

THE ROYAL ENGINEERS JOURNAL

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Volume 89

THE ROYAL ENGINEERS JOURNAL SEPTEMBER 1975

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THE COUNCIL OF THE INSTITUTION OF ROYAL ENGINEERS

(Established 1875, Incorporated by Royal Charter, 1923)

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ONCE upon a time a Secretary/Treasurer/Editor of an Institution (known to all of you!) wrote in an *Editorial* that the increased subscriptions approved at the 1973 AGM would "enable us to maintain a credit balance of income over expenditure for the next few years at the present level of service to Members".

Just how naïve can one be! The offender, brought up in the hard school of building and civil engineering contracting, should have known better! In common with many others he had used an obsolescent crystal ball and had based his calculations on a 71-10 per cent inflation, which at that time was considered to be horrifyingly high!

> "I am not surely always in the wrong! 'Tis hard if all is false that I advance— A fool must now and then be right, by chance." *Conversation, William Cowper*

For the years 1974/78 the publication costs for the Institution were, and are estimated at:

	For each Member per year in L's				
	1974	1975	1976	1977	1978
RE Journal	1.06	1.31	1.57	1.88	2.26
Supplement to Journal	0.64	0.76	0.91	1.09	1.31
RÉ List	0.61	0.56	0.71	0.85	1.02
AGM Report (Inst share)	0.07	0.08	0.09	0.11	0.13
Postage	0.60	0.80	0.84	1-01	J-21
5	2.98	3.51	4.12	4.94	5.93
Overheads	1.04	0.94	1.13	1.36	1.63
Grand Total	4.02	4-45	5.25	6.30	7.56

As this projection is based on 20 per cent inflation the estimates are more likely to be low than high!

In 1975, on current subscriptions 4.2 per cent of the Active List (AL) Members, 100 per cent of Retired List Members and 86.2 per cent of the Full Members will subscribe *LESS* than the cost of the publications they receive. In 1976, again on current subscriptions, 28.5 per cent of AL Members and 100 per cent of all other Members would subscribe less than the cost of their publications.

IT IS FINANCIAL SUICIDE TO CONTINUE ON THIS COURSE Ideally we Require a Subscription System Which Keeps Pace With

INFLATION

For AL Members this is possible as the Army Pay Office can now offer a system of subscription rates linked directly to pay rates, covenanted or uncovenanted, having them automatically deducted at source, and amended instantly on change of rate of pay. The Corps Committee approved and the AGM accepted that for the Institution the subscription rate would be 0.67 of a basic day's pay per year, covenanted. This will more than pay for the publications received by the AL Members. Forms will be sent out by the Corps Treasurer in the next few months to all Active List Members.

For non-Active List (NAL) Members this is not workable for obvious reasons. Under the current subscription system, two sets of rates are applied, one for Retired Regular Officers and one for Full Members. They receive identical service. The Council proposed and the AGM accepted that in future there would be only one set of rates for NAL Members. This simplifies administration and reduces overheads. The Council also agreed that although long term stability of subscriptions is desirable it is unrealistic in the present circumstances, though it should be possible to give stability over three-year periods. As the new subscriptions would become

SUBSCRIPTIONS

operative in 1976 it was agreed that 1977 would be taken as the "mean" year. From the table it can be seen that publication costs in 1977 are likely to be £6:30 per Member per year. On the principle that subscriptions should cover total publication costs the following rates were recommended by Council and approved at the AGM for all NAL Members.

All Combatant Commissions:	
General	£8-00
Lieut-General	£8-00
Major-General	£8.00
Brigadier	£7.50
Colonel	£7.50
Lieut-Colonel	£7·00
Major	£6·50
Captain	£5.50
Lieutenant	£5-00
2nd Lieutenant	£5-00
All Quartermaster Commissions:	
Lieut-Colonel	£6•50
Major	£5-50
Captain	£5·00
Associate Members	£2.25 (receive

Associate Members £2.25 (receive Journal only) In general these rates are significantly higher than the present rates and it was felt that some NAL Members who no longer have second incomes might find the rates too high and might be forced to resign from the Institution, which would be regrettable. The Council, therefore, recommended and the AGM approved that all NAL Members over seventy years of age on 1 January 1976 could continue membership at the present rates if they so request. There are also a small number of widows who will continue to receive publications at nominal rates.

To sum up, under the new subscription system beginning on 1 January 1976:

- (1) AL Members will pay through APO, forms will be sent to them by Corps Treasurer.
- (2) (a) NAL Members will pay a common set of rates as detailed above.
 - (b) If any Member over seventy years of age on 1 January 1976 wishes for financial reasons to continue paying at the present rate, he should write to the Secretary of the Institution.
 - (c) Instructions concerning changes in the methods of payment for NAL Members will be published in the *Supplement* and the necessary papers and explanations sent to those concerned.

You will have noticed that Covenants have not been mentioned. The tax relief on the Covenants plus the "surplus above publication costs only" of the AL Members is the money available to keep all the other activities of the Institution functioning; to pay the remaining overheads and, hopefully, to increase investment and hence investment income.

Although a high proportion of Members do covenant we will never be really happy until *ALL* Members covenant. The seven year Covenant (which automatically ceases on the death of the covenantor), in practical terms costs the covenantor nothing except the promise to continue as a Member for seven years. For this promise the income of the Institution is dramatically increased. Those Members who do not covenant are asked to seriously consider doing so, we can ill-afford to ignore this legitimate income.

* *

1975 Corps' Annual General Meeting

ADDRESS BY ENGINEER-IN-CHIEF

At the Annual General Meeting of the Corps, held on 25 June 1975, the Engineerin-Chief, Major-General J H Foster, spoke on the state of the Corps. *He said:*

As you will know this year has seen yet another announcement of a major reorganization of the defence forces and this in turn will have its effects on the size and shape of the Corps. I therefore propose to spend part of my talk dealing with this and will spend rather less time on the customary account of the Corps' activities world-wide over the last year.

CORPS' ACTIVITIES

In Northern Ireland we have seen the transition from the violence of a year ago, through the start of the cease-fire at the beginning of this year, to the sectarian murders and violence that we read about in the papers today. The so-called ceasefire has not reduced the load on the Sappers—if anything the load has increased as there is more time and effort available to improve facilities.

