the concrete in the sea water. The laying was achieved by the better swimmers of the troop working under water whilst holding their breath and hanging on to a weighted cable suspended from a crane. This was before the days of aqualung equipment and snorkel masks. Luckily the water, though filthy, was pleasantly warm. On top of this level base, shuttering was erected and concrete walls reinforced with old bedsteads and girders were built up. The walls were backfilled with rubble and a reinforced slab laid over the top of the fill. All these hasty repairs to the quay walls stood up to the test ahead. The repair of the mole was more difficult in that each gap could only be undertaken in succession and because the swell came pouring through. Again the solid bottoms of the gaps were roughly levelled with concrete filled sandbags, inclining the base towards the centre from each side. The mole was then built up to above the water level by placing concrete filled wine barrels in courses. These barrels were lowered into the water by a Le Tourneau crane and were exactly placed by swimmers. The slings were arranged so that, when released, each barrel was rolled by the lifting cable towards its already positioned neighbour. The swimming was less unpleasant on this task as the water was clear. There were two near accidents. One occurred whilst the

swimmers were below when a party of New Zealanders threw in an explosive charge near by to stun fish, and the other when the crane operator let the brake slip, whereupon the block struck the officer in charge as he was releasing the barrel below the water. In time the barrel wall emerged above the waves, the cavities were filled with stone and a reinforced slab was laid over the top. Work then began on the next gap. Pre-cast concrete blocks with lifting hooks were piled by crane on each side of the new mole sections to protect them from the direct force of the waves and from scour.

Looking back on these tasks, three points seem worthy of emphasis:—

(*a*) Improvisation in materials and in constructional methods is much more interesting and satisfying than normal practice.

(*b*) Decauville track and jubilee trucks are invaluable when working in restricted conditions beyond the reach of normal transport.

(*c*) The training of skin divers and the provision of suitable equipment available to a field squadron are unlikely to be wasted.

Trieste 1945–46

The second project was at Trieste 1945–46, mostly as a squadron commander. The brigaded field squadron was ordered to undertake constructional work with two German works companies under command. Major works carried out included the construction of a whole series of frontier posts, the building of a hutted camp for a battalion, including the laying of several miles of pipeline, the building of a PW camp and the rehabilitation of a barracks and of a hospital. To undertake this work efficiently, it was necessary to reorganize the squadron into a tradesman troop, a field engineer troop, an MT troop and to establish a squadron workshops and drawing office. Domestic arrangements such as cooking and store keeping were centralized. The situation was complicated by the need to keep one troop detached some thirty miles away and also to keep a troop in readiness to support the brigade or to undertake IS duties. This reorganization was not undertaken lightly as the squadron was built up on its troop spirit, carefully fostered through two and a half years of active service. However, the demobilization scheme was under way and it was inevitably a time of change. In the event, the reorganization paid large dividends, the MT was centrally controlled and used to the maximum advantage, but above all each tradesman achieved a new status, for the whole plan depended on his expertise and enthusiasm. To each tradesman was attached, not only a mate from his own fellows, but also a number of German tradesmen. Priorities were obtained from the brigade commander and from the CRE of the division. Where these conflicted, the CRE obtained a ruling from Divisional Headquarters. The plans were prepared at squadron headquarters and the stores demanded through HQRE. A works programme was then drawn up at squadron headquarters based largely on the phased employment of the tradesman teams, of the plant and of the MT. The MT commitment included the transporting of large quantities of dismantled wooden huts from Austria. Though not comparing with the modern timber prefabricated hut for ease of construction, partly because they were designed to take large snow loads, nevertheless the huts were quick to erect and provided much better accommodation than the nissen huts which were the only alternative. The squadron was fortunate in having an emergency commissioned officer well versed in building construction and another who in peace-time was an electrical engineer to

compensate for the general lack of knowledge of constructional work. By another piece of good fortune, the complete lack of clerks of works was made good by a German staff-sergeant in one of the works companies who seemed to know the answers to everything from survey and estimating quantities to electrical and water mains.

As all the German officers were wounded Panzer officers who had been medically downgraded, little help came from them other than rigid discipline and a tremendous keenness to prove that the German artisan was without question better skilled and more devoted to his duty than any other. This spirit pervaded all ranks among them. As an example, an elderly German was pouring hot pitch over the roof of one of the huts when he slipped and was badly burnt. He was at once taken to hospital 10 miles away in Trieste. To everyone's surprise he was seen working on the same hut in the afternoon swathed in bandages, having made his own way back to the task.

In addition to the Germans, about a hundred local Italians were recruited and these tradesmen too were integrated in the teams. There was so much work to be done that there was never any friction, though looking back it must have been a pretty mixed bunch.

This project emphasized two points:—

(*a*) When a field squadron is employed on constructional work, its resources of tradesmen, plant and MT must be centrally controlled by the OC. One way of doing this is to completely reorganize the squadron, but this step is taken at a risk to morale and to the ability of the unit to revert rapidly to its conventional role.

(*b*) A backing of clerks of works is essential to make sure that work is done properly the first time. At Trieste this deficiency was made good by chance.

Libya 1952–54

The third experience was in Libya in 1952–54 as DAQMG (Quartering). The fascination of the work was matched by its frustration. The whole field of planning was dominated by politics, the dominant issues being the need to create a favourable atmosphere for the Anglo-Libyan Treaty negotiations and the general uncertainty as to the future deployment of British forces in the Middle East. In the early days we were involved in handing back numerous buildings and installations, in fighting strenuous rearguard actions for others, in planning a large cantonment up on the djebel and in rehabilitating the barracks considered to have a reasonable security of tenure. It was sometimes hard to see the wood for the trees in the jungle of local politics and outside influences. This was one of the occasions when the writing of a full scale written appreciation was really valuable in order to clear the mind and arrive at a sensible plan. But even so, as later events have shown, many conclusions drawn from factors then considered to be based on incontrovertible facts have been proved false.

In Cyrenaica at that time there were virtually two bases and a sub-base. The ports of Benghazi and Tobruk were complete with fuel and other installations and the indifferent port of Derna also had its own supply depot. The constructional work was done by a CRE's organization controlling a plant troop, imported German artisans and locally employed Libyans. There was also a stores organization and engineer workshops. For political reasons it was impossible to increase this force by employing Italians from

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Tripoli or imported Maltese. As in Trieste some years before, the Germans, though now civilians, proved to be hardworking and excellent tradesmen.

After much work had been done in planning the djebel cantonment, the project was cancelled and the whole plan changed. This was particularly disappointing for a number of young officers forming a special team called the Deep Reconnaissance Unit. Working from a professional air survey, this unit had examined every pothole, some of great depth, over a wide area of these limestone hills. After many months their work was rewarded by the discovery of an underground source of water yielding 4 million gallons a day. It was this discovery that had made the selected djebel cantonment site a practicable proposition.

In the new plan it was decided to concentrate the works programme on cantonments outside the four towns of Benghazi, Tobruk, Derna and Barce. The selection of the cantonment areas was made after consideration of the military, engineer, accessibility and amenity factors but was dominated by the political scene. The dangers of accepting a compromise solution too readily are illustrated by this anecdote. When the Libyans rejected, for tribal reasons, the first and very agreeable site selected for the Benghazi cantonment, they offered another surprisingly level, fertile and pleasant area in lieu. However whilst travelling previously in an inspection truck along the Solluk railway, the writer had observed that the rail track had been rebuilt on rubble in two places directly in line between the wadi outflow from the djebel escarpment, the suggested area and the sea. Inquiries revealed that three times within this century the area had been completely flooded by the stormwaters from the djebel. The last flood had occurred in 1941 and had washed away many hated Italian troops and their equipment off this same site into the sea. On this information the site was rejected and after further opposition an area on a low stony plateau was agreed upon.

The experience gained in Libya left these particular impressions:—

(*a*) A Sapper officer is able to visualize a large project on the ground much more readily than anyone else. It is up to him to advise on the suitability of a site, on the area required and to foresee the need for expansion areas. On these grounds it would seem that a Sapper has many advantages when holding a Q (Quartering) staff appointment though he must take care not to usurp the functions of the Chief Engineer nor the CRE.

(*b*) Time spent in studying local history and geography is not only very interesting but it may be of critical importance.

(*c*) Certain staff officers, and particularly the financiers, will argue endlessly in trying to arrive at the exact figures of men by ranks and of vehicles by types that will occupy any completed project. Estimates of attachments and detachments are a particularly fertile source of contentious figures. This is a futile time wasting exercise as hardly a single establishment survives a year without being amended and the deployment plan usually changes even more frequently; therefore a difference of one here or there is no reason for delaying the whole scheme. It is far more sensible to plan on round figures slightly in excess of the anticipated strengths.

Christmas Island 1958-60

The final experience has been a chairborne one as a member of the RE planning team in London for Operation Grapple, the cover name for the

testing of nuclear weapons on Christmas Island in the Pacific. The main role of the planning team was to design for Christmas Island a large semi-permanent camp with supporting services, a smaller camp at the port and a wide variety of installations. Several articles have been written on these operations and on various aspects of the constructional work, therefore the execution of the work will not be discussed. However even in London, the operation has provided most interesting experience.

