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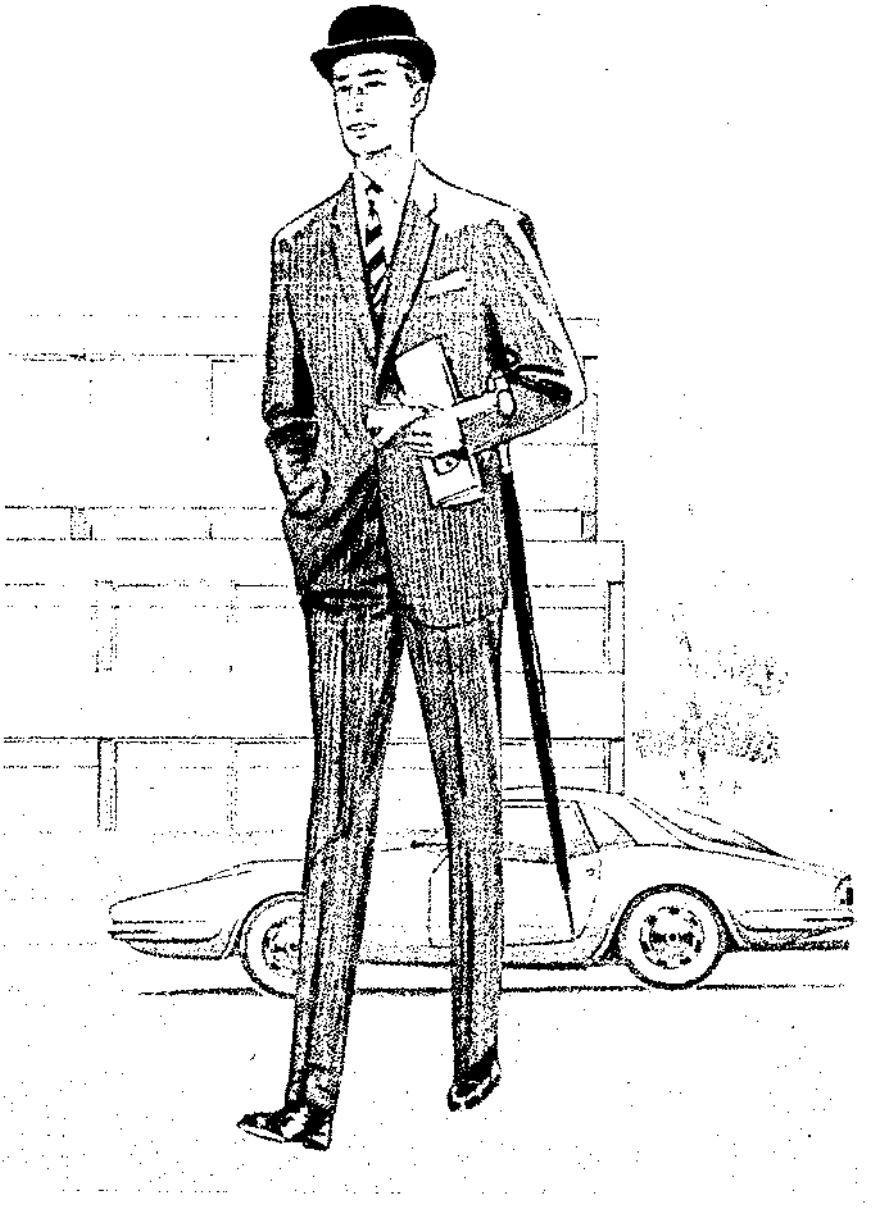
1870 . . . The well dressed man about town.



1970 . . . and the present day by Moss Bros of Covent Garden, of course.

Editorial

THIS is a Centenary issue marking the hundredth anniversary of the publication in August 1870 of the first *Royal Engineer Journal*.

On such an historic occasion an inquisitive reader might well ask:

(*a*) Why was a *Journal* published in the first place?

(*b*) If this is a Centenary issue, why should it be shown on the cover as Volume LXXIV and not Volume C?

(*c*) Why does not the year of publication of the first *Journal*, namely 1870, coincide with the date of the establishment of the Institution of Royal Engineers, shown in the *RE List* as 1875?

(*d*) When did the title of the *Royal Engineer Journal* change to the *Royal Engineers Journal*?

(*e*) After a hundred years, where does the *Royal Engineers Journal*, and indeed the Institution, go from here in the next similar span of time?

BACKGROUND HISTORY

Throughout what Fortescue calisth e Wars of the French Revolution, which began in 1793, to the conclusion of the Wars of the French Empire, culminating in Napoleon's final defeat at Waterloo on 18 June 1815, practically all civil engineering activities remained at a standstill. Furthermore, remarkable as it may seem, there was practically no advance in the art of military engineering even though armies grew enormously in size and fighting spread throughout Europe from the Atlantic to Moscow and, further afield, to North America, the West Indies, Argentine, Egypt, South Africa, India, Ceylon and the East Indies.

The years that immediately followed Waterloo witnessed a sudden renaissance in the field of pure and applied sciences and in engineering throughout Europe, and a rapid opening up of British Colonial Territories overseas. Sapper officers at home were not slow to follow closely the scientific and technological advances and to study how they could be put to military use. Simultaneously those serving in the far-flung Colonial Territories often found themselves the only professional surveyors and engineers in the land and personally responsible for their development.

A vast bank of knowledge and experience was thus built up in the Corps.

CORPS PROFESSIONAL PAPERS

As a result of this it was decided in 1837 to publish "Papers on subjects connected with the duties of the Corps of Royal Engineers in order that scientific and professional knowledge could be made more generally known to RE officers serving in different parts of the world". Lieutenant (later Lieut-General Sir William) Denison was the first Editor of the *Papers*. The subscription necessary to defray the cost of publication was "Ten shillings annually" and it is believed that all RE officers subscribed. Officers of the East India Company Engineers were asked to contribute articles to the *Papers* and become subscribers. And they did both of these things.

An Annual General Meeting, presided over by Lieut-General Sir Frederick Mulcaster, KCH, the Inspector-General of Fortifications, was held at the Royal Engineer Office in the Depot of the Royal Sappers and Miners at Woolwich in 1838 on "the First of February at Twelve o'clock when a statement of Receipts and Expenditure was placed before the Subscribers". AGMs have been held continuously from that day forward albeit at different venues, dates and times and with more embracing Agenda.

The choice of Denison as the Editor of the *Professional Papers* was a happy one. His stated aim was: "to collect, methodize and arrange the large mass of professional information (at that time) disseminated among individuals of the Corps, and to

combine it with that derived from other sources, thus enabling every officer to avail himself, not only of the experiences of his fellows, but also in some measure of that of all whose occupations and duties were similar to his own". This was a more comprehensive aim than the original one laid down, and Denison managed over many years to fill the *Papers* with excellent contributions from serving and retired engineer officers and also erudite articles written by learned gentlemen whose professions and activities were allied to the duties of the Corps.

The *Papers* maintained their original high standard and rapidly attracted wide interest. Their circulation soon increased outside the officers of the Royal Engineers and the East India Company Engineers and copies were purchased by almost every Military Library in Europe and America and by civilian professional bodies.

LIAISON WITH CIVILIAN PROFESSIONAL BODIES

The long period of peace that followed Waterloo saw also the birth of several civilian professional bodies whose aim was to spread their ever increasing specialized knowledge among their members. The links between these professional bodies and the Corps were very close and have remained so ever since.

The Institution of Civil Engineers, the oldest of the British professional Institutions, was founded in 1813. Among its earliest Honorary Members there were several famous Royal Engineers, and the Institution's highest award, the Telford Medal, has been awarded to Sapper officers on many occasions. In 1860 Charles Manby, the Hon Secretary of the Institution, was instrumental in the formation of the Engineer and Railway Staff Corps, RE an historic unit that exists today in the T&AVR.

The Institution of Mechanical Engineers was founded in 1847, and the Corps has provided two of its Presidents.

Somewhat later, the Institution of Electrical Engineers, a direct descendent of the Society of Telegraph Engineers, was formed in 1871. Three Royal Engineer officers were among its Foundation Members and the Corps has provided no less than five Presidents of the Institution.

The establishment of these Institutions germinated within the Corps a desire to set up within itself a professional body of its own "for promoting the acquisition of historical and scientific knowledge in relation to engineering as applied to military purposes", and in 1870 an RE Institute Committee was formed under the Chairmanship of the IGF—Major-General (later General) Sir Frederick Chapman, KCB.

THE ORIGINAL *RE Journal* OF AUGUST 1870

The first *Royal Engineer Journal* was published under the auspices of the RE Institute Committee. In his article "A Hundred Years Ago" *Nata Kacha* has described and reviewed this original *Journal*. It was complementary to the *Corps Papers*, which continued to be published as the main professional publication of the Corps, and was a combination of today's three separate publications namely the *RE List*, a directory to let readers know "where their brethren were quartered in all parts of the world"; the *Supplement*, giving Corps domestic news, and the *RE Journal*, limited in those days to subjects of interest primarily to officers of the Corps.

Captain R. Home, RE, was the first Editor, but the following year Major V. G. Clayton, RE, undertook the editorship and carried it on for the next five years in addition to his other military duties. He was also responsible for the publication of the first *Yellow Book*—Corps Funds Report for Annual General Meetings.

The *Journal* was originally printed by a firm in Old Brompton. When this firm folded up printing was carried out in London. The separation of the Editor from printers so far away however produced many difficulties and, after a very short time, printing was entrusted to W. & J. Mackay, Ltd of Chatham in 1888. Mackays have remained the printers of all Institution publications, including Corps Histories, ever since—a remarkable record.

ESTABLISHMENT OF THE ROYAL ENGINEER INSTITUTE

In 1871 a Royal Commission on Military Education approved the provision at Chatham of a building which would combine suitable accommodation for an Institute with the provision of classrooms, etc., required for normal instructional purposes. The design of the building was prepared by Lieutenant (later Sir Montagu) Ommanney, RE. The estimated cost of the building, which included terra-cotta ornamentation made by Doulton the famous chinaware manufacturers to Ommanney's design, was £21,000. The foundation stone was laid on 28 May 1872 by Field-Marshal HRH The Duke of Cambridge, the Commander-in-Chief and Colonel-in-Chief of the Corps of Royal Engineers. The building was carried out under the direction of the CRE Chatham, Colonel J. W. Lovell, and completed on 31 December 1873 at a cost, as was customary in those days, just within the estimate by a matter of a shilling or two.

On completion of the building the Committee drew up a final report on how a well founded Institute should function and be organized. The report was approved in its entirety by the Commander-in-Chief and the Secretary of State for War. A précis of the report was accepted at the next Annual General Meeting of the Corps and, with this acceptance, the Royal Engineer Institute was born on 22 May 1875. The exact hour of birth has not been recorded.

The Duke of Cambridge graciously consented to become the first Patron of the newly formed Institute. Nine *ex-officio* Members of the Committee (later termed Council) were nominated and fifteen Members were elected among whom were five captains and five subalterns. They obviously believed in letting junior officers have their say. A lieutenant RE had been selected as the first Editor of the *Professional Papers*, a captain as the first Editor of the *RE Journal*, another lieutenant as the architect of the Institute Building and now, out of a total of fifteen elected Members of Council, no less than ten were below the rank of Field Officer. It must, however, in retrospect be remembered that captains were then much older than they are now, and grey-haired subalterns were not unknown in those days.

Captain R. H. Vetch became full-time Secretary in July 1876 and also Editor of both the *Professional Papers* and the *Journal*. He was also responsible for the publication of the *Yellow Book* and many other Corps domestic duties.

FURTHER DEVELOPMENTS OF INSTITUTION PUBLICATIONS

The subsequent life story of the *Royal Engineer Journal* is somewhat involved:

(*a*) In January 1873 the directory, or roll of officers showing their place of duty, was printed separately from the *Journal* and was called the *Supplement to the RE Journal*.

(*b*) In 1881, some purist in modern English usage persuaded an AGM of the Corps that an "s" should be added to the name Engineer for all Corps Associations, etc. The *Journal* thus became the *Royal Engineers* (without an apostrophe) *Journal* and the Institute the Royal Engineers Institute.

(*c*) In 1905 the contents of the *Journal* were altered to include only articles on historical and professional matters, Memoirs of deceased officers, correspondence, book reviews and technical notes. *The Supplement to the RE Journal* was renamed the *RE List* and a new publication, containing extracts from Corps Memoranda, Gazettes and Army Orders and Regimental and social news, was produced which took over the title *Supplement to the RE Journal*. The *Journal* and the *List* were published quarterly and the new *Supplement* monthly. The *List* is now published half-yearly.

In all these changes the consecutive numbering of yearly volumes of the *Journal* was not maintained, and hence the present apparent discrepancy between Volumes LXXIV and C.

The subscription to the *Professional Papers* was merged into the subscription to the Institute and it became the practice to use the *Journal* more and more as the main medium for the dissemination of professional matters although occasional *Professional Papers* on particular subjects have been produced until quite recently.

Papers written for presentation and discussion at Joint Meetings with the leading civilian Engineering Institutions are now published in the *Journal*, and the host Institution is sent reprints of such papers.

The *Journal* today has a circulation of about 4,500. Copies are distributed to the 3,500 Members of the Institution. The balance is sent to the major professional Institutions in this country and to certain Universities, to the various Staff Colleges, the Royal Military College of Science, most of the Arms Schools, Sandhurst and Mons, and overseas to the Staff Colleges, certain Arms Schools and the Military Engineering Colleges of the Commonwealth, the United States and other NATO countries, the Republic of Ireland, Spain, Portugal and some South American countries. It has a circulation even more ubiquitous than that achieved by Denison's *Professional Papers*, and we must strive to maintain the high standards set by our predecessors bearing in mind the *Journal's* wide reading public.

A nickname—*The Pickaxe*—has often loosely been applied to certain Institution publications. To some it referred to the *Journal*, to others the *Supplement*, and to a minority the *List*. According to a ruling, published some time ago, the *Pickaxe* is the accredited nickname of the *Journal* as we know it today, so we ought to stick to that.

DEVELOPMENT OF THE RE INSTITUTE

There is insufficient space in this Editorial to describe how the present Institution came to be responsible for:

(*a*) The operation of the Corps Library of over 23,000 books, etc., of the "best authority on any of the multifarious duties which RE officers are liable to be called upon to perform", biographies, historical works and books on travel.

(*b*) The operation of the RE Museum which, in visual form, depicts the development of military engineering and of the Corps of Royal Engineers and its outstanding achievements in peace and war.

(*c*) The maintenance of certain Corps memorials.

(*d*) The custody and management of several Trust Funds for the provision of certain prizes and the award of educational grants to the children of officers and soldiers of the Corps who have been killed or died whilst serving.

In company with several other professional bodies, the RE Institute changed its name to the Institution of Royal Engineers in 1922. The word Institute was considered to smack of the Work House—yet another victory for a more precise usage of the English language.

In 1923 the Institution was granted a Royal Charter since it had, according to the preamble to the Charter among other things "during its existence for a period of forty-seven years steadily devoted itself to the promotion of the efficiency of Our Service dealing with problems in relation to the defence of Our Realm and Our Dominions beyond the Seas and thus materially assisted the highest interests of the State". The objects of the Institution were laid down as: "the dissemination of information of a professional character among its Members; the general advancement of Military Science, and more particularly for promoting the acquisition of historical and scientific knowledge such as is of paramount importance to the military engineer; for the custody of certain corporate property of the Corps of Engineers including the RE Museum, the Corps Library and Corps Memorials, and for the administration of funds, etc., in connection therewith; and generally for fostering and furthering all such objects as have a bearing upon the professional activities of the Corps".

A Royal Charter is a singular honour only sparingly bestowed and, since receiving

it, the Institution has always been most conscious of what it entails and striven to carry out to the best of its ability the objects set out therein.

On granting the Royal Charter HM King George V graciously consented to be Patron of the Institution, and subsequent Monarchs have, in their turn, graced the Institution with their patronage.

ACQUISITION OF HISTORICAL KNOWLEDGE

It is as well not to pass by this important aspect of the Institution's objects. Historical articles are from time to time published in the *Journal* and the Memoirs of many deceased officers are in themselves documents of great historical interest. In addition, however, the Institution has published nine volumes of the *History of the Corps of Royal Engineers* covering the period from Norman times to 1945, an *Early History of the Ordnance Survey*, a *History of Submarine Mining*, the *Works of the Royal Engineers in the European War 1914–18*, covering Bridging, Military Mining, Geological Work on the Western Front, the RE Signal Service, Water Supply, including water supply in Egypt and Palestine, Work under the Director of Works France, Engineer Organization and Intelligence and Training, Camouflage, Searchlights, Stores and Base Workshops. The Institution has also published two volumes of the *Military Engineer in India*, the *History of the Indian Sapper and Miners* and the *Royal Engineers in Egypt and the Sudan*, besides such lighter works as the two editions of the *Portraits and Plate of the RE HQ Mess*, the *History of Corps Cricket 1862–1924*, etc.

The Institution is known world wide as the source of all information on the past activities of the Corps wherever Royal Engineers have served. Constant requests for information are received from military historians, writers of fiction, the BBC and ITV, Motion Picture Companies, young men and women writing theses and school boys and girls, interested in the Army, and from the Friends of Somewhereville anxious to have full details and plans of a fort built to defend their town in the dim distant past by Royal Engineers. Thanks to the mass of information stored up in the Corps Library, it is only very seldom that a pretty full answer cannot be given to all these enquiries.

A REVERIE

Suppose a mythical inhabitant of today's Pasley House and his wife were able to call upon equally mythical inhabitants of the same house of a hundred years ago for a Victorian soirée, what unbelievable things they would have had to recount.

The talk may well at first have centred on the environs of Pasley House itself. The Crimean Arch, to commemorate the few handful of names of those Royal Engineers and Royal Sappers and Miners who gave their lives in the War of 1854–56, would have been known to those present at the soirée. They would, however, have been surprised to know that a second similar Memorial Arch would be unveiled by HRH Edward Prince of Wales, by that time King, on 26 July 1905 to commemorate the names of some 420 officers and soldiers of the Corps killed in a war in South Africa (1899–1902). More unbelievable still would be the story that the YO Horatio Kitchener, whom many would have known personally, would become an Earl, a Field-Marshal and Secretary of State for War and that at his bidding over three million men had volunteered to join the Colours at the hour of their country's need and been fashioned into New Armies that bore Kitchener's name, that he was lost at sea on board HMS *Hampshire* on 5 June 1916, and that an Obelisk was erected in 1922 between the two Arches as a memorial to him and to more than 18,500 "glorious dead" of the Corps who fell in a Great World War which lasted from 4 August 1914 to 11 November 1918. More poignant still would have been the news that the same obelisk was used to commemorate a further 11,000 Royal Engineers killed in a Second World War lasting from 1939 to 1945. They would have been interested to hear about the building erected to house the Royal Engineer Institute on a site, close to Pasley House, on which at that time stood some

derelict huts, remnants of the Crimean War. The story that Colonel Charlie Gordon, who had so distinguished himself in China, would be murdered while Governor-General of the Sudan at Khartoum on 26 January 1885 would have caused general sadness, but they would have been glad to know that a fitting memorial to him had been erected by the officers of the Corps in 1890 in front of the Institute building.

Pride and satisfaction would have been expressed on the conferring of the Royal title upon the School of Military Engineering on 2 July 1962 as a 150th Birthday present, and they would have been delighted to learn that a future Queen, in her capacity as Colonel-in-Chief Royal Engineers, had graciously visited Chatham on 28 March 1968 to see for herself how the famous School, the Headquarters Mess and the Barracks had been modernized.

No doubt considerable incredulity would have been expressed at the development of the means of waging war and the contributions made by the Corps in this respect in land, air and a diabolical form of chemical warfare. The credibility gap would have widened when they learned of the amazing development in military communications, first developed by the Corps, which would enable an instant order to be sent directly from a Ministry of Defence in London to an individual soldier on some distant battlefield. The development of RE skills, tools and equipments to carry out traditional Sapper tasks under ever-changing circumstances might, nevertheless, have been more easily understood.

It would surely have been difficult to explain the full destructive power of nuclear weapons, whose test firing in remote parts of the world had demanded considerable Sapper backing, and how, the mere threat of their use, had preserved an uneasy peace from 1945 to 1970.

Possibly harder still would have been an explanation of how an Empire, on which the sun never sets, was by 1970 to become a Commonwealth of self-governing countries, several of them Republics.

To many it would have been the final stumbling block, and to others sheer folly, a statement by the mythological visitor that he, his wife and their family had watched on a screen in Pasley House itself a man step on to the surface of the moon from a spacecraft and had heard what this extraterrestial traveller had to say on doing so, and that millions of other persons all over the world had seen the same historic event on their own screens and heard the astronaut speak. "Enough is enough" they might have thought.

Possibly, however, even more mundane things would have seemed no less unbelievable: for instance, the disappearance of the scarlet jacket and the introduction of a scruffy garment in its place known as combat dress. No longer would officers' ladies go to church, at homes and balls in their carriages, but in horseless vehicles under whose bonnets was an engine of many horse-power. How sad it was that the horse was gradually to disappear from the pageantry of the military scene and with it the mounted sapper, the driver, the riding master, the equitation officer, the rough rider, the farrier, the saddler, the wheeler and the feed major. The removal of the horse from the field of battle was, however, a mercy. Some 375,000 Empire horses fell in the Great War 1914–18; most obediently and often most painfully they died.

Hair styles and fashions were to change also, so they were told. Who would have thought that it would be almost impossible to distinguish, from hair style alone, a young man from a young woman in 1970? Possibly, in deference to the susceptibilities of the Victorian ladies present at the soirée, no reference was made to the mini-skirt of the late sixties.

However, all present must have been delighted to hear about the Engineer-in-Chief's address to the 1970 Annual General Meeting of the Corps, to realize that the Royal Engineers were in such splendid fettle, that they were so well trained and equipped, that they were still carrying out worthwhile and rewarding projects in many parts of the Commonwealth and that the highest traditions of the Corps were being maintained. Surely they would have had no doubts in their minds that this would be so.

A LOOK AHEAD

In his article "An Editorial of 2020" Brigadier Crosthwaite has criticized this Centenary issue of the *Journal* for not looking forward, and he has given his views on what the situation might be fifty years from now.

What would a 2070 Editor of the *Military Engineer Journal* have to tell us if he were to give an Institution-sponsored lecture in the Chattenden Study Centre next week? How many present would be unbelievers, and how many, including the RE Combat Development Staff, would take his words with a huge helping of salt even if he divided his talk on the next century into 20-year periods of time?

Would all present be as dumbfounded at his lecture as those who attended the 1870 Soirée in Pasley House were before them?

Perhaps for mortal man it is not a good thing to brood too deeply upon the past, nor to peer over anxiously and long into an unknown future. "Give us this day our daily bread" we ask: "Pray for us now and at the hour of our death". The present moment is the most important point of time. It will never come again and history, and life itself, is made up of a series of "nows". Let us be philosophic therefore and see what we can do this day to ensure a successful future for the centenarian *Journal* and the Institution.

Obviously, as an Institution, we must maintain close links with the civilian professional bodies in every way possible and, in accordance with our Royal Charter, remain enlightened custodians of the Corps Library, Museum and Memorials and the Trust Funds for whose administration we are responsible. Also we must not forget our responsibilities as custodians of Corps History.

The *Journal*, however, is the main medium for ensuring the dissemination of professional knowledge. Let us, therefore, remember those of the early nineteenth century and their erudite contributions to *Corps Papers*, the tap roots of both the *Journal* and the Institution. Even in these busy times, with the Corps running red hot, let there be sent equally worthy contributions to today's *Journal*. Surely at this moment there must be in the Corps a vast bank of scientific and professional knowledge of paramount important to the Military Engineer, ripe for dissemination among the Members of our Institution. Also young officers especially on whom, as in the past, the future well being of the Corps depends please voice your opinions through the Correspondence section of the *Journal* on how you think the Institution could be really meaningful in these days of rapid change, and how you yourself can play an active part as RE subalterns and captains did before you.

* * * * *

1970 Annual General Meeting Address by the Engineer-in-Chief

AT the Annual General Meeting of the Corps, held on 24 June 1970, the Engineer-in-Chief Major-General R. L. Clutterbuck, OBE, gave a talk on the state of the Corps. Below is a summary:

INTRODUCTION

Chief Royal Engineer and Gentlemen: I think every political analyst and every politician agrees that the last General Election was won and lost by the Party faithful by the extent to which they turned out or didn't turn out. Unlike the audience at the E-in-C's Conference at Chatham, this is not a captive audience—you are the Party faithful; your attendance here is entirely voluntary. You are all extremely busy on other things and yet have made time to come this afternoon. I will talk about the problems which I think the Party faithful can help to solve, and I will try to provide material with which you can give that help. So my talk will be about problems and highlights, and not much about the more ordinary things in between. I shall finish by telling you the ways in which I think the Corps most needs your help, whether you are serving or retired.

I will first give you a fairly brief run-down of some of the highlights of BAOR, then some of the highlights in the Strategic Reserve and the TAVR and then talk about the problems which we have to overcome.

BAOR

In Germany the new organization has now been going for one and a half training seasons with a full Colonel CRE at Division and a Regiment with each Brigade. It is going like a bomb. The commonest comment of the Division and Brigade Commanders is that they can't imagine how it ever worked before. The Armoured Engineers are, I'm delighted to say, a rising star in Germany. We are splitting them so that the three Squadrons which are being formed out of the two existing Squadrons are going to be distributed one with each Division instead of all being concentrated at Hohne. Everyone is learning more about what the Armoured Engineers can do and how in particular a lot of the rather awkward little obstacles, like the River Leine, are better crossed by the Armoured Engineers than by any other equipment we have. The week before last when I was in Germany there was a superb demonstration by the Armoured Engineers of crossings over the Leine. The dress rehearsal was attended by the Corps Commander and two of the three Divisional Commanders attended the demonstration, so the message is getting across.

While much of the Army has been cutting we have been increasing. Last year we raised a new TAVR Regiment; this year we are raising a new Regular Regiment—28 Amphibious Regiment which is being formed in Hameln. We have some superb equipment—the M2, the MGB and coming along soon will be the AVLB and the Bar Minelayer. The NCOs and Sappers are obviously delighted with this equipment. The Corporal in his APC is one of the happiest men in Germany: he commands his own ship so to speak. I've never seen such enthusiasm there before as there is now.

At the same time the Sappers from Germany are going off for one or two months a year to do projects in places like Norway, Austria, Bavaria and so on—again very rewarding. Then there is a tremendous amount of deep sea sailing, which is now officially recognized, from the Advanced Watermanship Training Centre in Kiel, run, of course, by the Chief Engineer.

Nearly all of our regular units are in Brigades and Divisions and therefore the logistic end and RAF Support relies tremendously on the TAVR. Recruiting in the TAVR has been going very well in most Regiments and there have been some staggering achievements with those which have been reorganized. 75 Engineer Regiment

in Lancashire inside two years has risen from 300 to nearly 700. Even more exciting, a new Support Squadron was formed in Bradford and reached its full strength in five months flat. We've got tremendous quality and enthusiasm in the TAVR and it's going very well because they know that they are training for a real role in war.

STRATEGIC COMMAND

The biggest commitment of Strategic Command is, of course, Northern Ireland. Our first major involvement was the Peace Line in Belfast, and there have been big problems of accommodation for the infantry. This commitment will continue. We're also optimistic about MACC Development Projects. We hope that Northern Ireland may to some extent replace Scotland as the main scene of short term visits by Strategic Command units from England to do development work as Training Projects. We also hope that this will give more employment to young people from both communities in Northern Ireland. This will bring them together working on useful development projects as we did in various parts of Scotland. There are good hopes for exciting developments here.

In Scotland we are meanwhile continuing with the same pattern of work. We are building an airfield on the Isle of Skye, and have done a large number of other smaller projects. In Edinburgh we are much involved with various items of engineer work for the Commonwealth Games.

Overseas training continues, again, in our case, with a valuable by-product in the form of development work, which brings goodwill for Britain out of all proportion to the cost involved. The countries where we have worked and are working are shewn on the map at Figure 1. We did such projects in twenty-one countries last year—and this excludes Survey units which covered about twenty-five countries. I see no sign of these activities decreasing. They are immensely rewarding and there is no better ambassador than the Sapper, stripped to the waist, visibly working for the benefit of the local community in a developing country. Anguilla is a good example, and opens up the vision of a new kind of soldier for Internal Security duties—ready to take up his rifle to support the Police if needed, but in the meantime carrying on with constructive work. This makes the Sappers especially popular, and helps to prevent the need for Internal Security action ever arising.

RECRUITING

Recruiting, perhaps because of the exciting work I have been describing, is going well. In the first five months of this year our other rank recruiting was up 40 per cent on 1969 and 60 per cent on 1968—see Figure 2—but here I would like to sound a note of warning. Recruit selection is being centralized and this means that, if in the interests of the Army as a whole they want to, they can turn off the tap to us almost completely. I hope they won't do it too often, but it does mean that we must go flat out to recruit all the time so that we can withstand such stoppages when they occur, and we must maintain a high rate of re-engagement and reduce our wastage rate. Generally, however, our OR recruiting is excellent and we must go on working hard to keep it so.

OFFICERS

The most important call I want to make to you is about officers. Although we're not short, in fact we are over strength in officers at present, our demand is rising. We are forming the new Amphibious Regiment, and we have other increases in the wind, and so we do need more officers. In particular we need more short service officers. We are getting as many regulars from Sandhurst as we are entitled to but, of course, the people we're interested in are the top people. If too few of really good people come into the Army, and we have to make do with more of those who are not so good, we as a Corps are going to suffer. At this moment the Sappers are in a splendid state as far as senior officers are concerned. We've had four more Brigadiers selected for promotion to Major-General this year which is good by any count, and we still maintain

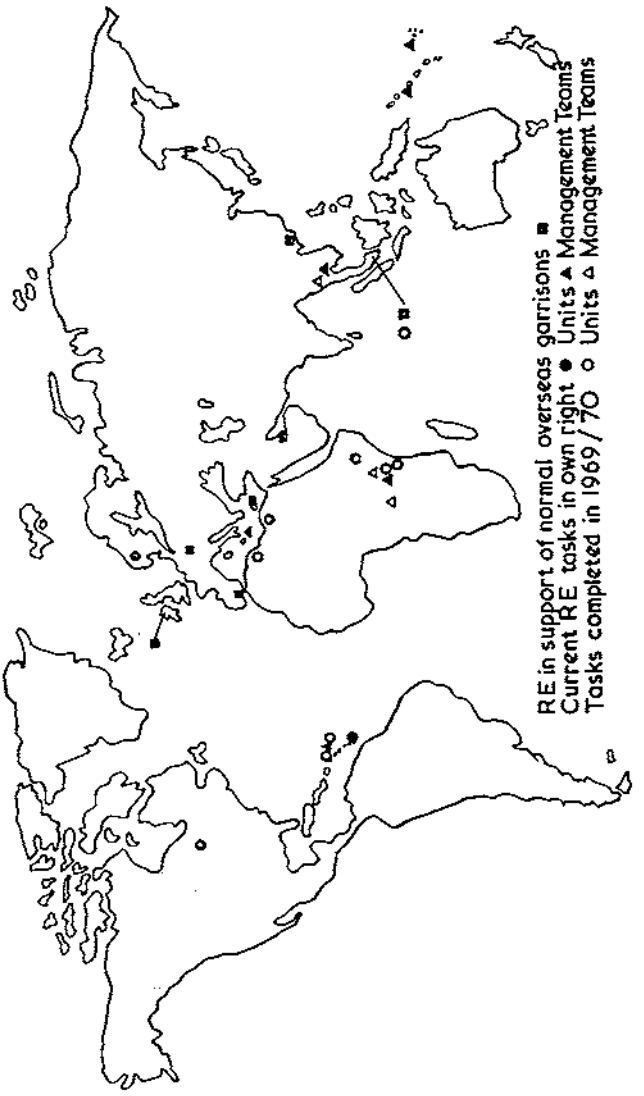


Fig 1.—Royal Engineers Overseas—June 1970
(Classified information excluded)

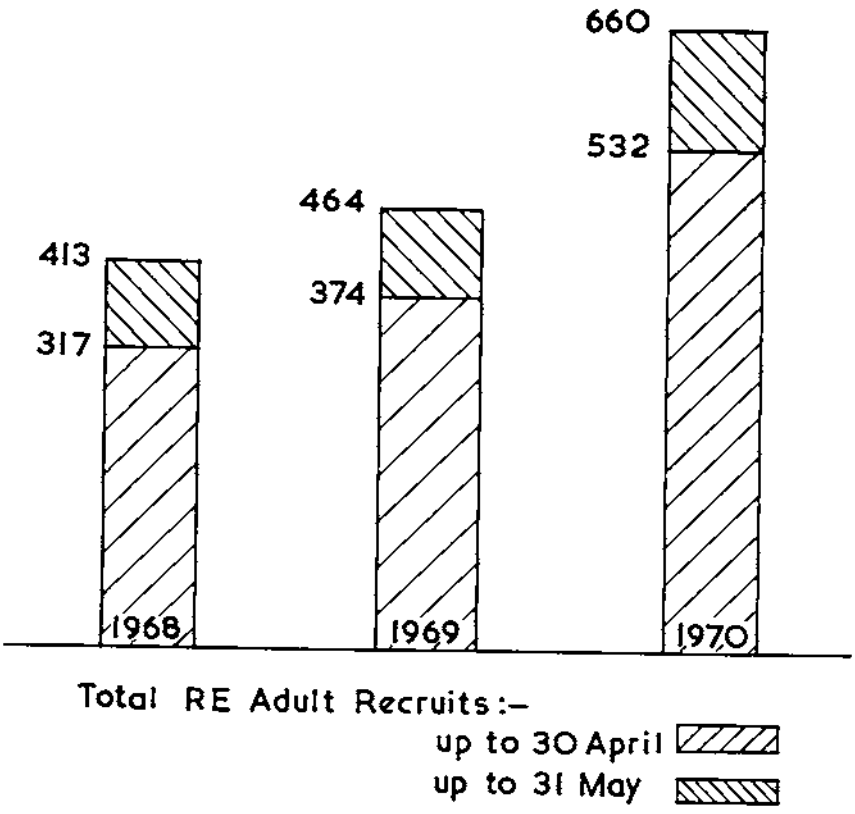


Fig 2.– RE Regular Soldier Recruiting

our record of having at least one Sapper on the Army Board. We have two Sappers commanding Infantry Brigades at the moment, and we have some of the best COs in the Army. What we must ensure is that the intake of 2nd Lieutenants continues to be of this standard. If we can get more short service officers to come in on three-year engagements we can accept smaller numbers of higher grade officers from Sandhurst and from Universities who come in on full regular commissions. This action will improve their career prospects because there will be fewer better people from whom to fill the higher ranks.