We have continued to deploy units during the last year in both the engineer and infantry roles although we have had a pause in the latter role for a short time. The major task which occurred at short notice was when the Maze Prison was burned down last autumn and we had to send a Regimental Headquarters and two squadrons from the United Kingdom to erect seventy Nissen huts—the task taking approximately ten weeks. Incidentally, one of the first jobs after the rebuild was for one of our own regiments acting in the infantry role to guard the rebuilt prison.

As I have already mentioned, there has been a change during the lull to rebuilding temporary sangars, site screens and the whole range of defences in more permanent form. These take longer to build but they last better and require less maintenance. All sangars are being constructed in high density concrete blocks to standard patterns as far as possible. A lot of effort is also being put into improving the appearance of the defences and giving a lead to the locals to try and tidy up the wreckage of the past few years.

We have also taken on the training of search teams and search advisers for all Arms and this training is done both at the RSME and in BAOR. This has turned out to be a growth industry and we have gained a great deal of experience which in turn has been put to good use in the training system. The current Northern Ireland policy is that Royal Engineer search teams will be tasked whenever IEDs are suspected and we also have two search teams manning the heavy goods vehicles search area in the province.

Units in Germany have continued to take their turn in Northern Ireland and this together with the changes started by the Defence Review have been the main feature of their life. In Germany training in their normal role has continued and there has been increasing emphasis on carrying out construction work required by the Army. The benefit of doing the work by RE units is the saving in both money and time. Examples of such tasks during the last year have been the work at Bracht on the construction of traverses for ammunition storage, involving the placing of 220,000 cubic metres of earth, and the construction of an urban dry training area. These projects provide good training and the second one in particular gave our tradesmen useful practice in vertical construction.

Also of note has been the acceptance by SHAPE of our rapid runway repair technique after an exercise mounted at an RAF airfield in Germany late last year. The necessary plant and equipment to effect the repair technique is available at 39 Regiment and at the RAF (Germany) airfields and our commitment to the RAF towards obtaining NATO funding for their airfields is therefore fulfilled. While on the subject of the Royal Air Force, I can report that our support continues at a high level. The numerous tasks undertaken range from the construction of a temporary prefabricated runway for Hercules and support of Harrier off-base operations to installing Rotary Hydraulic Arrester Gear at RAF stations and assisting in the recovery of crashed aircraft.

In the United Kingdom we have been busy on a wide variety of tasks. One which caught the headlines was the strike of heavy goods drivers of the Municipal Cleansing Department of Glasgow as a result of which troops were required in March to clear accumulated rubbish which was becoming a health hazard. The Royal Engineers contributed to the task force by providing four composite troops and certain individual reinforcements, who were employed in Glasgow for about a month. There is no truth in the rumour that their friends would not talk to them when they returned to their units. At the other end of the scale the Corps had the honour of providing the Guard at Buckingham Palace for a month last autumn.

Other matters of note in the United Kingdom have been the move of 22 Engineer Regiment into their new barracks and the approval for the construction of new barracks at Hawley for the training regiments. The latter will cost some £10 million at present day prices, is expected to be occupied in 1980, and will accommodate over one thousand soldiers.

Moving to the rest of the world the Corps has continued to be represented in many parts of the world as usual and I will now do a flying tour mentioning the main events.

In Gibraltar we have started to line with steel and concrete 80 ft of the Keightley Way tunnel, because sections of the roof were unsafe and funds were not available to meet the £100,000 cost of a full repair. Work started in November last year and we expect to complete the task next month. Also in Gibraltar we start work on 1 July on some tasks for the PSA, and I will be referring to these later. Meanwhile Gibraltar offers the best source of practical E & M training available to us.

In Cyprus, after the anti-Makarios coup and the Turkish invasion British Forces were reinforced and the main tasks undertaken by the Corps included the construction of facilities for the refugees in the Sovereign Base Areas and camp structure accommodation for infantry units at check points and observation points. At the moment we have a troop repairing the craters on the runways at Nicosia airport as a UN task.

In Malta, our Specialist Team continues to assist the Maltese Government with development projects. The works and responsibilities undertaken are probably greater here, and therefore of more training value to us, than anywhere else. The skill and daring of our divers has also been exercised during the construction of the Laboratory Wharf.

In Kenya, we have had two exercises. A survey squadron carried out a field survey technical exercise which involved a traverse of 350 miles from Central Kenya north to the Triangulation which marks the Kenya/Ethiopia boundary, using 60 ft steel towers to see over the bush. The second exercise involved the construction of some 11 km of murram road together with forty-three culverts, which employed a squadron for four months earlier this year.

At the end of last year a field squadron went to Southern Sudan to reconstruct a multi-span reinforced concrete and steel girder bridge. While they were there they also undertook several minor tasks for the local community and relief organizations including a 1,500 metre airstrip.

In the Far East, the Gurkha Engineers and Royal Engineers in Hong Kong continue to undertake a wide variety of tasks, including constructing both camps and ranges. They have also been on exercise in Brunei, the Solomon Islands and Fiji.

In Canada, in addition to the support for battle-groups at the Suffield Training Area provided by BAOR units, a field squadron from the UK exercised in the Valcartier training area in Quebec Province. They constructed 1,000 metres of gravel surfaced road through virgin forest, realigned and upgraded a further 1,200 metres of existing road, and constructed a 13 metre span bridge.

In Honduras, as opposed to British Honduras or Belize, a management team of five are supervising the erection of two 400 ft and one 100 ft Bailey bridges for the government.

Finally in this section I must mention Explosive Ordnance Disposal. Royal Engineers EOD work has been a continuous commitment since the end of World War II and last year was no exception. The EOD Regiment carried out over 3,000 acres of battle area clearance in the United Kingdom, Cyprus and the Falkland Islands and dealt with a variety of German bombs ranging from a 1,000 kg bomb in London to two V2s in Essex. For this and other work three members of the Regiment were decorated with a Queen's Gallantry Medal, an MBE and a BEM. Our EOD capability has now been strengthened with the formation of a TAVR squadron.

I mentioned earlier a task we are about to start in Gibraltar, and I would like to say now a few words about developments in the type of work we are undertaking in assistance to the Property Services Agency (PSA) of the Department of the Environment. The QMG is keen that the potential and capacity of the Corps should be increasingly used to help the PSA in the execution of Works Services for the Army, and possibly the RAF, with a view to helping our severely limited financial resources. In this context, a squadron is moving to Gibraltar shortly for a three months tour, to start work on the installation of twenty-three mobile homes, the conversion of a number of existing buildings into married quarters and the reconstruction of four sports pitches. In 1976 it is hoped that two squadrons will be available for three months each to carry out further projects either in the UK or abroad. This new approach to works for the PSA should give us practice in planning, designing and carrying out a number of interesting projects cach year which will also provide valuable opportunities for tradesmen to practice their skills. I place great importance on this development and am encouraged by the prospects.