The RE planning team is part of the Headquarters of Task Force Grapple in the Air Ministry. All the outline planning work is done on an inter-Service basis and often in consultation with other Ministries. Apart from drawingboard work, the planning has included the provision on time of all stores and military equipment for the island, the financial estimating of the project and the provision of technical advice when required. It has also been most important to keep all the service staffs in touch with the realities of the works programme. When money is relatively unrestricted and overall priority is high, there is a tendency to request one new service after another without much thought as to whether the resources of manpower, plant, transport and stores will permit the work being done on time. The underlying aim of all planning done by the RE planning team was to produce simple designs, making the maximum use of prefabrication so as to reduce the constructional time needed on the island. It goes without saying that the planning could not have been done without the services of an experienced E and M Staff Officer.

The Christmas Island project has brought together most of the ground covered by the other three experiences. As in the case of Sousse, some of the work has been done in close liaison with the Navy, as the tasks have included the construction of a 125-ton slipway, much of it built underwater with the aid of divers, the repair of a wharf, the construction of sea defences, this time on shifting sand, and the dredging of a boat channel. As with the work at Sousse and Trieste, the effort available by the field squadrons has been increased by augmenting the working strengths. On Christmas Island the squadrons have been boosted with detachments of the Fiji Military Forces, locally engaged Gilbertese labourers and sometimes by working parties from the other services or even from other units of the Corps, such as men of the Port Squadron when there was no ship to handle. Unlike Sousse and Trieste, a resident E and M Staff Officer and a strong team of Clerks of Works were always available on the island. A study of local history and geography was again useful and much was learnt from the United States Army records of the uses of coral aggregates and of lagoon mud. On the staff side, the Joint Services aspect of the work has been the most stimulating feature. Though less obtrusive than in Cyrenaica, political considerations have dominated much of the planning. Finally, as Headquarters Task Force Grapple has ranked as a Command Headquarters, direct access has been available to any Department of the War Office or other Ministries. There has thus been no "post-officing" of requests and demands and immediate results have generally been possible.

Four comments may be of general interest:—

(*a*) On a large scale project the well-tried processes of assessing each task in terms of effort and of relating the total to that available cannot be dispensed with without the risk of setting the troops an impossible task and of giving wrong information to the commander. The individual tasks for this

project were assessed in troop-weeks as a basis for calculation, though it was seldom in fact that a complete troop was employed throughout on one task.

(*b*) The priorities for the tasks must be assessed by a planning committee drawn from all services and from the scientists. The committee must be responsible to the commander, who may need to preside from time to time. The senior engineer officer may advise but he should not be expected to order priorities. He may of course phase the tasks within the broad pattern of the priorities in order to make the best use of his resources.

(*c*) A planning team in London is able without any great knowledge to provide the answer to almost any problem. With the help of a telephone directory and a reference book such as Specification, it is possible to get direct help from any firm or government research body. Everyone is astonishingly helpful and generous with time and advice.

(*d*) The detailed work of the planning team has been done by a team of clerks of works, architectural and mechanical draughtsmen and engineer clerks and storekeepers. Considering the amount of work done by these experts under the supervision of a very few officers, it is alarming to think that men such as these may not be available for a similar operation in the future.

Conclusion

It is a trite saying that a sapper unit is always able to succeed in any task it is given. One of the reasons is that by its nature it has within it a wealth of latent talent. Though every man may often be working to the limit of his physical capacity, it is rare that the knowledge and experience of each man is used to the best advantage. Therefore when a major constructional task arises, such as one of those outlined in this article, the squadron is able to achieve surprising results by diluting its tradesmen with locally employed artisans and unskilled labourers and by making the maximum use of plant. Any of these tasks could fall to the lot of a field squadron, therefore it is important to make sure that any future field squadron establishment is amply provided with skilled tradesmen and that Clerks of Works are always available for attachment to a squadron so employed.

But the theme of the article is the officer not the squadron. It is difficult enough for an officer to obtain constructional experience with troops in peacetime, and it may be typical that the writer is unable to draw on any notable practical and personal experience gained in this country. Overseas stations are comparatively few and confidence is only gained by practical experience, therefore the field must be extended to the United Kingdom. Unless officers are freely offered this opportunity, they will tend to underrate their ability and the Corps will suffer as a result.

Membership of the Institution of Royal Engineers

By THE EDITOR

A SPECIAL Resolution is to be put to the next Annual General Meeting which, if accepted, will fundamentally alter the present membership structure of the Institution of Royal Engineers. The aim of this article is to bring to the notice of all members the present position and to inform them of the system of grading membership which the Council recommends should be adopted with a view to increasing the professional status of the Institution of Royal Engineers in relation to the other professional Chartered Institutions.

PRESENT POSITION

Under the present Bye-Laws and Rules of the Institution there are three types of members namely Full Members, Associate Members and Honorary Members.

Anyone who holds or has held a commission in the Royal Engineers in the Active or Reserve Armies of the United Kingdom, or who holds or has held a commission in the engineer arm of any of the land forces of the Commonwealth is entitled to become a Full Member of the Institution.

Anyone who holds or has held a commission in the Royal Engineers of the Reserve Army of the United Kingdom or in the engineer arm of any of the Land Forces of the Commonwealth may elect to become an Associate Member, rather than a Full Member, of the Institution if he so wishes. In addition, Civilian Officers of the War Department Works Organization are eligible for Associate Membership if recommended by their Director General.

The Council from time to time invites gentlemen of eminence in professions, the activities of which are allied to the duties of the Corps, to become Honorary Members of the Institution of Royal Engineers.

The annual subscription rates for Full Members are based upon substantive rank held whilst serving or on retirement from the service. Associate Members pay a fixed annual subscription, irrespective of rank held. Honorary Members pay no subscription.

Full Members receive free copies of the *Journal, Supplement* and *List*; they are entitled to the free use of the Royal Engineers Library, Chatham; they are entitled to vote at General Meetings and they are eligible to serve on the Standing Committees that administer various functions of the Institution, and they are eligible to stand for election to the Council.

Associate and Honorary Members receive free copies of the *Journal* but not the *Supplement*, nor the *List*. They are entitled to the free use of the Library but they have no voice in the management of the Institution; they may not vote at General Meetings nor serve on the Council nor on any of the Standing Committees of the Institution.

It will be seen that under the present Bye-Laws and Rules anyone who has ever worn a "Sapper tie of sorts" is eligible for Full Membership of the Institution and no differentiation exists between the young, latest-joined, inexperienced Full Member and the more knowledgeable and highly-qualified military engineer found among Full Members of longer standing.

The Council's Recommended Alterations to the Present System

The Council has for some time been considering how the professional status of the Institution of Royal Engineers might be enhanced in relation to other professional Chartered Institutions and their preliminary views were explained by the President of the Institution to the Annual General Meeting held on 20 June 1960.

Since then a Sub-Committee, consisting of serving Officer Members and Civilian Members of the Council who hold high positions in other professional Chartered Institutions, has studied this problem in great detail and their final report has been accepted by the Council. This report recommends certain amendments to the Bye-Laws and Rules of the Institution and certain additions to the Regulations. The Bye-Laws and Rules of the Institution cannot be altered or added to without the consent of a General Meeting of the Institution, furthermore Privy Council consent is necessary to any amendments to the Bye-Laws agreed at a General Meeting of the Institution. The Council is authorized to make any alterations or additions to the Regulations as it deems necessary and such amendments do not require the covering approval of a General Meeting.

The detailed amendments to the Bye-Laws and Rules of the Institution, recommended by the Sub-Committee and accepted by the Council, will be placed before the Annual General Meeting to be held at the Royal Commonwealth Society on Wednesday, 28 June 1961, in the form of a Special Resolution. The general terms of these amendments are set out below:—

Amendments to the Bye-Laws of the Institution

These amendments introduce a system of grading membership, based on scholastic achievements and military engineering experience, similar to the system of grading membership in force in the civilian professional Chartered Engineering Institutions. The Council feels that, until such a system of grading is introduced, the professional status of the Institution of Royal Engineers will never be recognized by the professional Chartered Institutions nor by other Learned Bodies.

The amendments to be tabled at the next Annual General Meeting comprise the rewriting of Bye-Law II, the Bye-Law setting out the eligibility for membership of the Institution of Royal Engineers, and consequential amendments arising therefrom.

The amendment to Bye-Law II in no way alters the types of person who shall be eligible to join the Institution, or be invited to become Honorary Members. It does, however, stipulate that there shall be two types of membership, each type being further subdivided into grades namely:—

Corporate Members

To consist of Full Members and Associate Members, the professional qualification as military engineers for each grade being laid down by the Council in the Regulations of the Institution, and

Non-Corporate Members

To consist of Honorary Members (as at present), Companions (equivalent to the present Associate Members), Associates, Graduates and Students of the Institution. The professional qualifications for Associates, Graduates and Students shall be determined by the Council and set out in the Regulations of the Institution.

Subsequent amendments to the Bye-Laws stipulate that only Corporate Members of the Institution shall have the right to vote at General Meetings, which is the normal practice in the professional Chartered Institutions. They also lay down that only Corporate Members shall be empowered to nominate candidates for election to the Council and to serve thereon.

Apart from these two rights, reserved for Corporate Members only, no other changes are proposed in connexion with the existing privileges of Members, their use of the Library or their free issue of Institution publications.

It will inevitably take time to implement this proposed system of grading, and equally it will take time before the professional status of the various grades of membership is recognized and accepted by the professional Chartered Institutions, and persons who were Full Members of the Institution before the formal introduction of this system of grading shall be deemed to be Corporate Members of the Institution with the same status, privileges and voting rights that they at present enjoy. Present Associate Members shall be renamed Companions, but there will be no alteration to their present status or privileges.