The way to get this larger number of short service officers is for us all to tell the tale around the schools and Universities about the kind of thing that the Corps is doing. We must correct the popular fallacy that we're just in England and Germany and nowhere else. We must publicize the challenge which is available for our young officers to face.

There is a great opportunity for us at the moment because the Universities are turning out more Engineers than there are decent jobs for them to fill in the Civil Engineering profession. The result is that they are being offered salaries of anything between £1,150 and £1,250, not very exciting salaries for a graduate Engineer, and they are tending to be employed in their first years as technicians, ie as draughtsmen and surveyors and not as graduate Engineers. The result of this is that fewer good people are trying to enter the Civil Engineering profession. Compare the prospects of

a chap going for £1,150 to £1,250 a year into the Civil Engineering profession to be employed as a technician, with what we offer him—the kind of jobs we offer him and the pay that we offer him. A 2nd Lieutenant on commissioning now gets £1,442, and he doesn't need to be a graduate. From April next year he will get a starting salary of £1,606. As a Lieutenant, he gets £1,669 now and when the pay rates go up in April 1971, £1,843—at twenty-three. This compares very favourably indeed with what the Civil Engineering industry offers. I want to encourage all serving and retired members of the Corps to try by any means in your power to bring these opportunities to the notice of young men and those who handle and advise young men, their parents and their school masters.

I would mention particularly the Short Service Industrial Career Scheme, in which a chap comes for three years into the Army with an arrangement to go to a civil firm when he leaves. What he gets out of this is the certainty of knowing that he will have an interesting three years and the knowledge that there should be a good job waiting for him when he leaves the Army. What the firm gets is probably a better deal still. Without committing themselves at all beyond having a vacancy, subject to confirmation six months before he leaves, they get a man who has been through the selection system of the Regular Commission Board (which is better than any selection system industry has) and through Mons OCS, which is a first class Management Course, better than any offered by industry. He then, instead of being employed as a draughtsman or surveyor or technician, will normally get command of fifty men—a direct responsibility which he doesn't get in industry. In his three-years service he will either serve in BAOR (and from BAOR he will go to other countries in Europe like Norway and Austria and so on) or he will serve in the Strategic Reserve. Every Unit in the Strategic Reserve goes overseas at least once a year on the kind of work which I have described, so he's got a pretty fair opportunity.

We have today better Sappers than we've ever had, better NCOs than we've ever had, better equipment and magnificent opportunities. We have a future in which these opportunities show no sign of decreasing—on the contrary. All we need now is to encourage enough of the right sort of young men to join as officers.

* * * * *

THE

Royal Engineer Journal.

VOLUME I.

1870-1.

For Circulation among the Officers of the Corps of Royal Engineers only.

BROMPTON:
PRINTED BY T. WOOLLEY, 26, HIGH STREET, BROMPTON.

A Hundred Years Ago

"Mata Kacha"

ON Monday the first of August, 1870, there appeared the first number of the *Royal Engineer Journal*, for private circulation only, price sixpence. Comprising 22 pages of letterpress, in a somewhat unusual Folio Foolscap format with a banner title-line in ornate Gothic capitals, this new periodical came to its captive readership from the press of Thomas Woolley of 26 High Street, Brompton, in the Parish of Gillingham, in the County of Kent.

The aims of the Journal were defined in the first Editorial as to provide "a Corps Directory and also a newspaper that will give information on Corps matters in general". It was not thought that this would in any way conflict with the *Corps Professional Papers* which, in various forms, had been appearing since 1837, and which were intended to reach a wider public. This Journal would "enable officers, widely separated one from the other, to know what their brethren are doing and where they are quartered"; it would contain few subjects of interest to any but the Corps for which it was intended.

At that date the Corps of Royal Engineers was nearing the end of an extended process of gradual growth and reorganization following the fusion on 17 October 1856 of the Corps with that of the Royal Sappers and Miners, making good the deficiencies revealed in the Crimea, learning from the experiences of a succession of small wars in Asia and Africa, and keeping pace with (and not infrequently leading) the accelerated scientific and technological revolution which marked the second half of the nineteenth century. The Indian Mutiny lay thirteen years buried in history; the Abyssinian War of 1867–8, largely a Sapper operation, would have been fresh in memory; and the formerly separate East India Company's Corps of Bengal, Madras and Bombay Engineers were in process of integration with the Royal Engineers, resulting in an almost threefold increase of its officer cadre.

The Directory included in this first number of the Journal shows the Corps organized in fifteen battalions, of which the seven contributed by the Indian Corps are still listed separately. The battalions were, as we know, largely an administrative contrivance to provide for the necessary establishment of senior officers. Of the forty-three troops and companies in the erstwhile British Service, fourteen were then stationed overseas (or "Foreign", as it was then termed), the remainder in the United Kingdom, including Ireland. Among the Foreign stations listed, the 7th Company in St Helena, the 3rd and 8th in Quebec, and the 23rd, with Headquarters in King William's Town and detachments in China and Japan, strike romantically nostalgic notes. At home an experiment, begun in May 1870, had led to the 22nd Company being employed in London under the Post Office on the Electric Telegraph.

The Colonel of the Corps of Royal Engineers at the time was HRH the Duke of Cambridge, his appointment dating from 1861, but the effective "Head" of the Corps was Major-General Sir Frederick Chapman, lately returned from the Governorship of Bermuda and now occupying the post of Inspector-General of Fortifications at the War Office. The familiar crop of ERE appointments includes the Director of Building at South Kensington, The Surveyor-General in Jamaica, a clutch of Mint-masters, an Inspector of Railways under the Board of Trade, the Director of Works at the Admiralty and the Superintendent of Works at Chatham Dockyard; the Chairman of Directors of a Convict Prison, Deputy Superintendent of South Kensington Museum and an Assistant Personal Secretary to the Secretary of State. Here also we find HM Commissioner on the Danube, HM Consul-General in Egypt, unspecified postings in Constantinople, Persia, Jerusalem and Belgium, and two of those inevitable teasers, "Special Duty" and "Specially Employed". The spellings of Rawul Pindee, Kurrachee, Umritsir and Nynee Tal are, perhaps, phonetically more correct than those familiar to later generations of Sappers serving in India.

Turning now to the articles, we begin with "A French View of the Corps of Royal Engineers", printed in the original French, and offering a test of education which, perhaps, fewer readers of today's *Journal* could easily assimilate. The writer finds our officers liked and respected by their men notwithstanding the abyss which separated them educationally and in their habits. Being called upon to serve in the vast and distant territories of the Empire, Sapper officers, he opines, gain knowledge and experience which develop both character and intelligence to exceptional degrees. Because of this dispersion, however, and of the nature of work involved, our training for war seems to him incomplete, and we tend to work slowly. Our Frenchman sees in a mercenary (as opposed to a conscript) Army the reason for the marked repugnance of our men for manual labour, and notes, in support of this theory, that civilian workmen had to be employed to undertake the camp installations at Balaclava.

A new era of explosive substances started, says the *Encyclopaedia Britannica*, soon after the discovery of the compounds collectively termed gun-cotton, or nitrocellulose, and nitro-glycerine in the middle of the nineteenth century. By 1870, gun-cotton was beginning to come into use and to replace powder in many Service applications; the Editors devote a page of text to a description of its manufacture which, it appears, was at that date exclusively in the hands of one firm, Messrs Prentice of Stowmarket. It is not clear whether this reference qualifies as the first commercial advertisement accepted by the *Journal*.

Field Fortification occupied at the time a good deal of Sapper thought, though it was not then seriously considered by the Army as a whole. An article here describes the so-called "Shelter Trench", defining its essential form and claiming that the adoption of such a system as that advocated must completely revolutionize the tactics of future warfare. With the prophetic eye of caution, however, the Sapper observes that, where offensive movements are contemplated, a form of cover should not be adopted which creates an obstacle to the Army's subsequent advance. It was not until the Great War of 1914–18 that these lessons were really proved and, when the Infantry learned, at last and at their cost, to secure their lives by their own efforts, what problems did they not create for the Sappers who were eventually faced with getting the Artillery and administrative support forward across the obstacles presented by their excavations!

In the summer of 1870 Europe lay on the threshold of the Franco-Prussian War; indeed, German mobilization had actually begun by the date of publication of this first *Journal*. In anticipation, perhaps, of the events to follow, the remaining two articles dealt respectively with the organization of the French engineer arm and with the topography of the Basin of the Middle Rhine. The former is a very workaday assembly of facts and figures (the compensation payable by the French Government for a horse killed in battle was £18) occupying all but two pages; the latter a column in the best twentieth-century travel guide style and hardly, one might think, a subject of interest to none but the Corps for which the *Journal* was intended. We are not vouchsafed the names of any of the four English language contributors.

There follow familiar accounts of sporting events. Under the quaint heading "Aquatics" we learn that the Sappers decisively defeated the Gunners in the second of a series of eight-oar matches rowed on the Thames between Putney and Chiswick. Sir John Burgoyne (then in his eighty-eighth year) was, "to the delight of all" present on board the Umpire's Boat. The RE boat cost £76 6*s* in 1868 and the expense of building a boat-shed at Upnor had been £7 5*s* 5*d*, the whole event being financed by contributions from officers. At football, 13 Corps matches played in the season ended 30 March 1870 resulted in eight wins, four draws and one game lost to the Wanderers. The cricket season held little of interest, if we exclude the somewhat unusual affair of 7 May 1870, when thirteen Officers played twenty-two NCOs and Sappers and beat them comfortably by an innings.

The *Journal* concludes with a Register of Births, Marriages and Deaths. The balance of boys and girls proves equal, the births of five of each sex being recorded. Of twelve marriages, six were celebrated at home and six overseas, while six of the

brides were from Service families and six of civilian provenance. The list of Deaths contains the following reference to a melancholy event:

> Died at Sea, in the Royal Mail Steamship City of Boston, on returning home from Halifax, Nova Scotia, after five years' foreign service, Henry Horace Baker, Lieut RE, aged 28, third and dearly loved son of Mr and Mrs Henry Baker, of 108, Gower Street, London; also his Wife, Rebecca (Becky), daughter of James Taylor, Esq, of Summer Hill, Mayfield, Sussex; together with their children, Frederick Horace, aged 5, and Florence Hamilton, aged 3; and their faithful Nurse, Isabella Oliver.

Subalterns evidently married quite young even a hundred years ago.

To bring to its conclusion this review of the first issue of the *Royal Engineer Journal* it may be fitting to quote a passage from its editorial column:

> ". . . the peculiar difficulties the military engineer has to encounter and overcome, difficulties too often neither appreciated nor understood, tend to draw the bands which unite him to his brethren even closer, and thus it is that in all Armies of the World a peculiarly strong Esprit de Corps is found among the Engineers . . .
>
> Strongly embued with the advisability of strengthening these feelings and adding one more link between officers of the Corps, the Committee . . . have undertaken their work. A Work the labour of which will be amply repaid should it have the effect of uniting officers of the Corps more closely together."

Our thanks and respect are due to those pioneers and to their successors who have continued the labour through a century.

* * * * *

The Evolution of Equipment for the Royal Engineers 1870–1970

BRIGADIER B. G. RAWLINS, MA, FIPlantE

INTRODUCTION

THE traditional combat role of the Royal Engineers of increasing and maintaining the mobility of our own ground forces and impeding that of the enemy, combined with construction engineering, has not changed radically during the last hundred years as the following quotation from the recommendations of a Committee, set up in 1870, to review the organization and role of the Corps will show:

"A To take the field with the Army for:
  a Bridging rivers.
  b Demolishing and restoring bridges, roads, etc.
  c Rendering positions defensible.
  d Siege operations.
  e Water supply, piers, etc.
B Work in fortresses. Construction and maintenance of fortifications.
C Administration of the expenditure on War Department works, buildings and lands.
D Telegraphic communications of an Army in the field.
E Defence of ports by submarine mines.
F Construction and working of railways in war.
G Use of military balloons."

However, within this very wide range of responsibilities the Corps has pioneered a number of activities, which were later passed on either to a new branch of the Service or another part of the Armed Services. To mention a few—balloons and aircraft, tanks, trench mortars, sound ranging instruments, flame and gas projectors, transportation equipment and signalling stores.

In order to keep the scope of this article within reasonably well defined limits it has been necessary to restrict it to equipments which have been developed and used in the Corps' continuing roles and not to cover any equipments which were developed to meet the requirements of the branch which later assumed primary responsibility for the equipment. And, owing to their specialist nature, Survey (covered in another article in this *Journal*) and Bomb Disposal equipments have not been included.

The development of military engineering equipments has been covered in a number of excellent articles in the *RE Journal*, of which the following can be considered as being complementary to this more general review.

Date	*Subject*	*Author*
September 1934	Military Bridging Equipment	Brevet-Colonel A. P. Sayer
December 1944	The Conception of the Bailey Bridge	Lieut-Colonel S. A. Stewart
March 1946	Twenty Years in the Development of Military Road Bridging (1925–45)	Colonel S. A. Stewart
September 1961	The Development of Engineer Equipment for the Army	Brigadier H. A. T. Jarrett-Kerr
December 1965	Military Requirement and Employment of Engineering Equipment	Colonel T. H. Egan and Lieut-Colonel E. M. Mackay
December 1968	Electrical Power for the Army in the Field	Brigadier R. A. Lindsell and Dr W. R. S. Davidson

This article is divided into three sections:

Section I—Field Engineering and Construction Equipment
Section II—Military Bridging Equipment
Section III—Mines and Demolition Stores and Equipment

GENERAL

There is insufficient space in this article to discuss detailed technical aspects of design, or to give more than a fairly general description of the many equipments mentioned. Rather it is intended to give a broad indication of the major changes which have taken place over the years. The time scales used in the various tables, charts and composite photographs are not uniform. The reason for this is that some types of equipments only appeared in the later half, or third, of the hundred year period: for example, engineering construction plant and anti-tank mines; whereas other equipments, like bridging, have evolved over the whole period.

SECTION I

FIELD ENGINEERING EQUIPMENT

Basic Engineer and Construction Equipment

Despite the wide range of tasks required of the basic tactical unit—the Field Company—in 1870, the tools to do the job were remarkably few by type albeit in larger numbers than we find today. Manpower, elbow grease and skill with the hands were obviously the main element of any task, so the equipment tables in essence comprised entrenching and cutting tools, miscellaneous items and some explosive. The means of carriage was either on the man or pack animal (see Photo 1) but by 1887 the RE Tool Cart (see Photo 2) had been introduced into service and the range of stores had been increased.

Today, by the introduction into about one-third of the units of the Corps of the armoured personnel carrier (APC), the mobility and load carrying capacity of the RE Field Squadron has been increased many times. The APC is for the Corps the Section Tool Cart of the seventies, and in it a Section can live and from it work for days at a time (see Photo 3).

Mechanical Equipment and Water Supply

The Corps had early on ventured into the realms of increasing mobility and work capacity. This took the form of the "Steam Sapper" (see Photo 4), introduced into the Corps in the late 1860s, and to which many tasks were set and for which others were devised.

The "Instruction in Field Engineering Part V", published in 1878, lists the following tasks which could be carried out with the Steam Sapper's various attachments:

A saw bench for timber
A grindstone
A blowing fan for smiths' forges
A lathe for iron or woodwork
A general joiner for field work
A drilling machine
A band-saw machine
A lathe for turning

With the passing years new equipments and uses were added and the Steam Sapper was used for towing ordnance and water trailers and balloons, and, with a special attachment, as a crane and also for running generators to produce electricity.

In due course of time the tasks performed by the Steam Sapper were taken over by new equipments and in particular the air compressor and its associated tools (see Photo 5). These in turn have been replaced by the 400 Hz Generator and electric power tools (see Photo 6), and in those units equipped with APCs the power source is a component part of the vehicle itself. Thus, although the tasks performed are still much the same, over the years the equipment has become many times smaller and lighter and the work output from each tool has been increased considerably.

Water trailers were mentioned above and, when the Steam Sapper pulled them, they were of timber construction rather like a large barrel on wooden staved wheels. The capacity was about 150 gallons and this has apparently been much the standard size for a company-sized unit for a long time. In 1936 the barrel had given way to a steel tank (see Photo 7), but the wheels still had wooden staves and the capacity was now 200 gallons. Today the standard trailer looks much the same (see Photo 8). For the future the specialist water truck, or trailer, will give way to water carriage packs of 150 or 250 gallon capacity, but they will be carried in standard GS vehicles and trailers (see Photo 9).

With our overseas commitments in the past water has often been a most treasured commodity, and in many overseas campaigns of the nineteenth century drilling was frequently necessary to find it. The means were then primitive and many men were needed for the task (see Photo 10 taken in 1868). Today the Specialist Team (Well Boring) is a small and efficient unit which has once again proved its worth in many parts of the world. Now a few men can in a short time produce thousands of gallons of water using compact air portable equipment (see Photo 11).

Diving

The traditional roles of the Corps, and many of our specialist duties, have inevitably brought us into contact with deep water. In many of the tasks of the Corps it has been necessary to work under water and so military diving has always been a Royal Engineer responsibility. In 1870 the Sapper diver looked much as he did until the early 1950s (see Photo 12) when the lighter more compact rubber suit and compressed-air diving equipment began to appear (see Photo 13). Today the Corps still provides the Army's military diver but he is more efficient, better equipped and better able to perform those tasks required to be done under water.

Field Defences

On land another traditional Sapper task was that of "rendering positions defensible". Then, as now, this more often than not meant that a few Sappers designed and supervised the work of other arms in the construction of defensive works. As war has evolved so the requirement for large static bastions has passed and today a battle trench is nothing more than a hole dug by two men in an hour or so. Before long a machine will do the job in about one minute. Not so in the nineteenth century— then a fire trench was a formidable task and for 1,000 yards the following working parties were required:

"For Tracing" (ie setting out)	—2 Officers RE, 2 NCOs RE, 10 Sappers.
"For Throwing Up, by Common Trench Work"	—2 Officers RE, 2 NCOs RE, and 20 Sappers, 20 NCOs and 500 Privates, plus second and third reliefs.

In 1908 the "High Command Redoubt" was the design to use (see Photo 14) and, though not exactly similar in concept as the present command post (see Photo 15), the unit as a whole fought from within the redoubt and it was an essential part of the overall "defensible" plan.

Earth Moving Equipment

Period 1870–1939. Mechanical earth moving equipment, now usually referred to under the term "Construction Plant" was not organic to the Corps over this period. The first recorded use of an earth moving machine, probably under contract from Ruston-Hornsby, was a steam powered face shovel, used on railway construction at Longmoor. Previous to this all earth moving and levelling was a task for human labour gangs, occasionally assisted by animals.

Progress in the commercial world on all aspects of earth moving equipment went ahead although nothing eventful was recorded in the Corps until 1935 the year of The Quetta Earthquake. This occasion was probably the first in which the Corps used earth moving equipment on a large scale.

Period 1939–70. In 1939, under American influence and backing, this type of equipment was issued to Field Force units on a small scale. Some Field Companies were issued with two tractors D4 and D7, made by Caterpillar, and in some cases D8s. The Field Park Companies were issued with support equipments including a towed scraper and towed grader. Later, Mechanical Equipment units, liberally equipped with earth moving equipments, were raised for road and airfield construction.

Since the advent of World War II the Corps has never been without earth moving equipment, and experience in operating techniques, gained from theatres scattered over the world, has influenced both our choice of machines and our methods of teaching. Today the Corps has probably the best training facilities in the country using some of the most modern types of machines and teaching the most up-to-date doctrines on earth moving and construction.

Progress in the design of equipments from 1939 onwards can be seen in the photographs of typical items of plant which the Corps used in the early part of the period and the plant now in use (see Photos 16 to 23).

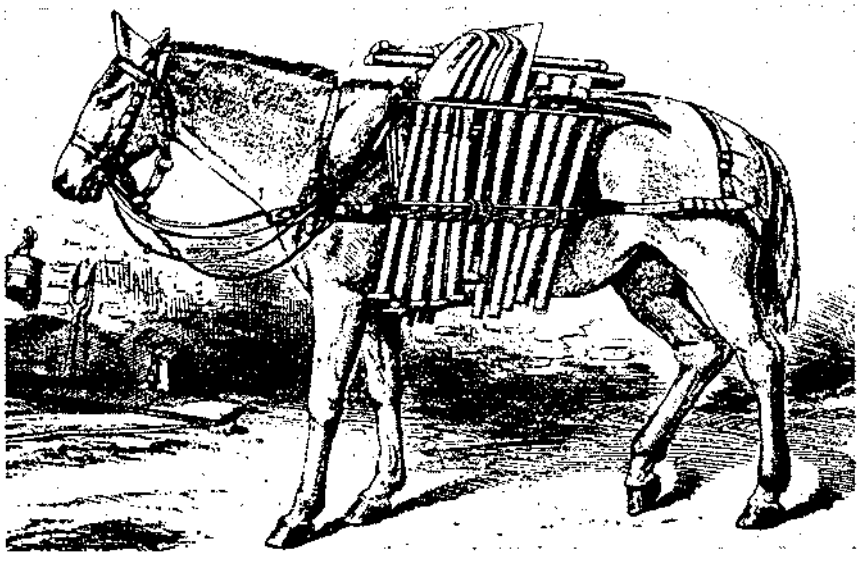
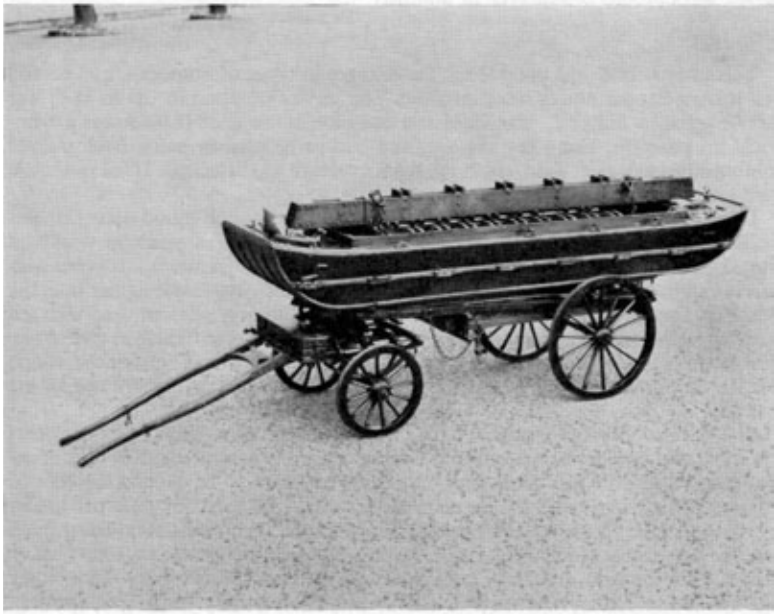


Photo 1. RE Train—Pack Saddle Equipment and Tools (*circa* 1870)

Blanshard Pontoon



Blood Pontoon

The Evolution of Equipment for the RE

Photo 2. RE Tool Cart (Introduced 1887 and in service until 1937)

Photo 3. Section APC—AFV 432 (Introduced 1965)

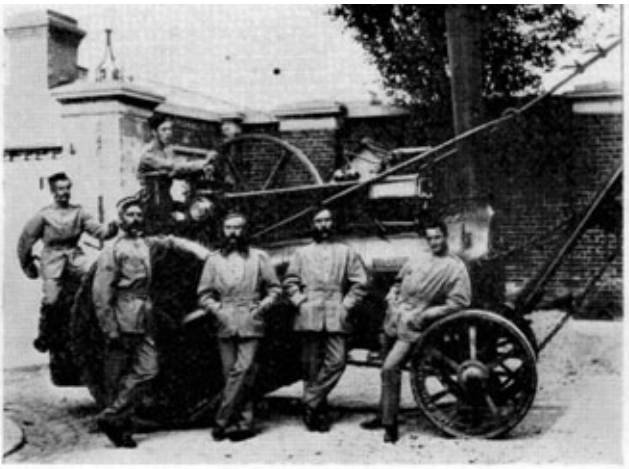


Photo 4. "Steam Sapper" (with crew which took it to ASHANTI 1873)

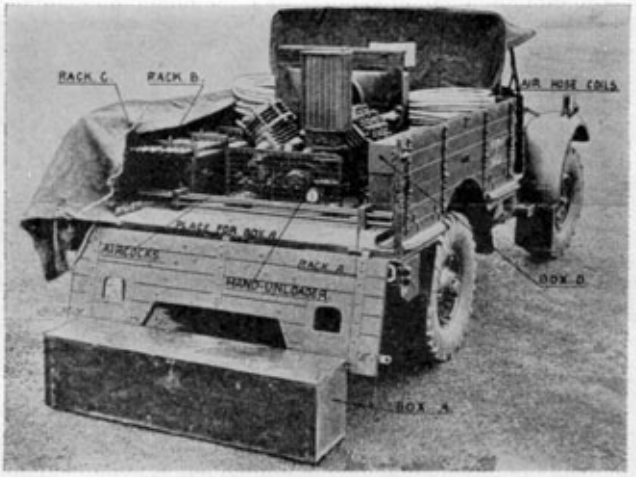


Photo 5. Compressor, truck mounted with associated tools (late 1920's to post 2nd World War)

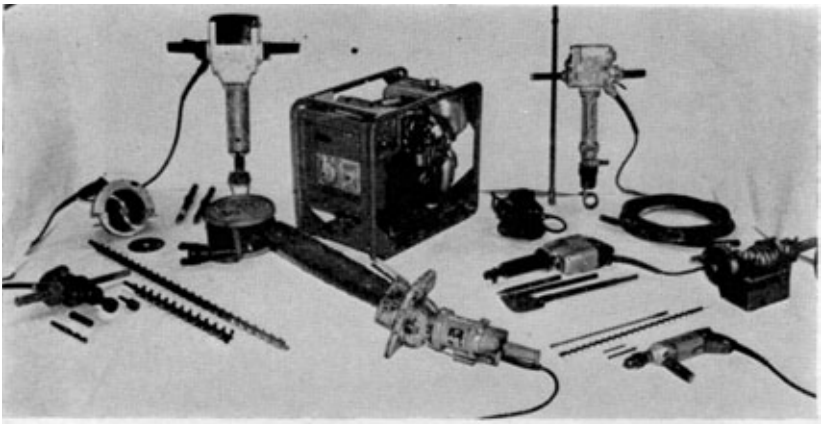


Photo 6. 400 Hz generator and associated tools (In service 1970)

Photo 7. Cart, Water Tank Mark VII (1936)

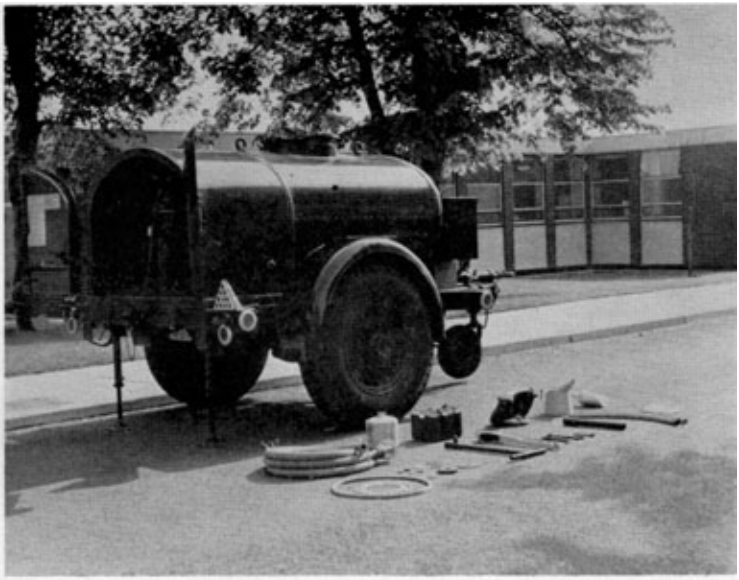


Photo 8. 200 gallon Water Trailer (in use *circa* 1940 to 1970)

Photo 9. Water Carriage Packs (1970)

The Evolution of Equipment for the RE 8 & 9

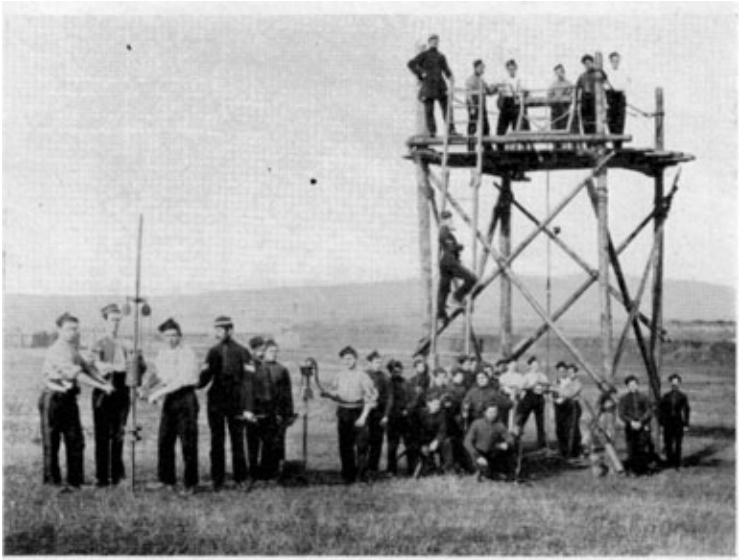


Photo 10. Well boring crew and equipment (1868)

Photo 11. Well boring rig (1970)

The Evolution of Equipment for the RE 10 &11

Photo 12. Diving Team, R MEDWAY (1868) (India rubber suit, leather boots lead-soled and air pump, winch operated)

Photo 13. Diving Team SOLENT (1963) (Joint Service, one piece dry suit with HEINKE self-contained compressed-air breathing apparatus)

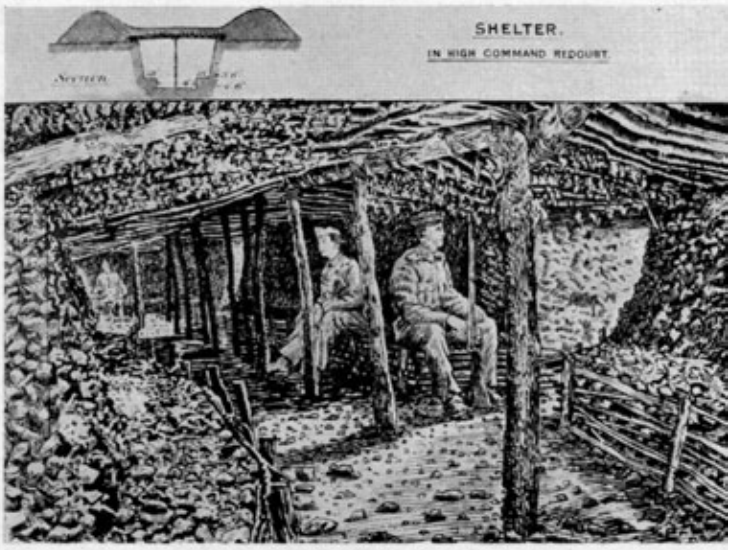


Photo 14. Shelter designed for construction from local resources (1908 to 1920)

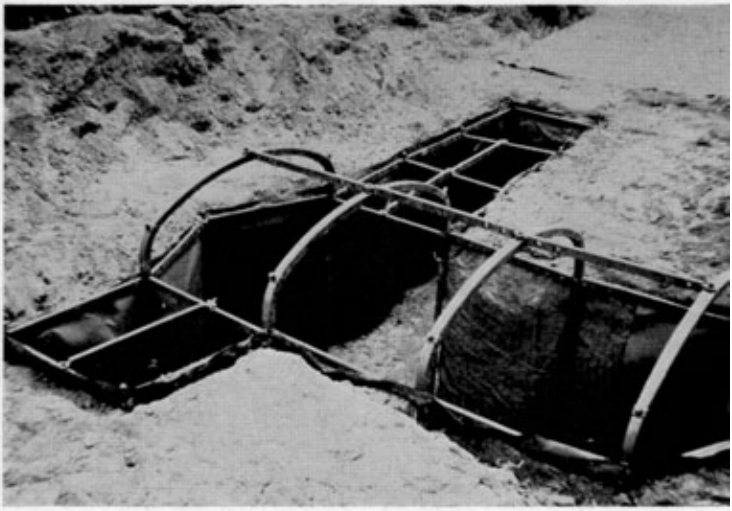


Photo 15. MEXE Lightweight Shelter Kit for Command and Regimental Aid Posts–Illustrated before overhead protection is added (1969)

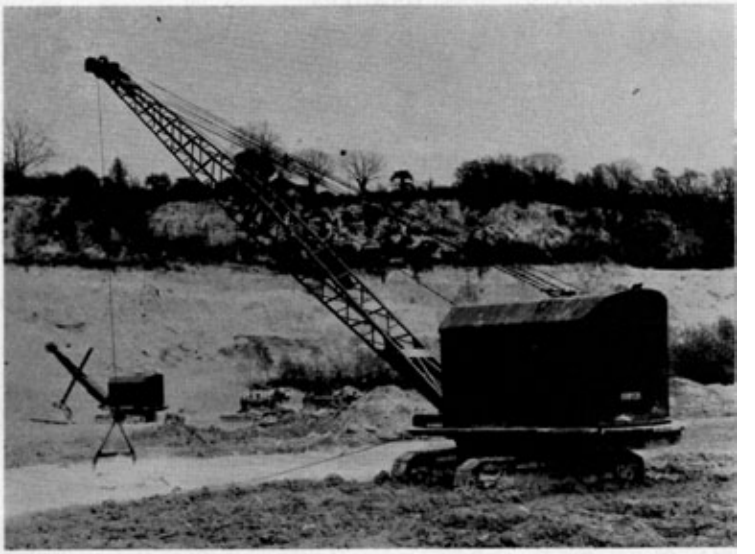


Photo 16. Ruston Bucyrus 19RB, cable operated, bucket capacity ¾ cu yd, approx weight 41,000 lb (1939)

Photo 17. Hy-mac 580 BT, hydraulically operated bucket capacity ¾ cu yd, approx weight 24,000 lb (1969)