The TAVR have also had a busy year and continue to play an important part in our roles. For what I believe was the first time, an Engineer TAVR squadron exercised in its operational role on a major BAOR exercise with regular units. Another squadron constructed 660 m of road and a 20 m timber improvised bridge in Braemar. The Europa Promenade in Gibraltar was constructed in June and July last year, a number of tasks in support of British Forces redeployment in Cyprus were carried out by the Bulk Petroleum Team, Public Utilities and Well Drilling Detachments from the STREs, and the Power Station Specialist Team constructed a 550 m extension to a 22,000 volt overhead line for the Royal Artillery Range on South Uist. Central Volunteer Headquarters sponsored personnel also trained or carried out consultancy work in Germany, Berlin, Hong Kong and the Caribbean.

Our Surveyors have also been busy. In addition to the task in Kenya that I described earlier they have undertaken major tasks in Norway and in Cyprus. Likewise Postal has provided support for a large number of exercises worldwide during the last twelve months in addition to their normal duties. They have also acquired a caravan which is fitted with philatelic and recruiting displays, and those of you who have been to any of the major forces tournaments or displays recently may well have seen this impressive caravan.

As far as equipment is concerned, I will only touch on two items. The Combat Engineer Tractor has undergone trials in BAOR, and the Armoured Vehicle Launched Bridge is starting to come into service.

THE EFFECTS OF THE DEFENCE REVIEW

I hope that I have given you some idea of our recent activities and I will now leave this side of life and talk about the effects of the Defence Review on the Corps. Here I am slightly hamstrung by the needs of security but will give you such details as I can. Although the general outline now seems clear, the details are still being worked out. The underlying aim of the Defence Review has been to save manpower, and the main principles of restructuring that have been followed by those planning are: the removal of one level of command, an increased span of command, the concentration of specialist functions, and a greater measure of co-operation between, and integration of, the TAVR and regular elements of the Army. In all our planning we have tried to follow these principles and I believe we have been successful.

Looking outside Europe to start with, the Review follows the pattern set over recent years of progressive withdrawal. In Hong Kong the reduction in the Garrison will result in the disappearance of 54 (Hong Kong) Support Squadron and the Gurkha Engineers are being re-organized to assume its responsibilities and commitments, but still with a small British specialist element.

In Singapore 28 Independent Field Troop will be withdrawn by the end of this year.

In Cyprus, HQRE and the Survey presence will cease to exist, but the MES (Works), Postal and resources support will remain, although on a reduced scale.

In Malta all troops including the troop of 59 Independent Commando Squadron will be out by 1979, and in Gibraltar the strength of 1 Fortress Squadron will also be reduced.

We next come to Germany where 1 (BR) Corps will be re-organized to consist of four armoured divisions, with one large Engineer Regiment in each division, and in addition a lorry mounted infantry force supported by a Field Squadron. The Engineer Regiment in each division will consist of three Field Squadrons, each larger than at present, and one armoured support squadron. This latter unit will be a command of about 250 all ranks and will include not only the normal support squadron elements of plant and resources troops but also the Regimental HQ and Admin Troop, and an AVLB Troop, a sizeable command. Corps Troops on current plans will include the Amphibious Engineer Regiment, with reduced manpower but retaining the same bridging capability, and also the necessary support organization. We will continue to supply Royal Engineers support to RAF (Germany) to the same extent as at present and BAOR are currently carrying out a detailed study of the new engineer organization in the rear areas.

In the UK, HQ 12 Engineer Brigade will disappear and the four regular Engineer Regiments will come under command of their District Headquarters. The present four Regiments will be re-organized on identical lines, which means that 39 Regiment (Airfields) will lose its specialist role and each regiment will have a field squadron ("construction"), the successor to the field squadron (airfields). We have still to decide the most suitable title for these squadrons and suggestions will be welcome. We are also reverting to field support squadrons instead of the Headquarter squadrons. The future scale of support required by parachute and commando forces is still not certain but we shall undoubtedly be required to retain some capability for both. Apart from a relatively small saving in the training staff, we expect to see few changes in the training organization.

As far as the support organization is concerned, this year has seen another committee investigating the whole subject of logistic support in the Army, and I am happy to say that the Somerville report leaves us with our own support organization. However, the requirement to make manpower savings is going to bear heavily on our engineer support organization, which will have to suffer a larger percentage reduction in its manpower than the Corps as a whole, in the interest of retaining field units. Studies have been conducted on how this might be done without destroying its effectiveness and final decisions have yet to be taken, but it seems reasonably clear that the deployment of resources units will be able to meet all essential needs of the Corps, albeit at the loss of some of that highly desirable assistance which we have been accustomed to in the past.

As far as the MES are concerned there will be virtually no change and we keep the two CREs and the specialist teams under the new HQ 12 Specialist Engineer Group in the United Kingdom in addition to the complementary MES Works appointments. I foresee a steady increase in work for these organizations and a bright future. There is no doubt that the TAVR have an even more important part to play in the future and steps are being taken to ensure closer integration between them and the regular elements of the Corps.

I am afraid that that is all that I can say at this stage about the Defence Review as there is still a lot to be worked out but I hope next year to fill in some more detail.

DEFENCE SALES, RECRUITING, ADVENTURE TRAINING ETC

During the last few years, an industry which is being encouraged to grow, and which keeps us on our toes as the international political scene changes, is the Defence Sales Organisation. Considerable effort at RSME is being put into training and demonstrations in support of sales, and courses for Iraq, Morocco, Iran, Nigeria and the United States have been run, in addition to visits from representatives of many other countries.

I am coming to the end of my report, but before I finish I would like to say a few words about recruiting. Recruiting of officers, I am happy to say, has improved and currently we are getting more applicants. Unfortunately, many of these will not make the grade. Despite our efforts not to waste these applicants, we are not prepared to lower the standard of officers coming into the Corps. We would like to increase the numbers of good applicants and I would be grateful for any help you can give. Soldier recruiting in 1974 has been much the same as in 1973 and the recruiting of juniors was the main success story. We expect this upward trend in junior recruiting to continue and are anticipating an intake of 1,200 juniors in the training year 1975/76. As a result of this the Junior Leaders Regiment will probably remain at Dover and plans to amalgamate it with Chepstow are shelved, I hope for good.