Amendment to the Rules of the Institution

These are minor amendments consequential upon those made to the Bye-Laws. No alterations will be made to the present subscription rates, based on substantive rank as set out in Rule IX, and rates will not be tied to grades of membership.

Scholastic Achievements and Military Engineering Experience Required by the Various Grades of Membership

As stated in the proposed amendment to Bye-Law II, these will be determined by the Council and set out in the Regulations of the Institution. For the general information of Members the Council's present views are shown in the Annex to this article. In general terms:—

Non-Corporate Members

A Young Officer on first commissioning shall normally be enrolled as a Student.

To be classified as a Graduate an applicant shall possess either an engineering degree or a diploma in engineering, or shall have obtained the scholastic qualifications required by a Graduate of a professional Chartered Institution whose activities are allied to the duties of the Corps.

The grade Associate shall be included to cater for those engineer officers who do not possess the scholastic qualifications of a Graduate, but whose rank, length of service and military engineering experience fit them for elevation from the grade of Student. Four years' commissioned peacetime service is considered a qualification for elevation to Associate grade.

Companions shall be similar to the present Associate Members, except that the field has been widened to include civilian officers employed at MEXE and such other establishments as the Council may decide and as shall be approved by a General Meeting, if their application is approved by their Director.

There shall be no alterations in the conditions regarding Honorary Membership.

Corporate Members

Associate Members shall be either:—

(i) Those who shall have qualified as Graduates and who shall have completed either a Long Engineering or equivalent Course, the Staff College or Technical Staff Course or are Corporate Members of a professional Chartered Institution, whose activities are allied to those of the Corps, and in addition shall have completed a period of peacetime service in a military engineering appointment, or

(ii) Those who shall have qualified as Graduates, and who in addition have commanded an engineer squadron or equivalent unit, or

(iii) Those who have not qualified as Graduates, but who shall have served for longer periods in engineer appointments than those applicable in (i) and (ii) above.

Full Members shall be those who possess the qualifications required by an Associate Member, and in addition have completed a specified time as a Lieut-Colonel or above in a military engineering appointment. In exceptional cases, however, the Council may make distinguished engineer officers Full Members, irrespective of their qualifications, if they consider it to be in the interest of military engineering and the Institution so to do.

The procedure for submitting applications for acceptance into the various grades of membership, the sponsoring of such applications and their scrutiny and acceptance are also dealt with in the Annex.

If the scheme is approved by a General Meeting and subsequently, where applicable, by the Privy Council the following designations will be adopted:

Full Member	M Inst RE
Associate Member	AM Inst RE
Companion	C Inst RE
Honorary Member	Hon M Inst RE

No designations will be used by Associates, Graduates or Students nor by any Members of the Institution who have not been officially graded.

The aim of this article, as stated above, is to bring to the notice of all present Full Members, Associate Members and Honorary Members the reasons that have prompted the Council to recommend to this year's Annual General Meeting this fundamental change in the membership structure of the Institution. Details regarding the Special Resolution to be tabled will be published in due course in the *Supplement*; meanwhile the Council is anxious to obtain the views of Members on these proposals and any comments or suggestions, which should please be addressed to me, are welcomed.

Annex

Set out below are the Council's views, to be incorporated in the Regulations of the Institution, regarding the grading of Members, the submission of applications for grading and the scrutiny of such applications:—

Constitution

1. Bye-Law II of the Institution sets out in general terms the constitution of membership which is divided into two classes, namely:—

(*a*) *Corporate Members*

Comprising Full Members and Associate Members,

and

(*b*) *Non-Corporate Members*

Comprising Honorary Members, Companions, Associates, Graduates and Students.

Qualifications

2. The qualifications for the various grades of membership shall be determined from time to time by the Council. The current qualifications are set out below:—

Non-Corporate Members

Students

3. Shall be persons eligible for membership of the Institution of Royal Engineers in accordance with Bye-Law II, but who lack the military engineering qualifications required for the more advanced grades of membership. Young Officers joining the Institution on first commissioning shall normally do so in the grade of Student.

Graduates

4. Shall be persons eligible for membership of the Institution of Royal Engineers in accordance with Bye-Law II and who in addition possess one of the following scholastic qualifications:—

(*a*) An Engineering Degree or Diploma in Engineering recognized by the Council, or

(*b*) The scholastic qualifications required by Graduates of the professional Chartered Institutions, the activities of which are recognized by the Council as allied to the duties of the Corps of Royal Engineers.

Associates

5. Shall be persons eligible for membership of the Institution of Royal Engineers in accordance with Bye-Law II who do not possess the minimum scholastic qualifications necessary for the grade of Graduate, but whose rank, length of service and military engineering experience fit them for elevation from the grade of Student.

6. Four years commissioned peacetime service in the Royal Engineers of the United Kingdom Active or Reserve Army, or in the engineer arm of any of the Commonwealth Land Forces shall qualify for the grade of Associate. For time served in areas where a state of "active service" has been officially declared see paragraph 15 below.

Companions

7. Shall be persons who hold or have held commissions in the Royal Engineers of the United Kingdom Reserve Army, or who hold or have held commissions in the engineer arm of any of the Commonwealth Land Forces, and who choose to become Companions of the Institution rather than seek election to the other grades of membership.

8. Civilian officers of the War Department Works Organization, of the Military Engineering Experimental Establishment, and of any other similar Establishment as the Council may from time to time decide and as shall be approved by a General Meeting, shall also be eligible for election as Companions of the Institution if recommended by their Director.

Honorary Members

9. Shall be persons as defined in Bye-Law II and more particularly in paragraph 22 of these Regulations.

Corporate Members

Associate Members

10. Shall be persons who, except as provided in paragraph 11 below, shall possess the scholastic qualifications of a Graduate, and in addition possess any one of the following qualifications:—

(*a*) To have completed successfully a Long Engineering Course, including Civil, Electrical and Mechanical Engineering, Transportation or Survey, or special training of at least two years' duration arranged by the War Office in a subject of value to military engineering, and

To have completed at least two years in peacetime in military engineering appointments approved by the Council, for active service see paragraph 15 below, and

To have passed the promotion examination currently in force for promotion to substantive major.

or

(*b*) To have completed successfully a Staff College Course, or a Technical Staff Course, and

To have completed at least two years in peacetime in military engineering appointments approved by the Council, for active service see paragraph 15 below.

or

(*c*) To have completed at least two years in command in peacetime of an engineer squadron or equivalent unit of the Royal Engineers in the Active or Reserve Army of the United Kingdom or in any of the Commonwealth Land Forces, for active service see paragraph 15 below

or

(*d*) To be a Corporate Member of any of the professional Chartered Institutions whose activities are allied to the duties of the Corps of Royal Engineers, and in addition to have completed at least five years' commissioned service in peacetime in the Royal Engineers of the Active or Reserve Army of the United Kingdom, or in the engineer arm of any of the Commonwealth Land Forces, for active service see paragraph 15 below.

11. Persons who do not possess the scholastic qualifications of a Graduate, as set out in paragraph 4 above, may at the discretion of the Council be admitted to Associate Membership provided that they fulfil both the following qualifications:—

(*a*) To have completed either:—

(i) At least six years' commissioned service in peacetime in the Royal Engineers of the Active Army of the United Kingdom or in the engineer arm of any of the Commonwealth Active Land Forces, or

(ii) At least twelve years' commissioned service in peacetime in the Royal Engineers of the Reserve Army of the United Kingdom or in the engineer arm of any of the Commonwealth Reserve Land Forces.

and

(*b*) To have commanded an engineer squadron or equivalent unit in the Active or Reserve Armies of the United Kingdom or in the Land Forces of the Commonwealth for at least two years in peacetime and in addition to have completed at least two years service in engineer appointments approved by the Council, for active service see paragraph 15 below.

Full Members

12. Shall be persons who possess the qualifications of an Associate Member, and who possess both the following additional qualifications:—

(*a*) To have completed two years in military engineering appointments approved by the Council in the rank of Temporary Lieut-Colonel, or above, in the Royal Engineers of the Active or Reserve Army of the United Kingdom or in the engineer arm of any of the Commonwealth Land Forces, for this purpose Corps appointments held after promotion out of the Corps carrying the rank of Colonel or above shall count as qualifying service, and

(*b*) To have completed two years in the substantive rank of Lieut-Colonel; for this purpose service as Brevet Lieut-Colonel shall count.

13. The qualifications set out in paragraph 12 can run concurrently, and for active service see paragraph 15 below.

14. In exceptional circumstances distinguished engineer officers, irrespective of the qualifications set out above, may be elected to Full Membership if their election is considered by the Council to be in the best interests of military engineering and of the Institution of Royal Engineers.

Active Service

15. For the purpose of these Regulations time served in areas where a state of "Active Service" has been officially declared shall count as double qualifying service for election to the grades of Associates, Associate Members and Full Members. In the case of officers of the Reserve Army called up for full time service, such service shall count as qualifying service as though they were officers of the Active Army.

Election to Grades of Membership

Students

16. On first appointment to a Commission in the Royal Engineers of the Active or Reserve Armies of the United Kingdom, or in the engineer arm of any of the Commonwealth Active or Reserve Armies an officer becomes eligible to be enrolled as a Student. He will apply to the Secretary for enrolment and the Finance and Membership Committee shall be empowered to confirm such enrolments.