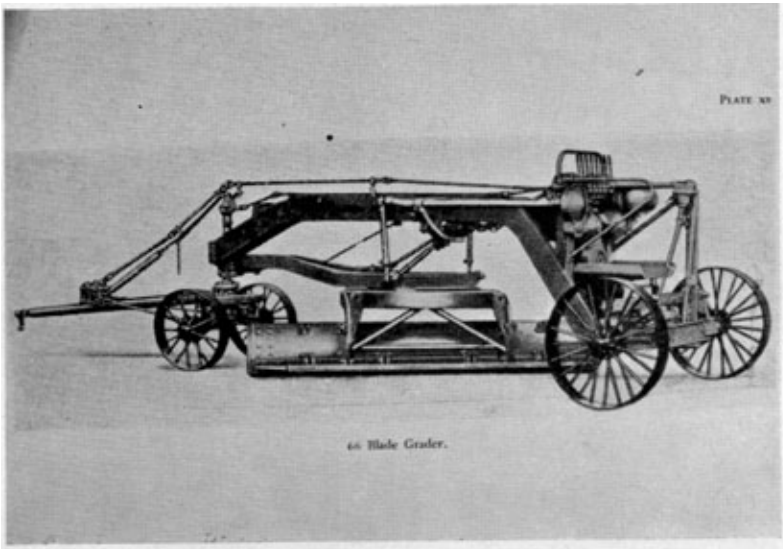


Photo 18. Caterpillar No 66 tractor towed, gear operated by power from 8 hp engine, weight 12,175 lb

Photo 19. Aveling Barford Super MGH, self operated, six-wheel drive, front and rear wheel steer, weight 35,000 lb

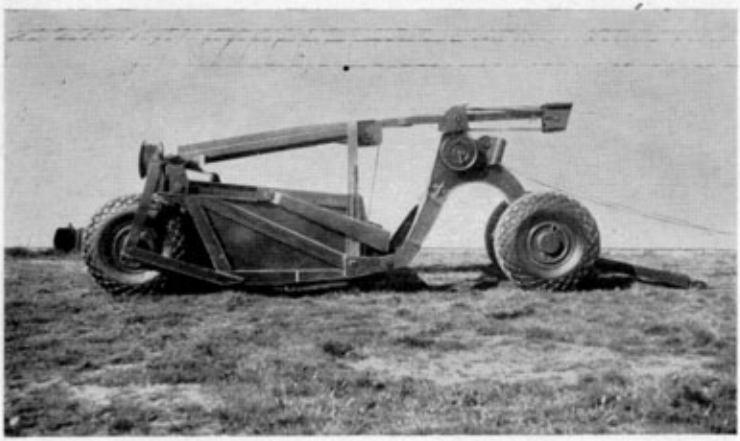


Photo 20. Onions 8 cu yd tractor towed, cable operated max capacity 9 cu yd, cutting width 8 ft 6 in, approx weight 16,000 lb (1941)

Photo 21. Caterpillar 621, self propelled hydraulically operated, capacity 20 cu yd, cutting width 9 ft 11 in, weight 51,800 lb (1969)

TRACTORS FULL TRACKED LIGHT

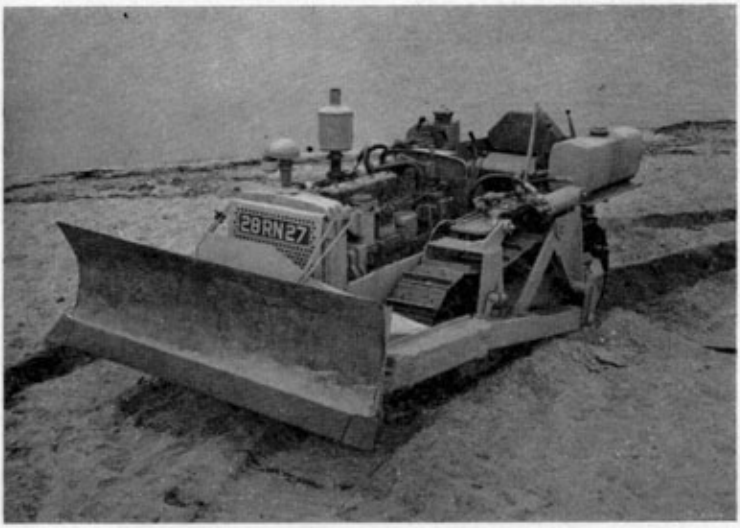


Photo 22. Caterpillar D4, engine caterpillar four-cylinder diesel 35 drawbar hp, started by 10 hp petrol engine, weight approx 15,000 lb (1940)

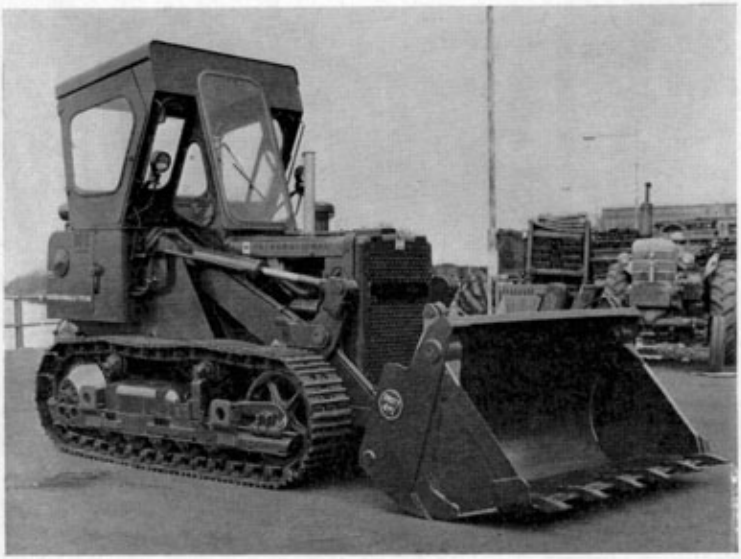


Photo 23. International Harvester 100, engine international four-cylinder diesel, approx 50 bhp, electric starting, weight 15,800 lb (1970) Hydraulic operated 4 in 1 bucket, capacity 1 yd, other attachments scarifier or winch

SECTION II

Military Equipment Bridging

General

Equipment bridging during the last hundred years has been influenced by two major factors; firstly the introduction of Mechanical Transport in place of the horse, with the subsequent large increases in axle loads of common vehicles, and secondly the technological advances in materials, especially since the Second World War.

The load maxima in use in 1870 continued almost up to 1900 and represented the purely horse transport era. The advent of mechanical transport increased the axle loads from: just over 2 ton in 1873, to nearly 4 ton in 1911 and to almost 6 ton in 1933.

With loads of 4 ton and over improvized bridging, using local timber with rough joints, was no longer feasible. Steel was not so readily available and did not lend itself to rapid field joints. Hence a case for more equipment bridges built up and since 1911 equipments, recognizable today, began to appear.

Technological advances were most notable during the last years of the Second World War with the demand for welded structures, and since that time material research has helped to provide lighter and more easily handled bridges. For convenience our one hundred years will be divided into four parts:

1870–1911	Pre-Mechanical Transport
1911–1939	World War I to World War II
1939–1945	World War II
1945–1970	Post World War II

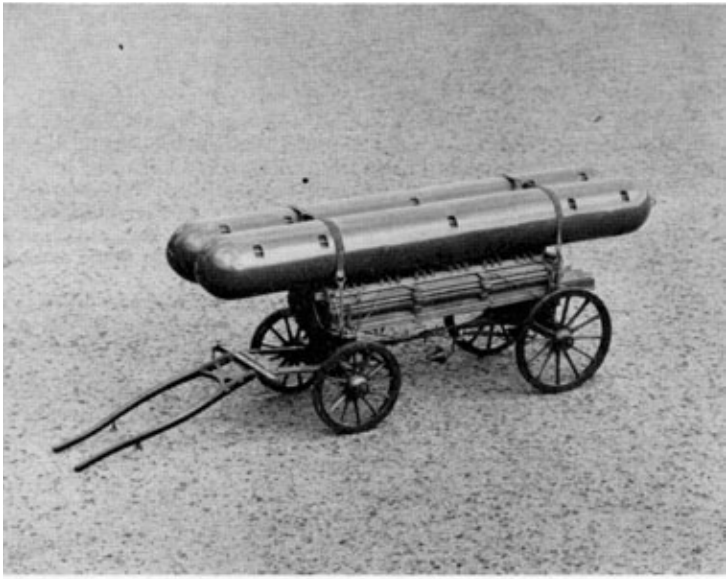
Throughout this paper two types of bridges will be considered, the dry gap bridge, which is usually of single span, and the wet gap bridge which is a roadway supported by pontoons of one type or another.

1870–1911

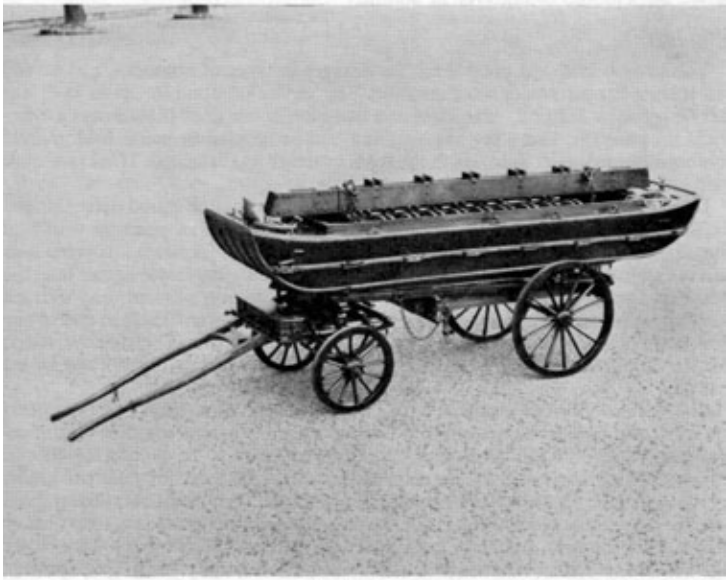
This early period was notable for the changes in types of pontoons, and several well known Sapper names were involved. The service pontoon in use in 1870 was that designed by Major T. Blanshard and had been in use since 1836. It was a cylindrical tin pontoon, like a big sausage, and had to be used in pairs. Each pair of pontoons formed a raft onto which the superstructure was attached. These pontoons were easily damaged and were heavy and bulky.

During 1870, a new pontoon designed by Lieutenant Bindon Blood (later General Sir Bindon Blood, Chief Royal Engineer) was adopted. This pontoon was boat shaped with covered ends and was constructed of a wooden framework covered with canvas and India rubber solution and coated with marine glue. It was lighter than the Blanshard type and was easier to repair. The Blood pontoon was first used with the roadway resting on the gunwhales. The bridge however was then unable to give to any movement of the water and very quickly a central saddle was introduced which enabled each boat to rock from side to side without affecting the stiffness of the roadway.

In 1889 various improvements were introduced and, as a result of experiments and trials, the pontoons were cut into two parts each of which could be used independently, each part was fitted with clips enabling them to be clipped together as required. This meant that the same pontoons could be used for different loads; light bridges used the bow and stern as individual pontoons; medium bridges, which were the most usual requirement, used the bow and stern connected together; heavy bridges used the bow and stern connected together but the pontoons were closer together. We see here one of the main characteristics of military bridging equipment; that is flexibility in its use.



Blanshard Pontoon



Blood Pontoon

The Evolution of Equipment for the RE Section

Although it was intended that the greater part of any bridge should be formed of pontoons, provision had to be made for bridging shallow water such as often occurred at each end of a floating bridge. For this purpose various forms of trestle were tried consisting of a cross transom supported on two legs. The transom had to be fitted so that it could move up and down on the legs to allow for variations in the depth of water.

The service pontoon equipment, consisting of pontoons, trestles and superstructure, was transported on special wagons each of which carried one or two bays of superstructure and either a pontoon or two trestles.

Care was required in the design and construction of roadways to ensure that there was adequate transfer of load to the pontoons. The superstructure was in fact timber with some metal fittings and this general form continued up to 1900, when some of the baulks were redesigned giving a considerable weight saving without loss of strength.

This then was the military equipment bridging of the time, and although the Field Engineering Bridging Manuals of 1901 and 1914 contained many sections on the use of pontoon and trestle equipments, the remainder of the text dealt with improvised timber bridges.

1911–1939

During World War I there was, except in Mesopotamia, only a limited demand for equipment bridging and this was mostly restricted to the provision of standard Rolled Steel Joists of various lengths arranged in various ways to give different load classes. The tank increased loads beyond all previous ideas and it continued, from its conception to almost the present day, to be the *bête noire* of bridge designers as its weight increased by leaps and bounds. By 1917 there was a requirement for additional equipment bridges and two more or less semi-permanent bridges were designed.

Inglis Bridge

This bridge, designed by Major C. E. Inglis, RE (later Professor Inglis of Cambridge University) appeared in 1918. It was formed of two girders built up of steel tubes connected together by means of junction boxes rigidly connected to transoms and stiffeners. The bridge was primarily designed as a tank bridge for spans up to 105 feet but for spans across water of greater than 105 feet, the girders could be combined with pontoons to give a floating bridge. This form of Inglis Bridge could also be used to produce a ferry.

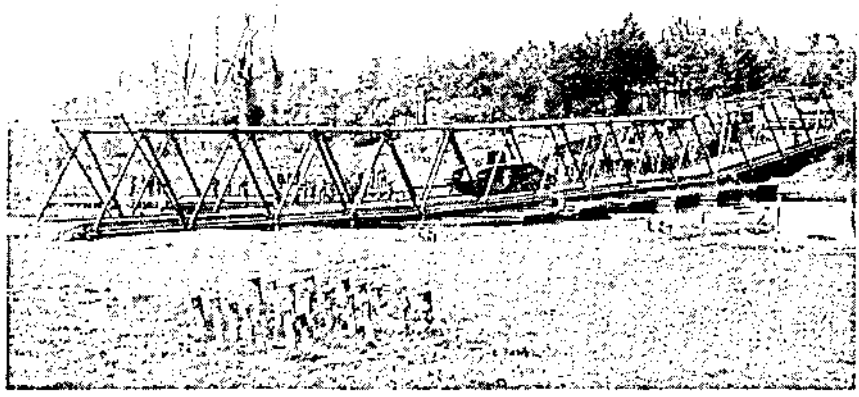
By 1921 there were two variations of the Inglis Bridge:

Mk I which had 12 ft bays and could carry 16 ton axle load (approximately modern Class 40) over 96 ft gap. The greatest disadvantage of this was that there were two lengths of tube and they were not interchangeable.

Mk II—this form had 15 ft bays and all the tubes were interchangeable. The bridge could support 35 ton tanks singly over 105 ft (this again is approximately Class 40).

Hopkins Bridge

This bridge was made from standard steel sections bolted together throughout to produce 2 Warren girders of 15 feet bays, these girders being arranged to provide a through bridge. The roadway was slung on suspension channels or plates to the bottom boom of the bridge. This bridge was relatively portable as the heaviest piece was only 10½ cwt. However, the construction timings quoted were 4,000 man hours for 120 ft span. One could hardly call this an assault bridge!



Inglis Bridge on Pontoons

Stock Spans

Little need be said of these except to mention the construction effort and timings for a bridge using rolled steel joists:

60 feet Warren girder	10 Officers	6 NCOs	80 men	24 hrs
30 feet		2 NCOs	20 men	8 hrs
21 feet 6 inches		2 NCOs	20 men	7 hrs

As already mentioned the load class of these was varied by the addition of extra joists and by changing the spacing between joists.

By 1934, the Corps had evolved four basic equipment bridges which were mobile and relatively quick to construct. They were:

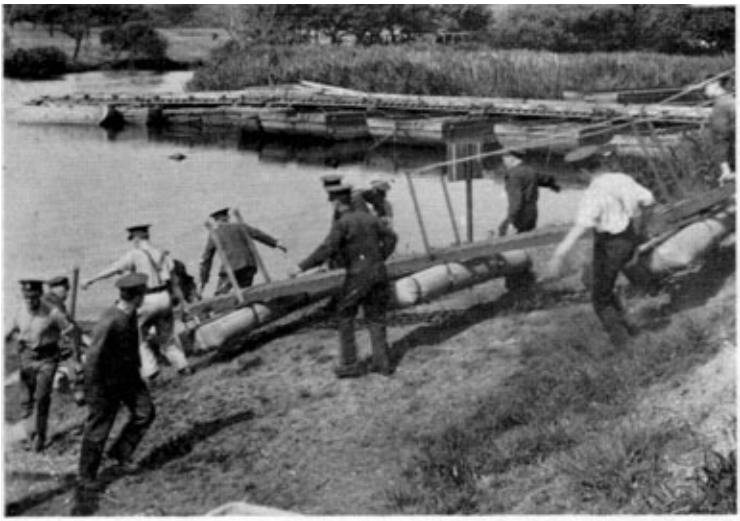
Kapok Assault Bridge

This provided a simple floating foot bridge for infantry in single file. It was a fighting bridge for use in the face of the enemy and everything was sacrificed for ease and speed of handling and landing. There were two main parts—the float and the deck section. Each part could be carried by one man and the complete bridge was carried and launched without previous access to the far bank. Each bay was 6 feet long and the length of the bridge could be varied by that amount. The float was a canvas bolster stuffed with kapok and retained its bouyancy for some time. At the time it was more or less immune to small arms fire.

Folding Boat Equipment (FBE)

This equipment was originally adopted in 1928 for loads of up to 5 ton; later developments to give limited articulation and changes of superstructure changed the capacity to 9 ton, and in 1939 the final version was adopted as the Army's Class 9 Floating Bridge.

It was a simple floating bridge the pontoons of which were folding boats. To the boats was attached a superstructure of fabricated steel bearers 19 feet 9 inches long and between these bearers deck panels were laid consisting of timber planks in a steel frame.



Kapok Assault Bridge being launched

Folding Boat Bridge

Bearers were connected by bay connectors which allowed a certain amount of articulation before the joint became rigid. A trestle set was provided with this equipment which could be used in up to 9 feet 3 inches depth of water.

A typical time for the construction of a Class 9 bridge, 380 feet long, was 2 troops, 4 hours by day or 6 hours by night.

It was also possible, using this equipment, to provide two ferries known as the Tracked Raft and the Decked Raft; so once again we see the use of a flexible equipment.

It is of interest that this equipment formed the only air portable bridging equipment until the introduction of the Air Portable Bridge (see later).

Pontoon and Trestle Equipment

This was probably the most important of all the equipment of the time. The pontoons which had continued to develop were made of a wooden framework covered with Consuta plywood. The stern of each had couplings to join two together to form a single pier.

For medium loads these piers were joined together with seven special steel joists which carried the decking. For heavy bridges floating piers were doubled and the roadway was carried by eleven joists.

The same equipment was readily adapted to produce a Close Support Raft. Trestles were provided for the entry and exit and they were still of the same basic form as in 1870! (At this time construction of a Class 20 bridge was considered a major task and would take two or three days to complete).

Small Box Girder (SBG) Bridge

The main members in this equipment, designed by Major (later Lieut-General) Sir Giffard Martel, RE, were made up of rectangular section girders 16 ft long by 1 ft 6 in wide and 3 ft 3 in deep. These girders could be linked by "dogs" to give spans of 32, 48 and 64 ft, the class varying with the span and number of girders. When the girders were in position they were decked down with timber planks and steel ramps were fitted at each end.

This equipment was designed to carry the Vickers Medium Tank and would rate at about Class 20 (the tank actually weighed 12 ton). The advent of the Matilda Tank, which started at 23 ton but later crept up to 26 ton before production, necessitated redesign of the bridge to raise its capacity.

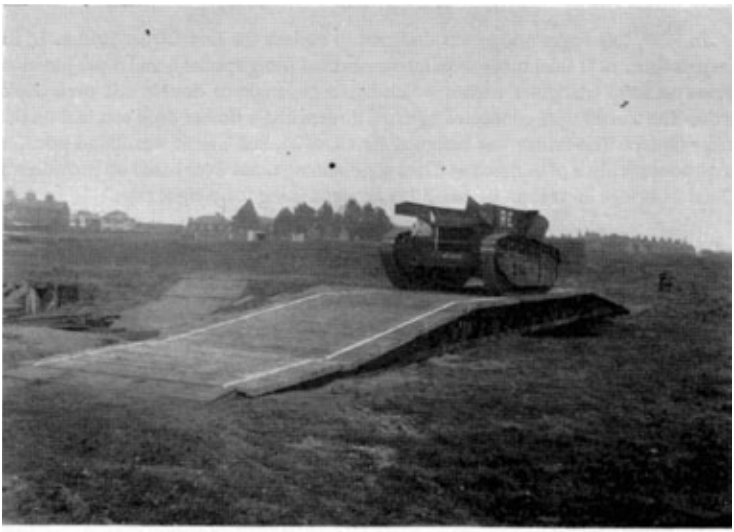
This was the first example of a girder bridge which was pinned together, rather than bolted, and as such can claim to be the forerunner of most modern bridging equipments.

Large Box Girder Bridge

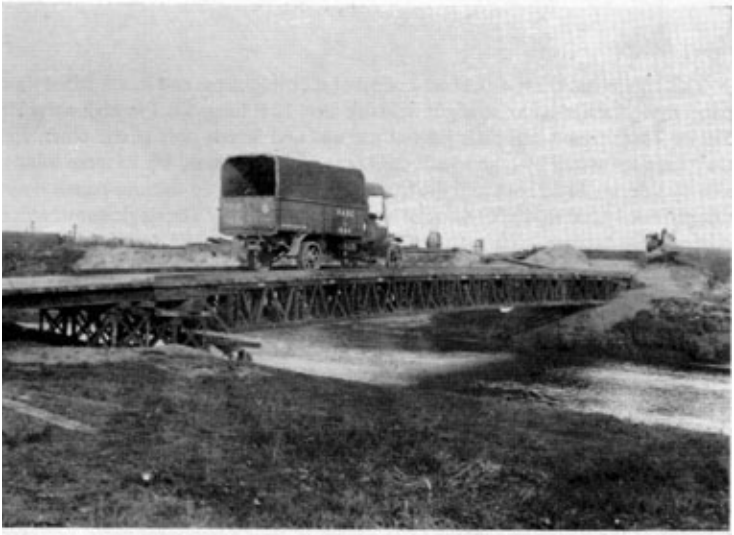
This form of bridge was of the semi-permanent type. The idea was a self stable girder broken up into short lengths for easy handling and transport. The sections were joined by pins. Assembly was thus comparatively rapid and the length could be varied to suit the gap. The roadway rested directly on the girder so that the number of girders could be varied for varying loads. Each section of the girder was 8 ft long 4 ft deep and 2½ ft wide.

Hamilton Unit Construction Bridge

This bridge was designed by Mr A. M. Hamilton, an engineer in the Iraq Public Works Department. Produced in 1937, it provided a bridge of about Class 30 for span of 120 ft but, despite ease in manufacture, construction was very laborious and a 120 ft bridge was regarded as a week's work! The bridge did, however, have one new and interesting feature—it was possible to erect girders as single or double truss according to the strength required and this characteristic was used in several later bridge designs.



Small Box Girder Bridge



Large Box Girder Bridge

Inglis Bridge Mk II

In 1939, this Inglis bridge was designed to replace the Box Girder Bridge. In its revised form 12 ft steel tubes were interconnected using special 4 and 6 pin junction boxes to form triangular trusses which could be single or double and even triple truss. The trusses were connected by cross girders and a timber deck was laid on the cross girders. The bridge was designed for Class 24, but later it was found possible to produce bridges of as much as Class 40. Planning times were based on providing a Class 24 bridge 60 ft span in 4 to 5 hrs at night using forty-eight men.

1939–1945

At the outbreak of the Second World War therefore there were in existence some apparently adequate bridging equipments. However, the increasing weight of the tank seemed destined to make the equipments obsolete almost before they were mass produced.

As already mentioned, the 26 ton Matilda Tank caused the Small Box Girder to be obsolete. By 1940 the Churchill tank of 40 tons was just inside the limits of the Mk II Inglis Bridge. The concept of a 40 ton tank, and the likelihood that this was not the upper limit, called therefore for a new design in bridging equipment.

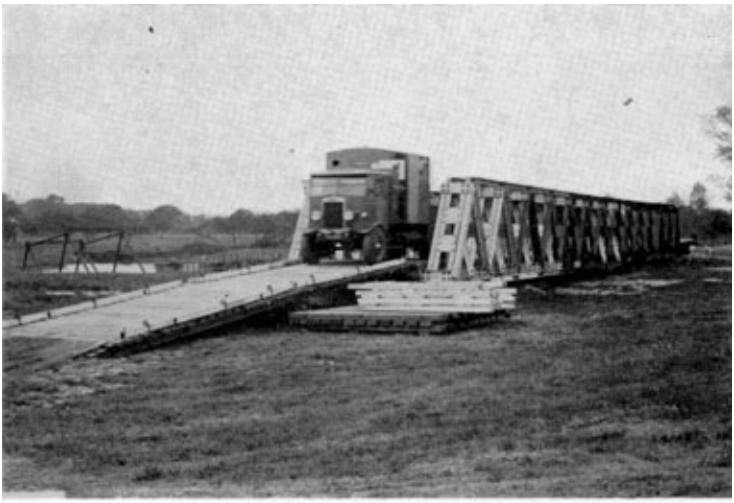
Mr D. C. Bailey (now Sir Donald Bailey) and RE officers at MEXE had been considering for some time a girder constructed of panels. With panels there was a logistic saving and manufacture would be simplified. Such was the success of the final design that production of the Small Box Girder, Large Box Girder, Hamilton and Mk II Inglis Bridges was stopped and Bailey Bridge equipment replaced them all.

Bailey Bridge

This equipment formed the best known of all equipments and it was based on a panel made from medium strength weldable steel 10 ft long, 5 ft 1 in high weighing 570 lb. These panels had male jaws at one end and female jaws at the other, and they were connected by high tensile steel pins to form trusses. Up to three trusses, side by side, could be built and the trusses could be made up to three panels deep; this provided great flexibility on span and load capabilities. The single construction gave a range between 90 ft span at Class 9 to 30 ft at Class 40, and the triple construction gave from 200 ft at Class 30 to 150 ft at Class 70.

Panels could be used on end to make piers for multi-span bridges and when used in conjunction with Mark 5 and Mark 6 pontoons, floating bridges of unlimited length could be made; the Bailey equipment made the trestle obsolete as a landing bay was virtually a fixed span bridge. Rafts of up to Class 40 could also be constructed. Construction timings for the equipment were 80 ft double single 1 troop 4 hours by day and 8 hours by night. Floating bays could be made in about 40 minutes by day and 60 minutes by night using 1 NCO and 32 men.

A Bailey suspension bridge was also designed. As a result of the increase in width of the Main Battle Tank at the end of the War, it was necessary to produce wider versions of the Bailey bridge, the extra weight of their component parts, however, destroyed many of the "beauties" of the Bailey Bridge as first designed.



Hamilton Unit Construction Bridge

Double Truss Inglis Bridge Mk II

Bailey Bridge, 140 ft TD with 80 ft DS approach span

Floating Bailey Bridge

Developments 1945–1970

Heavy Girder Bridge

This was a relative of the Bailey Bridge and was very similar in appearance and characteristics to it, but larger and heavier providing bridges of up to Class 100. The bridge was designed for construction using a crane and it was barely possible to build without one. The equipment is still in service primarily for line of communication fixed span bridges.

A Class 100 150 ft span bridge requires one troop 17 hrs to construct.

Light Assault Floating Bridge (LAFB)

This was a floating bridge which incorporated its own panels for stiffening and roadway members. A pair of pontoons formed 12 ft 6 in of Class 30 floating bridge.

The design of the bridge enabled the majority of the assembly to be carried out away from the river bank and launching and connecting up only was required at the bridge site. Hydraulic articulators were incorporated adjacent to the landing bay to allow the landing bay to rise and fall with variations of water depth. These articulators locked as soon as a vehicle started to come on to the bridge thereby providing continuity in the top cord.

A 410 ft Class 30 bridge could be built by a Squadron in 3½ hours by day or 5 hours by night. The equipment could also be adapted to provide Class 12 or Class 30 rafts.

Heavy Assault Floating Bridge (HAFB)

Now known as the Heavy Floating Bridge, is a heavier version of LAFB with modifications providing a floating bridge of Class 80 tracked or Class 100 wheeled. The piers themselves provide the roadway and each tripartite pier gives 18 ft of floating bridge complete. A landing bay of 4 close coupled piers with an articulator pier inshore gives the same effect as with the LAFB.

A squadron can expect to build 350 ft of Class 80 bridge in about 5 hours.

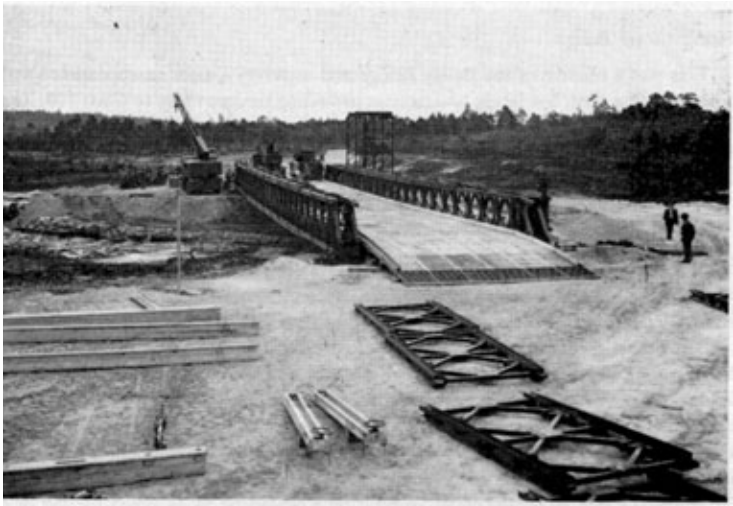
Heavy Ferry (1952)

This equipment is not a bridge but it provides a raft capable of carrying an 80 ton load. The equipment is a series of pontoons which are pinned together to provide a flat load platform. Special hydraulically-operated ramps form the ends of the ferry and propulsion is by means of four water jet units driven by Rolls-Royce engines. Capable of travelling at up to 6 knots, the ferry can be constructed by a troop in 1½ to 2 hours.

Air Portable Bridge (APB) 1967

This is a Class 16 bridge and, as such, will take virtually all vehicles in forward formations except the battle tank.

It has been designed to provide a fixed span bridge, a floating bridge or a ferry from the same basic components. Here is another example of technological advance, the main component of the bridge is a light alloy box which acts as roadway, girder and pontoon all in one. For the first time skin stressed construction has been used.



Double Truss Heavy Girder Bridge

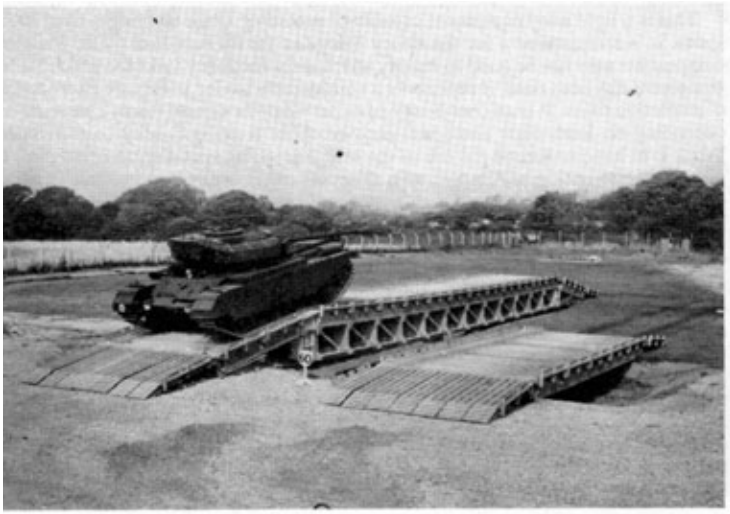
Light Assault Floating Bridge

Heavy Assault Floating Bridge

Heavy Ferry

Air Portable bridge as fixed span

Air Portable bridge equipment as Raft



Double and Single Medium Girder Bridges

M2 in Water

Medium Girder Bridge—1968

This is a light alloy equipment capable of providing Class 60 bridges over 100 ft spans. It is a replacement for the Bailey Bridge in the forward areas and, whilst its components may not be quite so readily adapted for the many tasks for which Bailey equipment has been used, it represents a considerable saving in logistic effort and in construction times. It is an over bridge of either single or double storey construction, depending on load, class and span, each component being readily man handled. Work is in hand to extend the use of the bridge by using specially designed piers to give multi-span bridges. A single span Class 60 100 ft bridge can be built in about one hour by a single troop.

M2

The British Army evaluated various amphibious bridging equipments before deciding to purchase the M2, a West German product. M2 is a vehicle which can drive directly into the water and several of them can be interconnected by deck units. Each vehicle can act as an individual raft of Class 8, while three linked together can carry Class 60 loads; they are independent of outside labour for construction, the crew being capable of all the required work.

In the water the vehicle is driven by propeller in the hull from an independent engine, although the 'land engine' can be switched to operate two additional propellers. A ferry can be produced within minutes of arrival on site, and 400 feet of floating bridge within an hour.

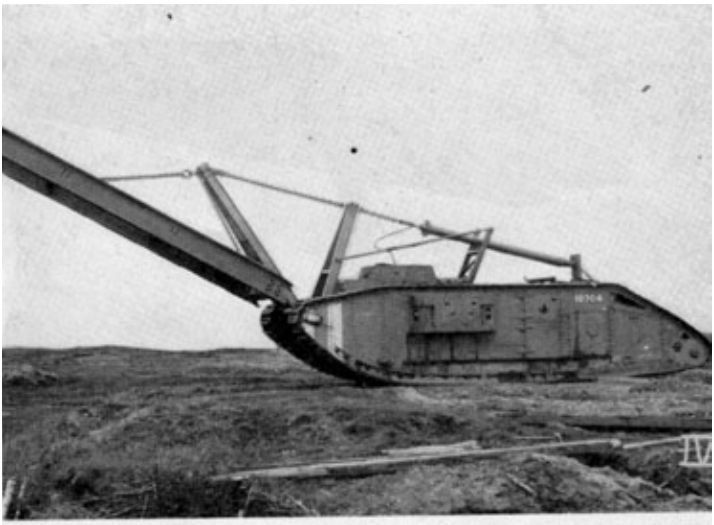
Tank Bridges

Another form of equipment bridges which must be considered are the tank bridges—that is, bridges designed to be carried by tanks. The first tank bridge was developed after World War I and was called the lock bridge; this was a simple girder carried on the front of a tank which could be used to cross canals at the lock gates.

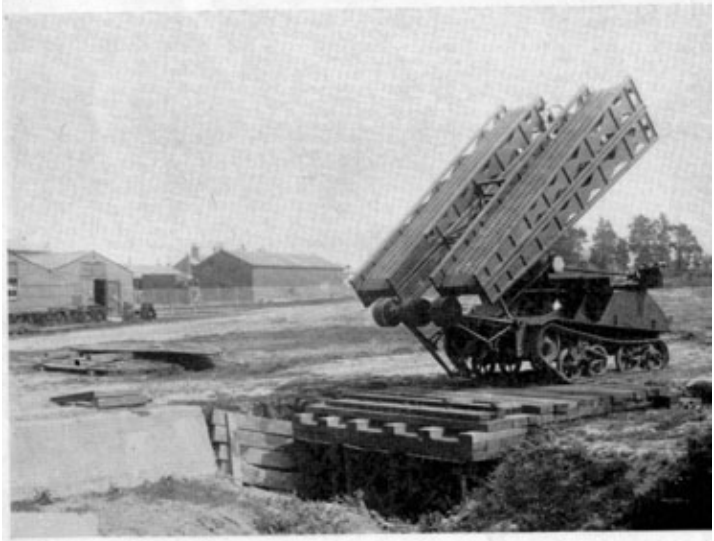
Little development occurred until the introduction of the bridge layer based on the Valentine tank (there was also a Covenanter version). This was a scissors bridge 34 ft long, Class 30 for tracked vehicles. The scissors action was achieved by use of steel wire rope cables and the launch was powered by a single very long screw jack.