On the adventure training side we have also played our part. You will have read about the Zaire River Expedition. Nineteen Sappers took part on this expedition out of a total of 165 men and women. The aim of the expedition was to navigate as much as possible of the Zaire River making a scientific survey *en route* and the sappers had much to do with assisting the expedition members to live, to move and to carry out their tasks. The other major expedition in which we have been involved ended tragically when Captain Richard Summerton, Royal Engineers, with another officer fell to their deaths while making an attempt on the summit of Nuptse in the Himalayas.

No report on the activities of the Corps would be complete without a mention of the extramural activities we are involved in and I am happy to be able to report to you that we have had our normal share of success during the last year. In shooting, tennis, canoeing, cross-country, fencing, boxing and judo, sappers have been prominent and those of you who watched the Football Association Cup Final on television, or perhaps were at Wembley to see it, will have seen the Massed Bands of the Corps adding colour and music to an exciting occasion. It is of course one hundred years since the Corps won the Cup.

CORPS FUNDS

Finally, I come to the matter of Corps funds. Inflation has affected this like every other aspect of life and the Corps Committee, taking advice from the other organizations within the Corps, has reviewed the income needed to run our affairs in a modern and economical way as well as looking for a more efficient system for the actual payment by officers.

The Corps Committee has decided that the subscription rate ought to be 2.25 day's pay proportioned as follows:-

0.75 uncovenanted to Headquarters Mess Fund

0.33 covenanted to RE Officers Charitable Fund

0.67 covenanted to the RE Institution

0.50 covenanted to the Royal Engineers Association

After income tax rebate on the uncovenanted portion no officers subscription will exceed two day's net pay. Officers above the rank of Licutenant Colonel are being invited to pay at the same proportional rate.

The Royal Army Pay Corps provide a system, and we are about the only major Corps not using it, by which these subscriptions will be deducted at source and we propose that this should be done quarterly. This method is efficient, keeps up with changes in rank and rates of pay and consequently has enabled us to keep the actual rate of payment down. The new system will be brought into effect on 1 April 1976.

I have written to all serving officers of the Corps explaining the problems and the new system and asking for their support. Virtually all the replies I have had accept the situation and have given me unstituting support.

SUMMARY

Gentiemen I have gone on for long enough, and in summary I would just like to say that although I cannot give you full details of the effects of the Defence Review today I am optimistic that the Corps will continue to fulfil its important and traditional roles for the Army despite the reductions and changes. The important thing is our versatility and I am sure that we will continue to show that, as a Corps, we are very good value for money—perhaps this year's "BEST BUY".

Centenary Year Dinner of Institution

THE Centenary Year Dinner of the Institution of Royal Engineers will be held in RE Headquarters Mess, Chatham on 30 October 1975 at 7.00 for 7.30 pm.

All Members who wish to attend should apply to Secretary, Institution of Royal Engineers, Brompton Barracks, Chatham, Kent ME4 4UG. As the capacity of the Mess is 150, no private guests can be considered. Successful applicants will receive an official invitation. In the event of over-subscription the unsuccessful applicants will be so informed and a "reserve" list will be maintained.

Cheques should NOT accompany applications. Members will receive Mess Bills. Overnight accommodation at Chatham is limited but every effort will be made to cater for those who have to travel long distances.

Dress: Mess Dress (soft shirts). Dinner Jacket with Decorations.

Centenary Year Meeting of Institution

THE Centenary Year Meeting of the Institution of Royal Engineers will be held on 27 November 1975 at the Institution of Civil Engineers, Great George Street, Westminster.

The theme of the Meeting is "*The Future of the Military Engineer*". The speakers will include General Sir William G F Jackson, GBE, KCB, MC, ADC (Quarter-Master-General), Major-General J H Foster (Engineer-in-Chief) and Major-General M E Tickell CBE, MC, FICE (Commandant, Royal Military College of Science), with a distinguished panel to assist in the discussion which promises to be lively.

Programme:	4.30-	5,30 pm	Tea and Exhibition
•	5.30-	7.30 pm	Meeting and Discussion
	7.30-	8.00 pm	Drinks and Exhibition
	8.00-	9.00 pm	Buffet Supper
	8.00-1	0.00 pm	Cash Bars available

Regrettably the numbers for the Meeting and Buffet are limited to 280 and 150 respectively. For this reason admission to the Meeting and Buffet will be by ticket only. The cost of the Buffet Supper, excluding drinks, will be $\pounds 2.50$.

Applications for tickets, including cheques (payable to the Institution of Royal Engineers) for Buffet tickets, should be forwarded to the Secretary, Institution of Royal Engineers, Brompton Barracks, Chatham, Kent ME4 4UG.

The Medium Girder Bridge Span Junction Set

D I KNIGHT, BSc (Eng), C Eng, MICE

Editor's Note: Derek Knight spent twenty years in the Army, starting at Sandhurst in Intake 2 and ending as a Sapper Major in the MGB Design Group at MVEE Christchurch. He retired from the Corps in 1968 and is now the MGB Group Leader.

MGB CONSTRUCTIONS

MGB was first developed as a Class 60 single span bridge with two types of construction:

Single Storey-up to 9 m (30 ft), and

Double Storey-up to 30 m (100 ft)

Span Junction Sets are now in production which allow an unlimited number of spans up to 25 m (84 ft) to be built. Any pier can be used provided it has sufficient strength and stability, including of course the MGB Pier which is also in production.

An article describing multispan MGB construction by Major D Philpott RE appeared in the *RE Journal* June 1974. In that article he concentrated on the use of MGB Piers. In this paper the concentration is on the use of floating piers. Figure 1 illustrates the four basic configurations and Photographs 1 and 2 show MGB with HFB Piers and MGB Piers respectively.

SPAN JUNCTION SET

A Span Junction Set is carried on two MGB pallets, and with two MGB Sets it provides all the parts needed to construct any two span bridge up to 51 m (168 ft).