Officers, other than Students, of the United Kingdom Army

17. A Royal Engineer Officer of the Active or Reserve Army of the United Kingdom, other than those joining on first commissioning, who wishes to be classified in a particular grade of membership shall apply to the Secretary for an application form on which he will state his qualifications and return the form with supporting documents to the Secretary through the senior engineer officer of the Command in which he is at the time serving. The senior engineer officer will, to the best of his knowledge, verify the qualifications claimed. Cases in which the senior engineer officer is unable completely to verify all the qualifications of an applicant will be sent by the Secretary to the Engineer-in-Chief for final verification.

Retired Officers of the United Kingdom Army

18. A retired Royal Engineer Officer of the Active or Reserve Army of the United Kingdom who wishes to change his grade of membership shall apply to the Secretary on the appropriate application form which will be forwarded to the Engineer-in-Chief for verification of service qualifications claimed.

Engineer Officers of the Commonwealth Land Forces

19. A serving or retired officer of the engineer arm of any of the Commonwealth Land Forces shall submit his application to join the Institution, or change his grade of membership, to the Secretary through the senior engineer officer of his Country who will be asked to verify the qualifications claimed.

Civilian Officers applying to become Companions

20. Civilian officers employed in the War Department Works Organization, in the Military Engineering Experimental Establishment, or any such other Establishments as the Council may from time to time decide and as shall be approved by a General Meeting, wishing to be enrolled as Companions shall submit their applications to the Secretary through their Director.

Sponsoring

21. All applications for upgrading to Associate Membership shall be sponsored by three Corporate Members; applications for upgrading to Full Membership shall be sponsored by five Full Members. No sponsors are required for Non-Corporate Membership.

SCRUTINIZING AND CONFIRMATION OF APPLICATIONS FOR GRADING

22. All applications for Student membership shall be considered by the Finance and Membership Committee who are empowered to confirm such applications. Applications for all other grades of membership shall in the first place be considered by the Finance and Membership Committee who will forward their recommendations to the Council. The Council alone has the power to confirm such gradings.

Memoirs

BRIGADIER J. A. BELL, CBE

BRIGADIER JOHN ALTON BELL of Long Valley, Farnham, formerly General Manager of the East Indian State Railways, died on 19 November 1960 aged 73 years. He served with distinction in the Royal Engineers in both world wars. In the 1914/18 war he rapidly rose to the rank of Lieut-Colonel despite his youth.

In the 1939/46 war he succeeded Brigadier C. H. Langley as Director of Transportation, Middle East and he was responsible for the vast extension of rail and dock facilities in the Middle East Base both in Egypt, the Western Desert, Palestine and the Sudan, including the construction of the 100-ft swing railway bridge at El Firdan across the Suez Canal and the military ports of Ataka and Adabiya south of Suez. In addition he was responsible for the establishment of the Railway Workshops at Suez and the conversion of Egyptian State Railway locomotives from coal to oil-burning due to the acute local shortage of solid fuel. He was also responsible for the construction of the metre gauge railway from Safaga on the Red Sea to Qena on the banks of the Nile in Upper Egypt. Later he joined the Transportation Directorate of 21 Army Group and became responsible for the vital rail communications necessary to carry forward the ever-increasing tonnage of stores demanded by the fighting formations.

In a moving tribute to him in the obituary columns of *The Times* a wartime Sapper colleague wrote of his sterling qualities and high moral and physical courage and how his many friends admired his efficiency, respected his integrity and loved him for his kindness, thoughtfulness and generosity.

COLONEL L. H. STOWELL, OBE

LANCELOT HUGH STOWELL was born on 2 October 1901. He was commissioned into the Corps on 22 December 1921 and after his YO Courses at Chatham he spent a year at Gosport before being posted to 39 (Fortress) Company at Sheerness where he served for three years. He was then posted to the Depot Battalion at Chatham and at the beginning of 1931 he was selected for a Long Electrical and Mechanical Course.

At the end of this course he served for four years in Egypt as Garrison Engineer in Cairo, in Moascar and in Abassia. He was also for a few months ACRE (E & M) Canal Zone at Moascar.

On returning home in July 1937 he became an Assistant Instructor in the Electrical and Mechanical School at the SME, Chatham.

His war service included the appointments of Assistant Director Works (E & M) with Allied Forces Headquarters during the North African Campaign of 1942, 18 CRE Works in North Africa and 17 CRE Works in Italy and in North West Europe where his unit was later sent. He was mentioned

in dispatches in August 1944 and awarded the OBE the same year for his outstanding work in the Italian port of Bari and in the base area developed around the port.

He returned from North West Europe in January 1945 to become Assistant Director DREE, Ministry of Supply. In 1951 he was promoted full Colonel and he remained serving in the Ministry of Supply with DREE until his retirement in February 1954.

On 18 September 1926, whilst serving at Sheerness, he married Beryl Roberta, second daughter of Mr and Mrs T. E. Monckton of Deal.

Stowell was not an easy man to know well, but in spite of his reserve he always inspired confidence and he was a most competent and genuine Sapper officer.

COLONEL W. H. TREAYS

William Henry (Tim) Treays was born on 28 July 1900. He was commissioned into the Gunners from the Shop on 17 July 1919 and on 18 January 1924 he transferred to the Sappers, having qualified as an Army Instructor in Signalling. He spent two years on courses at the SME, Chatham before being posted as Garrison Engineer, Lydd when he was engaged on building works, and road construction and in his official capacity he held the ancient *ex-officio* appointment of Controller of Walland Marsh and Denge Marsh Level.

From 1929 to 1931 he served in West Africa on secondment to the Colonial Office, being employed on the Gold Coast/Ivory Coast Boundary Commission and on topographical surveys in Sierra Leone. For health reasons he was posted home in April 1931 and, after a short period on half pay, he became Garrison Engineer, Woolwich for a year. He then became Adjutant, The Tyne Electrical Engineers (TA) which at the end of 1936 was redesignated 37 (Tyne) AA Battalion (TEE).

In January 1938 he was posted to Malaya to become DCRE Tanglin. In early 1941 the two RE Districts on Singapore Island were amalgamated under Colonel Treays, who assumed the appointment of CRE Singapore, for work on the defences assisted by the Engineer sections of the Federated Malay States and Straits Settlements Volunteers. Two days before the fall of Singapore in February 1942 Treays was detailed to sail to Java to supervise engineer work there. With twenty-two officers and men he left in a small oil tanker. The tanker was bombed and sunk, but Treays and his party were safely transferred to another ship that landed them at Tembilihan in Sumatra. From there they were taken by cruiser to Java. On 27 February they were ordered to leave Java in a Yangste river-boat in a convoy bound for Colombo, but the small river-boat soon lagged far behind the convoy. Fortunately, owing to her shallow draft, she avoided being sunk by torpedoes, from a Japanese submarine, that passed underneath her and she safely reached her destination.

In 1942 Treays became Chief Instructor in Field Works, Royal Bombay Sappers and Miners for a short while before becoming CRE Bihar, responsible for the construction of vast camps to accommodate the build-up of troops in India. In 1943 he became ADW Eastern Command, India and the following year Chief Engineer Bengal Area at the time of the counter-offensive in Burma. He held this appointment until the end of the war against Japan and

Colonel W. H. Treays

for a short while before being posted home in 1946 he was Deputy Chief Engineer, Eastern Command India.

On returning home he served for three years as Deputy Chief Engineer, Northern Command at York, and for the last two years of his service he was Deputy Director of Works FARELF responsible for the general direction of Works Services in Hong Kong, Malaya, Singapore and War Department Works in India. He retired 14 August 1952.

On retirement he remained in Malaya for three years in various civilian appointments and during that time he was Chairman of the Church Council

Colonel W H Treays

of the Roman Catholic Church at Kota Baru, the Secretary of the Kelantan Branch of the Ex-Service Association (Malaya) and a corresponding member of the Royal Empire Society. He returned to the United Kingdom in July 1956. He died from tuberculosis on 13 January 1961 after a long illness.

On 3 April 1934 he married Ines, the elder daughter of Sr and Sra Enrique Gaspar. They had two daughters and two sons, one of whom, Peter Treays, is a subaltern in the Corps at present serving with a field squadron in Germany. Our deepest sympathies go to his widow and to his children in their sad loss.

Correspondence

Colonel E. Gidley-Kitchin, OBE,
Zama Zai,
Brighton Street, Frankston,
Victoria, Australia.

The Editor,
RE Journal.

5 November 1960.

Dear Sir,

MEMOIR. BRIGADIER SIR CHARLES FREDERICK CARSON

"Bunt" Carson was nearly twenty-three years old when he joined our YO Batch at Chatham from Kingston. He had never played Rugger before, but in spite of this he very quickly made his mark as a half in the RE Chatham XV. Further, during the 1910/11 season he played half back regularly for the Blackheath first team, at that time considered with the Harlequins to be the best London Club XV. He was strong and most courageous in going down on the ball before the opposing forwards and he came up smiling from every melée. I believe he also toured with the Barbarians that season, his last in England.

Yours faithfully,
E. GIDLEY-KITCHIN.