During World War II a 30 ft bridge, Class 60 tracked, Class 40 wheeled, was cantilevered out in front of the Churchill AVRE; the end nearest the tank was fitted with a bird's mouth which was located over pivot points on a special attachment to the tank. The forward end of the bridge was held up by two cables attached to a derrick pole which in turn was connected through blocks and tackles to the AVRE winch. On arrival at the gap the winch was paid out to lower the bridge into position. The bridge, consisting of two tracks with a bank seat, was of welded steel and complete with derricks, etc it weighed 7 ton.

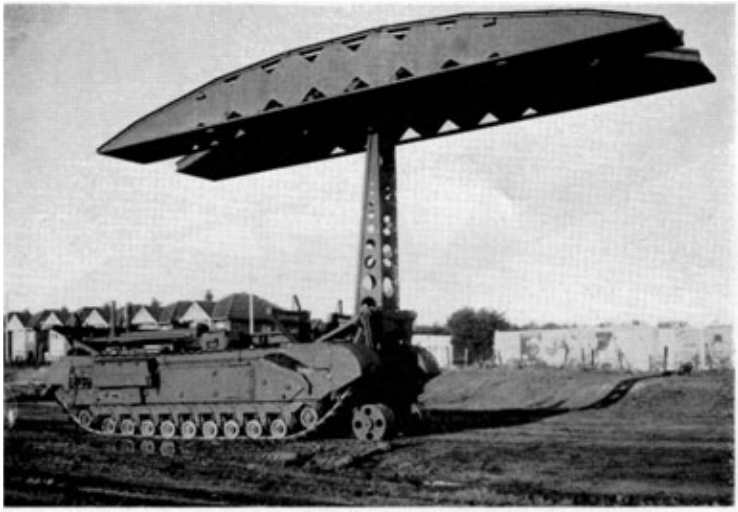
Shortly after the War the Churchill Bridge layer came into service. This was based on the standard Churchill tank with the turret removed and a launching structure incorporated in its place. The 30 ft span Class 80 bridge consisted again of two tracks in welded steel construction joined together by cross diaphragms near the centre of the bridge in lieu of bank seats. The total weight of the bridge was 3 tons. The launching principle consisted essentially of a launching arm, which pivotted about the forward end of the tank and which was located at the centre of the top cord of the bridge. This arm would rotate through some 180° carrying the bridge with it from its position on top of the tank until it had laid it down on the ground ahead of the tank. The bridge was free to pivot on trunnions at the head of the arm and, therefore, remained horizontal and right way up throughout the launching operation.



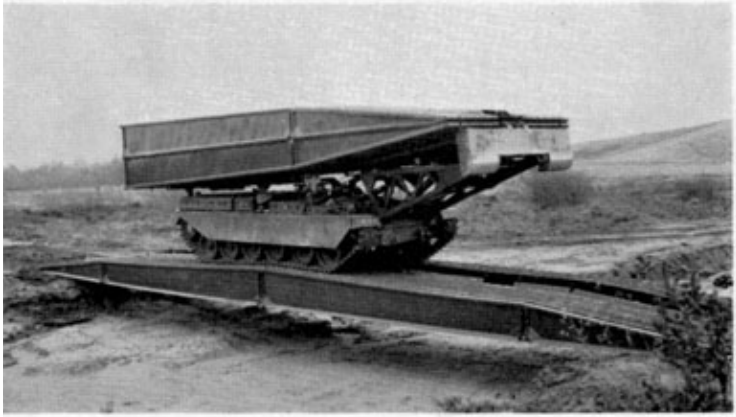
Lock Bridge



Valentine Scissors Bridge



Churchill Bridge Layer



Chieftain AVLB

The Evolution of Equipment for the RE section 2

Centurion Bridge Layer

This laid a high strength light alloy bridge 52 ft long (45 ft clear span) with a Class 80 load capacity. The bridge consisted of two tracks but centre decking was also provided which could be laid by hand after the bridge had been launched. The launching mechanism was somewhat similar to that incorporated in the Churchill Bridge Layer, except that the bridge was carried upside down on the tank and locked firmly to the launching mechanism. The bridge was then rotated through 180° to be laid right way up. The launching time was 1½–3 minutes and the bridge could accept a maximum difference in bank height of 8 feet. The bridge was launched without exposing the crew, unless the centre decking had to be positioned.

Centurion Ark

This has maximum span of 75 ft, load Class 80, and a launching time of 10 minutes. A roadway is fitted to the top of the tank running longitudinally along its length and there are ramp sections at each end. After the vehicle has been driven into the gap, the ramp sections are thrown over at each end. Centre decking has to be placed after launching for all vehicles except tanks. Recovery and re-rigging requires up to twelve hours.

Armoured Vehicle Launched Bridge

Finally, a tank launched bridge, based on the Chieftain, has now been accepted for service. It provides an 80 ft long bridge at Class 60 within less than 5 minutes of arrival at site; it is launched without crew exposure, and represents a major advance on any other known equipment. A major factor in this achievement has been the research which has made it possible to use a 90 ton proof 18 per cent nickel maraging weldable steel for both bridge and launching mechanism.

CONCLUSION

What can we learn from this look into the past? The most striking fact seems to be that none of the essential requirements have changed; it is only the time scale which has been drastically reduced.

For the future the requirement is for:

(*a*) Faster construction and dismantling times with less manpower.

(*b*) Better overall mobility.

(*c*) Greater versatility and usability on a wide range of sites with minimum site preparation.

(*d*) Improved reliability with easier maintenance.

(*e*) If feasible, more commonality of components in an integrated family of equipments.

SECTION III

Mines and Demolition Stores and Equipments

General

Since gunpowder was first used in war the placing of explosive charges to hinder or destroy the enemy has been the concern of the military engineer. In this section no attempt has been made to cover the whole vast subject of mined charges; the aim has been to give a brief account of some of the more interesting items of specially designed equipments which the Corps has used, and in many cases has originated, during the past hundred years.

Submarine Mining

The story of purpose-designed minewarfare equipment in the Royal Engineers began in 1839 when Colonel (later General Sir Charles) Pasley first applied electricity to the explosion of submerged charges in destroying the wrecks of the Royal George and the Edgar. This feat opened the door on a new dimension of warfare, and it was the American Civil War, (1861–65), which focussed interest on the subject when, in a period of less than three years as many as 37 ships were disabled or destroyed by mines or torpedoes.

In 1863 a Joint Naval and Military Committee was set up composed of a sailor, a gunner, a sapper and two Fellows of the Royal Society, and from the findings of this Committee blossomed the Submarine Mining Service which was almost entirely sapper-manned. The first Submarine Mining Company was formed at Chatham in 1871 from the 4th Company RE, which had just returned from Bermuda, and in 1873 an old 80-gun ship, a previous HMS Hood, anchored in the Medway, was turned into a barrack and Submarine Mining School. The aim was to develop and use mines and torpedoes as a means of coast defence and the force was progressively expanded until, at its zenith, it controlled some 30 shore stations, 3 schools, and had a total strength of nearly 6,000 men. Indeed in 1885 it was said that the transfer of so many sapper companies to submarine mining was causing a scarcity of officers and men for ordinary field, fortress and works duties.

For us, now, the chief interest lies in the equipment which was designed and introduced. The submarine mines themselves were at first cylindrical, but soon became spherical and could contain 5, 100 or 500 lbs of explosive. There were two sorts: 'observation' mines which were moored close to the bottom and could be detonated from the shore, and contact mines which were moored just beneath the surface and exploded when a ship collided with them. Observation mines were fired electrically from large batteries of Leclanché cells housed ashore, through a most ingenious system of switches, cables and connections.

Perhaps more remarkable was the Brennan Torpedo, an underwater wire-controlled guided missile, originally designed for shore to ship use and later used from ship to ship, having a speed of 25 knots and a range of 1,000 yards. It was invented by an Irishman resident in Australia, who, in 1887, was bought-out on the advice of the RE Committee, in spite of Admiralty objections that the aparatus was not considered suitable for Naval service. The transaction turned out to be a splendid piece of technical foresight for, even 21 years after the purchase, no similar weapon was in the possession of any foreign Government. Coast Defence searchlights were first introduced by the Submarine Mining Service in 1880, and in 1895 the internal combustion engine was adopted for the generation of electricity in searchlight engine rooms.

Then, as now, success bred take-over bids, and having survived an attempt by the Gunners the Submarine Mining Service was eventually taken over by the Royal Navy in 1905. Searchlights remained with the Royal Engineers and the remarkable

technical advances which had been made both in the electrical firing of explosive charges and in the general use of electricity for military purposes were to lead the Corps to new fields and stand it in good stead in the future.

Anti-Tank Mines

Although for very many years various forms of traps and automatically operated charges, such as fougasses and alarm guns, had been described in Manuals of Field Engineering, and in 1918 the German Army had made considerable use of buried shells and charges set off by mechanisms such as time fuzes, the history of specially designed anti-tank mines in the British Army really goes no further back than 1939. The first British anti-tank mines, recognizable as such, were the Anti-tank Mines Numbers 1 and 2 which were still appearing in Manuals as late as 1942 and were designed to be issued empty and to be filled by any RE unit with "readily available" commercial explosives. The No 1 had a spring-loaded striker retained by a copper shearwire, whereas in the case of the No 2, the striker was arranged to rest directly upon a 1.7 grain cap. Neither had removable fuzes so that it was necessary to insert detonators at the time of laying. Needless to say both were soon superseded by ready-filled mines, with separate fuzes, such as the GS Mark II containing 4 lbs of TNT. This was progressively developed, through the Marks III and IV to the Mark V which in its final, higher content (HC), form contained 8¼ lbs of explosive and discarded the plain steel pressure cover in favour of a pressure 'spider' to prevent actuation by blast. The Mark V saw service in increasing numbers from about 1942, and it lasted until many years after the war although it was fully detectable and was always considered to be underpowered compared with the German Tellermine which had 12 lbs of explosives.

Egyptian pattern (EP) mines, manufactured in Egypt from 1941 to offset the supply shortage of mines from the UK, ran through several Marks terminating with the Mark IV, contained 8 lbs of dynamite in their final form. They were operated by either a pressure operated chemical igniter or a shear-pin controlled fuze. They were produced in large numbers and extensively used in North Africa for most of the campaign. Also of interest was a light anti-tank mine designed by an RE officer known as the Hawkins Grenade No 75. It was basically a liquid polish tin on its side, containing 1½ lbs of explosive and fitted with a pressure plate bearing upon two chemical igniters.

After 1945 the fact that our mines carried too little 'punch' was corrected. The Mark VII, which is in current service, has 20 lbs of TNT inside it, enough to disable any known tank. Non-detectable mines have been introduced and laying methods have been speeded up so that, for example, the Towed Mechanical Minelayer Mark III can bury mines at a speed of several hundreds an hour. The Mark VII Mine is to be replaced by the Barmine, now under development, with the aim of providing a minefield of equal effectiveness with fewer mines, which can be machine-laid from under-armour protection more quickly and with far less effort. Future anti-tank mine design is likely to give consideration to such features as attacking the belly of a vehicle as well as its track and wheels, remote laying using missiles, laying from aircraft, and the remote control of minefield arming.

A comparative table illustrating the development of British anti-tank mines, is at Table A.

No review of anti-tank mines, however brief, would be complete without a mention of mine clearance equipment. The first 'Scorpion', which was a modified tank capable of thrashing the ground in front of it with weights attached to a whirling drum by lengths of chain, was built by a Field Park Company of the South African Engineer Corps in the Western Desert in early 1942 and the equipment won its spurs at El Alamein. Later called the 'Flail', it was the forerunner of a number of mechanical devices which included rollers pushed in front of tanks. Electronic mine detectors too, which originated in the post-Dunkirk period, were of great significance and progressive development has culminated in the Mark 4c which is in current use.

Anti-personnel Mines

Mines designed specially for anti-personnel effect first came into prominence during the Second World War in the Western Desert where the German Army began to sow 'S' mines and later wooden Schumines and others, most liberally and skilfully.

Our own World War II armoury in this respect was comparatively meagre. In the opening years we possessed a jumping mine, the Anti-personnel Shrapnel Mine Mark II, which could be buried or picket-mounted. It was however cumbersome to carry and, not possessing a treadswitch like its more versatile counterpart the 'S' mine, could only be operated by trip wire. There was also the curious Small Arms Mine, or 'groundspike', which fired a rifle bullet vertically upwards when stepped on, and two Marks of 'EP' anti-personnel mines from the Egyptian factories containing three-quarters of a pound of gelignite and having a chemical crush igniter fired through a three-pronged pressure head. They had cylindrical metal cases but did not jump. Later came the Anti-Personnel Mine No 5 having half a pound of explosives in a cardboard case with a pressure switch and, postwar, the No 6 a small, all-plastic mine, with a three-pronged igniter, which is still in stock.

Currently in service is 'Dingbat', an easily dispensed surface tread-mine about the size of a boot polish tin, and a compact plastic mine named 'Elsie' which is designed to be heeled into the ground before it is armed. For the future the lines of development are likely to include anti-personnel mines capable of destroying, or sterilizing, themselves after periods of emplacement, increased laying speeds both from vehicles and aircraft, and fragmentation mines with both directional and area effects. Close compatibility with anti-tank mine systems will also be of great importance.

Table B illustrates the development of British anti-personnel mines.

Explosive Demolitions

The earliest explosive demolition techniques were based upon gunpowder which continued to be listed in British Service Manuals as a demolition explosive until 1956. Up to 1870, whenever the need arose for a field demolition, Sappers borrowed powder and firing accessories from the Gunners and there was no need for special stores to be carried. Powder was plentiful and the fact that there was no particular need for economy in its use is shown in the manual "Instruction in Military Engineering, 1870" which states: "In all demolitions of bridges, powder must be used freely in excess of the calculated charge . . .".

Modern explosives available for demolition work derive from efforts to find an improved propellant to replace gunpowder. Nitroglycerine, invented by Sobrero in 1847, was adapted by Nobel in 1864 and, in an experiment in Cornwall in 1865, a wrought iron block weighing 3 cwt, having a central cavity charged with 1 oz of the explosive, was blown to pieces. This was probably the first time that a metal target had been scientifically attacked with high explosives.

Guncotton (Trinitrocellulose) was invented by Schönbein in 1846, and Messrs Hall of Faversham began its manufacture in the same year. Their enterprise was however destroyed by an explosion the following year. By 1863 the Royal Gunpowder Factory and Messrs Prentice of Stowmarket had begun production, and the Royal Engineers used guncotton at Corfu to destroy the fortifications there. In 1865 the Royal Engineer Committee ordered trials to be carried out and found that the results were 'quite extraordinary'. A big step forward came in 1868 when Mr E. O. Brown, assistant to Professor Abel the War Department chemist, found that guncotton did not need to be confined in a strong receptacle, and it is noteworthy how quickly such discoveries were adopted for field use. 'Instruction in Military Engineering, 1870' includes a paragraph on firing guncotton with detonating fuze, and its use as a surface charge in hasty demolitions, whilst the experiment on which this information was based took place at Chatham only on 30 June 1869. In 1870 experimental shots were fired against brick, masonry and wooden stockades, and in 1872 tests were made with "lengths of rail of soft tenacious iron in order to see

whether, owing to the suddenness of the blow, a crystalline fracture could be produced". In 1873 Royal Engineers used guncotton to remove the sunken wreck of the steamer 'Kate'.

The First World War produced TNT (Trinitrotoluene), which being readily cast in a molten state simplified the making of filled charges, such as shells, and led to its use in made-up demolition charges, developed between the wars by the Armament Research Establishment, Woolwich. Shaped charges, producing a molten jet of metal to penetrate the target, require a homogeneous explosive free from voids in close contact with the metal liner, and various compositions of TNT are still used for this purpose although the relatively low melting point of TNT causes some minor problems in long term tropical storage. It is hoped that a better castable composition will eventually be found.

The search for new high explosives in the inter-war years discovered RDX (Cyclonite) which is still the most powerful explosive suitable for use in weapons and probably represents the limit of what is chemically practicable. Further development will centre on improved binders and matrices.

In 1942 plastic explosives entered the service 'to replace all others, being equally suitable for use as a cutting, mined or borehole charge'. That prophesy has proved nearly correct and plastic will remain the best all-purpose explosive for many more years. Improvements concern better methods of fixing a charge of efficient size and shape quickly and firmly to a target, and variations have included paste explosive, sheet explosive, and plastic packed in different containers. The present PE 4 Slab is an attempt to combine the advantage of the intimate contact which plastic confers with the rigidity of fixing obtainable with bolt guns, and an improved range of firing accessories make demolition circuits far quicker to install and more resistant to weather and battle hazards.

The supremacy of plastic explosive is challenged only when used as a buried or mined charge. In this application better performance can be obtained with explosives which give greater gaseous expansion, and where the total impulse is spread over a longer period of time. Pellets of RDX/wax/aluminium have recently been used with success, and ammonium nitrate fuel-oil mixtures and slurries are in use commercially and are gaining acceptance by the Services. These slurries have the advantage of cheapness and close contact with the walls of a cavity but the disadvantage of a relatively short storage life once they have been mixed.

Since the introduction of guncotton a hundred years ago it can be concluded that there has been no far reaching increase in the power of conventional explosives. Demolition techniques must, therefore, be improved by reducing the time, manpower and stores needed to prepare tasks. This can be achieved by a better understanding of the modes of collapse of targets, more efficient use of explosives, better packaging into convenient shapes and sizes and by reducing the complexity of firing circuits.

The development of explosives and explosive accessories is summarized at Tables CI and CII.

* * * * *

RE Kitchener Scholarships Fund

This Fund gives financial assistance towards the education of the children of RE officers and other ranks who have been killed or permanently disabled whilst actually serving, or who have died or become disabled as a result of military duty.

There are many calls upon the Fund's limited resources and donations for this very deserving cause will be most gratefully accepted.
THEY SHOULD BE SENT TO:—

The Secretary The Institution of Royal Engineers
Chatham, Kent

TABLE A

SOME BRITISH ANTI-TANK MINES COMPARED

Serial	Anti-tank Mine	Approximate date introduced	Approximate weight		Shape	Principal dimension	Fuzing arrangement	Method of laying	Remarks
			Mine	Explosive charge					
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(j)	(k)
1	Anti-tank Nos 1 and 2	1939	8 lb	4 lb	Round	Diam: 8 in	Integral; mechanical	Hand	Issued unfilled. Intended that user should fill with commercial explosive. Detonator inserted at time of laying
2*	GS Mark II	1941	8·25 lb	4 lb	Round	Diam: 7·5 in	Separate; spring-loaded striker	Hand	
3	Hawkins grenade mine No 75	1941	3 lb	1·5 lb	Rectilinear	Length: 7 in	Separate; chemical ampoules	Hand	The mine case was said to be derived from a commercially available liquid polish tin
4	Egyptian Pattern Mks III–VI	1941 onwards	10 lb	5–8 lb	Round	Diam: 10 in	Separate; chemical ampoule or spring-loaded striker	Hand	Two fuze alternatives; one mechanical and one chemical
5	Beach Mine "B" Type C	1940–1	50 lb	20 lb	Round	Diam: 12·5in	Bow-spring mechanism	Hand	
6*	GS Mark V	1942	8·75 lb	4·5 lb	Round	Diam: 8 in	Separate; spring-loaded striker	Hand	
7	GS Mark V (HC)	1943	12 lb	8·25 lb	Round	Diam: 8 in	Separate; spring-loaded striker	Hand	HC stands for "higher content" (of explosive)
8*	GS Mark VII	1950	32 lb	20 lb	Round	Diam: 13 in	Separate; mechanical	Hand or machine	Can be laid buried or on the surface by the Mark 3 towed mechanical mine-layer
9*	Light Non-Metallic Anti-tank Mine (L2A1)	1966	17 lb	13·25 lb	Round	Diam: 10·75 in	Integral	Hand	Mainly plastic. Undetectable by electro-magnetic detectors. Armed by turning arming lever in top of mine
10*	Barmine	Near future	22 lb	18 lb	Bar shaped	Length: 48 in	Integral	Hand or machine	Emplaced by special layer towed behind APC and other vehicles. Compared with the Mark VII a minefield of equal effectiveness can be laid using fewer mines and with far less effort

Notes: 1. This table is by no means fully comprehensive, and consists of representative items which have been selected for interest and comparison.
2. Illustrations are included of those Serials marked * in column (a).

TABLE B

SOME BRITISH ANTI-PERSONNEL MINES COMPARED

Serial	Anti-personnel Mine	Approximate date introduced	Approximate weight		Shape	Principal dimension	Fuzing arrangement	Method of laying	Remarks
			Mine	Explosive charge					
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(j)	(k)
1*	Shrapnel Mks I and II	1941	10 lb	1 lb	Cylindrical	Height: 5·5 in	Two spring-loaded strikers (one for jumping, one for bursting)	Hand	A jumping mine with a fragmenting iron case. It could be buried or picket-mounted
2	Egyptian Pattern No 5	1941 onwards	0·75 lb	0·4 lb	Cylindrical	Height: 3 in	Separate; chemical ampoule	Hand burial	This mine was also used as the chemical pressure fuze for the EP Anti-tank mine. In this role it was known as the chemical pressure fuze EP No 2. Non-jumping
3	No 5 Mk I	Late 1940s	0·5 lb	0·4 lb	Cylindrical	Height: 3·5 in	Separate; spring-loaded striker	Hand burial	A very simple mine with a shellacked cardboard case. Non-jumping
4*	No 6 Mk I	Late 1940s	0·48 lb	0·25 lb	Cylindrical	Height: 8·3 in	Separate; shear-ring controlled striker	Hand burial with special tool	The first all-plastic British mine. The fuze has a three-pronged pressure head. Non-jumping
5*	"Dingbat"	Early 1950s	0·25 lb	0·11 lb	Disc	Diam: 2·25 in	Built-in striker; slide-in detonator	Hand-laid on the surface	A light, simple, metallic mine about the size of a boot-polish tin, with a fabric camouflage cover, designed to be rapidly emplaced upon the surface of the ground. Non-jumping
6*	"Elsie"	Mid 1960s	0·16 lb	0·021 lb	Inverted cone	Height: 3 in	Separate	Heeled into ground before fuzing	All plastic. Non-jumping

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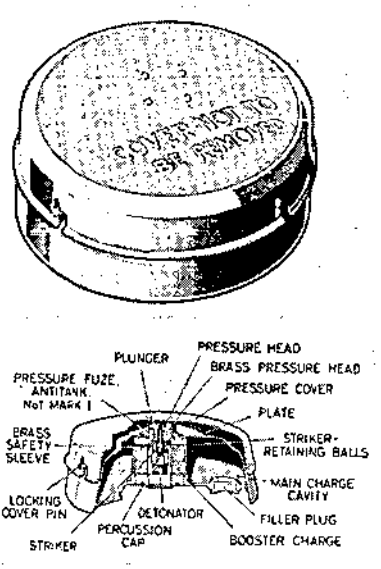
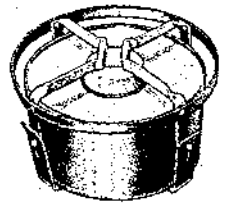
2. Illustrations are included of those Serials marked * in column (a).



Anti-tank Mine GS Mark II



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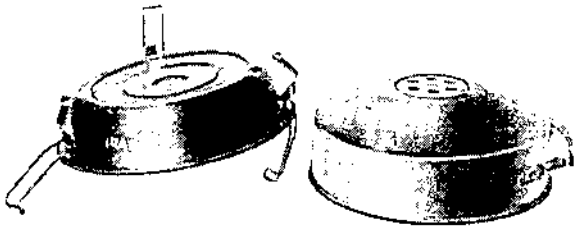

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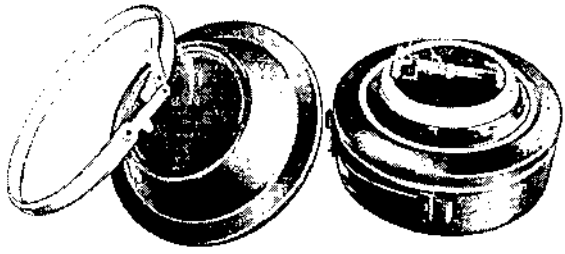
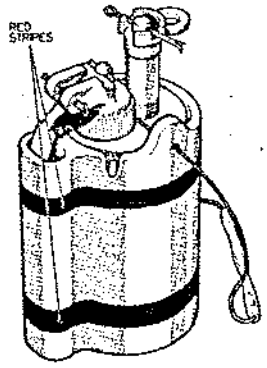
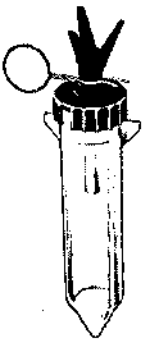


Anti-tank Mine Light Non-metallic (L2A1)

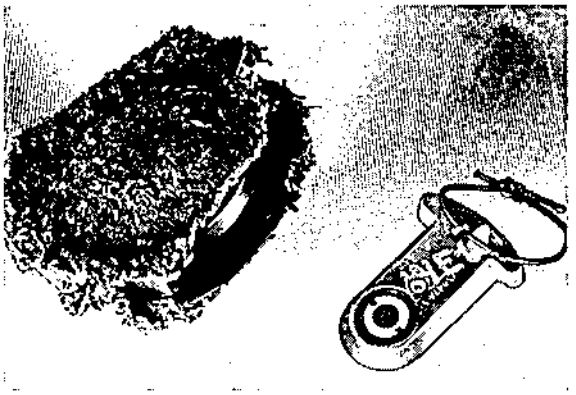
Anti-tank Barmine



Anti-personnel Mine
Shrapnel Mark II



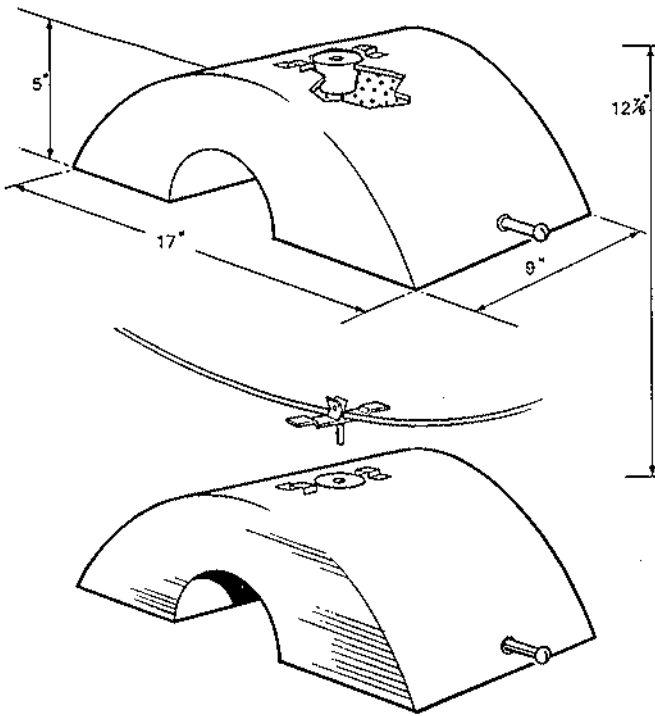
Anti-personnel Mine
No 6 Mark I



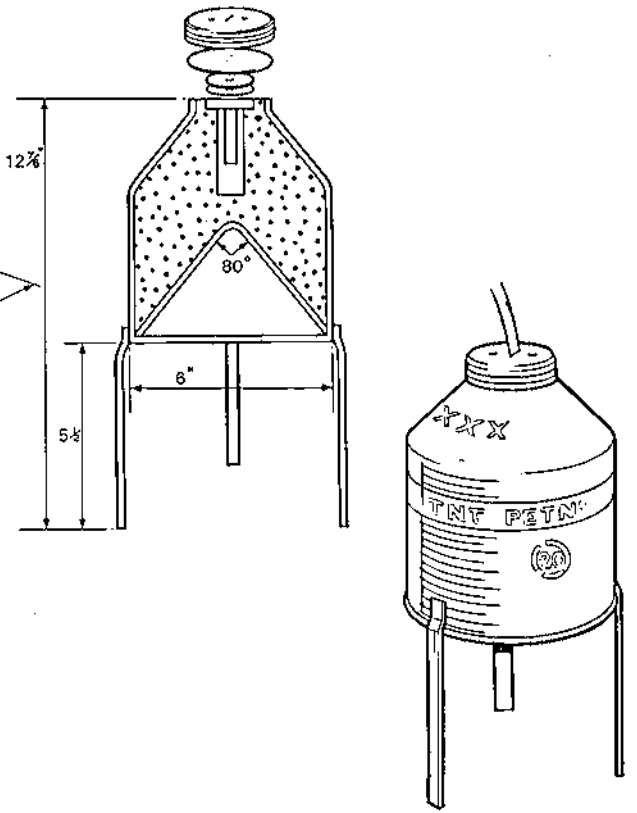
Anti-personnel Mine 'Dingbat'

Anti-personnel Mine 'Elsie'

Note: The illustrations on these pages are not to uniform scale. The principal dimensions of each mine will be found in the comparative table.



Charge Demolition No 2 ('General Wade')



Charge Demolition No 1 ('Beehive')

TABLE C 1

SOME BRITISH SERVICE EXPLOSIVE ACCESSORIES COMPARED

Serial	Explosive Accessory	Approximate date introduced	Size or weight	Packaging	Remarks
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)
1	Bickfords Fuze (gunpowder)	1870	—	24 ft coils	Burning rate varied between 45 and 75 sec per yd
2*	Groves battery (for electrical initiation) and Thermogalvanometer	1870	—	—	—
3	No 16 gauge copper wire	1870	—	—	—
4	Platinum wire fuze	1870	—	—	—
5	Fuze Safety No 9	1892	Diam: 0·3 in	8, 24 or 50 fathoms to a tin	Burning rate varied between 45 and 75 sec per yd. Black in colour
6	Fuze Instantaneous	1892	—	100 yds to a tin	Burning rate 30 yds per sec. Orange in colour
7	Detonator No 8	1892	—	25 to a tin	Red in colour
8	Detonator No 13 (electric)	1892	—	25 to a tin	Red and white in colour
9	Siemans Dynamo Electric Exploder	1892	—	—	—
10	3-coil Galvanometer	1892	—	—	—
11	Resistance coils (100 ohms)	1892	—	—	—
12	Guncotton (dry) primers	1910–11	1·25 × 1·35 in—1·15 in	10 to a tin	—
13	Insulated leads; (D14 and D15	1910–11	—	—	—
14	Exploders Dynamo Electric Mk V	1910–11	27 lb	In canvas waterproof bag	—
15	Fuze Instantaneous Detonating	1925	Dia: ⅜ in	—	Detonation velocity 7,000 m per sec
16	Fuze Safety No 11	1925	—	8 fathoms to a tin	Burning rate 2 ft per min. Black in colour
17	Cable Electric E1 Mk II	1925	—	On wooden drums	—
18	Boxes Testing and Jointing	1925	12 lb 3 oz	—	Part of unit equipment
19	Detonator No 27	1935–40	—	—	Detonators No 8 still in service but obsolescent
20	Cordtex	1935–40	—	500 ft on a drum	Of commercial manufacture. White in colour
21	Detonator (Electric) No 8 Mk I	1935–40	—	25 to a tin	Detonators No 13 (electric) still in service but obsolescent
22*	Exploder Dynamo Electric Mks VII and VII*	1935–40	12 lb	—	Mk VII obsolescent 1947. Mk VII* obsolescent 1955
23	CE Primers	1942–7	1·25 × 1·35 in—10 cylinders to a box	10 to a cylinder	
24	Primer Cord Detonating Fuze	1942–7	—	100 ft on a spool	Yellow/orange in colour
25	Detonator No 33 (Electric) Mk I	1942–7	—	10 to a metal cylinder 10 cylinders to a box	—
26	Exploder Dynamo Condenser Mks I and II	1942–7	·18 lb	—	Mk I obsolescent 1955
27	Test Set Demolition Mk I	1942–7	—	Wooden case	—
28	Igniter Safety Fuze, Percussion Mk III	1953–8	—	10 to a tin	
29	Fuze Instantaneous Mks IV and V	1953–8	Diam: 0·23 in	300 ft on a reel	Burning rate 90 ft per sec. Orange in colour
30	Detonating Cord	1953–8	—	500 ft on a reel	Detonation velocity 6,500 yds per sec. White in colour
31	Megger Test Set	1953–8	—	Leather case	—
32	Igniter Safety Fuze, Electric	1953–8	—	20 to a packet 100 to a tin	—
33*	Firing Device Demolition (New Range)	1967–8	—	15 packs to a box	The "gripswitch"
34*	Initiator Flash (New Range)	1967–8	—	10 to each primary box	—
35*	Safety Fuze (New Range)	1967–8	—	2 × 25 ft coils to a tin	Burning rate 2 ft per min. Green in colour
36*	Detonators Demolition (Flash) (New Range)	1967–8	—	5 to a pack 25 packs to a box	—
37	D10 Signal Cable (for firing circuits)	1967–8	—	—	—
38	Exploders Dynamo Lightweight	1967–8	3 lb	Webbing carrier	For use by airborne, etc, troops
39	Detonators Demolition (Electric) (New Range)	1967–8	—	—	—

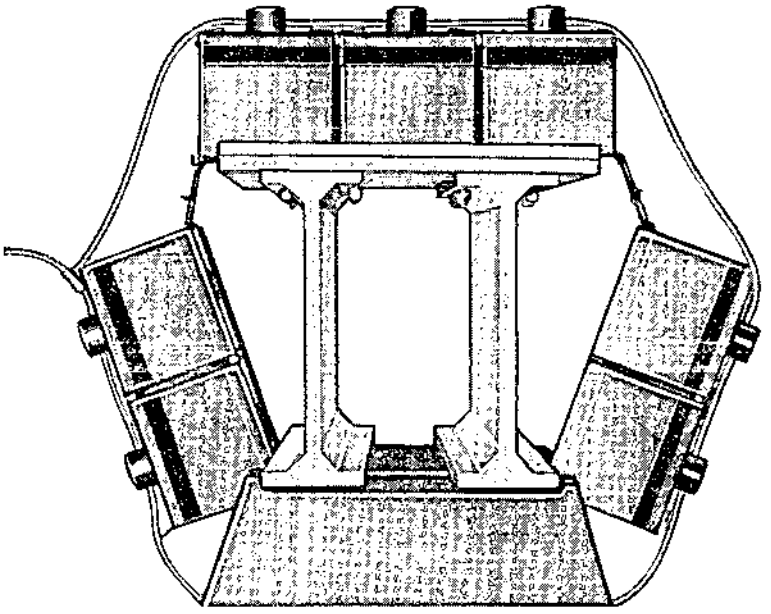
Notes. 1. This table is by no means fully comprehensive, and consists of representative items which have been selected for interest and comparison. The designations and descriptions have been taken from instruction manuals of the period concerned.
2. Illustrations have been included of those Serials marked * in Column (*a*).