It contains the Span Junction Bay shown in Figure 2, which has four identical Span Junction Posts, and Span Junction Links to allow the bay to be launched over rollers. Articulators, which are large hydraulic jacks, are used in construction to remove the Links and also to raise or lower a section of the bridge. The set also contains a pier capsill, bridge anchorages, some special launching and jacking components, and the standard MGB pallets and straps.



Figure 1. Basic MGB Constructions. 142

THE MEDIUM GIRDER BRIDGE SPAN JUNCTION SET

The Span Junction Set has a wide range of uses, and has proved particularly cessful for constructing MGB on pontoons as a floating bridge. The landing bay in from the shore to the first pontoon can be up to 26-5 m (87 ft) which is a very ractive feature allowing for high banks, large tidal variations, and the ability to dge across large areas of marsh or shallow water that are so often found on the ide bends of meandering rivers.



Photo 1. Centurian on 51 m (168 ft) Two Span MGB on HFB Piers.



Photo 2. Chieftain on 64 m (210 ft) Three Span MGB on MGB Piers.

The Medium Girder Bridge span junction set 1 & 2



Figure 2. The Span Junction Bay.

TWO SPAN BRIDGES

Photographs 1 and 3 (a) and (b) show completed two span bridges with piers made from HFB, Heavy Ferry and M2. No special parts were used other than strops to secure the bridge to the pier. Bridge loads from the MGB Capsill were distributed into the floating piers by using MGB top panels, and M2 ramps when using M2.

CONSTRUCTION OF TWO SPAN BRIDGES

The easiest way to launch a two span MGB is to use rollers on the pier as shown in Figure 3. If it is not convenient to use the pier to help launch the bridge, an alterna-

tive method can be used as shown in Figure 4. In this case the two spans are launched as a continuous girder, using a launching nose, and the Articulators are used, first to remove the Links and then to lower the Span Junction Bay on to the pier.

In Photograph 4 the bridge has been launched with a nose, and the Articulators are being used to raise the Span Junction Bay to allow a pier to be floated in underneath. This method of construction allows the bridge and pier to be built at the same time.

In some tactical situations the whole of the initial effort may be needed to construct a ferry to get the first tanks to the far bank. As more bridging equipment arrives at the site the crossing rate can be increased by building a bridge and using the ferry as the floating pier.

In another situation it may be attractive to withdraw a lot of vehicles over a Class 16 bridge, and later to strengthen the bridge to allow a rearguard of tanks to cross. A single span Class 16 bridge up to 49 m (160 ft) can be built having a Span Junction Bay at mid-span with the Span Junction Link left in. Later a pier can be floated in to give a two span Class 60 bridge.

LONGER BRIDGES AND FERRIES

Figure 5 shows the method used to construct three span Class 60 bridges up to 78 m (258 ft). For this construction special saddles are bolted to the pontoons. Pinned to the saddles are Rocking Rollers which are standard components from the Span Junction Set combining rollers and bridge bearings. An unlimited length of bridge can be built in this way using a Span Junction Bay

An unlimited length of bridge can be built in this way using a Span Junction Bay and raft every 25 m (84 ft), but this is not an economical use of equipment for long bridges. Trials have been completed in Germany, in which a Span Junction Bay and



Photo 3. 47 m (156 ft) Two Span Bridge. (Top) Using Heavy Ferry Pier. (Bottom) Using M2 Pier.

The Medium Girder Bridge span junction set Fig 3



Figure 3. Launching a Two Span Bridge using Rollers on the Pier.



Figure 4. Launching a Two Span Bridge using a Launching Nose.

THE MEDIUM GIRDER BRIDGE SPAN JUNCTION SET

raft were only used at the ends of the bridge, the centre section consisting of con-

The three spin construction can also be used as a Class 60 ferry as shown in Photograph 5 where a 30 m (102 ft) length of MGB supported on three-pier HFB rafts is being winched across the river on a fixed line.



Photo 5. Chieftain Tank on Class 60 MGB/HFB Ferry.

The Medium Girder Bridge span junction set 4 & 5

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Figure 5. Construction of Three Span Bridge or Ferry.

CONCLUSIONS

The Span Junction Set has opened up a considerable range of new bridge constructions. It has proved a simple and yet most versatile equipment, designed to be used with any suitable pier. The form of the Span Junction Bay is something new in the field of military bridging, providing a hydraulically operated hinge between spans. Except on tank launched bridges, this concept has never been tried before.

The introduction of MGB Span Junction and Pier Sets enables a whole family of bridges to be built. Like the versatile Bailey Bridge, MGB can be used for fixed or floating bridges or ferries and an unlimited length of bridge can be built using any piers of sufficient strength.

Very Much a Sapper Task (An Account of the Recently Completed Zaire River Expedition)

MAJOR J N BLASHFORD-SNELL, MBE, RE

OLD Nzabi stood on the slab of polished black basalt and gazed across the foaming rapids that interrupted the smooth flow of the wide river. The sun was warm and the air still as the men emptied their fish traps. From the bridge of the rusting steamer, lying stranded on the rock edge, a black kite watched them. Suddenly the bird, seeing a sudden movement on the river, took off in alarm. The fishermen looked up and Nzabi saw it too. In all his years never had he seen such a sight. "They must be mad!" he gasped, "Mad, or very, very, sick!"

Coming slowly down river was a procession of strange grey craft. There were three huge bulbous boats and several smaller ones darting about like flies upon the water. Both black and white men were perched upon the boats and the National flag fluttered from a bamboo pole on the stern of the leading craft. To Nzabi's horror the convoy was making straight for the cataracts! He tried to shout a warning, but his voice was drowned by the thunder of the falls. He waved his arms frantically. Incredibly the men waved back and smiled! Did they not know that they were about to crash headlong over one of the worst rapids on the Zaire River? Did they not know that ten miles of raging water and whirlpools that ran like a torrent between the jagged reefs were known as *Portes d'Enfer*—"The Gates of Hell?"

The leading boat, long and fat like a great silver marrow, slid slowly towards the lip of the cataract and Nzabi knew he could do no more. He raised his hand and made the sign of the cross. To the amazement of the watchers from the bank the boats wobbled through the tossing waves with hardly a splash.

Aboard my Flagship our TV cameras whirled as we sped down the chutes, enjoying the scenery and the welcome breeze. Fifteen days before at Bukama we had met up with the battered boats of Gambier Force, who had been exploring and navigating the river for its first 300 miles.

The natives on the bank could not know that what they were watching was the product of years of painstaking preparation.