THE LATE COLONEL A. H. B. HUME

Andrew P. Hume Esq, CIE, the son of Colonel A. H. B. Hume whose Memoir appeared in the December issue of the RE JOURNAL, writes to say that when he was Sub-divisional Officer, Roorkee from 1929 to 1931 he saw the basket of the Balloon his father had brought from Pekin to the Sapper and Miner Depot in 1900 after the Boxer rebellion—an historic piece since it belonged to the first military aeronautical equipment ever used in India.

He also states that when his father was in Kabul in 1917 he commanded the New Year's Day Proclamation Parade which was noteworthy for the presence on parade of some six thousand Nepalese troops then quartered there. When Deputy Chief Engineer in Ireland towards the end of his service he had the unenviable task of handing over the RE Stores to the Sinn Feiner Rory O'Connor. Editor

Brigadier N. L. Hammond, CBE,
Old Mill, Loders, Bridport.
6 December 1960.

The Editor,
The RE Journal.

RE JOURNAL DECEMBER 1960

Dear Sir,

I have read with much interest Lieut-Colonel Lawrie's article "Engineering and Politics in Jordan" and I hope he will not mind me correcting him in one small detail. The road across the desert via Mafra to Baghdad had nothing to do with the IPC pipeline. Indeed the IPC's attitude towards the road was one of indifference bordering on hostility. It was in fact built by an RE unit the CRE Haifa Baghdad Road. It was planned and started by the late Brigadier (then Major) Rawdon Briggs. I took over from him in May 1939 and handed over to Lieut-Colonel Peter Noble in May 1943.

The same unit built the roads:

Mafraq–Amman.

Mafraq–Deraa Juncion via Ramtha.

Ras-el-Naqb–Akaba.

I am sorry to hear the main road described as inferior. Narrow it certainly is (5 metres)—far too narrow to share with three-tonners driven by Polish or Indian drivers as I used to find. But I hope that its present condition is due to lack of maintenance and not to faults in its construction on which all concerned took a lot of trouble and considerable pride.

Up to the time I left I could still clock my regular 100 kilos in the hour even though parts of the road especially in Transjordan had carried a good deal of heavy traffic for upwards of three years with negligible maintenance, while Norman (one of the famous Nairn brothers) did the trip Baghdad–Haifa in under twelve hours.

As regards the road Naqb–Shtar–Akaba, I should be very interested to know what alignment it is proposed to follow.

The difficulty is the section from the Guweira plain down through the Wadi Ytem which has a flat sandy bottom about fifty yards wide with steep granite cliffs on either side. In normal years it is either bone dry, or may at times have a small stream meandering through it.

But about once in five years, on average the whole wadi is said to come down about a meter deep.

The possible alternatives are:—

(*a*) Concrete roadway with drop walls both sides.

(*b*) Heavy side cutting and innumerable culverts to get above the flood level.

Both alternatives were expensive in cost of materials and plant.

The time factor, and shortage of plant and materials forced us in 1942–3 to take a chance and simply lay mix-in-place (sand and bitumen) on the wadi bed.

Much the same difficulty would I imagine apply to a railway with the additional problem of getting down the Ras-el-Naqb escarpment, though here you exchange granite for glass sand which is easier to work in!

The best we could do was 1 in 16 but with curves too short for a railway.

Yours faithfully,

N. L. Hammond, Brigadier (retd).

Lieut-Colonel R. J. Wade, RE,
British Army Staff,
British Embassy,
Washington 8, DC.

4 January 1961.

The Editor,
The RE Journal.

Dear Sir,

LONG WELDED RAILS

I have no personal experience of the track distortion which is dealt with at length in Major Rose's article in the December 1960 *Journal*, but I do not think that his dismissal of the dynamic effects of moving trains over heat-stressed track is borne out by available published evidence.

On the contrary, four out of five recent Ministry of Transport reports on derailments due to heat distortion conclude that the track moved under either the preceding train or the derailed train itself. (The five occasions were at Bletchley in May 1947, Wath Road in May 1948, Tollerton in June 1950, Abington in August 1953, and Darvel in 1957). In every case the ballast was described as being poor in quality (viz ash) or quantity, and the expansion gaps had either closed up or were "frozen" open by tight fishplates, thus simulating long-welded track.

Perhaps the most valid conclusion is that the inherent instability of welded track has been concealed so far in the UK by its limited distribution and by the use of heavy concrete sleepers and high-quality ballast in a moderate temperature range.

In the USA Middle West, where the annual temperature range is over a hundred degrees, the track is laid at 50–60°F, which is said to take care of normal variations, but much heavier rail sections are used and traffic is generally lighter than in the UK.

It would be most interesting to know whether any instances of buckling of long-welded track have occurred, and if so what conclusions have been drawn.

Yours faithfully,
R. J. WADE.

Book Reviews

REINFORCED CONCRETE PILING AND PILED STRUCTURES

By F. E. WENTWORTH-SHIELDS, W. S. GRAY, AND H. W. EVANS

(Published by Concrete Publications Limited. Price 18s.)

This is the second and revised edition of this book which first appeared in 1938. The revised edition, as would be expected, is similar in arrangement to the original but includes an extra chapter on bearing capacity of piles.

The text however has been considerably amended to conform to present-day allowable stresses in both concrete and steel and to the Code of Practice on Foundations (CP4).

The new chapter on design has been elaborated, as has the one on groups of bearing piles. The new chapter on bearing capacity of piles is a useful addition and it includes references to trial bores, test piles and test loading of piles.

The tables and graphs are intermingled with the text and some of them will be useful to the designer, for example the table on size and spacing of links for different sizes of pile and differing amounts of cover. There is a separate index of tables for easy reference.

W.C.

AVIATION CARTOGRAPHY—A HISTORICO-BIBLIOGRAPHIC STUDY OF AERONAUTICAL CHARTS

By WALTER W. RISTOW

Second Edition (Revised and Enlarged)

(Available from Card Division, Library of Congress, Washington DC, 1960. Price $1.75)

This is a revised and greatly expanded version of the first edition, published in 1956, and reviewed in the *RE Journal* of March 1957.

The original basic plan has been retained, running to some fifty pages, based on, and referenced to, a 170-page annotated bibliography. The bibliography comprises a detailed list of works which bear on the use, design and production of aeronautical charts. It even includes references to articles reviewing the major publications listed, including some of those reviewing the 1956 version of Aviation Cartography itself.

The earlier edition proved a most valuable guide and aroused considerable interest amongst those concerned with charts used for air navigation. Since its publication, the fiftieth anniversary of the aeronautical chart has been celebrated by an international exhibition at Munich in September 1959, and the transition of the artificial satellite from a dream to almost a commonplace, coupled with astonishing developments in electronic equipment, has revolutionized future concepts of navigation. The present edition, which owes much to the recent detailed bibliographic work of such specialists in this field as Karl-Heinz Meine of the Bundesanstalt für Flugsicherung, Germany, includes references to many of these new ideas and will prove a most useful work for all those engaged in this field. R.A.G.

RUSSIA AND CHINA, FROM THE HUNS TO MAO TSE-TUNG

By COLONEL J. V. DAVIDSON-HOUSTON, MBE, FRGS

(Published by Robert Hale Ltd, London. Price 21s.)

Russia and China, by the author of *Armed Pilgrimage* and *Armed Diplomat*, is perhaps the first attempt to give the general reader a complete history of the relations between these two great Communist countries from the earliest times up to the present day.

Colonel Davidson-Houston was commissioned into the Corps in 1921 and, has spent most of his service in a number of diplomatic and military missions abroad. He is a qualified interpreter in both Russian and Chinese and has travelled extensively in the lesser, as well as the better, known parts of the Far East and Russia. He was an official observer in China during the civil wars and the Japanese invasion, and during the Second World War he acted as a liaison officer between the British Command and the Soviet forces in Persia. This background has placed him in a unique position to write on the relations between Russia and China in recent years and to analyse the events which have led up to them.

Perforce in dealing with a subject so vast, a great deal has had to be compressed into a small compass. The first three chapters, over a third of the book, describe events up to the sixteenth century, when the Russian and Chinese governments came into contact for the first time. The presumption is that the author considered that, without this introduction, subsequent history would be less intelligible. However one is left with the impression that these chapters might have been omitted without affecting the main purpose of the book, particularly as in this early period the authorities, on which he has had to rely, are confusing and have, it is believed, led him into some minor errors.

After describing early contacts starting in the time of Ivan the Terrible, subsequent chapters lead us through the break up of China, the Chinese and Russian revolutions, the wars between the War Lords and the triangular war involving Japan to the Moscow-Peking axis. Finally there is a chapter giving the author's forecast of coming events. His conclusions, which are interesting in the light of the recent Communist conference, are that, although there is a tradition of Sino-Russian antagonism, there

are also forces making for concord. Communism is the common bond: should that weaken, discord will inevitably result. All this is excellent.

The text is illustrated with sixteen maps which, though clear, are sometimes difficult to follow owing to their positioning in the book. They mostly refer to the less important early history.

This is a book written from personal experience by one who has travelled nearly all the countries concerned and been an eye witness of many of the more recent events described. It is extremely informative and interesting, whether one has any specialized knowledge or not. P.A.C.

THE WAR AT SEA
VOL III. THE OFFENSIVE. PART I

By CAPTAIN S. W. ROSKILL, DSC, RN

(Published by Her Majesty's Stationery Office, 1960. Price 45s.)

Captain Roskill has found himself compelled to divide the third volume of his admirable history into two parts. Only thus will he be able to find space to maintain the scale of his crowded narrative. So Part I, covering June 1943–May 1944, is, as it were, an adagio movement introducing in Part II the tremendous events which ended in the absolute victory of 1945.