TABLE C 1

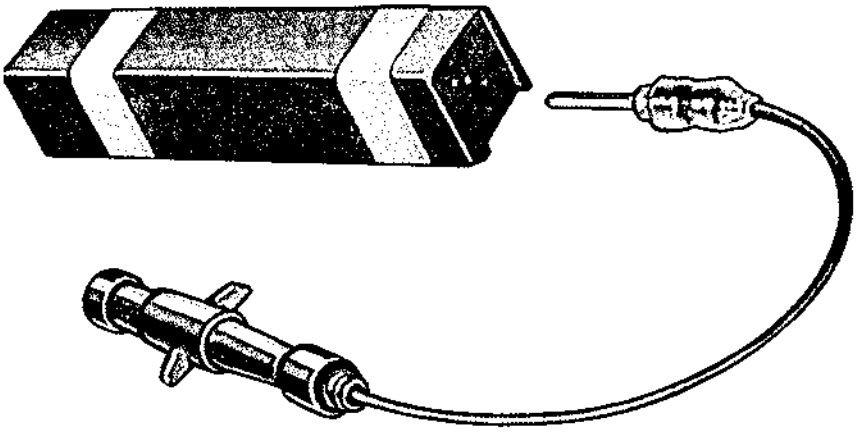
SOME BRITISH SERVICE EXPLOSIVE CHARGES COMPARED

Serial	Explosive charge	Approximate date introduced	Weight	Size	Packaging	Remarks
(*a*)	(*b*)	(*c*)	(*d*)	(*e*)	(*f*)	(*g*)
1	Gunpowder	Before 1870	—	—	90 lb to a barrel	Repacked in 50 lb bags, waterproofed with tar and beeswax, by user unit as required
2	Guncotton slabs	1892	1½ or 2 lb	6⅛ × 6⅛ × 1½ in or 1⅝ in	Clarkson box	Other explosives considered for trials at this period were glycerine, dynamite No 1 and 2, blasting gelatine, gelatine dynamite, picric acid and nitro-benzole
3	Guncotton slabs	1910–11	15 oz	6 × 3 × 1⅜ in.	Each in a sealed tin	Gunpowder and dynamite listed as alternatives
4	Guncotton wet slabs	1925	1 lb	6 × 3 × 1½ in	14 to a box or metal case	Obsolescent 1947
5	Ammonal in powder form	1925	—	—	Tins of 25 or 50 lb	Obsolescent 1947
6	Dynamite cartridges (plastic)	1925	2 oz	—	Boxes of 5 or 50 lb	Commercial origin
7	TNT slab	1935–40	1¼ lb	6 × 3 × 1½ in	14 or 15 to a box	
8	CE/TNT demolition slabs	1942–7	1 lb	4½ × 2¾ × 1¾ in	14 to a box	
9	Nobel's 808 (plastic) cartridges	1942–7	4 oz	3 × 1⅜ in	80 to a box	Green in colour
10	Plastic Explosive (PE 2) cartridges	1942–7	8 oz	8 × 1¼ in	20 lb to a box	Dull yellow in colour
11*	Charge Demolition No 1 ("Beehive")	1942–7	10 lb (expl: 6¾ lb)	Diam: 6 in	4 to a container	CD No 11 ("Nesting Beehive") is a larger derivative containing 15 lb of explosive
12*	Charge Demolition No 2 ("General Wade")	1942–7	30 lb (expl: 25 lb)	17 × 9 × 5 in	1 to a box	Arched in shape resembling bridges built in Scotland by General Wade
13	Charge Demolition No 3 (30 lb "Hayrick")	1942–7	30 lb	17½ × 9⅜ × 6 in	2 to a box	Shaped like a hayrick
14	Charges Demolition Nos 5 to 8, and 10	1942–7	7 to 100 lb	—	—	Hollow cone charges for various applications
15	852 (plastic) cartridges	1953–8	4 or 8 oz	4 or 8 × 1¼ in	20 lb to a box	Obsolescent 1958
16	Rapid Demolition Device (RDD) for concrete	1953–8	—	4 ft 10 in × 1 ft 4 in × 2 ft 3 in	—	Steel container filled with guncotton (5 cwt)
17*	Charge Demolition No 14 (11 lb "Hayrick")	1953–8	11 lb	—	—	Linked to make up RDD "necklace" for steel
18	Plastic Explosive (PE 3 and 3A) cartridges	1958	8 oz	8 × 1¼ in	20 lb to a box	Black in colour
19	Plastic Explosive (PE4) cartridges	1967–8	8 oz	7 × 1¼ in	10 cartridges to a carton. 4 cartons to a box	White in colour
20*	New Range PE 4 Demolition Slabs	1967–8	2 lb	2 × 2 × 10 in.	6 slabs to a metal container. 2 containers to a carrier. 2 carriers to a box	Each slab sheathed in polythene
21	Sheet Explosive (S × 2)	1970	0·59 kg	465 × 250 × 3 mm	40 sheets to a box	For issue to selected units
22	Rapid cratering device	1970	—	—	Packed in steel container	User trials 1970

Notes: 1. This table is by no means fully comprehensive, and consists of representative items which have been selected for interest and comparison. The designation and descriptions have been taken from instruction manuals of the period concerned.
2. Illustrations have been included of those Serials marked * in Column (*a*).

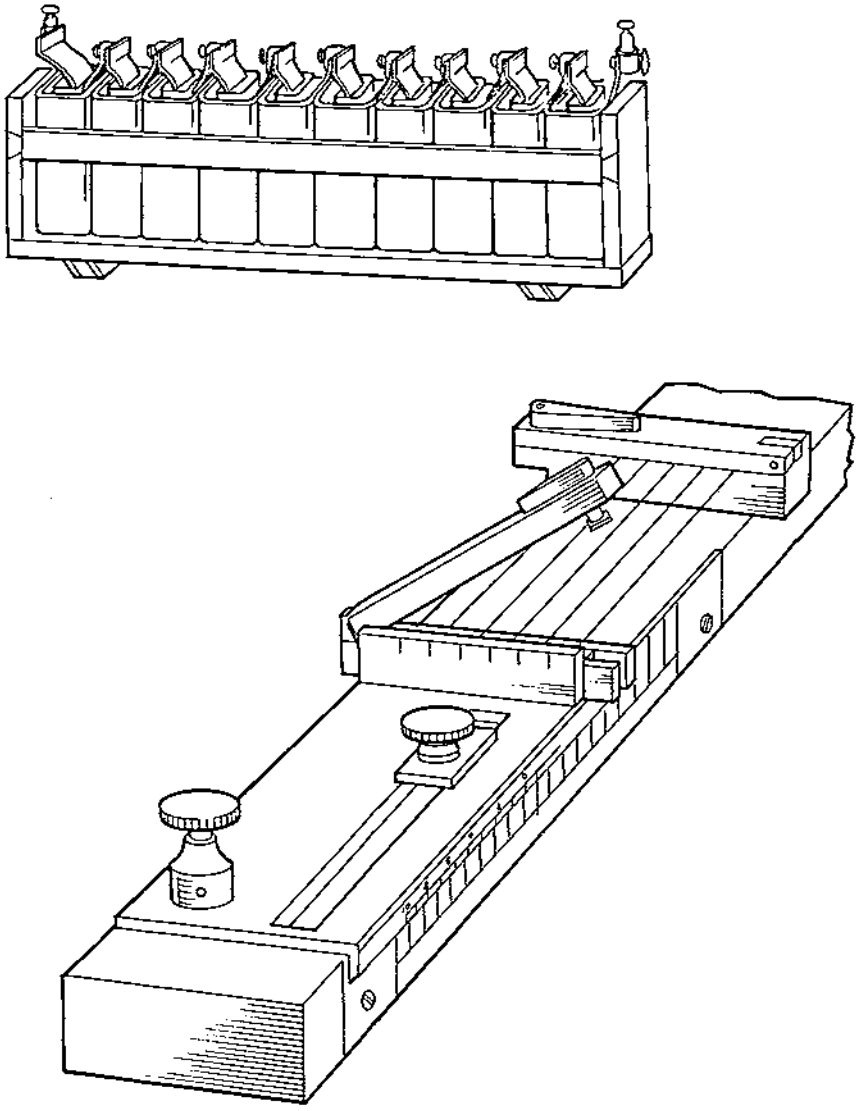


'Hayricks' (CD No 14) linked to form a 'necklace' for the rapid demolition of a typical steel target.



New range demolition equipment. Initiation train composed of gripswitch, flash initiator, safety fuze, couplers and detonator, about to be screwed into the 2 lb PE 4 demolition slab.

Note: The illustrations on this page are not to uniform scale.



Groves Battery (Upper) and Thermogalvanometer (Lower)

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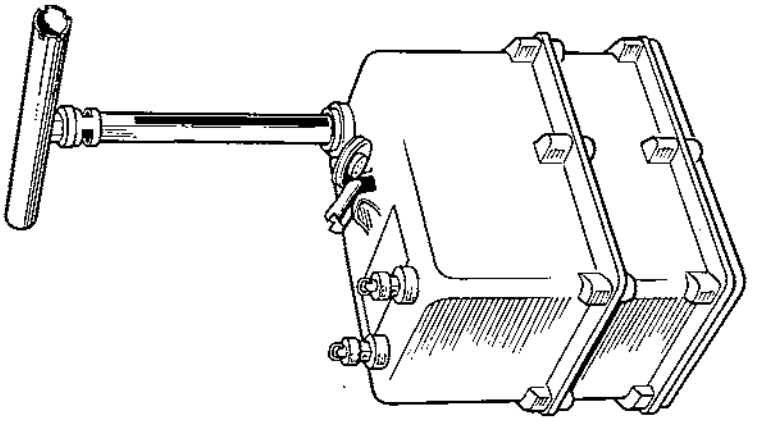
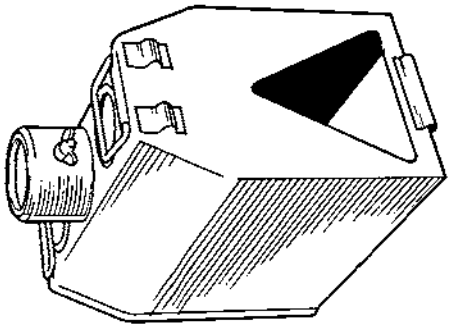


Exploder Dynamo Electric Mk VII



Charge Demolition No 14 (11 lb 'Hayrick')

Note: The illustrations on this page are not to uniform scale.

CONCLUSION

In these three sections we have shown how the equipment used by the Corps has changed over the last hundred years, and we know that many items of Engineer Stores and Equipments have not been mentioned, such as airfield surfacing materials, POL bulk fuelling stores, materials handling equipments such as cranes and fork-lift trucks, to mention a few, but the article is already long enough and most of these items have been covered in other articles which have dealt in more detail with a particular subject.

With Combat Development studies endeavouring to predict the future form of warfare up to twenty years ahead it is possible to see how equipments may evolve during this period, but technology is advancing so fast that it appears likely that the equipments of a hundred years from now will have much less in common with those of today than these have with their predecessors. Though we have given some indication in parts of this article of the trends of future development no attempt is going to be made to predict what the 2070 equipments may look like.

* * * * *

ACKNOWLEDGEMENT

To: Lieut-Colonel B. S. Beddall, OBE, MC, Lieut-Colonel G. S. Harris, Lieut-Colonel W. E. Dotterill (retd) and Major A. R. Young for their substantial contributions to this article and to the staff at RSME and MEXE (now MVEE(C)) and the Corps Librarian, Lieut-Colonel F. T. Stear who helped with the photographs and records.

Developments in Military Survey 1870-1970

CAPTAIN D. E. LYDDALL, RE

INTRODUCTION

In tracing the history and development of military survey over the past hundred years it is necessary to follow that of the Ordnance Survey of Great Britain particularly in its early stages. After the Battle of Culloden in 1746 the Board of Ordnance, who in those days administered the artillery and the engineers, sent its Sappers to build roads and map the Highlands of Scotland. Later the threat of invasion from Revolutionary France made necessary a national survey, and thus the Ordnance Survey was born and named. Once the provision of an accurate military map of the British Isles had thus been assured an extension of the existing Department, or the creation of a new one, which could devote itself to the collection of geographical and topographical information about the Colonies and foreign countries seemed logical in a country with such vast overseas interests as Great Britain.

Consequently, in 1803, a Department under the Quarter Master General with the title "Depot of Military Knowledge" was formed. However in the long peace following the defeat of Napoleon in 1815, and the consequent lack of interest in military affairs, little was done in the field of mapping. Only during the Crimean War (1854–56) through the persistence of Major (later Lieut-Colonel) T. B. Jervis, who had acquired and reproduced at his own expense copies of a Russian map, was the value of such information fully realized by the Government. A separate Department, directly responsible to the War Office, was thus formed in 1855 and called the Topographical and Statistical Department. It is against this background that the Military Survey Service came into being.

From the time the Ordnance Survey was formed, RE officers have been involved in its work, and indeed the first military Survey Companies of Royal Sappers and Miners were formed in 1824–26 to assist the Ordnance Survey in the trigonometrical survey of Ireland. This close association continues to exist to the present day, and in times of peace, up until 1939, the majority of military survey personnel were employed with the Ordnance Survey.

THE SITUATION ABOUT 1870

In 1870 the Military Survey Service was represented in the War Office by the Topographical and Statistical Department. The Department consisted of two officers, thirteen civil assistants and draughtsmen, four labourers and one military clerk. The condition of the Department was however unsatisfactory, not due to any lack of enthusiasm by the organization, but resulting from a lack of funds and the reluctance of the authorities to recognize its value.

When the Franco-Prussian War of 1870 broke out and the Government was in need of information about Continental Armies, it was apparent that a re-organization of the Department was urgently required. This took place in 1871 and, two years later, the Intelligence Department was created in the War Office and the Topographical and Statistical Department allied to it. In 1874 the Intelligence Department was transferred to the QMGs Department and, with minor alterations, continued as such until 1904.

In 1870 the survey of an area was carried out by classical methods, that is to say measurement of a base line to establish scale, astronomical observations to determine latitude, longitude and azimuth and triangulation to provide accurately determined positions. From these positions map detail was inserted by chain survey or by field sketching. These methods, established on sound scientific principles, had

been used since Renaissance days and changed little over the next half-century. Indeed the major developments that did take place were generally limited to refinements of equipments.

Base lines were measured in the horizontal on wooden trestles by composite bars of iron and brass, each 10 feet in length, six to a set. This was a slow, tedious and relatively costly operation but an important one on which the scale of the subsequent triangulation and mapping depended. (See Photo 1.)

Although Ramsden's two Great Theodolites, each with horizontal circles 36 inches in diameter, had been used up to about 1862 on the triangulation of Great Britain, smaller theodolites, with 5 inch horizontal circles, were being used. The vernier, invented as long ago as 1631, was still in use as the principal method of reading the circles.

Computations were made laboriously by logarithms, the number of figures used depending on the accuracy required, seven figures being the most common.

The chain, introduced by Gunter in 1620, was used to provide detail at large scales. Abroad, the compass was used to make field sketches by those engaged on military reconnaissance.

Maps were reduced successively from larger to smaller scales using a camera, the process having been proved accurate and adopted by the Ordnance Survey in 1854. If the photographic process overcrowded detail at the smaller scales, the pantograph was used. Printing plates were prepared in a number of ways, the most common being direct engraving on a copper plate, drawing directly onto zinc or stone, or photographing a fair drawing and printing the negative on zinc, known as helio-zincography. Copper engraving gave the best results for producing limited copies but corrections, when necessary, were difficult and expensive. Helio-zincography was the most useful of all the processes and is still in use today to some extent. Printing of maps was carried out entirely by the Ordnance Survey on hand presses, two men producing 80 to 100 copies in eight hours. (See Photo 2.)

DEVELOPMENTS FROM ABOUT 1870 UP TO THE BOER WAR (1899–1902)

Despite the lessons of previous wars, the British Army was sent to South Africa at the outbreak of the Boer War with neither military surveyors nor maps. This situation was again due, not so much to defects in the topographical organization, as to neglect on the part of the authorities to make proper use of it. Money was available to build coast defences in South Africa, but none was spared to make military maps of the country. Although maps were available commercially their existence was not discovered until the war had been in progress for some time. For the first year of the war there was no officer specifically responsible for map making nor for sketching the topography. Consequently successive columns of troops travelled over the same ground in complete ignorance of what lay ahead. In due course three Topographical Sections were formed and these were able to compile maps from farm surveys, other topographic material and route sketches.

As far as technical methods were concerned, an important advance in base measurement was made in 1880 with the introduction of steel wires 20 metres long supported in catenary. Base lines could now be measured on the slope and more quickly than before but it was not until 1896, when the alloy invar became available, that accurate and comparatively easy measurements could be made with wires which were virtually unaffected by temperature changes. (See Figure 3.)

About 1900 a prismatic astrolabe was invented which simplified astronomical observations. By its use surveyors were able to determine latitude and longitude simultaneously. (See Photo 4.)

Although a form of plane table had existed since about 1600, it was not introduced for military survey use until as late as 1879 possibly because it was considered too cumbersome for mounted officers. For the next sixty years or so it formed the main equipment for all military surveyors engaged in the rapid production of reconnaissance maps at smaller scales.

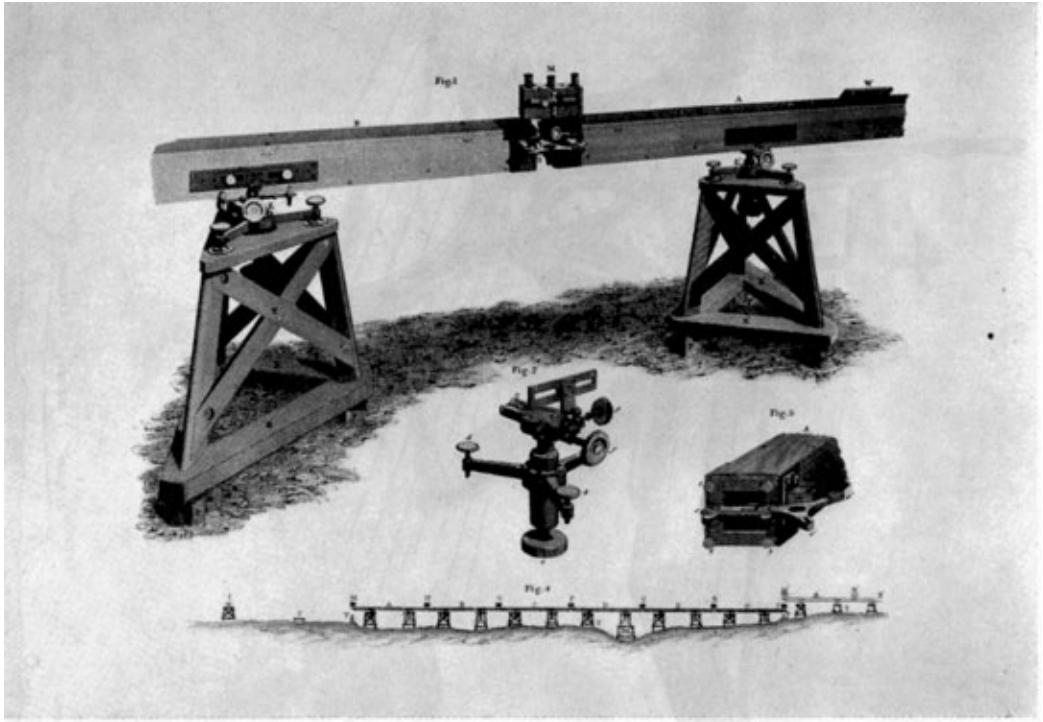


Photo 1. Base line measuring equipment in 1870

Developments in Military Survey 1870-1970

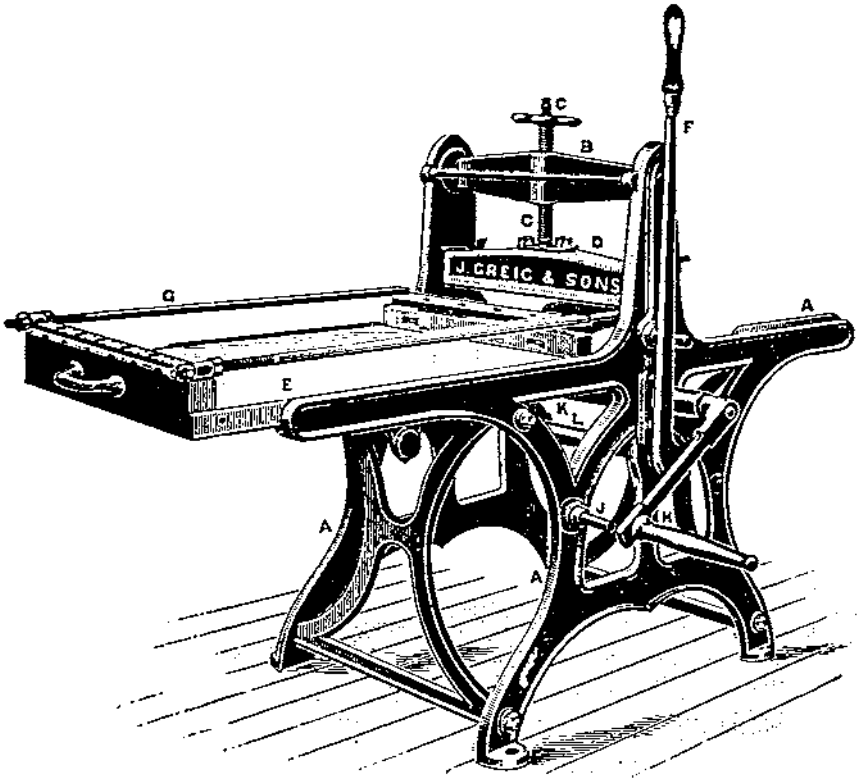


Photo 2. Early lithographic hand press

Figure 3. Base line measurement in catenary

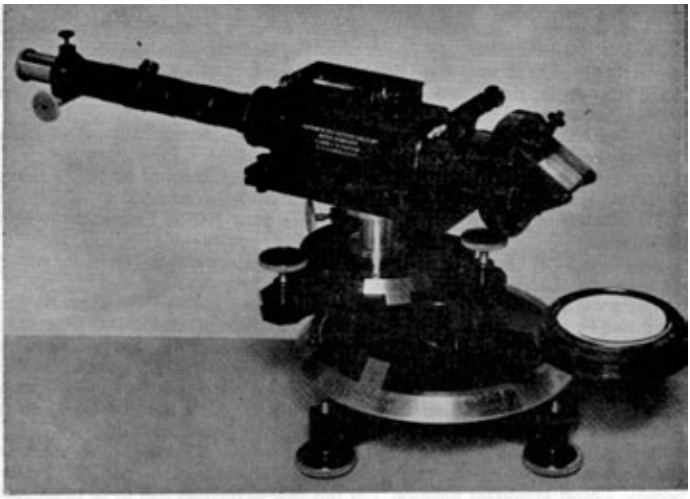


Photo 4. Prismatic Astrolabe (1900)

PROGRESS UP TO 1914

In 1904, as a result of experiences in the Boer War, the Intelligence Department was again re-organized and the name changed to the Directorate of Military Operations. The Directorate formed one of the Branches of the newly formed General Staff and was divided into four sections, the fourth being the Topographical Section (MO4). Not only was the new Topographical Section expanded but for the first time was allotted substantial funds with which to work. It undertook compilation of maps in several partially explored regions of the Empire and it was able to increase the number of officers working on Boundary Commissions. The staff of the Topographical Section in 1905 comprised nine officers, four soldiers and thirty civilians.

In 1905 Major (later Sir Charles) Close, RE was appointed to command the Topographical Section and this coincided with a new Director of Military Operations who fully realized the Section's importance. It was further re-organized, designated the Geographical Section General Staff (GSGS) and given improved status. By 1911, when Close left the Section, a new principle had been introduced, that of forward planning, and for the first time in its history the British Army included maps in its mobilization equipment.

Techniques and instruments changed little during the period up to 1914. Vernier theodolites were still in use, but theodolites fitted with micrometer microscopes to read the circles and also transit instruments were now generally available.

The printing of maps was still almost entirely the responsibility of the Ordnance Survey on power-driven flat bed and rotary offset machines and hand presses. Flat beds, although capable of about 1,200 impressions an hour, normally produced only 3,000 impressions in an eight hour day. The problem of registering each colour reduced this figure for a multi-coloured map. The more expensive rotary machines were able to print at about double that rate.

EXPANSION DURING THE 1914–18 WAR

In 1914, the organization for map provision in war was based on the anticipated needs of a small Expeditionary Force, operating under favourable conditions, and on the supply of small scale maps printed in England. It comprised:

(*a*) A Topographical Sub-Section of the General Staff at GHQ consisting of one Captain and a clerk.

(*b*) One officer and a clerk attached to HQ Lines of Communication to supervise map supplies.

(*c*) One Printing Company RE with its HQ on the Lines of Communication. In the original plan, a small Mobile Printing Section was attached to each Corps HQ. Unfortunately, these were returned to Company HQ by Corps shortly after mobilization.

As events turned out this showed a totally inadequate conception of the survey requirements of an Expeditionary Force embarking on a modern war.

The growth of the Military Survey Service during the war was extensive and rapid, and by 1918 the organization had increased to one of nearly 5,000 officers and men. Topographical Sections were formed from trained military surveyors, recruited from the Ordnance Survey, and from suitable men in other RE units in France. Printers particularly were obtained from men in the printing trade serving in units within the BEF. As the war developed the Topographical Sections expanded to Field Survey Companies and in 1918 to Field Survey Battalions.

Originally the main task was the provision of large scale maps of forward areas but, later, the fixation of enemy gun positions and other targets for our own artillery became a most important function. For this new techniques had to be developed, including sound ranging and flash spotting. (See Photo 5.)

Photo 5. Mapping the Western Front (1914–18)

These were not the only technical advances; perhaps the most significant was the use of aerial photographs to provide up-to-date intelligence and mapping information in inaccessible territory. Although the errors inherent in a single photograph were known, methods to correct them were basic. Rectification of the photograph to make the detail on it fit fixed positions on the ground was all that was done.

Another development was the introduction of the grid. Formerly, map references were made by referring to lettered and numbered squares drawn arbitrarily on the map, a method applicable only to individual maps. The use of the grid provided a unique reference to any point within the theatre of operations on any scale of map. This involved a study of the use of map projections and compelled the GSGS to take a greater interest in geodesy.

The Printing Company RE that went to France in 1914 was equipped only for rapid reproduction of field sketches, panoramas and enlargements of existing maps. It was not until the end of 1916 that maps were printed in France; before then the Ordnance Survey printed all maps. Field Survey Companies and Battalions used flat bed printing machines. Later machines capable of printing larger maps became available. Although not regarded as mobile, both types proved reliable and withstood constant dismantling and re-erection. In 1917, proposals to carry mobile printing plant in 3-ton lorries were vetoed because of the shortage of transport.

The supply of maps was not without problems. Large mobilization stocks of maps of the areas where the British Army was expected to operate were issued to units of the BEF on embarkation. At the time it was thought that the BEF would be independent of further supplies for some time, perhaps the duration of the war, which was not expected to last more than a few months. However the BEF evacuated the area covered by the maps in its first operation and the greater part of the original issue found its way back to the base areas on returning supply trains. Limited supplies of maps of the new fighting areas were hastily acquired and issued personally by the officer in the Topographical Sub-Section. After that the supply situation improved enormously and, by the end of the war, 34 million maps had been printed of which 31 million had been issued to troops.

PROGRESS DURING THE INTER WAR YEARS 1919–1939

At the end of 1918, all RE Survey units were disbanded except for one located near the Ordnance Survey office at Southampton. This was the Survey Battalion and became in effect, a depot unit for military personnel serving with the Ordnance Survey. A further unit, 19 Survey Company, RE was formed in 1929 for training purposes. Few RE survey personnel served elsewhere except on occasional exercises either at home or abroad. The responsibility for Artillery Survey, which had developed to become one of military survey's major tasks, was passed to the Royal Artillery.

The employment of military survey personnel thus reverted to the pre-1914 system. This was unfortunate because in the critical years leading up to the Second World War, there was little opportunity for them to learn and practise their wartime survey duties or to accustom themselves to Army organizations and procedures. The only survey representation at staff level was GSGS at the War Office. This Section worked under the Director of Operations and Intelligence, after 1920 as MI4. It was headed by an RE Colonel and worked at Branch level. It totalled, at its maximum, shortly before war was declared in 1939, about eighty officers and civilians.

In 1939, immediately prior to the outbreak of war, the strength of the Military Survey Service was:

	Officers	*Soldiers*	*Civilians*	*Notes*
GSGS (MI4)	8	—	75	
Survey Battalion	20(*a*)	450(*a*)	—	(*a*) All serving with the Ordnance Survey.

19 Field Survey Company	3	50(*b*)	—	(*b*) Some non-RE Survey.
Secondments to Colonial Office	20(*c*)	50(*c*)	—	(*c*) Numbers varied. Average number quoted.
	51	550	75	

During the 1914–18 War the Military Survey Service had undertaken to provide maps for the Royal Flying Corps, later the Royal Air Force. When the war ended the question of permanent map supply to the RAF was raised. Accordingly in 1919 it was agreed that henceforth the Military Survey Service would continue to be responsible for this, an arrangement which exists to the present day.

This period is marked notably for improvements in theodolite design and developments in air survey. British theodolite design, which earlier had been supreme, had fallen behind Swiss and German practice. Rather than purchase from these sources it was decided to invite instrument manufacturers to meet surveyors at a place where British and foreign models could be compared. This took place at Tavistock in 1926 and resulted in the introduction of the "Tavistock" theodolite which remained in favour until very recently. One of its features was the use of glass engraved circles, completely enclosed, illuminated and viewed through an ingenious optical micrometer which eliminated the need for vernier scales. (See Photo 6).

Much had been done in the 1914–18 War in air survey, and, on the Continent, new ideas and instruments for plotting from air photographs were becoming increasingly in evidence. However, because our country had been so well mapped previously, our developments in this respect tended to lag behind. The appointment of Captain M. Hotine RE as a permanent research officer to the Air Survey Committee in 1925 did much to remedy this. Under his direction, methods and equipment suitable for field use began to appear. The most notable of these was the "Arundel" method, based on the radial line principle, and a simple topographical stereoscope used with it for mapping from air photographs by graphical methods. This system was in use in 1926. By 1939 these and later developments in air survey were such that they could supplement and indeed replace the plane table as a means of producing topographical maps. (See Photo 7.)

THE 1939–45 WAR

The pre-war organization of GSGS was inadequate both in size and general arrangement for dealing with all the problems that would arise when preparing for a major war. The geographical extension of active operations and the increased planning involved made it necessary that the GSGS be kept fully and immediately informed on current and future operational requirements, and whilst it remained a Branch it was not getting sufficient information of this type. Accordingly in 1941, it became the Directorate of Military Survey under Colonel (later Brigadier) M. Hotine with much the same organization as exists today. For the first time also Survey Directorates were established on the Staffs of all major Commands at home and abroad.

During the course of the Second World War, the Military Survey Service grew to a size undreamt of a few years earlier. At its peak it numbered about 10,000 officers and men.

The war provided impetus in many fields of development, the main one again being in air survey. Up until about 1942, the standard method of plotting from air photographs was based on the radial line (Arundel) principle. American topographical units arrived in Europe in 1942 equipped with "slotted template" machines and, when introduced into British survey units a year or two later, largely replaced the tedious graphical method. The Americans also introduced the Multiplex plotter, an equipment which attracted considerable attention owing to its obvious advantage

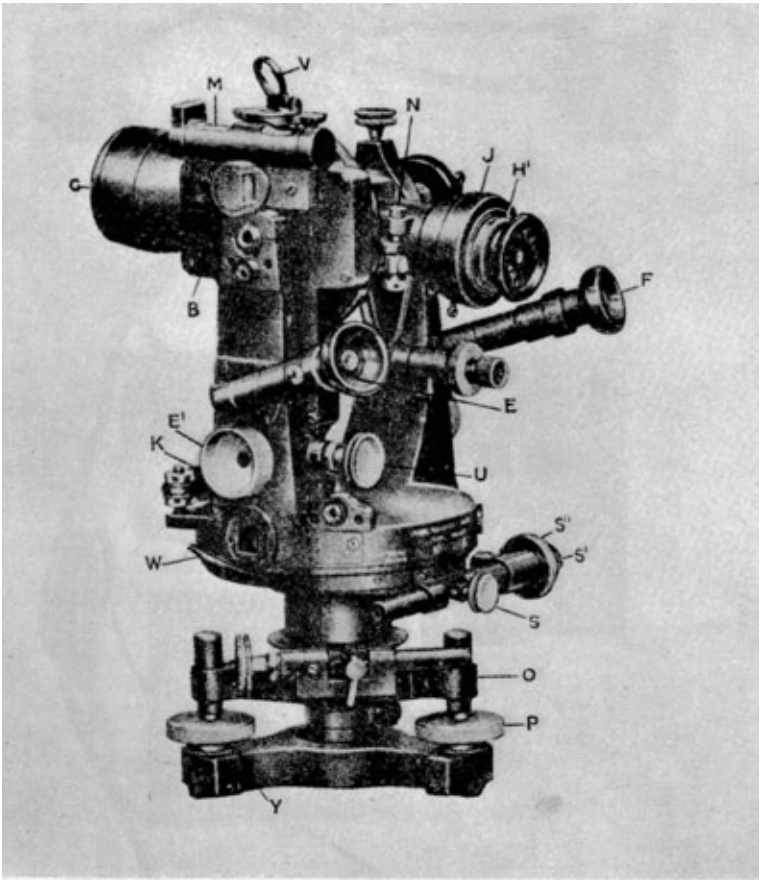


Photo 6. Tavistock Theodolite

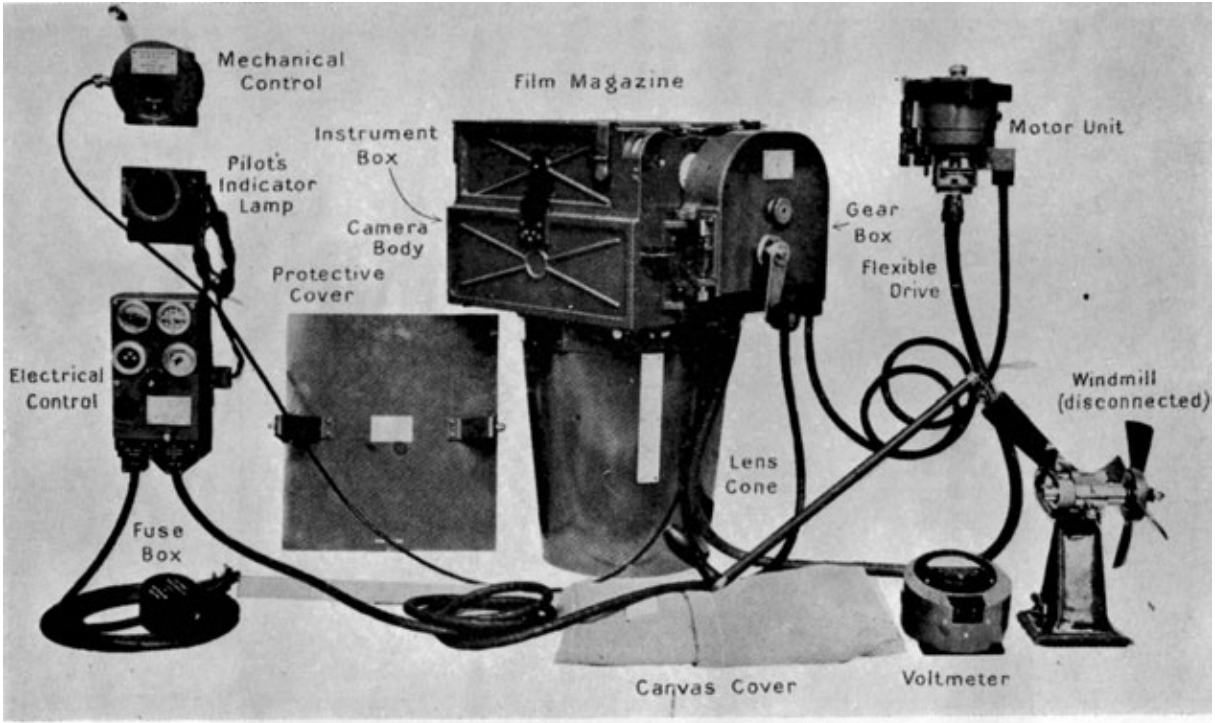


Photo 7. F8 Automatic Film Camera for air survey (1932)

in speeding up war-time mapping. (See Photo 8.) These were basic changes and it is natural that they finally brought about the demise of the plane table.