1974 was not a good time to launch one of the most ambitious expeditions ever to leave Britain. Money was, to say the least, a trifle hard to find. The RAF was desperately short of aircraft and civil air charter rates were soaring. The price of petrol was rising daily, as indeed was the cost of almost everything. British Army units were hard pressed and could ill afford to spare good men. In Africa, political feelings were running high. The wind of change was sweeping through Angola and Mozambique. President Mobutu had recently nationalized the petrol companies in Zaire and was actively encouraging former white settlers to leave the country. Nevertheless, we believed it could be done and encouraged by the Ministry of Defence and the Foreign and Commonwealth Office, planning went ahead.

The Corps played a leading part in the preparations and we were especially grateful to our friends at HQ E-in-C, RSME, Central Engineer Park and MVEE Christchurch. It is strange, but I have noticed that whenever a massive obstacle or problem faces us, the Corps really bands together to crack it.

Originally the idea for the expedition was put forward by members of the Scientific Exploration Society with a view to attempt the first full navigation of the Lualaba-Congo River, as it was then known. There had then followed years of hard, problem studied planning. The expedition proposed to take a large number of scientists down most of the 2,700 miles of this dangerous, rapid-strewn river, much of which had not previously been penetrated. We also aimed to commemorate the centenary of H M Stanley's epic trans-African journey which had led to the first tracing of the course of that great river to the Atlantic. However, President Mobutu in 1971

Jaunched his campaign of authenticity. Place names honouring Stanley changed and his statue in Kinshasa, capital of Zaire, was knocked down. Accordingly, the expedition changed its name and Stanley was played in very low profile. Major-General Griff Caldwell, formerly Engineer-in-Chief, formed a committee to direct overall policy. He was joined by various civilian and service experts, including Colonel Bruce Maude, who, as treasurer was faced with the daunting task of raising £150,000 in cash and kind.

At first, I envisaged a small team of approximately forty all ranks. However my, early studies of the area showed that the sheer scale of this country and its river would mean a much larger expedition. The Zaire is the seventh longest river in the world and the second biggest in its outflow, averaging 42,000 cubic metres per second. Zaire is the third largest country in Africa and approximately the size of Europe. Thus, our team expanded until it had reached 165 of whom fifty were scientists and nine women. We drew our members from all over the world, selecting them mainly for their compatibility and industry. People with experience of Africa and in particular those able to speak French or local languages were especially sought after. Our membership included Americans, Australians, Canadians, New Zealanders, Belgians, French, Nepalese Fijians and a Dane. But although the great majority were from Britain, there was a large contingent of soldiers and scientists from Zaire herself, including nineteen serving members of her Corps.

Gordon Mitchell, a well known and utterly unflappable Scots Guards Major was appointed as our Quartermaster. Working for long hours from his London office he amassed over twenty tons of stores and supplies and together with his aide, Licutenant Dick Festorazzi, RE, saw to its shipment to Zaire. Whilst this was going on, the Headquarters of the expedition had been established in an MOD cellar and here we organized the publicity, fund-raising, presentations, equipment trials, issue of instructions and orders, communications, reconnaissance and documentation. It was a mammoth task and at the end there were twenty eight servicemen and civilians working in the small airless headquarters.

At last D-Day came. The old Scientific Exploration Society formula appeared to be working once again; a thorough going scientific expedition with the added spice of an attempt of to run a dangerous river. The varied scientific programmes made it all objectively worthwhile; the prospect of heroics on a river attracted the media and the commercial sponsors whose support made it all possible.

The use of the river Zaire was no gimmick. To move from Shaba (formerly Katanga) to the Atlantic with a vast team, scientific equipment and stores and a variety of nationalities was no easy task. However, there are few roads or any means of communications in Zaire and therefore the river was the natural way. Indeed the Belgians had seen this in colonial times and had inaugurated a steamer service throughout the navigable parts of the river. Where cataracts intervened, below Kinshasa, at the Stanley Falls and at the "Gates of Hell", they put down narrowgauge railways round the obstacle. If we were to move along the river then we had to find a way of getting through the cataracts. After much research and a time spent on the Colorado River in the United States, we designed and produced three giant inflatable rafts. These multi compartment craft were assembled at Central Engineer Park and could carry up to twenty tons. They were propelled by two 40 HP Mercury outboards. However, our research did not stop there, and we also ordered certain types of inflatable boats from the Avon Rubber Company in Britain and two rather unusual water jet craft from another company in Southampton. I believed that with a combination of these various boats we could tackle almost any rapid that we came against, and if, in the end, we could not get through then with the help of our Sappers, we should be able to portage around the difficult area.

The story of how we got the stores to Africa, through customs, overland, and finally to where we wanted to use them, is an epic in itself. However, much of the credit is due to our logistic support organization commanded by Major Derek Jackson, Intelligence Corps, ably assisted by Major Tom Hawkins, RE and WO I



Jim Winter, RE (both of whom had just spent two years training Zaire Army Engineers). This organization achieved administrative miracles.

The river is 2,700 miles long and by the end of our voyage our scientists, medical research groups and boat parties would be split up as if they had one team in London, another in Athens and a third in Sicily. The lack of roads, railways, bridges and ferries did not help matters. Much of the country is covered in dense equatorial forest, swamp or mountain. Furthermore, the Congo basin has one of the heaviest rainfalls in the world. Apart from the help given by the Zaire Army, we had no back-up organization for Derek to call on. Unlike most military operations, everything had to be paid for and due to the serious lack of funds, we had started the project £20,000 short of our target. It was rather like going into battle, but first of all having to buy the stores from the PRI! Lesser men might well have given up if faced with such a situation, but our support group was never to let us down. Using trains, planes,

boats, steamers, a collection of "cast" British landrovers and even porters, they worked tirelessly to win the logistic battle. It is true to say that expeditions depend on good logistics if they are to succeed. Communications were equally tenuous. From the various teams and the fleet, we communicated to the support group on the relatively old radios, designed to operate over distances of up to 350 miles and hardly suitable for the mileage over which we expected them to work. However, they were all that was available and apart from these, our Signals section had only the civilian Racal sets with which to communicate. Nevertheless, great credit is due to the Royal Signals detachment who, without complaining, managed to get our reports through to both the *Daily Telegraph* and the Ministry of Defence in London. We also estabtished a rear base in Kinshasa to liaise with the Zaire Army and Government and to run a special Expedition Post Office which had been set up by our postman Corporal John Winterbottom, RE.