Readers, delighted with the first two volumes, will not cavil at the author's decision and certainly no one of British race would wish to have a cramped and distorted picture of the final struggles for the mastery of the sea. Indeed we in Britain must note with particular attention how Japan, in this penultimate period, was already heading for disaster, largely because of her failure to grasp the inward meaning of sea power. Whereas on the Western seas during two great wars "the linchpin of Allied maritime strategy" was the protection of convoys, Japan in the East developed no effective measures for solving this vital problem. As a direct consequence of this neglect, she was soon to lack sufficient ships to import the materials required for her bare existence, let alone for the waging of a great war.

The Allies, for their part, never let up in the battle of the convoys. During the year under review, the relentless hunting of U-boats, to which much of this book is devoted, continued with unabated fury on all the oceans of the globe. The list of U-boats destroyed, given in Appendix D (ten pages), is a silent but eloquent testimony to the magnitude of the job, for each success usually resulted from a fierce and merciless sea battle in miniature.

Captain Roskill records with satisfaction that the convoy escorts with which aircraft were now playing a prominent part, were by this time at last accepted as the most deadly antidote to U-boats and that the separate hunting of them by special patrols had become almost a heresy. Yet the temptation to route the faster ships unattended occasionally proved irresistible and resulted in some heavy losses in the South Atlantic and Indian Oceans. Ships are, indeed, fidgety entities, which cannot bear to be kept waiting for anything, even for their own good.

The air/sea arrangements for the invasion of Sicily and for the landings at Salerno and Anzio were capitally carried out and are admirably described. Although the Axis evacuation from Sicily was a model of professional competence, the history does not quite explain the Allied failure to prevent it. Military history, however, has record of many successful withdrawals and after Dunkirk no one will grudge the Germans their success at Messina, which is worthy of closer examination.

The author quotes Nelson on the slowness of armies and wonders that landings behind the enemy lines were not used to speed up the capture of Sicily. The fact is that the threat of such action is often more agonizing to the enemy than an actual landing. On a much larger scale both Salerno and Anzio showed that unless the forces on land can quickly move up in support, the odds are on the enemy being able to reinforce the quicker and so to make the landing abortive. At Anzio, moreover, a smallish Allied force unsupported by the Fifth Army, advancing gaily on the Alban

Hills to meet a commander of the quality of Kesselring might have run into great trouble—to say the least of it. As with the handling of convoys, there is more to landing behind the enemy than is at first sight apparent.

A reference to the Adriatic during Nelson's time is a reminder that in World War II the Mediterranean had the same significance as it had in the Napoleonic Wars, i e, the control of the Mediterranean was a first essential to the mastery of Europe. Directly the Allies gained effective control of that classic sea in the spring of 1943, Allied supremacy in Europe seemed merely a question of time.

As with its two predecessors, the interest of Volume III never flags. As they read of the countless exploits of their brethren of the sea and of the air, mere land-lubbers will fondly hope that their own timid blood is nevertheless of the same heroic strain. Thus hoping, they will also be exploring a rich mine of information about war, much of which will either be new or be seen from another standpoint—that of maritime power. The style of the book is admirable, the illustrations are fascinating and the maps are refreshingly nautical in that the reader must measure his distances in minutes of arc-dividers in hand. And why not? B.T.W.

ENGINEERS OF THE SOUTH-WEST PACIFIC 1941–1945
VOL IV AMPHIBIAN ENGINEER OPERATIONS

OFFICE OF CE GHQ ARMY FORCES PACIFIC

(US Govt Printing Office, Washington, 1959. Price $11.50)

This fourth of a series of eight volumes on the work of the US Corps of Engineers in the South-west Pacific measures 11 × 9 × 2 in (thick) and weighs nearly eight pounds. It comprises in all nearly 800 pages of print with 39 excellent maps and 137 magnificent photographs. Even German military historians can hardly match such determination to make every detail of Amphibian Engineer Operations in the South-west Pacific available for posterity.

Detail is, in fact, the chief content of this truly monumental work, on which various authors and editors have laboured for nearly ten years. Perhaps Vol viii entitled "Critique" will summarize the amphibian operations of the Corps in more general terms and highlight the broad essentials for successful landings in oceanic warfare.

The general reader would like to learn more about the three-cornered disputation which no doubt took place between the US Navy, the Corps of Marines and the Corps of Engineers, concerning the responsibilities for the handling of amphibian operations. It would also be of interest to know how the landing techniques of the Corps of Marines in the finally decisive Central Pacific compared with those of the Corps of Engineers in the SWP. Information about the extent to which experience acquired in the Pacific affected or was affected by that of the Mediterranean and the Channel would be useful too.

The first chapter on the past history of amphibious operations starts off in the classical era and arriving at the twentieth century, includes references to Admiral Fisher's "beetles" (500 men or forty horses) which were designed for the Baltic and used too late at Gallipoli.

Full reference is also made to the 1922–40 series of British LC, of which the US service authorities pleasingly retained, for their own models, the original British distinguishing letters. It is to be noted in conclusion that by March 1944 two Engineer Amphibian Brigades were in the SWPA with a third one forming in the USA. Each brigade disposed of 8,000 men and 550 LC of various kinds. These impressive figures well reveal the American aptitude for thinking big about war material and for translating thought into achievement by quickly harnessing their immense and lively industrial system to the job. Britain was short of LC throughout the war and was still short of them at Suez. Reading this book makes one wonder uneasily what the position is now. B.T.W.

A WAR HISTORY OF THE ROYAL PIONEER CORPS, 1939–45

By MAJOR E. H. RHODES-WOOD

(Published by Messrs Gale & Polden. Price 35s.)

The author of this interesting history traces the growth and work of the Corps from its non-existence in 1939 to the vast organization which it eventually became, extending to every theatre of war where British military forces were engaged.

By 1939 the lessons of World War I had largely been forgotten and the army was launched into a campaign in Europe without any previously organized pioneer or labour units and without the machinery for controlling the civilian labour force which it was optimistically hoped would be available. Quickly the necessity for a disciplined labour force was driven home and the Auxiliary Military Pioneer Corps, as it was then called, was formed.

This Corps, raised initially from officers and other ranks in the older age groups recalled from the reserve and from young conscripts, was increased by the temporary diversion of personnel from the Territorial Army for service in France. Later both in the United Kingdom and as the war spread in other areas, the same requirement for a disciplined labour force was appreciated. The Pioneer Corps which then became its official title, was enlarged to include units raised from India, all parts of Africa, Palestine, Mauritius, the Seychelles and Cyprus and also units raised from well-disposed aliens who could not be accepted into other arms of the service.

The author traces the growth of the Pioneer Corps and the various tasks its units were called on to perform in each of the theatres of war. These accounts, based on official war diaries, are enlivened by many incidents both humorous and interesting which convert what might have been a dull recitation of facts into a live story.

At different times every branch and arm of the service was dependent on the support of Pioneer units working with them. The Royal Engineers, in particular, must ever remember their work on the docks, in store depots, on airfield construction as well as in more forward areas in bridging operations and on work on communications. In the United Kingdom during the period of heavy air bombardment clearance work in London and at the ports provide also outstanding examples of the co-operation of the two Corps.

By the end of the war in every theatre the army's dependence on the work of the Royal Pioneer Corps was fully recognized and aptly expressed in the phrase "No labour—no battle."

E.P.D.

BRITISH OCEAN RACING

By DOUGLAS PHILLIPS-BIRT

(Published by Adlard Coles Ltd. Price 35s)

Any Royal Engineer officer who buys this book from any ordinary bookseller will be irritated to see that the caption for Plate 3 describes *Ilex* as the *Gunner's* famous yawl. On page ix this is corrected with an errata slip. This monumental error has been eliminated in the special Royal Ocean Racing Club edition of the book, which is available for members of the Club at a similar price.

It is not an inaccurate book however and the author, a trained naval architect, has been at much pains to verify his facts. For purists, nevertheless, one or two other corrections might be made, for example:—

Page 40. 1925 Fastnet Race. Actually *Fulmar* (REYC) not only saved her corrected time on *Saladin* and *Gull*, but also finished ahead of these larger yachts.

Page 48. 1926 Fastnet Race. *Halloween*'s record time for the course (other sources give it as 3 days 21 hours 35 minutes) does not still stand. It was bettered in 1939 certainly by *Nordwind* and *Latifa* and probably by *Benbow* and *Bloodhound* as well.

Page 71. 1930 Fastnet Race. *Maitenes II* did not finish ahead of *Ilex*: she finished some 2½ hours after her, but beat her fairly easily on corrected time.

Page 96. 1933 Fastnet Race. The finish for this extra long race was at Spithead and not at Plymouth and though *Ilex* was only 12 minutes behind *Lexia* on corrected time, she actually finished some 11 hours after her.

These are but pinpricks and any keen member of the REYC would be well advised to read this book—a history of a sport to which the Corps has contributed so much. It is doubtful if it would appeal to the purely arm-chair sailor, for in a book of this sort the names of yachts and people, if utterly unknown to the reader, might be confusing and there is no space for, nor desire to include in such a book, sensational stories nor (ghastly thought) "thrilling tales of the sea". But the great story of the rescue of the American schooner *Adriana*'s crew by *Jolie Brise*, owned and skippered by Bobby Somerset, is admirably told on pages 133 and 134 and should appeal to any amateur or professional seaman.