Another development during this period was the introduction of hand calculating machines to speed up computations. Surveyors were now able to use natural figures and tables of trigonometrical functions as opposed to logarithms.

The survey units which went to France with the BEF in 1939 were equipped with hand-fed printing presses mounted in trailers. Although there were advantages in being able to print maps of normal size the great weight and size of the trailers proved a disadvantage. Further, the prime movers were not part of the unit's establishment and had to be borrowed when required. Work was thus hampered by lack of mobility. After 1940, new lorry-mounted equipment was introduced which became standard for all Field Survey Companies. The lorries contained printing presses with fully automatic feed. Each printing lorry was paired with another containing ancillary equipment. Similar vehicles, again working as pairs, were equipped with a camera and dark room.

POST WAR PERIOD

Demobilisation and the end of National Service, saw the Military Survey Service gradually contract from its war time ceiling to its present day total of about 100 officers, 500 military surveyors and 800 civilians.

Photo 8. Multiplex Sterco Plotter

It is in this period that the most significant advances in ground survey techniques took place. The geodimeter (invented in 1947) and the tellurometer (1956), known collectively as electro-magnetic distance measuring equipment (EDM), have made possible the rapid measurement of long lines, revolutionizing the classical method of triangulation. (See Photo 9.) Tri-lateration, that is to say the measurement of all the sides instead of the angles of a triangulation, and traversing with these instruments are now accepted methods.

Photo 9. Tellurometer

The threat of inter-continental missiles caused military surveyors to take a closer interest in the shape and size of the earth. During the last few years it has become possible to link continents with the aid of artificial satellites and two methods are currently used to determine the position of an unknown ground point in relation to three known ground points which may be hundreds of miles apart. The SECOR method relies on radio ranging, whilst the BC4 method relies on simultaneous photography of a satellite against a star background. Both are employed by 512 Specialist Team RE (Geodetic Satellite Survey). The SECOR method was described in the *RE Journal* of September 1965. (See Figure 10 and Photo 11.)

Hand computing machines have gradually given way to electric desk calculators and in recent years to electronic computers; now it is possible to perform in a matter of hours calculations that would formerly have taken a human brain many months to complete.

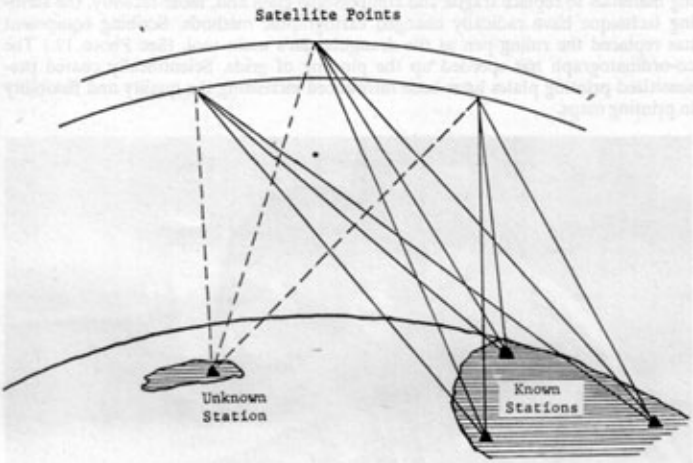


Figure 10. The Secor method of fixing the position

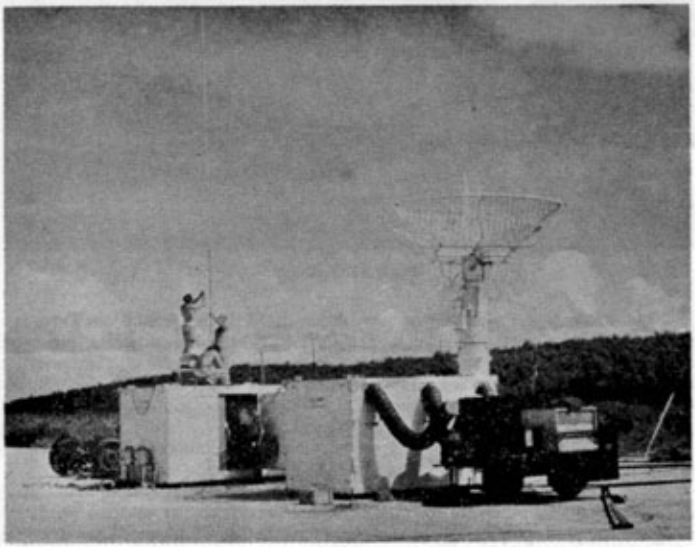


Photo 11. Secor Station on Guam

In the drawing office the introduction of dimensionally stable but flexible drawing materials to replace fragile and cumbersome glass and, more recently, the scribing technique have radically changed cartographic methods. Scribing equipment has replaced the ruling pen as the draughtsman's main tool. (See Photo 12.) The co-ordinatograph has speeded up the plotting of grids. Scientifically coated presensitized printing plates have been introduced increasing the quality and flexibility in printing maps.

Photo 12. Scribing

Field Survey Squadrons are now provided with the mobile print train. These are fleets of six 10-ton semi-trailers equipped for all map making processes, from the compilation and scribing stage to the finished article. (See Photo 13). The printing machine in the print train is a Crabtree rotary offset which will print two colours of a multi-coloured map simultaneously at 5,000–6,000 copies an hour. (See Photo 14.)

All theodolites now in standard use are extremely compact and incorporate graduated glass circles reading to one second of arc or better. (See Photo 15.)

Air survey cameras and film have undergone continuous development since 1945. Then, it was necessary to rely on photographs taken by cameras primarily designed for photographic reconnaissance. Now the use of advanced stereoscopic plotting machines calls for special attention to camera design and film manufacture to eliminate errors and distortions.

Photo 13. Mobile print train in BAOR (1968)

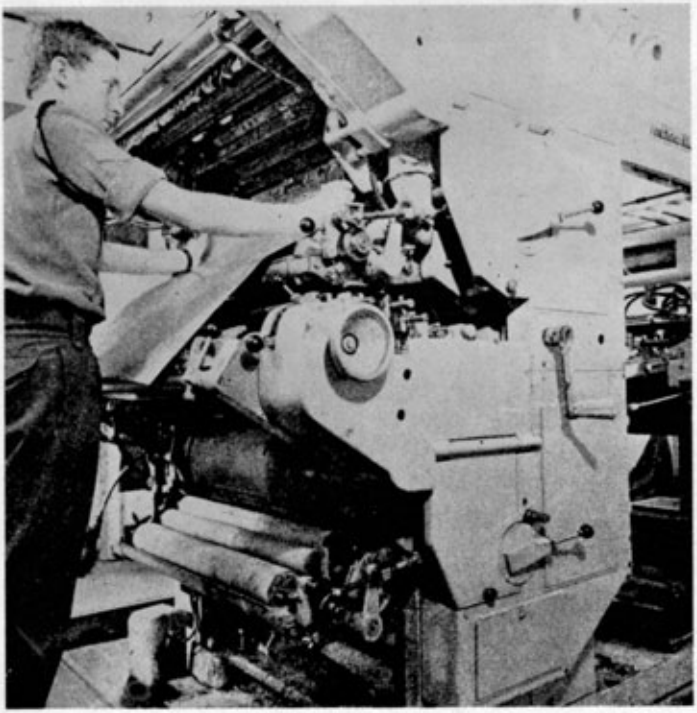


Photo 14. Crabtree rotary offset printing

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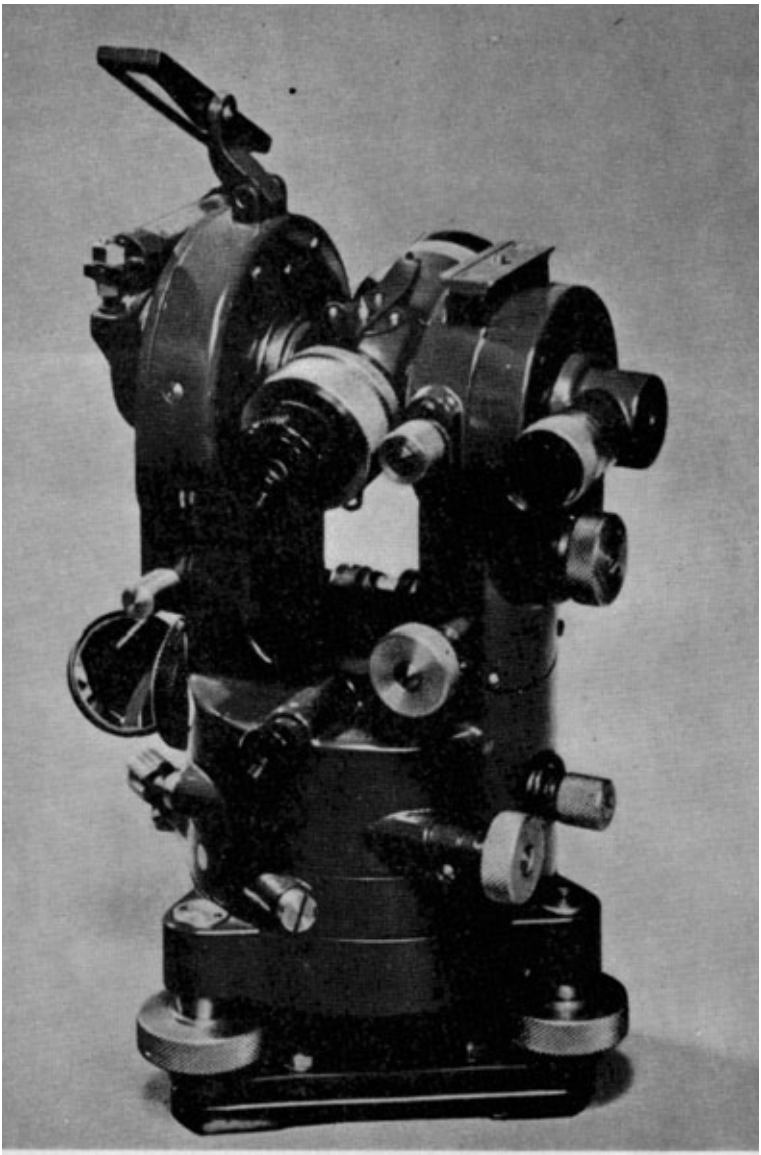

Photo 15. Watts Microptic Theodolite (1954)

Developments in Military Survey 1870-1970

The re-projection of map detail on film for moving map displays inside the cockpit of an aircraft as an aid to navigation is a process which has recently been developed.

CURRENT TRENDS

In a modern technological age, the Military Survey Service strives to keep pace with developments elsewhere and currently research is being made in a number of fields. The electronic computer is making, and will continue to make an increasing impact on mapping for military purposes. It offers a method of storing huge quantities of survey data in digital form for use later in many ways.

One such use now under development is for automated cartography. All points of detail on a map can be digitized and are then capable of being re-created at any scale to the programmer's choice. Topographical information may be supplied direct to the user in a number of forms without even producing a recognized map.

In air survey the trend is towards automation and economy. The computer permits the processing of large quantities of data supplied by simple high precision photogrammetric plotters more quickly and accurately than before, with fewer aerial photographs and less ground control.

Modern weapon systems using advanced tracking, navigation and locating devices demand mapping information obtained direct from a computer store.

Rapid response printing and overprinting of maps are real requirements of modern war, and a number of processes are being examined. Equipment for this purpose may become air portable.

CONCLUSION

This résumé of the development over the past hundred years of military survey would not be complete without a brief mention of the Survey of India. This was a gigantic enterprise in which for nearly 200 years, RE Officers played a leading role. When Independence came to India, Pakistan, Ceylon and Burma in 1947 the Sub-Continent was in many respects the best mapped area of comparable size in the world.

It is true to say that the busiest time for the Military Survey Service is in time of peace; in war it, may be too late to produce sophisticated maps of operational areas. The Military Survey Service can best fulfil the needs of the Armed Forces by mapping wisely in peace.

* * * * *

The Post Call
A Story of the RE operated Postal Service

MAJOR R. N. R. P. JAMES, RE AND MAJOR J. WILLIAMS, RE

INTRODUCTION

ALTHOUGH spasmodic references to a military mail service appear from the early 17th Century, our service takes its origin from a memorandum to the Post Master General, dated 15 August 1799, in which HRH Duke of York, second son of George III, recommended that "a good and intelligent clerk should accompany the Army (to North Holland) to manage the whole correspondence, to facilitate delivery and to collect letters and protect the revenue". The man appointed was Henry Darlot who recorded upon arrival of the mail "I was beset by at least a hundred officers and non-commissioned officers who insisted on looking for their personal letters before the Drum Majors (who were appointed Post Orderlies) could get them."

In 1855 a small volunteer element from the Post Office was seconded to the Secretary of State for War to handle mail for the Crimean War.

FORMATION OF A POST OFFICE CORPS AND RE TELEGRAPH RESERVE

The formation of a Post Office Corps was authorized on 22 July 1882 by Queen Victoria by a Warrant which also coupled with it the formation of a Corps of Military Foot Police. Although it gloried in the name of a Corps it was formed from a Company of the 24th Battalion Middlesex Volunteers (Post Office Rifles) first commanded by Major John Du Plat Taylor, then Private Secretary to the PMG. Thus the "Corps" of two officers and one hundred men were transferred to the Army Reserve for service overseas when needed. A detachment of the Corps served with the Expeditionary Force in the Egyptian Campaign of 1882 where they earned high praise.

In 1884 a second Army Postal Corps was formed with the title of Royal Engineer Telegraph Reserve, which provided a detachment for service in the first Sudan Campaign (1884–85).

In 1899 the two Reserve Corps were formed into two Supplementary Companies, one preserved the title of Royal Engineer Telegraph Reserve and the other was entitled the Post Office Corps. Under these two companies an efficient postal and telegraph service was provided during the South African War (1899–1901). When the 11 officers and 640 other ranks returned from South Africa after the War they transferred to the Reserve and were re-employed by the civil Post Office.

FORMATION OF THE RE POSTAL SECTION

A further reorganization of the two Reserve Companies took place in 1908 when they were amalgamated into the Royal Engineers (Postal Section) with a complement of 10 officers and 290 ORs, and it has remained under the wing of the Corps ever since.

FIRST WORLD WAR

At the outbreak of the First World War the total establishment of almost 300 were sent to France with a small nucleus remaining behind to set up a base Depot. By the end of the war about 7,000 officers and men of the RE (PS) were serving in every theatre of operations.

The mail was carried from home to its destination by the most wide variety of transport imaginable. The ingenuity and resourcefulness of the postal Sappers in

getting mail to the troops earned the following tribute from Ian Hay: "The Postal Service provided for the forces in 1914–18 was one of the unadvertised marvels of the war."

The Home Postal Depot, formed in 1914, fulfilled two functions. It trained personnel for Formations proceeding overseas and provided reinforcements, and it served as the central sorting and distributing point for all Forces mail for the Armies overseas. When the armies abroad were at their maximum strength the outward mail consisted of about twelve million letters and a million parcels a week. From a strength of 300 personnel in 1914, the Depot grew by 1918 to 2,500, of whom nearly 1,200 were women, and it was eventually housed in premises with five acres of floor space.

THE FIRST AIR MAIL SERVICE

During the latter part of 1918 experiments, using specially modified aircraft, were made for transporting troops' mail by air. In March 1919 the first regular Airmail Service was set up to provide the British Army of the Rhine with a fast mail service. In 1969 the 50th Anniversary of the occasion was celebrated by producing a special philatelic cover despatched and flown across the original airmail route—Folkestone to Cologne. RE (PS) can, therefore, claim to be the pioneer of the use of air transport for mail, and the system was so successful that it was soon adopted by civil Post Offices all over the world.

In 1929 and 1930 volunteers maintained a postal service during the troubles in China with bases at Shanghai and Tientsin. And in 1936–39 the RE (PS) raised a detachment of volunteers for service in Palestine during the Arab Rebellion.

However the lessons of the period up to 1914 had not been learned, and between the two World Wars the RE Postal Service was allowed to dwindle to an all reserve force of 15 officers and 250 ORs.

SECOND WORLD WAR

Predictably in 1939 a similar precipitate rush occurred to that in 1914 to form operational Postal Sections. Fortunately a great response by GPO employees, all volunteers, soon put the RE (PS) back on a sound footing, and by 1945 the total number of personnel employed was 7,000, the same as in 1918.

The Second World War brought with it the particular problem of transport, especially to the Mediterranean where the Navy was so sorely stretched in protecting the sea routes. Again ingenuity provided an answer, albeit unpopular, namely the airgraph. Letters were photographed in UK, reduced in size, and sent by air as film to the forward base where they were reproduced in larger print. Naturally the lack of privacy in this form of correspondence was not liked; the airgraph however was soon superceded by the introduction of the flimsy air-letter form which was vastly more popular.

As the War progressed Field Force Commanders realized fully that a regular detachment of RE (PS) with forward troops was a primary factor in the maintenance of morale, and it was held by a famous Commander that his soldiers could march for three or four days without food on the strength of one letter from home. RE (PS) landed with the Sixth Airborne Division by parachute and glider during the opening of the Second Front in June 1944, and Postal personnel were amongst the sea assault troops with the Fifth and Sixth Beach Brigades. Field Post Offices were established on the Beachhead within a matter of hours. Within a week or so of the assault all letters and postcards were being transported by air, the aircraft landing on emergency landing strips in Normandy. In 1944 the old system of bringing up the mail with the rations was finally buried and mail was given such priority that a regular 24 hours a day network by air, rail, and road was provided for the forward troops. The pattern was set for the future, and it is certainly now the tradition that both on Exercises and on Operations the postal support is always in the advance party.

POST WAR DEVELOPMENTS

With the cessation of hostilities in 1945 there remained a relatively large number of servicemen in overseas commands, and the retention of National Service enabled the British to maintain a global role which demanded the continued presence of an efficient Forces Postal Service. From the lessons learned at the outbreak of the Second World War it was quite obvious that there could be no question of the RE (PS) reverting to a Reserve Force as this would entail subjecting the troops to a lower standard of service. The RE (PS) therefore adjusted itself to meet the needs of a comparatively static customer and with the improvement in communications, such as the re-introduction of civil air routing, it capitalized on every opportunity to achieve the fastest transmissions of mail.

In 1949 the Services Postal Executive Committee was formed. This was the first step in the direction of rationalization and brought together representatives from the Admiralty, War Office, Air Ministry, General Post Office, Ministry of Transport and Ministry of Aviation. The Committee under the Chairmanship of the Director of Army Postal Services became the policy-making organization of the three Services with a charter to "Settle postal procedure and technical questions as between the three Services, the Merchant Navy, and Postal Authorities, and to carry out the necessary planning for wartime postal services for the Armed Forces and the Merchant Navy." It continues to function and it was largely responsible for the smooth progress in reaching the totally integrated tri-service system which now prevails.

The outbreak of the Korean War in November 1950, and the inclusion of British troops in the United Nations Force, re-activated the RE (PS) to its field force support role. Postal units were sent to serve the two British Brigades and an L of C unit established a base in Japan, which included representative elements of the Canadian and Australian Forces Postal Services. It was during this period that the first civil jet air service was utilized for the carriage of mails with the result that mail from the United Kingdom was reaching operational troops within a few days of being posted.

In the early fifties the service consolidated its position in Europe and, although withdrawal of British troops from Istanbul and Trieste saw the closure of Forces Post Offices in those locations, new commitments arose. The formation of SHAPE, HQ ALFCE and HQ AAFCE brought about the introduction of postal units into France. The withdrawal from Egypt also entailed a transfer of the Middle East Command Depot to Cyprus and establishment of units in Tripoli and Aden. It soon became an established fact that the high standard of service provided by the RE (PS) was superior to that of civil administrations with a consequent demand from Commands for BFPOs to serve in all overseas locations. The outcome was to find the ubiquitous RE (PS) represented from British Guiana in the west to Honolulu in the east.

In 1953, initially as an experimental measure in BAOR, the Army Postal Service undertook the responsibility for the transmission of classified official mail, which was subsequently to become the "Security Courier Service". This commitment was taken over from the Royal Signals and the Royal Air Force (Special Despatch Service). It is of historical interest to note that, when the Corps of Signals obtained separate identity from the Royal Engineers in 1920, they took with them the responsibility for handling classified mail. Unfortunately this arrangement did not prove particularly satisfactory and, with the sophistication of modern electronic communications, the Royal Signals found it increasingly difficult to maintain a ground and air movement capability for this function. The obvious, and already proven, alternative was to devolve the task on to the Army Postal Service with its established worldwide network of mail communication terminals. By gradual process the transfer took place, and today the Forces Courier Communication network undertakes the responsibility for the safe transmission of classified material, not only for the three Services, but also for Government Communications. This is achieved by scheduled and

unscheduled movement utilizing both civil and military air opportunities. The Courier service in the main parallels itself on, but is separate from, the normal mail service.

The RE (PS), in keeping with other Arms of Service, maintained an Army Emergency Reserve with varying liabilities. Selected units from this force were mobilized for the Suez operation. One took part in the landings whilst others stood by in reserve in Malta and Cyprus.

Today, under its new title of T & AVR, the reserve element numbering over 1,000, wholly recruited from the civil Post Office, provides a highly technical, trained reinforcement backing for Strategic Command, and NATO, as well as being ready to meet a communications' task in the United Kingdom in war. In peacetime the reservists, apart from normal training, participate in exercises both in UK and overseas commands, they also establish FPOs in camps throughout the United Kingdom in support of T & AVR units during the Annual training season. This close relationship with members of the GPO presents opportunities for exchange of technical information from which many improvements in the service have evolved.

Following the consolidation of the Service in the fifties, RE (PS), now the RE (Postal and Courier Communications Service), became organic to every field formation. Each Brigade and Division includes a PCCU, tailored to provide maximum Postal and Courier support in any situation. Operational demands such as Radfan and Borneo required a PCC presence as did the RAF task force in Zambia.

A further development in the cause of rationalization took place in 1962 with the take over from the civil Post Office of the responsibility of HM Ships mail. Previously mail for Royal Navy and auxiliary ships afloat had been processed through GPO London. With the transfer of the Home Postal Depot from Acton to its present location at Mill Hill it was found that the new mechanized sorting office offered a capacity to absorb the Ships' commitment, and the new customers were soon to discover that the Forces Post Office was every bit as capable as its civilian counterpart. The new arrangement presented opportunity for improvement in the Ships' mail delivery system. Teleprinter communications accelerated the complex location change mechanism, so vital to meet the synchronization of mail arrivals at ports of call. It also became possible to supplement the civil air outlets by RAF flights, hitherto unavailable to the GPO.

The RE (PCC) by virtue of its close liaison with the RAF, recognized the possibility of improving air drop facilities to ships at sea. Following an arduous and initially frustrating series of trials off the Aden coast a suitable container (Lyndholm), originally used for Air Sea Rescue purposes, was adopted for air drops. In succeeding months a full scale air drop programme was introduced to serve HM Ships operating on the Biera Patrol with only one minor mishap initiating a signal from HMS Eskimo which read: "DAMP BUT READABLE KEEP THEM COMING". To date over 1,000 successful container drops have been achieved and, although the coordination and painstaking packing falls to the RE (PCC), much of the credit goes to the RAF.

In any particular presentation of the Forces Postal Service one cannot pay sufficient tribute to the contribution made by the WRAC, formerly ATS, in both World Wars, and in the present organization. There are currently nearly 200 WRAC personnel employed in the service mainly at the Home Postal and Courier Communications Depot at Mill Hill and in 8 Command Postal and Courier Communications Depot at Dusseldorf. They are also serving with PCC units in Hong Kong and Cyprus. As qualified Postal and Courier Operators they undertake a full range of duties including sorting office and counter work in which they display particular aptitude. From their first introduction to the service in 1916 they have shown considerable resource qualities which are well maintained by those serving today.

In the History of the Second World War it was written: "It is to compliment by not being able to criticize the achievements of the Army Postal Service". When it is considered that the best possible standards only are acceptable, indeed tolerated, by those within the service there is little scope for criticism from without.

THE BRITISH ARMY POST OFFICE AT CONSTANTINOPLE

(from our Special Artist)

I send you a sketch of the British Army Post Office at Constantinople, an establishment of no mean importance in the vast military operations now going on in the East; conferring, as it does, such advantages both on the Army and the Navy, and in the midst of strife and bloodshed keeping up home ties, and carrying us back in thought to our peaceful firesides.

The staff employed consists of a postmaster and three assistant postmasters; eight clerks, who have been selected from the General Post Office in London; and two natives of Constantinople, who act chiefly as interpreters; for, although it was established as a British Army Post Office, many letters pass through it to and from the soldiers in the Turkish contingent, etc. Two of the postmasters and three of the clerks are employed in the Post Office in the Crimea, assisted by two intelligent non-commissioned officers.

The scene on the arrival and departure of the mails is one of the greatest activity. The boat from Marseilles brings from twenty to twenty-five bags, each as much as one of our strong-backed hamals (or porters) can stagger under; and the number of letters is said to exceed 12,000, and that of the papers 8,000. This vast number is sorted into regiments, brigades and divisions, and despatched to the Crimea and Scutari in the short space of two hours. The courtesy and attention shown by the officials in this establishment to the public presents a vast contrast to the brusquerie of the other post offices in this city.

Sorting mail at Dernacourt 1916.

Sorting mail in the Balkans 1917.

First airmail 1 March 1919.

Sorting mail BEF 1939.

The Post Call 3

An Editorial in 2020

(from the *Journal of the Military Engineer Institutions*)

BRIGADIER M. L. CROSTHWAITE, MBE, CEng, MICE, MBIM

IN 1970 the old *Royal Engineers Journal* celebrated its centenary. It is now fifty years since that time and although this issue is in no way intended to be a landmark in the publication of this Journal, it is perhaps appropriate to take stock—using that 1970 centenary edition as a point of departure.

The first point of interest to the reader of today is that in that issue of 1970 there was little attempt to look forward. As was to be expected, developments since 1870 were treated in full, but there was a discreet silence on the future. Why was this? Were our predecessors so obsessed with the past and present that the future was of no interest? Surely not! Was the subject too difficult and did the rate of change at that time seem so great that there was no inclination to indulge in what could have seemed mere science-fiction?

It is true that the rate of change round about the 70s was very great. Space travel, computers, automation—all these were just getting into their stride and it must have indeed been hard enough to keep up with existing thought—let alone to be sensible about the future.

It is, too, understandable that to judge whether the speed of change at that time was likely to continue at a constant pace, or whether it was increasing or declining, could have seemed an impossible task. The assumption must have been that it was increasing. In which case it was a formidable prospect for anyone attempting to think about the future.

However, as we would now know, the vital changes—those that would really effect the next few decades (anyway as far as the Services were concerned)—were already there, and could perhaps have been discerned. It has taken the best part of these last fifty years for the trends which were then apparent, to work themselves out.

But let us first take a look at that hundredth anniversary edition of 1970.

Our predecessors, when commenting on the old Journal's first 100 years, had a relatively easy task. At least like was being compared with like. In 1870 the Corps of Royal Engineers may have been primitive in technique, but the era of, say, Rorke's Drift had problems which were reasonably familiar, even at a time when a "Colonial" British Army was finally adjusting to being no longer the self-styled World Policeman. Furthermore, however remote a moon landing must have been to the young officer studying his engineering at Chatham in 1870, his successor in 1970 appeared to have no conviction that this symbol of technocratic victory could greatly effect his personal future. Perhaps it was all too difficult, as we have speculated above. But if the then readers of the Journal apparently expected no comment, it certainly made the Editor's task easier.

To be fair, on reading that centenary edition, and other contemporary military literature, it is remarkable how the rate of change until nearly the end of that hundred years had, in fact, been relatively slow. Militarily speaking, the changes in organization, training and equipment would have been perfectly understandable to a Sapper of 1870 and he would have had little difficulty in adjusting to the 1960s. Indeed, social and environmental changes are likely to have taxed him more than the impact of technical developments on his military life.

Certainly there was no particular grieving for times past or for opportunities missed. An Empire had gone, a role had still to be found and, for many, the quality of life was slipping. But it had been a hundred years of evolution—that is until the very end of the period in question.

The acceleration of change in the late 60s and 70s, as discussed above, must surely have given rise to considerable frustration. We have gently chided the generation of that time for assuming that this acceleration would be kept up, and that to look into the future was too difficult. It is as likely that the inability to comprehend

the trends more fully caused considerable unease. Especially so, if intuitively there was a feeling that the trends were indeed there, but the intellectual capacity to grasp them was lacking.

Let us now for a moment look back ourselves.

It has not been a particularly happy half-century, even though we have escaped a major war. If the moon landings, a triumph for the technocrat of fifty years ago, caused little premonition, the officer of that time was the happier for that. That is, if he was in any way a traditionalist which most were. However, it was clear even then that we were heading for absolute mobility, for selective annihilation, for total weapon automation. Total control of the fighting services by the politician and technocrat was well on its way and we can only wonder that our predecessors, however much "regimentally" minded, did not realize that total amalgamation within the Army, and to an extent between the Services, was to be planned for rather than resisted. In some ways we are still paying for this shortsightedness. The Services were reshaped from without rather than within, and much that could have been preserved, in the traditional sense, did not survive and we are the poorer for it.

This publication is no longer the *Journal of the Royal Engineers* as such, but the professional journal of those concerned in the application of engineering in military circumstances. Looking back, it is not really surprising that the Corps of Royal Engineers as a separate entity is now no longer. However, we are lucky that, thanks to its high standing, many of the traditions of that Corps, including its Headquarters, its School at Chatham and the form of its Journal, are still to be found in the Military Engineering organization into which it was absorbed.

The history of this development is outlined in this issue. Many will be surprised to learn that the architect of this wider development, and the man who managed to preserve so much of the old Royal Engineers was not a Royal Engineer officer at all! It was very fitting that this officer should have been the first President of the Military Engineer Institutions.

The second half of the twentieth century was the era of the deterrent. This was a concept which could only last so long as "pre-emption" could not be made absolute. Since the surety of a "second strike capability" can no longer be relied on the whole concept has had to be changed. The jargon of the era now seems strange, and readers not familiar with it should turn to the article on page 180.

The consequential emergence of a three power, mutually exclusive, grouping has not meant that other problems have been any easier. The management of universal unrest and the problem of maintaining stability in the face of rising populations and rising individual expectations, has bedevilled this century. This is discussed in the article on "Engineering for Peace—2020". Those that ever questioned the need for officers to have a university education, with the right blend of engineering, economics and politics, will surely find an answer here.

Push button weapons, sophisticated but understood, have given rise to a seemingly cast iron case for service integration. On the other hand the handling of universal unrest requires large numbers of paramilitary forces—forces on the whole best kept trained and compartmented according to function. It will be a long time before a generally accepted solution is found to the complete restructuring, which such conflicting factors have demanded.

As indicated above, the pull towards integration has won. But no one would pretend the solution is a happy one except, perhaps, in the Military Engineering world.

In the context of 1870, the article on "Submarine Miners—2020" has much of interest. The situation depicted here is a very far cry from the stalwarts who protected our ports towards the end of the nineteenth century. The sea, as we all know, may be a refuge, but security on the sea bed can only be founded on logistic power. In its turn logistic power depends on construction power. It is a fascinating development, and illustrates well how technical developments were bound to destroy divisions between the erstwhile technical Corps.

The article on "Recruiting" contains much of importance. Unlike our predecessors, for us soldier recruiting is not so much a problem. Automation and selective service have seen to that. Curiously enough, we are back to a time when a Corps of Officers—like the original Corps of Engineers—is required almost as an entity apart from the "Soldier Artificers".

It is, perhaps, not surprising that one common factor between then and now is the need for good officers. As this century has proceeded, it has become more and more difficult to come to terms with so called professionalism requiring, as it seemingly does, an excessive and unquestioning loyalty to technological values. An appreciation of these values, and the changes they must bring, is certainly needed, but for those in the Services there is still room for some of that quality in everyday life, which our forebears, in their time, had reasonably come to expect. If they would have been horrified by much of what they would find today, it is not difficult to sympathize. It is aspects of this quality which only good officers can hope to maintain.