Linking up this scattered force were three eight-man mobile "Forward Support Teams" (FST), each commanded by experienced officers. One of whom was Major John Benham-Crosswell, RE. It was their task to do advanced reconnaissance, scatablish good relations with the local people (who, after the recent history of white mercenaries in the area, were naturally rather suspicious) and to move stores, scientists and scientific specimens to and from the river. Each FST was responsible for a sector of the waterway.

Our air support was an Army Beaver fitted with the latest Sony Video equipment and commanded by Warrant Olficer Cliff Taylor of the Army Air Corps. This robust six-seater plane was used for reconnaissance, parachute delivery of stores and aerial photography. On the door it bore the proud motto, "Pas de Problem". Even so, local aviators did not envy them their job. Flying a single engine aircraft out from Britain, over the Sahara, four months flying above dense jungle with a country-wide fuel shortage, no diversionary airstrips, poor weather and no air rescue facilities is no pienic.

The first part of the expedition was to navigate the upper reaches of the river. Here, with our base at the mining town of Kolwezi, we proceeded down river in Avon Professional inflatables. These excellent boats were steered by long sweep oars and the occasional use of small outboard motors. Captain Jim Masters, our Chief Engineer (boats), had developed this technique after experience on the Blue Nile and trials on the Colorado. The team had some ferocious water to navigate and experienced a great many thrills and spills. One incident was almost too thrilling when an angry hippopotamus decided to make a meal of the boat, which it did very successfully.

Many of our team had been with me on previous expeditions and were extremely experienced, but as always, we brought in fresh blood, particularly junior officers and young soldiers so that they too might gain experience. It was very comforting to see how well the team moulded together in these early and rather trying days.

At Bukama the river was wide enough for us to launch the giant inflatable rafts. Resembling outsize rubber mattresses these boats were 40 ft long and when fitted with pontoons as out-riggers, some 15 ft wide. Exact dimensions depended on how hard you blew them up! Each was powered by a 40 hp Mercury outboard motor and another was carried as a spare, which could be fitted on midships to provide additional power. The minimum crew was only three but they could carry up to thirty people on each raft. In addition there were fuel, rations, scientific equipment, radio sets, line-carrying rockets, engineer stores and tools, plus television cameras, artists materials and medical stores to be stowed securely aboard.

On the Flagship La Vision we also carried a yellow fibreglass six-wheeled, threeseater amphibian. It was a useful vehicle and allowed us to get about more easily in the swamps and along some of the flood plains. We called it the Buggy, but the Sappers who had to manhandle it called it something else.

The smaller craft in our fleet consisted of the Close Reconnaissance Sections two Avon reconnaissance boats. These were 4-metre fast inflatable dingies powered by



Photo 1. Giant Inflatable Barclays Bank (Kenneth Mason-Daily Telegraph)

40 hp Johnson outboards. The task of this section was to scout ahead of the big crafts and when required, to find a safe way through the rapids. They were a hard working bunch who undoubtedly enjoyed the flexibility and speed of their little boats compared with the lumbering crafts which they led. In addition there was the overland engineer section commanded by Major Ernie

In addition there was the overland engineer section commanded by Major Ernie Durey, RE. Ernie had led our Pathfinder engineer group in the Darien Gap and is one of the most experienced Combat Engineers I have ever met. His bunch of Sappers was the greatest collection of piratical rogues on the river. They moved with their own boats and vehicles almost at will throughout the country. Their task was to ferry landrovers, build bridges, dynamite anything they could find, move scientists, collect fresh water and locate stocks of beer. All this they did admirably and with great success. The section used the same inflatable raft and MEXE ladders that we had developed for the crossing of the Darien Gap and they were also equipped with excellent Turfor Jacks and Husquvarna power saws.

From Bukama I hoped to be able to reach Kinshasa, 2,000 miles away, without taking our giant craft off the river. But sailing into the flat, treeless waste of the Upemba Swamp I was extremely worried that the river in the "Gates of Hell" might be too low for navigation. As we picked our way carefully through the mass of Papyrus Islands, I discussed the problem of portaging with our Chief Engineer (boats), Jim Masters. We agreed that portaging would be a devil of a problem and we must try to stay on the water as long as possible. Stanley's boat, *The Lady Alice*, had been built in sections for ease of overland movement. Our giant inflatables were collapsible, but the central float chamber, shaped like an elongated doughnut, weighed 750 lb, even when deflated. We were also somewhat concerned about passing through the "Gates of Hell" with this vast boat, however, our Army Chaplain, Basil Pratt, assured us that with our sins the gates would be wide open.

As we cruised through the great swamp the water birds wheeled around us and

Very Much A Sapper Task 1

the occasional crocodile slithered into the muddy brown river. However, our greatest worry was still ubiquitous the hippo.

Each night our scientists would explain their work to us. This was most helpful because on such an adventurous project it is easy to forget that the results of lasting value are those achieved by the scientists. Captain Scott had said of his last Polar expedition that he believed it was primarily a great scientific project with the Pole as the bait for public support. Similarly, I believed that although the problem of navigation of the river was most important, the news-worthy challenge was also necessary to gain us funds for the entire project. Although immediate results are not easy to obtain from the scientific research, some of the subjects under scrutiny were extremely interesting.

Jeremy Mallinson, from the Jersey Zoo, was to be treated to the rare opportunity of spending five days in close proximity to a large family of mountain gorillas that he found in dense forest in the highlands. Whilst there, one enormous male suddenly gave a deep roar and beating its chest charged to within 6 ft of Jeremy, before calling off the attack! These bluffing tactics are well-known in gorillas and Jeremy stayed put long enough to get a very splendid photograph. Another expert on primates; stocky, rugged, Scotsman, Sinclair Dunnett, spent his time on the expedition seeking the rare pygmy chimpanzee and eventually, after months of painstaking searching over many hundreds of miles, managed to capture three of these quaint little creatures. These are believed to be the first ones ever caught for zoological research.

On the river our geologists, both Zairois and British, studied rocks. Zaire has a great wealth of minerals and in some places we saw whole hills of what looked like solid copper. Meanwhile the fish team sought its specimens with nets and line. They included in their group Professor Geoffrey Hazelwood, holder of the Chair of Biochemistry at Guys Hospital. At sixty four he was one of our senior scientists and had come with his wife, Beth, to study fish bile, whilst Dr Roger Sweeting, a Research Fellow at the St John Cass College was concerned with the parasites. The Sappers readily took to helping the fish team and a day's netting became a popular past-time, certainly catches were excellent, even if they had to be pickled for posterity.