The book is mainly a history of the Royal Ocean Racing Club, but the beginnings of the sport are described. In 1866 three large yachts—all American schooners—raced across the Atlantic. But they were manned by professional crews and all were well over 100 tons. Three more Transatlantic races—also for very large yachts—were sailed before 1914 and in 1906 the first Bermuda race, of about 600 miles, was sailed by smaller yachts. Five such races were sailed before the 1914–18 war and the Bermuda course was reintroduced in 1923. In 1925 the first Fastnet Race was sailed and the REYC entry, *Fulmar*, 14-ton cutter, won second prize. After the race that year the Ocean Racing Club, within a few years to become the Royal Ocean Racing Club, was founded.

The growth of the RORC and of ocean racing in these waters over the years to 1957 is traced, while an appendix brings the story up to the end of 1959. At the same time the book describes some of the races held by overseas or foreign clubs in which British yachts have taken part—the Bermuda race, various transatlantic races and the Sydney to Hobart race.

In the earlier years of British ocean racing, those who took part in it were regarded as cranks. Their yachts were mainly cruisers of the old type, some good, some bad, but all were considered as dull sailing machines—as indeed they were by modern standards—by the round-the-buoy enthusiasts. The theme-song of this book is the gradual change of the sport and of the yachts taking part in it. Firstly through the influence of the American yachts *Nina* and *Dorade*, which stimulated better competition, then by the use of successive RORC rules of rating and measurement, the breed of yachts has steadily improved. The small, well-designed offshore racing yacht of today is now almost universally built, whether for racing or cruising. Compared with the larger cruising yacht of thirty or forty years ago she is a better seaboat, more comfortable to live in, very much faster to windward and infinitely more fun to sail, whether racing or cruising. With her has grown up a numerous breed of amateur seamen who are not chary of taking their yachts offshore and of driving them hard by day or night in conditions when a prudent cruising man of thirty years ago would have considered it advisable to heave-to.

Ocean racing has in fact become a fashionable pastime and so much can be said for it as a manly sport that it is perhaps wrong for some of the older generation to sigh for the old days when they played the same game against a very small band of brothers who, like them, were regarded by most other yachtsmen—not without a grudging envy—as cranks.

Those who are interested in yacht architecture will be delighted to see that the hitherto unpublished lines of *Myth of Malham*, *Bloodhound* and *Griffin II* have been included, but all who go offshore in small yachts should certainly read this book.

L.R.E.F.

Technical Notes

CIVIL ENGINEERING

Notes from *Civil Engineering and Public Works Review*, November 1960.

"The Unprocessed Layer in In-situ Soil Cement Stabilization." A problem exists when soil is stabilized in two layers. During the construction of a motor road two six-inch layers were successively stabilized, using a typical single-pass machine. Samples were taken which showed that there was a layer of unprocessed material at the joint between the two layers. This sandwich layer varied from $\frac{1}{4}$ inch to approximately 2 inches in depth. Anxiety was felt that water might percolate into the unprocessed filling of the sandwich, with additional problems arising from freezing and thawing. The article is the first of a series in which several experiments are described which aimed at studying the behaviour of different soil types under different conditions of rotovation, in an effort to see how the stabilizing agent (cement) penetrated the soil at different depths. It is hoped that these tests will give some guide as to the practical depths at which soil stabilization can be guaranteed.

"Single-Lane Traffic Flow." This is a Pure Mathematician's approach to the problem of how traffic behaves. The results are set against practical experimental data, and it is surprising to find that a generalization can be set down mathematically, differentiated, substituted, integrated, some constants eliminated, and the answer is quite clearly how fast your car goes one minute after being stopped behind a large lorry at a traffic light.

TWT

Notes from *Civil Engineering and Public Works Review*, December 1960.

"Formwork discussion group": At an informal meeting of executives representing all aspects of formwork, held recently in London, it was agreed that a need exists for such an association as "The Formwork Discussion Group" to act as liaison between the detailed preparatory work carried out by technical colleges and the overall general interest shown by institutions and associations; it was agreed that the formation of such a discussion group should be investigated, and that further meetings be arranged to discuss formwork.

Further information can be obtained from Mr W. F. Whyman, London Director of Kwikform Ltd, East Road, Upper Wickham Lane, Welling, Kent.

"Engineering Developments in the USSR—Prestressed Steel Bridge": The notes are a precis of a Russian article describing a prestressed steel bridge crossing a river gap of 1,554 ft in five spans, of which the three maxima were 358 ft each. The bridge has a deck of RC made monolithic with steel girders with in-situ concrete and shear plates which are also used as bearing supports to the jacks during stressing operations. The unusual design feature of the bridge is the use of prestress to steel girders on a bridge of this size. It is hoped to achieve an over-all saving of 15 per cent in the weight of steel by this means.

"Simple Concrete Lintels": Advisory Leaflet No. 49, published by the Ministry of Works under the title "Simple Concrete Lintels", describes how to make simple RC lintels, conforming to BS1239, for openings to take British Standard wood and metal windows and doors. The lintels described are suitable for $4\frac{1}{2}$-in or thicker solid walls, and for cavity work, spans ranging from 11-in to 7 ft 7-in. Copies are obtainable from HMSO, price 4*d*.

"Elastic analysis of a Symmetrical Fixed-End arch of varying Section", by A. F. Gee, MA, AMICE: A fixed-end arch is statically indeterminate to the third degree, and if in addition the arch rib is of varying section, it does not lend itself to direct analytical solution. Consequently, the derivation of influence lines for this type

of structure is a laborious mathematical operation, and the amount of work involved is in almost direct proportion to the accuracy required.

The author therefore considered that the problem was ideally suited to the use of an electronic computer, and prepared the programme described in the paper.

"Constructing Missile Launching Sites", by R. J. Salter, BSc (Eng) AMICE, AMI Mun E. This short article describes in general terms the methods employed in constructing launching bases for Titan missiles in the Colorado Plain, USA.

"Standard Beam Sections for PC Bridges": The use of prestressed concrete for highway bridges has become an established technique. In order to avoid the use of a large variety of sections, each requiring its own special formwork, a design for a standard type of PC bridge construction has been prepared by the Prestressed Concrete Development Group of the Cement and Concrete Association, in co-operation with the Ministry of Transport. By using the standard bridge beams, design time will be saved as tables and specimen designs are provided. The designs are for spans between 25 and 55 ft, and the field may be increased later to include greater spans. The article describes the chief items of standardization.

Notes from *Civil Engineering and Public Works Review*, January 1961.

"Cylindrical Concrete Tanks on Elastic Foundations": The paper describes a method of determining the bending moments developed in a cylindrical concrete tank supported on a foundation in which the reaction pressure at a point is proportional to the deflection at that point.

Most of the information is provided in a graphical form and the use of these charts in conjunction with the principle of superposition provides a rapid means of calculating the bending moments set up in the tank under specified support conditions.

The application of the method is demonstrated by an example in which comparisons are made between the structural behaviour of a tank supported on (i) an elastic foundation, (ii) a foundation giving uniform reaction pressure; and (iii) an edge ring beam.

"The Use of Prestressed Steelwork for Wide Spans" (translated from the German by G. Bernard Godfrey, AMICE, AMI Struct E). The idea of using the technical and economic advantages of prestressing has engendered developments in prestressed concrete which have been without parallel in structural steelwork until recently (see "Notes from *Civil Engineering and Public Works Review*, December 1960"). When it is realized that in prestressing lattice construction in steel no special duct is needed for the prestressing tendon and no loss of force through friction need be anticipated, it is hard to understand why the incomparably more favourable conditions presented by prestressed steelwork were not exploited long ago.

"New London Benchmark Provides Datum Point": During the construction of "Shell Centre" on the south bank of the Thames, it was essential to have a stable benchmark on the site so that accurate measurements of the settlement of different sections of the buildings could be recorded. The ground immediately under London is in a state of permanent motion downwards, the sinking being irregular and varying from place to place. The nearest reliable benchmarks (until the erection of "Shell Centre") were in the Chilterns, 30 miles away.

The article describes the method by which a stable benchmark was established, and will be of great interest to those faced with a similar problem elsewhere.

"Measured Rates": A price index has been produced for some 130 of the more common items of work in civil engineering construction. Where practicable these items conform in scope, sequence and method of measurement to the "Standard Method of Measurement of Civil Engineering Quantities". Although it does not claim to be fully comprehensive, the index serves as a useful guide in obtaining an estimate for any particular civil engineering task.

"RIGIFLEX" AND "LUBRITHENE/A": When an asphalt carpet is laid over old or new concrete, cracks and joints in the base are liable to be reproduced in the asphalt surface. Apart from impairing the riding surface, such cracks permit seepage of water beneath the asphalt and lead to further deterioration of the surface and of the foundation.

It is claimed that considerable success has been achieved in preventing such cracks by using a bridging member of aluminium foil ("Rigiflex") to separate the asphalt from the concrete in the region of the joint. To prevent adhesion between the asphalt and the aluminium, the foil is used with a tough, flexible plastic film ("Lubrithene/A") which will not adhere to or be softened by hot asphalt, and is an effective barrier to water. D.L.J.