This Editorial started on a patronizing note. Will our successors also accuse us of failure to recognize whether the rate of change during our times was increasing or declining? Our thesis has been that by the 1970s the main changes were already apparent and the trends were there for all to see. However, our own position may be exactly the reverse. The era of comparative evolution since the 1980s may be ending and the rate of change for us may now be about to accelerate. How blind are we also being to the trends of our time?

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W. & J. Mackay & Co Ltd

PRINTERS OF THE RE JOURNAL FOR OVER 80 YEARS

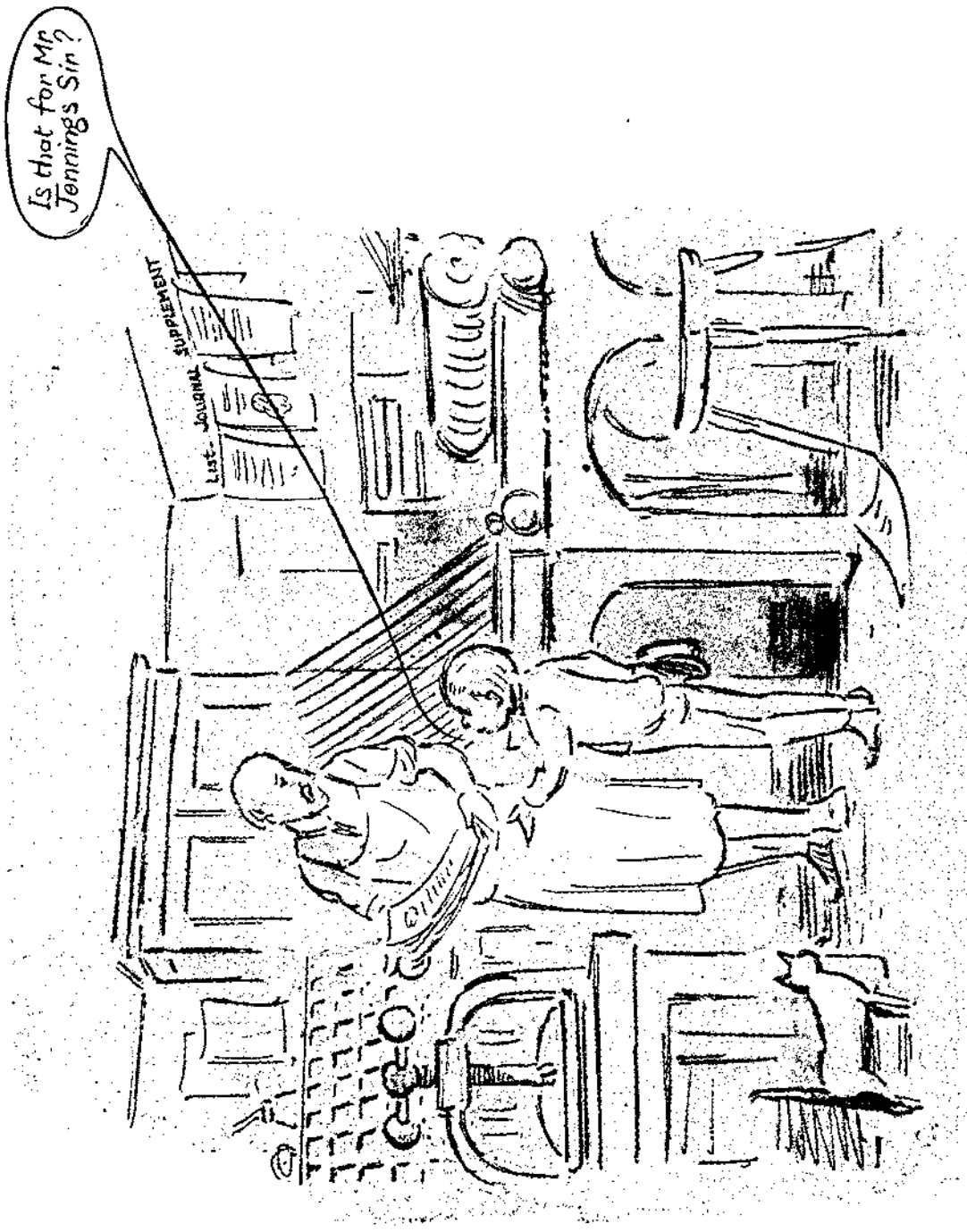
In 1870, the year in which the *RE Journal* was first published, two brothers, William and James McKay, set up a business in Leith, Edinburgh, as printers, lithographers and stationers, and called their business W. & J. McKay & Co. A few years later James caught pneumonia and, having recovered, was advised to move south to a warmer climate. This is why we have Mackays of Chatham today, for the two brothers purchased the small printing, publishing and stationery business of Mullingers in Chatham High Street, the publishers of the *Chatham and Rochester Observer*. Apparently at that stage they changed the spelling of their name to Mackay, perhaps to conform with the more general practice in England.

The partnership became a limited company in 1897, by which time the firm had already been printing the *RE Journal* for nine years, and has continued to do so ever since—a wonderful record of co-operation spanning eighty-two years and three generations of the Mackay family.

The firm had additional premises in Chatham High Street, a branch in Rochester and had acquired a candle factory in Fair Row, which is part of the present building. This, according to old documents, "abuts on the site of the old Town Ditch" now known as the Brook (from which the road gets its name) and which, like the river Fleet in London, runs through a culvert completely underground and under the post-war extension to the printing works.

A year after the formation of the limited company a branch was opened in Gillingham (then called New Brompton). It may be of interest that the first Linotype machine—which marked the end of type matter being set by hand—was purchased in 1903 and the first Monotype in 1912.

In 1908 the process engraving department was started by John Mackay, son of William, enabling the *Observer* to have illustrations for the first time. This department, which has grown into the Mackay Engraving Co Ltd, and which makes


Is that for Mr Jennings Sir?
List - Journal Supplement

blocks for the *RE Journal*, enjoys a reputation for work of very high quality in black and white and full colour. John, who never married and was the only member of William's family to come into the business, died after the Second World War. James' son, Percival, became a director of the firm in 1911 but, following a tragic accident, died in 1914. His brother, Leslie, took his place, sacrificing his chosen career as a musician. A few months later he was joined on the Board by his brother-in-law, Norman Miller. During the First World War James' then unmarried daughter, Nora, came in to "help out" with the wages, became a director in 1918 and remained with the firm until after the Second World War. Leslie and Nora are now living in retirement. The two founders died between the wars, James in 1925 and William in 1933. Leslie Mackay and Norman Miller became joint managing directors. Before the war started in 1939 each had a son in the business, Neil Mackay and James Mackay Miller. Both were to serve long periods in the forces. Shortly after the war another accident caused the death of Neil, who was Leslie's only son. Today the family directors are the three Mackay Miller brothers, James, Antony and Keith, and already the first of the fourth generation, James' son, Hamish, has joined the firm.

There have been many changes; the branches in Rochester and Gillingham have gone, the *Observer* was sold to the *Kent Messenger* in 1938 and the firm, now employing over 300, specializes in the printing and binding of books and other high quality work. A large warehouse and the book-binding works are in Gillingham, while the printing is still done in Fair Row. But this will not be for much longer as there has been a compulsory purchase to make way for the redevelopment of the centre of Chatham, and plans are now well advanced for a new factory to house all the printing and binding at Chatham's new industrial site at Lords Wood. Perhaps this will be a good way to start the second hundred years.

Note by Editor

The illustration accompanying this article is a reproduction of a picture on a calendar sent us some years ago by Messrs W. & J. Mackay & Co Ltd, of Chatham, on which some members of the Institution staff added a few doodles. The galley proofs of the *RE List*, *Supplement* and *Journal* are seen hanging up and the young messenger boy is about to collect proofs for delivery to us for checking. Mr F. D. Jennings was the Institution's Publications' Clerk from 1952 to 1968.

Today's printing works of course bear no resemblance to the antiquated equipment shown in the picture. However the arrival of Messrs Mackay's messenger at our office is still a daily occurrence, and this close liaison between the Institution and its Printers "spanning eighty-two years and three generations of the Mackay family" has always been a most personal and happy one.

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Correspondence

Brigadier P. St B. Sydenham, CBE,
Langley House,
Misterton,
Nr Crewkerne, Somerset
23 June 1970

THE ARDENNES

Sir,—I have read so many books about the various theatres in which I served in the last war that I am greatly inclined to agree with that mythical Cavalry officer who answered a staff officer by saying: "I never read orders of more than one page; they only confuse me." He then turned to his next junior officer and said: "Hack on Algy."

My gen about the Ardennes came from an aunt with whom I spent virtually all my holidays from 1906 (incl) to 1910 (incl) while my father was finishing his time as a box-wallah in the mofussil in the Madras Presidency before returning to London to set up his own office.

I should explain that, owing to the activities of the Attlee gang, I had some difficulty in proving that I was not an Indian, though my 21st ancestor had been MP for Bridgwater in 1297 and I had held a regular commission in the British Army for 30 years.

My aunt was very friendly with a rich Belgian family, who had a house in Brussels and a chateau in the Ardennes, to which she was invited every summer. She was a keen walker and bicyclist—this was still fashionable then—and also a collector of photographs and picture-postcards. The impression which I thus formed, albeit at second hand, was that, though the terrain was more hilly than the New Forest, there were plenty of good roads, a lot of towns, small ones, and good cover from the air.

In 1934 I was selected to act as Chief of the German General Staff on one of the two German syndicates at Camberley. I think that a copy of Miss Ginchy's typescript must somehow have reached the Kreigsamt in Berlin. Anyhow von Rundstedt adopted my plan almost to the last detail. Not so the Commandant. In full conference he said "Only a sapper could produce so mad a plan!" Our syndicate teacher Major, local Lieut-Colonel, William J. Slim refrained from comment.

Consequently in May 1940, when I was starting up the first battle-school at Imber and was living in the Royal Tank Corps Mess at Warminster, I was able to forecast daily for the officers of the RTC the next movements in France. At this time an old friend of mine, Captain Douglas Wahl, RE (Retd), was brought to the Mess under open arrest under Emergency Regulations. I am quite sure that many of the RTC officers thought that, because I talked to him in a perfectly ordinary manner and was making such accurate forecasts, that either he or I, or both of us, were German spies. During the First World War several of Douglas' first cousins had commissions in the German Army and it was evident that some clever-dick in Whitehall had kept him on a black list ever since. I was able to ease the strain with the RTC CO until he was released some ten days later.

During November/December, 1944 I was serving in the Engineer Division at SHAEF. One of my duties was to attend a daily conference chaired by Brigadier Kenneth MacLean, one of the two Deputy Assistant Chiefs of Staff G 3, at which we were provided with such of the latest gen as G 2 thought fit to release to us. Thereafter our views were requested either then, or after consultation with our divisions, on any appropriate action. For some weeks DAC of S G 2 had been reporting the re-equipping of certain German armoured and light divisions in the Ruhr, and their subsequent movements to and across the Rhine and on in the direction of the Ardennes. One day the AC of S G 2 appeared in person and gave a similar report. At Camberley he had been one of the two attendants of the Fairy Queen in the pantomime in 1934; the theme song was: "Hitch your wagon to a star".

As von Rundstedt was back in overall command in the West, and bearing in mind my previous experience in the Kriegsamt in Berlin, I offered all my companions on the committee odds of 5 to 1 in pounds that the attack would come through the Ardennes. Though they all kept saying it would not happen, not one of them had the guts to back his opinion for even a quid. To some extent they were influenced by the weather; it would have been particularly suitable for that old King of Bohemia whose daughter married King Richard II of England. It was not so far from the Feast of Stephen when the whole thing blew up.

It is true that I had one unfair advantage, which I had mentioned in conference but which was wholly ignored. Com Z were using much more timber than they had ordered to be shipped and shipping was limited even for SHAEF. In the Engineer Division, dressed in red flannel, was the Professor of Forestry at Oxford University. He was only too delighted to take a trip to the Ardennes and then on to Switzerland. On his return, bringing with him two Rolex Oyster watches, which I had asked him to buy, he reported: "The Swiss can let us have x standards of lumber at once, but we shall need forestry companies to extract from the Ardennes."

He added: "The US divisions up there are on very wide frontages and they report frequent deep patrolling by the Germans, but they carefully avoid any fighting."

Although I knew that many of the British had very poor opinions of George Patton, he was not all that stupid. His next target at that time—at the particular wish of General de Gaulle—was the City of Strasbourg, which lay in a South-Easterly direction. However Patton's AC of S G 3 and AC of S G 4 teed up plans for moving in a Northerly direction in case of an emergency. When the emergency broke I asked my USA Deputy, an elderly West Pointer who had retired and come back for the duration, and who might have been a contemporary of Patton's, to go and look see about demolitions. He returned 48 hours later to report that his first encounter had been with a very large coloured gentleman, who was sitting on the bridge at Dinant, chewing in a very equable frame of mind. He eventually reached Patton himself who seemed no less equable and said: "Demolitions, what the Hell for. We've got the Krauts by the short hairs."

In one way my conference companions were quite right. If the attack failed, as it was likely to do in winter, the results would be disastrous for the Germans. Patton's men secured the bridge at Remagen almost intact, and there were no really heavy counter-attacks immediately after we had got over the Rhine. I sat on the near bank with John Savage while 42 Regt ferried over 311 tanks and SP guns, British and USA, almost without a shot being fired.

My apologies for being long-winded, and also for differing from "Nobby". I can only plead that I was there.

May I add the hope that "a good time was had by all" on the recent 25th anniversary tour of the Rhine. Yours faithfully, P. Saint Barbe Sydenham.

Brigadier A. Prain, CBE, FRICS
Thalassa, Birguma Road,
San Pawl TatTarga, Malta, GC
24 June 1970

KIRKEE REVISITED

Sir,—I must express my thanks to you for publishing, and to Pat Easton for writing, the account of his visit to Kirkee for the anniversary celebrations.

I am quite unable to express in suitable words how much pleasure and joy I got from reading the account, but I like to think that that joy was shared by the many "Quoi Hais" who served with the "Royal BOs".

It is remarkably fortunate that the present Kirkee Officers had the good sense to choose Pat Easton as their guest. They could not have made a better choice.

Out of a flood of mixed feelings which arose after reading the account, two thoughts are very much in my mind.

For those of us who look back on all the effort we put into building up and keeping alive the strength and spirit of the three Indian Sapper and Miner Corps it must be a great consolation to know that our efforts have left behind a sound tradition and a foundation on which the present Indian Engineer Officers are so successfully building.

For the new generation of Royal Engineer Officers who will sadly now never have the opportunity of Sapper and Miner Service in India, it must be inspiring to be so pleasantly reminded of one other honourable chapter in the history of their Corps. Yours faithfully, A. Prain.

Memoirs

GENERAL SIR EDWIN L. MORRIS, KCB, OBE, MC

Colonel Commandant RE 1944–50, Chief Royal Engineer 1951–58,
ADC General to the late King George VI

GENERAL SIR EDWIN LOGIE MORRIS died in the Cambridge Military Hospital, Aldershot on 29 June at the age of 81. Son of Clarke Morris, MRCS, JP of Blackheath, he was educated at Wellington College and the Royal Military Academy, Woolwich and commissioned into the Royal Engineers on 23 July 1909.

After finishing his young officer courses at Chatham and Aldershot he joined the 54th (Field) Company, RE then serving at Potchefstroon, South Africa. He returned to Chatham in 1914. During the First World War he served continuously, except for a few months recovering from wounds, in France and in Italy. He was mentioned in dispatches five times and awarded the MC and OBE, a brevet majority and the Italian Croce-di-Guerra. The Military Cross was established on 31 December 1914 and the MC awarded to Morris was one of the first to be awarded to a Royal Engineer. In his Dispatch, dated 2 February 1915, Sir John French describes how Captain J. R. Minshull-Ford, Royal Welsh Fusiliers and Lieutenant E. L. Morris, Royal Engineers with 15 men of the Royal Engineers and Royal Welsh Fusiliers successfully mined and blew up a group of farms immediately in front of the German trenches on the Touquet-Bridoux Road which had been used by German snipers. When in Italy he served for a year as Brigade Major 144 Infantry Brigade and as a GSO2 in HQ XIV Corps, and from 1918 to 1920 as Brigade Major 84 Infantry Brigade serving with the Army of the Black Sea. It was a rare occurrence in those days for a young sapper officer to serve in such staff appointments and they were the precursor of the many high staff appointments that he was to hold later with such outstanding ability.

In April 1921 he entered the Staff College Camberley as a student and, on graduating, was posted to the Military Operations Directorate of the War Office. From 1924 to 1926 he was employed in the Directorate of Organization and Staff Duties at the Air Ministry. He then commanded the RE Mounted Depot at Aldershot for a year before returning to Camberley as an Instructor in April 1927. In 1930 he did a short spell in Works as DCRE South Aldershot. This was followed by a two year posting to the Military Training Directorate in the War Office before going to the Imperial Defence College in 1933. Posted to India in 1934, he served as CRE Delhi and as Deputy Director Military Intelligence at Army Headquarters. He returned to the home establishment in January 1937 to become Deputy Director of Military Operations at the War Office, and in January 1939 he was posted as Brigadier General Staff Northern Command at York.

On the outbreak of the Second World War he was promoted Major-General and made Director of Staff Duties at the War Office. In 1940 he was an Area Commander and in 1941 a Divisional Commander and later a Corps Commander with Home Forces with the temporary rank of Lieut-General and the award of the CB. In 1942 he was appointed to be Chief of the General Staff in India and was promoted substantive Lieut-General in 1943. During this appointment he served first Sir Archibald Wavell and then Sir Claude Auchinleck. His previous service in Army Headquarters Delhi enabled him to understand the complex way in which the Army in India operated. It had never been geared to a major war on its immediate borders and in 1942 the Japanese forces were pressing hard on the Assam frontier. Under his inspiring direction plans were rapidly put into operation for the expansion of the logistic backing for the troops engaged in holding off the Japanese and the improvement of the training organization. He had a wonderful way of getting through a vast amount of work without fuss and friction and his sympathetic but firm personality

General Sir Edwin L Morris KCB OBE MC

promoted a smooth efficiency in the staff and services working under him. When he arrived in India a Japanese invasion seemed almost inevitable. When he left India two years later to become GOC-in-C and Army Commander Northern Command victory, although not immediately at hand, was sure. For his services he was created KCB.

In September 1946 he became the British Army Representative on the Military Staff Committee of the United Nations Organization. He held this appointment until his retirement on 15 November 1948.

He was appointed Colonel Commandant RE on 23 November 1944 and was Representative Colonel Commandant in 1950. His tenure as Colonel Commandant expired on 30 September 1958. He was appointed Chief Royal Engineer on 11 September 1951 in place of General Sir Guy Williams, KCB, CMG, DSO whose tenure had expired. A dinner was held in the RE HQ Mess at Chatham on 10 September 1951 presided over by Lieut-General Sir Charles King, the Representative Colonel Commandant for that year, at which the Chief Royal Engineer, General Sir Guy Williams, was dined-out and the Chief Royal Engineer elect, General Sir Edwin Morris, was dined-in. He completed his tenure as Chief Royal Engineer on 30 September 1958, his place being taken by General Sir Kenneth Crawford, KCB, MC. He was ADC General to King George VI from 1947 to 1948.

After his retirement, being a Liveryman of the Worshipful Company of Skinners, he was invited to become a member of the Court and in 1954 he was elected Master.

He was twice married, firstly to Celia, daughter of Arthur Meade of St Ives, Cornwall in 1921, and secondly in 1953 to Mary Amy, widow of John Sinclair of Farnham, Surrey.

A memorial service was held for him on 20 July 1970 at the Chapel of the Royal Hospital Chelsea, which was attended by numerous senior Royal Engineer officers, serving and retired, and dignitaries of the Skinners' Company. General Sir Geoffrey Baker, GCB, CMG, CBE, MC, ADC (*Gen*), Chief of the General Staff, represented Her Majesty The Queen, Colonel-in-Chief of the Corps of Royal Engineers. General Sir Charles Jones, GCB, CBE, MC, Chief Royal Engineer and Governor Royal Hospital Chelsea, and Colonel B. A. E. Maude, MBE read the lessons.

GENERAL SIR JOHN WHITELEY, GBE, KCB, MC

Colonel Commandant RE 1954–61

GENERAL SIR JOHN (JOCK) WHITELEY, who died in Salisbury Infirmary on 20 May 1970 in his seventy-fourth year, served on General Eisenhower's personal staff throughout the Second World War and was Deputy Chief of the General Staff from 1949 to 1953, and Chairman of the British Joint Services Mission in Washington, DC and the UK Representative on the Standing Group of the Military Committee of the North Atlantic Treaty Organization 1953–56.

John Francis Martin Whiteley was born on 7 June 1896, the son of Mr J. J. Whiteley. He was educated at Blundell's School and the Royal Military Academy, Woolwich where he was awarded the Pollock Medal. He was commissioned into the Royal Engineers on 10 February 1915 at the age of eighteen and, while still a teenage officer, he joined the 10th (Signal) Company, RE and served with that unit in Salonika, Palestine and Syria. He was mentioned in dispatches and was awarded the Military Cross in 1917 "for valuable services in connexion with Military Operations in the Field".

He returned to Chatham for a Supplementary Course in July 1920 after which he was selected to become an Instructor at the Royal Military Academy, Woolwich in 1922 and he became the Shop Adjutant in 1924. Early in 1926 he was posted to a Works' appointment at Salisbury and the following year he entered the Staff College, Camberley as a student.

On graduating from the Staff College he was posted to India in 1929 for a five year tour of duty where he first served as Garrison Engineer Meerut and, after a year in that Work's appointment, he became Brigade Major to the Jallundur Brigade. In 1932 he was made DAAG at Army Headquarters Delhi.

Returning to the home establishment in 1935 he was given command of 9th (Field) Company RE, then stationed at Shorncliffe. The following year he took up a staff appointment at the War Office and he was promoted Lieut-Colonel in July 1936. In 1939 he became a student at the Imperial Defence College.

Early in 1940 he was posted to GHQ MELF in Cairo as Brigadier-General Staff and Deputy Director of Military Operations, first under General Wavell and then under General Auchinleck. In 1941 he was sent by General Auchinleck personally to inform the Prime Minister of the situation in the Western Desert and to explain to him exactly why the date of the projected autumn offensive against Rommel could not be brought forward. In 1942 he was selected to be the British Deputy Chief of Staff to General Eisenhower at Allied Forces Headquarters, Algiers. He was thereafter involved in the planning of the final destruction of all German and Italian forces in North Africa, the invasion and capture of Sicily and the invasion of Italy. When General Eisenhower left Italy to become Supreme Allied Commander for OVERLORD, the opening of the Second Front with the invasion of NW Europe, he took Whiteley with him to serve as his Major-General Intelligence. Two weeks before the Normandy landings he became Major-General Operations and he held that appointment until the unconditional surrender of all German Armed Forces on VE Day—8 May 1945. In his book "Crusade in Europe" General Eisenhower wrote: "One of my finest memories of the War is the service rendered me by my personal staff. Seemingly by common consent they gave my affairs and welfare, even my comfort and convenience, complete priority over any consideration of their personal desires and ambitions. On the official level I had an outstanding staff, many members of which had served me throughout the War"—in this respect he mentioned by name Major-General Whiteley among other American and British officers and he went on to say that: "They and their many associates mastered, during the North African campaign, the art of dealing with large allied forces operating under single command. Without men of their calibre in the important staff positions of AFHQ the unification of the Allied Forces could not have been achieved. Their names are virtually un-

General Sir John Whiteley GBE KCB MC

known to the public. But they and their counterparts in many other high headquarters were responsible for the teamwork out of which came the victories of Tunisia, Sicily, Italy and North West Europe. Every Commander is always careful to select only the best officers he can find for key staff appointments in his Headquarters. Yet these men who, in the average case would do anything to obtain a field command and would have served brilliantly in such positions, devoted their talents to the drudgery of the staff with few of the rewards that go to their comrades of the line."

For his war services Major-General Whiteley was awarded the CB and CBE, the American Distinguished Service Medal and made an Officer of the American Legion of Merit. He was mentioned in dispatches six times.

The war over, Whiteley was selected to become the Army Instructor at the Imperial Defence College, and in 1947 he was appointed Commandant of the Canadian National Defence College. From 1949 to 1953 he was Deputy Chief of the Imperial General Staff and was created KCB in 1950. From 1954 to 1956 he was Chairman of the British Joint Services Mission in Washington and the United Kingdom representative on the Standing Group of the North Atlantic Treaty Organization. As the representative of the British Chiefs of Staff he was involved in the introduction of tactical nuclear weapons and the consequential readjustment of NATO defence plans. He was created GBE in 1956 and he retired in September of that year.

He was a Colonel Commandant Royal Engineers from 1954 to 1961, being Representative Colonel Commandant in 1957.

After retirement he was Chairman of the Royal Engineers Benevolent Fund from 1958 to 1962. He was also on the Executive Committee of the Corps of Commissionaires from 1961–6. He was very active on various Committees of the "Friends of Salisbury Cathedral". He was an active member of his local church, and was a member of the Parochial Church Council for six years. After he reached the age of 70 years he decided younger men should take over his various jobs, and he retired from them all. He was a very keen gardener and spent a lot of time improving the garden of his house. The last two years of his life he was not able to do much. However he kept up with as many of his friends as he could and was intensely interested in world affairs, and changes that took place in the Services, especially the Army and his own Corps.

On 6 February 1929 at Holy Trinity, Brompton Captain Jock Whiteley, MC, RE married Margaret, youngest daughter of Mr and Mrs Frederick Anderson of Standen Manor, Hungerford, Berkshire. They had a son and a daughter. Our deepest sympathies are extended to his widow and children.

BRIGADIER G. H. CLIFTON, DSO**, MC

Honorary Member of the Institution of Royal Engineers

THE death occurred at Taupo, New Zealand, on 13 March 1970, of Brigadier George Herbert Clifton, New Zealand Army, retired, at the age of seventy-one. He was an Honorary Member of the Institution of Royal Engineers, and in 1937 was the Corresponding Member for New Zealand.

George Clifton was born in Greenmeadows, Hawkes Bay on 18 September 1898. Following attendance at Wairoa School and Pahiatua District High School he spent almost a year at a Commercial College where he passed the entrance examination for the New Zealand Government Service in 1914. Entry to the Royal Military College of Australia at Duntroon followed in February 1915, and throughout the First World War he studied there to graduate first in his class and become a Lieutenant in the New Zealand Staff Corps. After a short period as aide-de-camp to the GOC New Zealand Military Forces Clifton embarked for India in 1919 and served with distinction as both a company officer, and for a time acting officer commanding, 55 Field Squadron of the 1st (KGO) Bengal Sappers and Miners. It was whilst serving with the Dejarat Column in Waziristan on the North West Frontier that he was awarded the Military Cross. After a period in Nelson on his return to New Zealand early in 1921 he was staff officer to the GOC for two years, before taking up the appointment of adjutant of the Wellington Regiment in May 1924.

In 1925 Clifton and his wife came to England where he attended a year long course at the School of Military Engineering, Chatham followed by a number of attachments to British service schools, including the RAF establishment at Farnborough, and formations during annual exercises. He was able to make good use of his training on his return to New Zealand in September 1926 when he was appointed adjutant of the Northern Depot Corps of Engineers and Signals at Auckland.

Attendance at the two year course at the Staff College, Camberley in 1933 was followed by attachments at the War Office and other schools and it was not until late 1935 that he returned to an intelligence appointment he held for four years at Army HQ in Wellington.

Shortly after the outbreak of war in 1939, George Clifton at the age of forty-one, was appointed Brigade Major to 5 New Zealand Infantry Brigade. The Brigade sailed from Wellington on 2 May 1940 in troopships carrying the New Zealand Second Echelon which, with an Australian Contingent, formed the famous fast convoy of Great Britain's largest liners. Though destined for the Middle East, the convoy was re-routed in the Indian Ocean via Cape Town and arrived in England just after the fall of Dunkirk.

The training and outfitting of the New Zealand Force in the United Kingdom kept Major Clifton busy until the end of July 1940 when he received orders to proceed to Egypt to take up the appointment of CRE 2nd New Zealand Division, his first command since he was in India twenty-five years previously.

Colonel Clifton did not get his Divisional Engineers together until March 1941 on the arrival of the 7th Field Coy from England. By this time the NZ Division was already on the way to Greece. Following the move of the Division north to the Aliakmon Line and the subsequent withdrawal under German pressure Colonel Clifton ably organized his field companies in delaying operations south to Thermopylae when on 21 April the Greeks capitulated and he was given command of the New Zealand rear-guards covering the withdrawal of the Expeditionary Force from Greece. Colonel Clifton was evacuated to Egypt and missed the Battle of Crete where his Engineers fought as infantry and suffered heavy losses. For his work in Greece he was awarded the DSO.

During the period of reorganization and re-equipping of the 2nd New Zealand Division after the Greece and Crete campaigns Colonel Clifton took an active part with his engineers in developing and practising methods of laying and clearing mine fields which later became a major task for field engineers in the desert battles.

Brigadier G H Clifton DSO MC

In November 1941 he was appointed Chief Engineer of XXX Corps under General Sir Willoughby Norrie and promoted to full Colonel. He served in this capacity during the 1941 Libyan offensive and on 18 November he was called upon by General Norrie to take a three hundred vehicle supply convoy through to the NZ Division heavily engaged around Sidi Rezegh. He succeeded in getting the much needed ammunition to the Division and later his empty vehicles through the Tobruk corridor into safe harbour. For this achievement he was awarded a bar to his DSO.

Early in February 1942 Colonel Clifton found himself back with the NZ Division, this time in command of 6th NZ Infantry Brigade with the rank of Brigadier. He commanded the Brigade during the fighting in the southern part of the Alamein Line, escaped when his Headquarters was overrun by German tanks at El Mreir on 22 July, and finally on 2 September while out on a first light reconnaissance during the Alam Halfa Battle, drove into the Italian lines and was captured.

Then began the extraordinary series of escapes and near escapes from enemy hands in Libya, Italy and Germany, so ably recounted in his book, *The Happy Hunted.* In all he made nine attempts and in five of them he managed to break out of his place of confinement. He was one of the few British officers to be interviewed by Rommel who wrote of him as a courageous and likeable man. On his eighth escape attempt from a PW train in Southern Germany he broke a leg when shot by a German guard. He spent three months in hospital in Wurzburg where good medical treatment saved his leg. In due course he came to Offlag XIIB at Hadamar, and his leg being fit again, thought once more of escape. The opportunity came on the evening of 22 March 1945, and after making his way towards the Rhine he walked exhausted but triumphant into the American lines at Remagen.

He was awarded the second bar to the DSO in 1945 for his services whilst a prisoner and for his escapes.

His wife died in Auckland shortly after his return to NZ by air in early April. After a spell of well-earned leave, Brigadier Clifton left for the Far East for duty as liaison officer with the UK and Australian Organization for the recovery of allied prisoners of war and civilians interned by the Japanese. This proved to be a short assignment followed by an equally brief period as the New Zealand Joint Chiefs of Staff Representative in Melbourne before he joined the British Commonwealth Occupation Force in Japan as Brigadier General Staff.

Back in New Zealand in February 1947 he was appointed Commandant of the Army Schools of Instruction at Trentham and held this post until he again went to the United Kingdom, this time as the New Zealand Military Liaison Officer in London.

In his last appointment in the New Zealand Army Brigadier Clifton commanded the Northern Military District in Auckland.

On retirement in October 1953 Brigadier Clifton took up sheep farming in southern Hawkes Bay and carried this out in the usual energetic and enthusiastic manner associated with all his activities.

In his retirement he maintained an interest in the organizations he had been associated with during his Army career and was Colonel Commandant of the New Zealand Infantry Regiment from November 1960 until March 1964 and an active Patron of the New Zealand Ex POW Association until his death. On moving to Taupo in 1968 he took an immediate interest in local affairs and was elected to the Taupo Borough Council and President of the local branch of the New Zealand Red Cross.

Brigadier Clifton was buried with full Military Honours at Taupo, the officiating Padre, a fellow member of the NZ Ex POW Association, the Reverend J. Walton, said of him that he was respected and loved by all who knew him well.

He is survived by his second wife whom he married in Melbourne in 1947 and his son Charles aged fourteen.

Our deepest sympathy is extended to them.

R. McL.D.

BRIGADIER W. D. ROBERTSON DSO,

WILLIAM DOUGLAS ROBERTSON was born in Staten Island, New York, USA on 23 March 1897. His father was Canadian, a mining engineer and geologist, and his mother American. He was brought up in Canada and was educated at McGill University and the RMC Canada, where he played Rugger for the College. He was commissioned into the Royal Engineers in 1916.

After his YO course at the SME, Robertson embarked for Salonica in May 1917 to join 33 Base Park Company RE. He volunteered at once for secondment to the Royal Flying Corps and soon qualified as an Observer with the 47th Squadron RFC in Salonica. He was wounded over enemy lines while flying with this Squadron but was soon back with them again after a spell in hospital.

In 1918 the RFC changed its identity and Lieutenant Robertson must have been one of the very first soldiers to be trained by the new Royal Air Force when he joined No 3 School of Aeronautics RAF in Cairo in June 1918. Six months later, now a qualified RAF pilot, he joined HQ Home Establishment RAF prior to returning to Canada for five months well deserved leave.

In November 1919 Robertson's secondment to the RAF came to an end when he was ordered to India for duty with his own Corps. He then spent three years as a Bombay Sapper, mostly in Quetta, serving with 17, 73 and 80 Field Companies before returning to England to join No 9 Supplementary Class at Chatham and Cambridge.

In August 1924 "Robbie" successfully demonstrated that he was just as at home in the saddle as in the cockpit by passing a Mounted Duties course at Aldershot, after which he returned to India for duty as a Garrison Engineer, first in Peshawar District and later at Abbotabad. He was promoted Captain in June 1926 and married Phyllis Winch of London six months later. This, his second tour in India, lasted for twelve years, including five months on active service on the North West Frontier in 1930 and Works appointments in Ambala and Quetta.

H.W.K. writes:—

"On 5 May 1935 more than 30,000 people were killed in the Quetta earthquake. The city was completely destroyed and those parts of the cantonments nearest the city were severely damaged. Robbie, who was Garrison Engineer Civil, was on tour and returned to find his bungalow in ruins. At the military hospital he discovered that his elder daughter and her nannie had been killed and his wife was there with severe back injuries. This shock would have broken many men, but Robbie threw himself into the gigantic tasks that confronted him in his, the worst hit, area; his only respite was a few hours sleep each day and a quick daily visit to the hospital. It was characteristic of Robbie that he cabled to England for stores on his own initiative, exceeding his financial powers by a factor of many thousands. Consequently it was not long before his was the only source of many scarce but essential building materials in Quetta. His CRE deplored his action, but practically every sapper officer engaged on emergency work blessed him for his foresight and subsequent generosity."

Robertson, now a Major, returned to England late in 1936. After a period in HQ Aldershot Command, he assumed command of 38 Field Company and took them to France soon after the outbreak of war. He did a wonderful job during this difficult time, as this extract from a letter to Phyllis Robertson by the CRE 3 Division, Lieutenant Colonel (now Major-General) Desmond Harrison testifies:

"Nobody could have been more delighted than I to see Robbie's DSO come through at last. He probably wouldn't tell you much of what he did to earn it, being Robbie, but I can assure you that he was a real tower of strength to all of us. Quite fearless, never taking a rest, unbelievably blasphemous in the most cheerful way, he inspired his men to sustained efforts which resulted in many Infantry being embarked

who might otherwise have got left behind. Even when he was wounded he kept it up, and I know he was in great pain. You should be even prouder of him than I am sure you already are. There aren't many like him, but don't tell him so."

The citation for Robertson's DSO read as follows:—

"This officer commanded a Field Company RE at the evacuation from La Panne on the night 31 May/1 June. His disregard of danger, his cheerfulness and his driving energy were a source of real inspiration to his crews and it is due to him that a large number of men were evacuated. Later he was severely wounded while wading out to find and guide in more boats. He refused to be moved until he had assured himself that all his men had been got away."

After eight weeks in hospital and seven months sick leave Robertson was posted to Ripon as Commanding Officer of No 3 Training Battalion RE, an appointment he held until December 1941. After the wounds he had suffered in two World Wars it is perhaps a little surprising to find that the third course he attended during his period of command was a COs' PT Course at Aldershot! Such was the spirit of this indomitable man.

Towards the end of his tour in command, Robertson learnt that he was to attend a short course at the US Army Engineer School; and he was much amused to find that he had to declare before his departure, in view of his American birthplace, that he did not wish to stand for President of the United States. After his course, Robertson took over the important appointment of AAG AG7 and held it for nearly three years until he returned to India for the third time in April 1945 to be Deputy Chief Engineer (Works) as a Colonel. Four months later, as a Brigadier, he became first Director of Works, and then Chief Engineer, Southern Command (India), a post which he held for the next eighteen months. His last active appointment was in Bermuda as OC Troops and CRE from December 1947 until his retirement in July 1949.

In his retirement he remained an active supporter of the Corps. A regular attender at the "3 TB" table at the annual Corps Dinner, he was delighted to see his old Battalion reborn in 1968 as 3 Training Regiment and he took an active interest in its fortunes. He died in Fleet on 9 February 1970 at the age of seventy-two, survived by his widow and by one married daughter.

One of his former Staff Officers writes:—

"Robbie will never be forgotten by those whose privilege it was to work with him or under his command, for probably the greatest of his many splendid qualities was the gift of friendship. This was the foundation of his personal magnetism which welded together a wide circle of officers—Regulars, Territorials, SR and AER, and War Emergency commissioned, of different age groups, personalities, interests and background—into a group whose common bond was the association they had in serving with him, albeit in different circumstances, parts of the world and in time.

"Robbie's particular brand of friendship was lasting, exceeding the bounds normally implied by the word; for his personal specification—derived from his own background and experience, inherent unselfishness and a special appreciation of man-management—was founded on a rare combination of leadership, humour, determination, domination and a deep understanding of human frailties, combined with the best qualities of a Sapper—technical ability and a natural gift for soldiering.

"But for the serious wounds he sustained during the evacuation from the beaches at La Panne when in command of 38 Field Company—his work in these operations was recognized by the award of the DSO—those who subsequently served with him had no doubts that he would have been destined for higher command in the field. He had been an inspiration to his Company in the BEF; he had gained admiration in his service with the Royal Flying Corps in World War I; despite a personal tragedy in his life in the Quetta earthquake he had played a leading role in the tasks allotted to the Corps following the devastation; he moulded the way and purpose of many young Sappers who passed through No 3 Training Battalion RE when in command

Brigadier W D Robertson DSO

(1940–41) to serve with the Corps in all theatres of operations; and, as AAGRE (1942–45), he took a personal interest in the welfare of all ranks of the Corps to ensure that the right man was in the right job to the benefit of the Corps in general and the individual in particular, and would not tolerate impersonal dealings in personnel matters. The appointment of AAGRE was no easy task and there were times when not everyone could be satisfied by decisions and actions taken, but the needs of the Corps in war he always appreciated with, at the same time, considerations for the individual.

"Robbie's strength and determination carried him through to the last. Just six months before his death, en route from Dartmouth to the Solent in an old twin-engined cruiser, the craft got into the Portland Race; sea conditions were such that all instruments were overpowered and the only point of orientation was an occasional glimpse of the Shambles Lightship. Robbie took the wheel, disdained to hand over to a younger but somewhat frightened crew, and held the vessel for over an hour until conditions eased."

Those whose privilege it was to know him and be included among his friends will not forget this big-hearted man; he was an unforgettable character, a man of inspiration and strength who will be remembered with affection and admiration.

As Tennyson wrote: "The world would lose if such a man . . . should vanish unrecorded."

A.M.P.

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COLONEL R. I. C. BLENKINSOP, DSO

RUPERT ISMAY CLAUDE BLENKINSOP, who died at Torremolinos on the 8 November 1969, was born on the 16 November 1902 at Raipur, in the Central Provinces of India, the second son of E. R. K. Blenkinsop, Esq, CIE, ICS. Educated at Clifton, where he was in the XV and Shooting VIII, he passed into the RMA, Woolwich, gained his "Rep" Colours for Rugger and Boxing, and was Commissioned into the Royal Engineers on 31 August 1922. While at Chatham on his YO Course he played Rugger for the Corps, and boxed for the Army on four occasions.

On completion of his YO Course it was not unnatural that he should follow in the footsteps of his father and grand-father and go out to India, where he joined the KGVO Bengal Sappers & Miners in January 1925 for a normal three months attachment. After a year in the MES in the Peshawar Area, he returned to the Bengal Sappers & Miners in July 1926, and was posted to No 7 Bridging Train—a unit which, with its pontoon wagons drawn by teams of six huge bullocks, was reminiscent of Kipling's India. He remained with the Bengal Sappers & Miners, filling various appointments until July 1931 when he was posted back to the MES as AGE Razmak. The next two years were spent in Waziristan, largely on work connected with the alignment and construction of the new Wana-Razmak road. Lieutenant Colonel E. W. C. Sandes, in his book *The Indian Sappers & Miners*, has given a brief indication of the problems connected with this project. With the road running through hostile Mahsud territory, the Field Engineers had to work under considerable difficulties, and in very close co-operation with the Waziristan Scouts—a body of men whose whole training was based on the fact that it was dangerous to loiter on those hillsides and, perhaps even more unhealthy, to form a habit of following the same route to a place every day. The Field Engineers had to be as fit as the Scouts, and had to be complete masters of their job, so that no time was wasted hanging about. The fact that the alignment was successfully pushed through without any unfortunate incidents is a fine tribute to them.

After two years in Waziristan, and a period of furlough in the UK in the course of which he married Mary, the daughter of J. H. Paton, Esq of Lethangie, Kinross, he returned to India and, in July 1934, assumed Command of 35 Field Troop KGVO Bengal S & M. This posting gave him ample scope for development in his great love—the game of polo. On the polo ground he was in his element, riding hard and hitting prodigiously long balls with sticks which were heavier than most people could use. He was a regular member of the Bengal S & M polo team and, when he moved with his Field Troop to Risalpur in 1936, he was well able to take his place in the high standard of polo that was to be found in a Cavalry Brigade Station. Had he yielded to any of the many approaches which were made to him to transfer to the Indian Cavalry, it is very probable that he would have made a name for himself in the polo world. But he preferred to stay with the Corps.

His other love in India was big-game shooting, with a preference, perhaps, for the jungles and tiger. But the High Hills also called to him, and the best Markhor head in the outstanding collection of shikar trophies in the RE Mess at Rookee was his.

Reverting to the Home Establishment at the end of 1938, he was appointed Adjutant of the Royal Monmouthshire Royal Engineers (Militia) in January 1939. The outbreak of war interrupted this appointment, and he served in various other posts until joining 56 Infantry Division as CRE early in 1943. He took part in the Salerno landing, served in the Anzio Beach-head, and was present at the crossings of Volturno and Garigliano. His award of the DSO, for distinguished services in Italy, was published in the *London Gazette* of 24 August 1944.

He returned from Italy in 1944 to take up a Colonel's appointment at HQ Combined Operations, where he remained until 1946. Then, after a short tour as a CRE Works in Germany, he went to Palestine, as CRE 62 Works, in April 1947. Invalided back to the UK in September 1947, he retired on Medical grounds in December 1947.

Colonel R I C Blenkinsop DSO

On retirement, he joined the Forestry Commission and was appointed Conservancy Engineer responsible for the Forest roads in the North-east of Scotland, an area covering the country between the Findhorn and the Forth. While there he surveyed, and supervised the construction of, over 500 miles of new roads. Of special technical interest was his invention of a technique of sand/cement soil stabilization which enabled a road to be built across the shifting Culbin Sands, a problem which had, till then, appeared to be insoluble. Needless to say, once he had mastered the new outlook on life and the rules of a Civil Service department, he managed to fit in a very reasonable amount of shooting and fishing in the course of his duties.

Ill-health, however, again overtook him, and he retired finally from an active life at the end of 1962. After living for a few years in Dorset he was forced, for health reasons, to seek a warmer climate, and in 1967 he moved to the South of Spain.

Bill Blenkinsop was always a "character" in the best sense of that word. Quite "unflappable", he had a never-failing dry sense of humour, and an ability to produce an apt, sometimes caustic, but always amusing and original, phrase describing a person or a situation.

A characteristic which was surprising in a man of such a quiet and patient personality, was his love of speed, whether it was on a motor-bike, as a YO, or on a polo pony, or, in later years, in his Volvo car. Only a few weeks before his death he was asked how fast a car which he had just bought could go. A wicked gleam came into his eye as he replied "When it's run in — 120." And one can be sure that, had he lived, he would have seen to it that, on a suitable stretch of road, the speedometer needle would have touched that figure. But he had none of the flamboyance and restlessness which often goes with a love of speed, and he was never a reckless nor an impatient driver. He was, in fact, a very quiet, unassuming and patient man. There was nothing slap-dash about him, and if he had a job of work to do, or was starting on a new hobby, he went to great pains to master the details of the subject.

In his later years his fortitude was an example to everyone. Forced by ill-health to give up many of his old interests and activities, he never complained, and he never moaned about his health. A letter written to me four days before his death gave the impression that he had made a good recovery from a bout of "flu". In fact, as he wrote, he must have been suffering from the strain which finally overcame him. The courage which, in his early days, had often taken him into the ring to fight a heavier opponent was still with him.

Someone who knew them both, and was in a position to make a fair assessment, has said that, had Blenk been an ambitious man, he might well have equalled the achievements of his more famous uncle "Pug" Ismay. But Blenk was not ambitious. Like the singer in Masefield's "Sea Fever" he was happy with the "merry yarn from a laughing fellow rover." And so, though he never achieved fame, he will be remembered by many as a gallant officer, a most courteous and generous host and a good friend and companion at all times—a man who never did a mean or petty thing.

He is survived by his widow, a son and a married daughter, to whom we extend our very sincere sympathy.

The English Cemetery at Malaga owes its existence to the courage and persistence of William Mark, a one-time Purser in Lord Nelson's Fleet and, later, the British Consul at Malaga. It was he who, after lengthy negotiations, secured and enclosed a plot of land allotted for the purpose by the Spanish Authorities. Lying on the hillside above the city, and looking out to the sea, it is beautifully maintained and full of flowers, a resting place for birds on their migrations. Blenk is buried there, and we may hope that, in its peace, he enjoys the "quiet sleep and a sweet dream" that he earned so well.

G.C.C.

Book Reviews

THROUGH TO 1970
ROYAL SIGNALS GOLDEN JUBILEE

(Published by the Royal Signals Institution, Cheltenham Terrace, SW3, Price 12*s* 6*d* net)

This copiously illustrated book was devised by the Royal Signals Institution to mark the hundredth anniversary of the formation at Chatham on 1 September 1870 of the first independent telegraph unit in the British Army namely C Telegraph Troop RE, raised from No 2 Section B Troop, RE Train.

The dates 1870 to 1970 have been quoted many times in this issue of the *RE Journal*, and it is fitting that *Through to 1970* should be reviewed in this Centenary Number.

The establishment of C Telegraph Troop RE, commanded by Captain Montague Lambert, was:

Officers		*Other Ranks*		*Horses*	
Capt	Lieut	Sergts	Rank & File	Riding	Draught
1	1	7	126	30	25

Carriages				
Wire	Office	Pontoon	Forge	Store
12*	4	1	1	6

*Each carrying 3 miles of cable

From this small beginning sprang the vast Signal Service RE, and the RE-officered Telegraph Troops and Sections of the Madras, Bengal and Bombay Sappers and Miners.

A separate Signal Service, Sappers and Miners was set up in the Indian Army in 1911 officered by RE officers, and in 1920, the halfway mark of the centenary 1870 to 1970, the Royal Engineers gave birth to the Royal Corps of Signals. Military telecommunications had reached such a size and complexity during the First World War and demanded so much manpower and specialization that this birth was inevitable. The specialist officers and soldiers of the RE Signal Service were rebadged and became the founding fathers of a new Corps that was to go from strength to strength.

Military signalling by electrical means had, of course, existed in the Army long before the raising of the first independent Telegraph Troop, RE in 1870. From the earliest fundamental experiments carried out by Farraday when an Instructor at the Royal Military Academy, Woolwich, into the properties of electricity and magnetism the Royal Engineers had sought to put these phenomena to military use. The Voltaic cell of 1805, Ampère's electro-magnetic theory of 1820, the introduction in 1836 of Samuel Morse's electric telegraph repeater and his famous Code and the first submarine cable laid from Dover to Calais in 1851 were land marks in the development of telecommunications. In 1854 the electric telegraph, only recently introduced for civilian use in England, was first used in war. A 340 mile submarine cable, the longest submarine cable of its time, was laid under the direction of Captain Francis Du Cane, RE from Varna to Balaclava thus enabling the British and French Commanders-in-Chief to be connected by transcontinental land line and submarine cable to their Governments in London and Paris. Simultaneously Lieutenant George Stopford, RE laid a land line of twenty-one miles of cable connecting Army Headquarters with Kadikoa, Balaclava and the French Base at Kamiesh.

A new era in the conduct of war had dawned. No longer were commanders of overseas Expeditionary Forces to enjoy their accustomed independent liberty of action free from constant directives from their superiors at home. At the same time a Commander could now transmit his instructions to his subordinates at a speed of 180,000 miles a second rather than at the speed and endurance of the horse on which his galloper was mounted, or send messages by visual means when the elements were propitious for that primitive method of signalling. At the same time also accredited Press Reporters could telegraph their copy speedily back from the battlefield to their Editors at home with all the political consequences which that involved. Indeed it was largely the harrowing press reports, sent home from the Crimea, that brought about the major reorganization in the archaic command structure and administration of the British Army after that unhappy war.

From those early days it had always been the tradition that a military signal must get 'through', come what may, 'certa cito'—swift and sure.

"*Through to 1970*" describes just how that has been done in major and minor wars, insurrection and confrontation. The story is told with the minimum of text and the maximum of illustrations. This is a splendid way to commemorate a hundred crowded years of history especially when the illustrations consist of such excellent coloured and black and white pictures and drawings and a host of most carefully chosen coloured and black and white photographs of the Military Signallers at work and at play over the period 1870 to 1970.

The Author Colonel R. M. Adams and the Editor Lieut-Colonel E. G. Day, Secretary to the Royal Signals Institution, and Miles Hutchins, the Designer, are to be congratulated on their work, and Brigadier P. E. Hutchin's paintings and drawings are of the highest order.

On the title page of the book is printed: "If this book arouses interest and pride among serving men and their families and gives pleasure to our Old Comrades and our friends, it will have served its purpose". The book should be of the most absorbing interest to all Sappers with a thirst for history of their own Corps and that of their sister Corps—The Royal Corps of Signals. J.L.

SILVER GHOSTS AND SILVER DAWN

W. A. ROBOTHAM

(Published by Constable & Company Ltd. Price 50*s*)

This book is written by a man who has recently retired from the Board of Rolls-Royce Ltd after forty-four years service commencing as a "premium apprentice" in 1919. It might be thought that this autobiography would be full of Rolls-Royce praise for the Best Car in the World. The story revealed is so unlike the legend and magic surrounding The Name that it is amazing that the company survived the 1930s let alone the war. Nevertheless it is a fascinating and most readable insight into the problems besetting a company attempting to keep up to date and entering new fields of commerce both in peace and in war.

Mr Robotham starts his story with his ingenious release from the Army in 1918 and his tribulations as a "premium apprentice" in Derby. He was not very impressed with the Rolls-Royce training scheme in operation, but he became technical assistant to (later) Lord Hives in 1923, manager of the Experimental Department. He recounts some interesting tales of testing motor cars at speed on French roads—there being a 20 mph limit on all British roads at the time which necessitated the use of Continental roads if a reasonably large test mileage was to be achieved quickly.

It must not be forgotten that Rolls-Royce have been building aircraft engines for a long period and their efforts in preparing for and winning the Schneider Trophy laid the foundations for success in the Battle of Britain. Although the Spitfire and the Merlin aircraft engine are well known few are aware that Rolls-Royce were instrumental in installing the Merlin engine in the Crusader tank. This modified engine became known as the Meteor. This incredible feat was not considered possible by many at the time yet in less than five months the prototype re-engined Crusader was showing its paces at over 50 mph to the amazement of the spectators. Despite this the RAC had to be persuaded to accept this redesigned tank which had started out as a hopelessly unreliable 330 bhp machine with a 2 pdr gun but was now transformed into a thoroughly reliable 600 bhp tank capable of carrying a 17 pdr gun. Mr Robotham goes on to give his views on the General Staff who made several conflicting decisions regarding tank requirements thereby holding up production.

It is interesting to note that Rolls-Royce were contemplating a new range of car models before the war and were able to test these as experimental vehicles during hostilities. These engines were later incorporated into the B Series of military power units.

After the war a decision was made to branch out into the Diesel field and in company with Vickers, the Vigor tractor was produced in face of keen competition of other well established tractor firms. This enterprise was not successful but the Diesel Division managed to ride the storm and now provide power units for ships, compressors and railway locomotives.

The cognoscenti will of course follow the references to different car models and engines without difficulty but the book might have benefited from a comprehensive list of vehicles and engines manufactured by the company together with their main characteristics and representative photographs.

Mr Robotham has written a fascinating and readable book of the behind-the-scenes story of Rolls-Royce Ltd over most of the past 50 years and although he has removed some of the legend surrounding the company, he has not diminished the stature of a famous British Institution. It is a 'must' for followers of Rolls-Royce lore. L.H.J.

ENGINEERING METROLOGY

Third Edition (Metric)

K. J. HUME, BSc, CEng, FIMechE, FIProdE

(Published by MacDonald & Co (Publishers) Ltd, 49 Bland Street, London, W1. Price £2. 5*s*.)

The author, Professor of Production Engineering at Loughborough University of Technology, is an authority on the science of engineering measurement, with a scientific training background coupled with practical experience of engineering inspection and the manufacture of scientific instruments.

This book was first published in 1951 and reprinted in 1967 with an appendix giving metric values for certain wave lengths and other data. This, the third, completely metric edition meets the requirements of British students preparing to take metrology examinations for the Higher National Certificate in Production Engineering, the Institution of Mechanical Engineers and the Institution of Production Engineers.

The 350 pages of text, photographs and diagrams, divided into sixteen chapters, an appendix, bibliography and index, covers: Basic Principles—mathematics, mechanics, optics and heat, Standards of Measurements, Standardization, Manufacture of Gauges, Optical Projectors and Microscopes, Linear and Angular Measurements, Circular Division, Straightness, Flatness and Squareness, Alignment Testing, Screw Threads and their Measurement, and Automatic Dimensional Control.

The text is mainly descriptive and the mathematics, where used, within the scope of HNC students. The author points out the necessity for students to keep abreast of the latest BSI standards and other relevant documents as they are issued in the near future. F.T.S.

EXPERIMENTAL FLUID MECHANICS

(Second Edition)

P. BRADSHAW, BA AERONAUTICS DEPT IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

(Published by Pergamon Press Ltd, Headington Hill Hall, Oxford. Price: 25*s* soft cover; 35*s* hard cover)

This textbook supplements the series of books included in the Thermodynamics and Fluid Mechanics Division of Pergamon's Commonwealth and International Library of Science, Technology, Engineering and Liberal Studies. The first edition was published in 1964.

The book is intended for students intending to specialize in the experimental side of the subject as a method of solving flow problems or to obtain information for the betterment of theoretical analyses.

Apart from an introductory chapter to the subject the text is largely concerned with experimental techniques and methods, and as these have largely been developed by the aircraft industry with the aid of wind tunnels a chapter has been devoted to them and their associated test rigs. Four chapters on the techniques of measurement follow and these are supplemented by a chapter on the planning and reporting of experiments. References to the fluid mechanics problems being dealt with by scientists and engineers within the fields of aeronautics, chemical engineering, oceanography, etc., are also included.

The text is only suitable for students of HNC or graduate ability. F.T.S.

RATIONAL DESCRIPTIONS, DECISIONS AND DESIGNS

DR MYRON TRIBUS

(Assistant Secretary of Commerce for Science and Technology. Formerly Dean, Thayer School of Engineering, Dartmouth College, USA)

(Published by Pergamon Press Ltd, Headington Hill Hall, Oxford. Price 105*s*)

This book deals with engineering creativity, which is the process of conceiving a new idea and bringing it to fulfilment—an intentional art which follows from a need to find a creative solution to a particular problem.

Invariably each new idea involves multiple problems for which a variety of solutions make themselves apparent at stages throughout the whole process of design and manufacture. They begin with the conceiving of solutions, choosing at least one of the most promising, developing new sources of information and new techniques, organizing production resources, management of the resources, distribution of the product and disposition of the waste. This book presents the disciplines used to ensure efficient selection.

This is not a chatty book presenting ideas in descriptive text, but a detailed, advanced mathematical exposition of the factors involved in engineering creativity. Its 469 pages are chaptered to cover: Rational definition, Rational descriptions and some mathematical preliminaries, Bayes' Equation and Rational inference, Rational measures of uncertainty, The principle of maximum entropy, Contigency tables, Rational descriptions, Decision theory, Engineering design and Reliability engineering.

Engineering statisticians will find the text absorbing—but possibly not engineering students. F.T.S.

Technical Notes

THE MILITARY ENGINEER

MARCH—APRIL 1970

The lead article concerns ocean engineering work. It gives a useful summary of the state of the art at present and suggests future lines of progress.

"Hurricane Flood Protection" describes ideas and experiments designed to lead to the construction of an effective barrier against the tidal surges that occur under hurricane conditions.

On the combat engineering side, the problems, and solutions, of demolishing Vietcong tunnels are discussed. This would be a useful reference article in case we should encounter similar problems.

The construction of a "hasty" reservoir and notes on water distillation are also of interest.

An advertisement for the Darda rock split splitter might well be worth pursuing (page 3). This instrument, it is claimed, breaks up rock and concrete with a splitting action and would seem to eliminate secondary blasting. P.W.H.

MAY-JUNE

In Project Pre-Gondola is described the experiments and results of explosive trials designed to produce a channel connected to a reservoir. The project was carried out in several phases over a period of four years. A 1300 ft long by 100 ft wide by 13–39 ft deep channel was produced and considerable experience was gained in channel blasting techniques. The experiment was part of a programme designed to produce information to enable a nuclear blasted canal to be built as a replacement for the Panama Canal.

Problems and solutions on the construction of an Antarctic base are discussed in detail in the second main article.

For the Combat Engineer, a method of mounting Claymore mines on a T pile is interesting. This has the effect of rendering the mine more effective on hilly slopes, lessening the chance of the enemy reversing the mine and reducing back blast problems.

Progress on the design and production of quickly erected structures for airfield use (sleeping accommodation, repair facilities hangars and services,) is described. P.W.H.

CIVIL ENGINEERING

APRIL 1970

DRAINAGE AND FLOODING IN THE GLOUCESTER REGION by R. S. Waller, MA, C Eng, MI Mun E of Gloucester RDC and T. L. Shaw, BSc, C Eng, PhD, MICE of the Civil Engineering Department of Bristol University. The consequences of urbanization include a greatly increased surface water drainage problem. The article describes measures now being taken in Gloucester to study existing problems caused by inadequate drainage, and to ensure that future building development does not increase the likelihood of serious flooding. Present records of rainfall and river levels are inadequate, and much data must be collected before solutions can be put forward. A local study group, Bristol University and the

Meteorological Office are expected to co-operate. When completed the work may benefit other areas which have similarly failed to keep pace with the surface water problem.

EXPLOITING GEOMETRICAL SIMILARITY IN TIMBER STRUCTURES by H. J. Burgess, BSc (Eng), C Eng, Head of the Engineering Section, Timber Research and Development Association. After reminding the reader of some of the basic principles of model analysis the author describes how geometrical similarity can be used safely to reduce design work in timber structures by taking advantage of proven designs for different spans. The method can even be extended to gusset plate design. Reference is made to steel and concrete design, but this application is of less practical value. For timber engineering the approach is one which is often forgotten when it could save much time and effort.

MULTIAXIAL FAILURE DIAGRAM FOR CONCRETE by D. J. Lewis, BSc, MI Mech E and G. D. T. Carmichael, BSc of CEGB Berkeley Nuclear Laboratories. Nuclear Power Station design has emphasized the need for simple methods of checking multiaxial compressive stress systems in concrete structures. These must be based on experimental data, which in the case of triaxial systems is still scarce. A major problem is the collection and presentation of accurate information. This article illustrates how reference diagrams may be compiled and used for checking such systems when the relevant data becomes available. Safety factors still raise problems when making design checks. The whole subject is a complex one, and the author has made reference to many research papers and reports. He concludes by hoping that the diagrammatic presentation of multiaxial concrete failure data will lead to a clearer appreciation of the significance of principal stresses in design.

A SUCTION DREDGER IN SAND PITS by Ir J. De Koning of Amsterdam Ballast Dredging, Amsterdam and Anglo Dutch Dredging Company, London. This article goes into the details of the density currents in deep borrow pits (up to 70 m depth). Field observations are reported from the sounding results of the new Honeywell echo profiler. The article goes on to explain how the introduction of the submerged sand pump in 1960 in the Netherlands changed the physical picture of flow in borrowing pits. N.H.T.

MAY 1970

'HIGH STRENGTH' REINFORCING STEELS is a report of results obtained during a test programme for the use of strength steels for compression reinforcement in reinforced concrete. Normally steel strengths in tension and compression are almost identical. For cold worked alloy steels however, the compressive strength may be very much lower than the tensile. One particular steel gave these results:

	As rolled	Cold worked
Tension	95,000 lb/in^2	135,000 lb/in^2
Compression	98,000 lb/in^2	70,000 lb/in^2

The mechanism for these changes is not given, but it is clear that designers should be very careful in selecting a suitable grade of high strength steel for use in columns.

FOYERS PUMPED STORAGE HYDRO ELECTRIC PROJECT. This contract, on the site of one of the first British Hydro Electric schemes (in 1896), has been let to Edmund Nuttall, Sons and Co. Maj E. R. M. Pringle, a student on 17 Long Civil Engineering Course, is attached to the firm and is working on this contract. The article is particularly interesting for the way in which the various design alternatives were considered.

CONCRETE AGGREGATES CONTAINING SEA SHELLS. This report carried out for the Sand and Gravel Association of Great Britain describes tests to determine the effects of sea shells in aggregates. The GLC specifications:

Aggregate	% *Weight of Shell*
1½ in	2
¾ in	5
Fine	30

is reported as being unnecessarily restrictive and that many concrete properties are not adversely affected at double the above percentages. Neither are hollow shells any disadvantage.

PERTSIM is a computerized game concerned with decision making and based on CPM/PERT techniques. It would appear to have possibilities for training. The major project used for the game is the construction of an access road. The book by Swanson and Pages is published by International Textbook Co at 42*s*. It may prove to be the Civil Engineers equivalent of a war game.

POLYPROPYLENE REINFORCEMENT FOR CONCRETE. Wests' Shell Piles are now incorporating short lengths of polypropylene fibre as a replacement for steel mesh in the outer casings for their piles. The resultant piles are more resistant to hammer blows, produce a stronger pile and less "scatter" of results. W.G.C.

JUNE 1970

ROYAL SOVEREIGN LIGHT TOWER. Many yachtsmen in the Corps know the light vessel which guards the Royal Sovereign shoals off Beachy Head. The rising cost of maintaining this vessel with a crew of eleven compared with the four man team in a lighthouse caused the Corporation of Trinity House to investigate the possibility of a permanent structure. The article by C. J. Antonakis, BSc (Eng), ACGI, FICE of Sir William Halcrow and Partners describes the design and construction.

The site was found to be unsuitable for piling and a steel tower design would have proved too expensive, so the structure has been designed in reinforced concrete. A hollow cellular concrete base, rests on the sea bed and supports a tubular concrete tower on which are the reinforced concrete control cabin and light tower.

The whole structure will be 160 ft high and 120 ft above water level (LAT). However the underside of the cabin is only 9ft above the crest of the 500 year wave. The top of the cabin forms a helicopter deck, so that emergency landing of crew can be carried out even if the seas are too rough for a tender. The light has an output of 2,500,000 cp which is expected to give a range of 28 miles in clear weather. The minimum geographical range is 15 miles. Perhaps the most interesting aspect of this project is the method of construction. The concrete is a 4.3 to 1 mix using Ordinary Portland Sulphate Resisting Cement and a water cement ratio of 0.33. This has been made possible by the use of a plasticising additive, Sika Plastiment. The caisson, lower tower and upper tower have been constructed in a berth behind a shingle bund to the east of Newhaven harbour. The lower tower encases the upper tower. This whole structure is now aground in shallow water awaiting preparation of the sea-bed at the site. Meanwhile, the cabin and light tower were built on the beach and then raised and moved out onto a temporary pier. At installation, the caisson and towers will be floated out and sunk in position. This operation will take two days and must be done at a period of neap tides, waves no larger than 2–3 ft and virtually no swell.

The cabin and light tower will be floated out to the base structure, located by 16 in diameter steel pins and secured with 1¾ in diameter Macalloy bars. The inner tower will be raised by twelve 150 ton jacks.

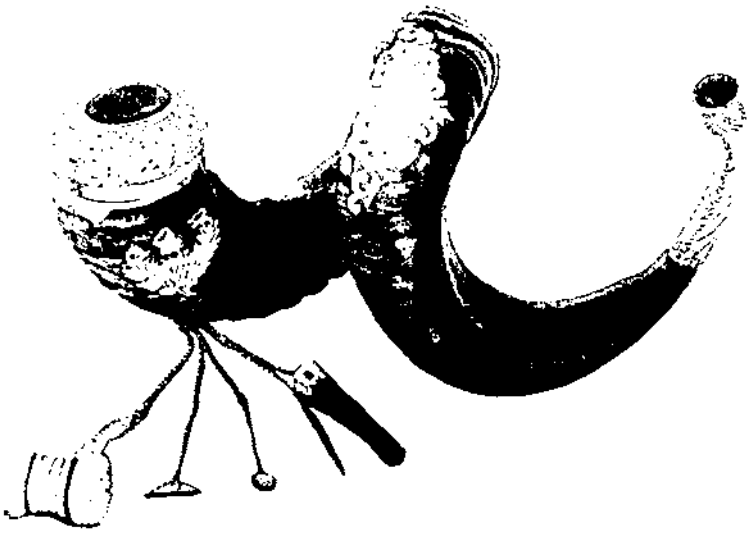
In case it appears that there should be little trouble in placing and completing this new feature of the English Channel by the autumn of this year, it is worth noting some of the main dimensions.

Caisson	120 ft wide	16 ft 6 in deep	
Lower Tower	20 ft dia	2 ft thick	
Upper Tower	14 ft dia	1 ft 6 in thick	
Cabin	60 ft dia	14 ft deep	} 1100 tons
Light Tower	14 ft dia	40 ft high	}

CRACK CONTROL IN HIGHWAY STRUCTURES. Although the requirements for the limit state of local damage in the draft Unified Code for Structural Concrete are not yet obligatory MOT Memorandum 577/2 does specify a maximum crack width of 0.25 mm. This article by S. Winter and G. Jones of the City Engineer's Department of Sheffield gives three design charts and two worked examples to illustrate the use of the charts.

PUSH-PULL SCRAPER LOADING. Push loading of motorized scrapers is a well known technique, but nevertheless one which often keeps a dozer idle while awaiting a returning scraper. Near Maidstone on the M20, Costains are using Special Caterpillar 627 scrapers which hitch together and load while being pushed or pulled by the other scraper. Each machine loads 18 yds of sand and the pair can load in 75–100 seconds.

BONDING FRESH CONCRETE TO OLD. Quentcourse is a two course system based on epoxy resins and a flexible curing agent. New concrete is poured while the Quentcourse is still tacky and the bond formed is stronger than the concrete. In some situations the property of the adhesive to act as a damp proof membrane will be of additional value. W.G.C.



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

THE PORTRAITS AND SILVER OF THE RE HQ MESS

The book is obtainable from the Secretary, Institution of Royal Engineers, Chatham, Kent. Price 30/-, post free in the United Kingdom.

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Major-General Sir William A. Liddell, K.C.M.G., C.B.	D.F.W.	16.1.20 to 25.7.22

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Major-General D. C. T. Swan, C.B., C.B.E.	1961 to 1965
Major-General T. H. F. Foulkes, C.B., O.B.E.	1965 to 1970
Major-General Sir Gerald W. Duke, K.B.E., C.B., D.S.O., D.L.	1970

(The names of those deceased are printed in italics.)

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SAVE and prosper with the Forces savings plan. Naafi's special arrangements with Scotbits Securities (a member of the Save and Prosper group) give you the benefit of regular investment in first-class business enterprises, and immediate life assurance at specially reduced rates. Lump sum investment in any of the Save and Prosper units and mini-bonds (for small cash sums) are also part of the scheme.
For full details of the big opportunities Naafi offers, complete and post the coupon today.

Marketing Dept. MKG/C/6
Naafi London SHx1

Rank _____

Name _____
(Block letters)

Address _____
(Block letters)

☐ New car for use in _____
☐ New caravan for use in _____
for delivery at _____ date _____

☐ Used car HP ☐ New car HP ☐ Caravan HP
☐ HP deposit saving
☐ Life assurance
☐ Monthly savings plan ☐ Lump sum investment in unit trusts ☐ Mini-bonds

Please tick box where appropriate. A