THE MILITARY ENGINEER

NOVEMBER–DECEMBER 1960

"Nuclear Power: Promise and Problems", by Lieut-Comdr. E. J. C. Ledoux, Civil Engineer Corps United States Navy. A summary of the history of the development of Nuclear Power with a description of the factors governing its production and an explanation of why at present, it is more expensive than the production of power from oil or coal. The subject is clearly stated but no detailed information of a technical nature is given.

"Foundations in Permafrost", by Colonel William C. Gribble, Corps of Engineers. This is another article on the problems of construction work in the frozen North. The particular subject of this paper is the best method of driving piles, or rather positioning piles, which penetrate the permafrost at a combined Aircraft Control and Warning Station, and Communication stations for the Air Force and Army. The article is well illustrated and clear and gives three different methods which were used for overcoming the danger of upsetting the permafrost regime by temperature variations.

MILITARY ENGINEER FIELD NOTES

"Polar Research and Development", by Colonel J. H. Kerkering, Corps of Engineers. A brief description of some of the work being done by the Army Polar Research and Development Center in support of various projects, there are over fifty being studied. The article describes the construction of a camp and nuclear power station under the surface of the snow in a series of long tunnels, special types of heavy sleds, road construction and water supply.

"Thin Concrete Overlay for Runway", by John B. Puritan Jnr. A detailed description of the repair of a 200 ft by 7,000 ft runway by spreading over the surface a layer of concrete about 2 inch thick. The method of cleaning and preparing the old surface is also given. Unfortunately no information is given of time or cost.

"To Bridge a River", by Richard C. Knopf. A short note on an early design of a military bridge using inflatable floats. The interest lies in the fact that design was submitted to the Secretary at War at Washington by Daniel Bartling a Lieutenant in the United States Dragoons in 1812. There are facsimiles of the drawings illustrating the project. There is no evidence that the invention was received with any enthusiasm but it is remarkable that Bartling's plan, using different materials, is close to modern practice.

"Reopening of the Port of Leghorn", by C. W. Lynch. When Leghorn was occupied by the allies in July 1944 they found the port blocked by sunken ships, the harbour and the land surrounds heavily mined and the quays almost completely destroyed. This article describes in some detail the work of the 338th Engineer General Service Regiment which was entrusted with the task of rehabilitation. The article is well illustrated and gives a very good picture of the planning of the operation and of the various items of equipment used and various expedients resorted to.

"Jet Aircraft Tie-down Anchor Tests", by Maxwell C. Papanek. A most important phase in the manufacture of an aircraft is the testing of the power plant in the aircraft after assembly and before it flies for the first time. To make this test the aircraft is fastened by means of a wire cable to an anchoring structure, called a tie-down, in the concrete pavement. The increasing power of jet engines has made it necessary to provide tie-downs with a resistance of 50,000 lbs. After a series of tests had been completed examination of the tie-downs showed that there were signs of possible failure from turnover due to the inclined pull of the aircraft during test. The serious results which would follow from a failure during test led to a decision to proof load one of each type of tie-down at an aircraft construction plant in the US. This article is a clear description of how the tests were carried out.

"Mobile Cranes for a Moving Army", by Edward C. Kinker. A short article with illustrations of a 10-ton and a 20-ton mobile crane undergoing tests at the Engineer Research and Development Laboratories. There is also a description of an airborne 7-ton crane shovel with a lift of 18,000 lbs.

News and Comment

There is a photograph of the Engineer-in-Chief on a visit to the Waterways Experiment Station at Vicksburgh on page 502. J.S.W.S.

ENGINEERING JOURNAL OF CANADA

Notes from *The Engineering Journal of Canada*, October 1960.

This issue of *The Engineering Journal* is given over entirely to the general subject of "Power in Canada". The first two papers are, respectively, a statistical review of achievements in each province during 1959, with an indication of the over-all trend up to June 1960, and a forecast of the sources likely to be developed in the next twenty years. The salient features are that the net generation of power has more than doubled in the last eleven years, that the annual rate of development continues to rise, and that marked changes in the pattern of energy sources in use are likely to occur in more than redoubling over-all output by 1980.

The remaining papers are briefly summarized below:—

"Saskatchewan Power's Boundary Dam generating station": This is a fairly conventional solid fuel power station, but unusual problems were set by the use of lignite fuel, and by the lack of large areas of water for cooling purposes. The paper contains interesting information about mining, handling, and burning lignite, and the main power station equipment is briefly but adequately described.

"Whitehorse Rapids power development": The decision to proceed with this hydro-electric installation in the Yukon was made in August 1956, and the first unit started generating power in November 1958. There are two 7,500 hp Kaplan turbines, and power is generated at 6,900 volts by two 6,700 kVA generators. The paper deals briefly and clearly with the method of river diversion, and with the design of dams, spillway, canal, intake, and penstocks. There is an interesting account of hunting trouble with the generating unit governors.

"Kelsey generating station dam and dykes": The Kelsey generating station, about 425 miles north of Winnipeg, is the first hydro-electric development on the Nelson River. It is situated on the southern fringe of the permafrost zone, and has a mean annual temperature of 25°F, with only some 140 frost-free days each year. The occurrence of permafrost is remarkably sporadic, and dykes were constructed on both unfrozen and permanently frozen foundations, while the main rock-fill dam, 955 ft long and 120 ft high, was built on bedrock.

The influence of soil mechanics upon the design of "earthworks" is clearly exemplified in this thorough and clearly-presented paper, and the design of dykes, built of imported sand, over permafrost is particularly interesting, especially as regards the provision of sand-drains and measuring devices to combat anticipated settlement due to changes in the thermal regime.

"CHUTE-DES-PASSES 345 kV TRANSMISSION LINE": This overhead line, some ninety-one miles long, connects a newly completed generating station, comprising five 200,000 hp units, to an existing hydro-electric system. Design and construction features are discussed, and the notes on tower design and erection, and on stringing operations in severe weather, are of general interest.

"AUTOMATION IN THERMAL POWER PLANTS": This rather technical discussion presupposes some knowledge of the application of computers to control work. The adoption of complete automation in the complex process of thermal generation is shown to be economically justified.

"STANDARD ALUMINUM SUBSTATION STRUCTURES": The prefabricated structure described is unlikely to be economically advantageous in this country, but the paper includes some interesting information about design and production techniques.

"LONG RANGE HYDRO PLANNING FOR MANITOBA": This paper will appeal to those interested in the economics of power-system development, and to those seeking statistical information.

"LAKEVIEW AND R. L. HEARN GENERATING STATIONS DESIGN": These two modern thermal power stations are superimposed on a predominantly hydraulic generating system, their long-term function being to reinforce output during peak loading. Mechanical design features are discussed. The centralized control system and a steam by-pass to facilitate daily start/stop operation are unusual.

Notes from *The Engineering Journal of Canada*, November 1960.

This issue includes three papers of specialist appeal, all of which, however, may be of interest to the mathematically inclined. The titles are:—

"Design of industrial gears."

"Optimum adjustment of governors in hydro-electric stations."

"An exercise on operations research RCAF aircraft maintenance."

The other three papers, of more practical value to the military engineer, are dealt with below.

"THE WARSAK HYDRO-ELECTRIC AND IRRIGATION PROJECT": Where the Kabul River debouches from a deep gorge, just north of the Khyber, to flow across the plain to join the Indus, a multi-purpose development project has been virtually completed in the past five years.

The permanent works include a dam, 650 ft long with a maximum height of 270 ft, below which is a stilling basin; a power-house designed to accommodate six 55,000 hp units; a 700-ft power tunnel, 39 ft in diameter, to feed the six 18-ft diameter penstock tunnels; and a 3½-mile irrigation tunnel of 10 ft diameter.

For dewatering the site, four rock-fill cofferdams were built, and a diversion tunnel, 1,700 ft long and 35 ft in diameter, was driven in the north bank. For construction purposes, a bridge 370 ft long was built to carry 70-ton loads, and two cableways were installed for placing concrete.

This project was financed jointly by Canada and Pakistan, an important feature of the agreement being the training of many Pakistanis in modern construction methods.

This is a most interesting paper, and the discussion of labour problems, as regards both Canadian personnel and the local tribesmen who formed the bulk of the labour force, will be found diverting by those with personal experience of the NW Frontier.

"Soil problems in mining on the Precambrian Shield": Although it deals primarily with exceptional soil conditions, this paper is a convincing illustration of the value of elementary soil mechanics techniques. It gives two startling examples of serious failures due to the sudden liquefaction of soil which had appeared to be reasonably solid, and describes two projects whose success was attributable to careful but relatively simple soil study. The authors approach the subject in an eminently practical way, and their paper is both interesting and constructive.

Apart from shaft sinking, there is some useful information about road construction, open excavations, and building foundations, and the main features are clearly summarized in an excellent table.

"Structural behaviour of highway bridge decks": The design of bridge floors is usually based on empirical rules, since the theoretical analysis of contiguous elastic structures must be based upon assumptions, and the degree of composite action between deck and stringers is often uncertain. After a comprehensive and interesting theoretical discussion, the authors describe in some detail the practical tests carried out on three different bridges, two in the field, and one, after dismantling and reconstruction, in the laboratory.

The floor of each of the first two comprised a 6-in concrete slab supported on I-beam stringers at 3 ft 3-in centres; for the laboratory test the original 6-in RC slab was replaced by 6-in laminated timber decking. From the test results it is evident that bridge floors of the slab and stringer type are considerably stronger than conventional calculations indicate, and the conclusions tabulated at the end of the paper include valuable practical information. R.P.A.D.L.