In spite of our misgivings the "Gates of Hell" did not turn out to be as bad an obstacle after all. Our boats proved to be as excellent as we had hoped and we sailed on enjoying a slightly bumpy, but otherwise uneventful ride in what could have been very dangerous water. On 10 November we emerged from the last cataract of this stretch. The banks were crowded with villagers in brightly coloured clothes, cheering and waving excitedly. They had come from miles around to see the first boats ever to come through the rapids and as it was midday, we pulled in for our lunch. Chiefs came aboard and were offered lemonade powder and Army biscuits, thinly spread with Shippham's paste! Greetings over; the Chiefs announced that their people wished to sing to us; which they did. For Squadron Leader Mike Barnard, our musical navigator, it was too good an opportunity to miss and he soon unwrapped his saxophone to give us a rendering of "Sweet Sue", which sent the people clapping with applause. We also entertained the villagers with the music of the Royal Engineers Band from a cassette player. Their reactions to "Hold him down while I get at him" were mixed! That night we camped on a grassy bank looking across what was now a slow moving river almost 1,000 m wide to a low ridge in the east. It was from this ridge that Stanley had first viewed the river in 1876 when his Anglo-American Trans-African expedition, sponsored by the Daily Telegraph and the New York Herald had reached this point. At dawn the local Chiefs arrived by canoe. These 10 m long craft were propelled by twenty paddlers who worked in unison, chanting as they dug in their blades. Boats like this had been used by hostile natives to attack Stanley, but to us the people showed nothing but kindness.

A few days later we came to the village of Nyangwe, near where Stanley had launched the *Lady Alice* after his march from Zanzibar and where Dr Livingstone had lived for almost a year; trying in vain to persuade the local people to take him down the river. Then, after witnessing a most dreadful massacre, the Doctor had marched back to Ujiji on Lake Tanganyika where Stanley had found him, sick and weak in 1871. In the field behind the village were the graves of Belgian soldiers who had died fighting with the Force Publique that Stanley had set up in the 1880s to defend the new Congo Free State. Ironically these men had perished whilst driving out the Arab slavers under the infamous Tippu-tib, who had supported Stanley in 1876.

We next reached Kindu, scene of more modern tragedies in the 1960s for it was here that the drug-crazed Simba rebels had started their revolt which had resulted in their seizing large areas of the country. The hard working Commissaire du Zone greeted me with a bottle of Scotch and entertained us royally. He had already been chatted up by Major John Benham-Crosswell who had arrived earlier with his FST and understandably had been mistaken for a group of mercenaries. However, all was now well and the people of Kindu extended to us the most wonderful hospitality. Occasionally we were mistaken for mercenaries, probably due to our jungle green uniforms and the liberal quantity of weapons that we carried. However, one useful feature of our dress was our shoulder title which, reading "L'Expedition du Fleuvre Zaire", helped to convince people that we were friendly.

At Kindu our entomologists, assisted by our Gurkhas, set up a camp in the tropical rain forest. The entomologists were sampling the flying insects at different levels between the top of the trees and the ground. They believed that this study would give them the first overall indication of the composition, vertical distribution and richness of the flying insect fauna of the rain forest canopy in Central Africa. Such knowledge is essential in order to assess the importance of the forest as a natural resource. Working closely with a team of Zaire scientists, some of the best in the land who had been sent on the orders of President Mobuto to join us, our experts set electrically powered ultra-violet light traps to collect the insects at different heights above the ground. In order to get the traps up into the trees, a small team of sappers was employed as climbers. One of these, Sergeant Mick Hough, RE, managed to survive an 85 ft fall. It was not surprising, as he was from 9 Squadron and after some ten minutes unconsciousness stood up, shook himself and muttered one or two expletives which are best deleted. However, we later discovered that he had a minor brain hemorrhage, so he was put on light duties for a while!

Meanwhile, 400 miles from Kindu, in a remote village, ex-commando doctor, Mr Freddie Rodger, our SMO, was leading the expedition's medical research team investigating many diseases including "River Blindness' which afflicts more than twenty million Africans. His enquiry was unusual in that apart from studying the disease, the natives for eye damage and the tell-tale skin nodules which accompanied the infection, his team was also studying the environment of the endemic areas. It was a pathetic sight to watch the queues of people outside the Headman's straw hut awaiting examination, some blind, some semi-blind, many, although disfigured by these subcutaneous nodules, apparently healthy. The only light relief was the arrival of four Pygmies, who politely declined Freddie Rodger's invitation to have their eyes looked at, on the grounds that he would then be able to glimpse their souls. The researchers' efforts were directed at finding clues towards a cure for the disease which is caused by the bite of black fly with the horrific name of "Simulium Damnosium".

Back at Kindu we re-fitted the boats from the Quartermaster's Stores train for the next obstacle. Our mobile stores were certainly unique. In a railway siding guarded by Zaire soldiers stood a "wagon-lits" and a collection of closed trucks. The Quartermaster paraded up and down with a large stick. Men approached at their peril, but when the custodian of all we possessed, decided that an issue should be made, it was a great moment. A huge bunch of keys was produced and like a medieval jailer, Gordon Mitchell would stride up to the selected wagon, which might bear the magic words, G 1098. The huge steel doors slid open revealing a host of goodies inside, but a few were permitted the privilege of actually entering the inner sanctum.

The Stanley Falls were a stretch of seven cataracts over some 70 km. The usual

thorough reconnaissance being carried out by air, land and river and in spite of local stories that the river went underground, we did not expect too much trouble. How wrong we were! We were passing through some moderate rapids, when without warning, all hell let loose. "Look out," yelled Captain Peter Marett, RE, our Intelligence Officer, who had seen that we were about to plunge into a yawning 14 ft deep hole, which inexplicably had opened up in the river bed. Already one of the Avon dingies was in the boiling pit being hurled about like a cork in a washtub. Now the 40 ft raft on which I was riding came crashing down the slope, a giant wave swamped our engine hurling the sapper helmsman, Sergeant Bob Russell, off his feet. A wall of water struck the bow sweeping away precious stores that had been lashed in with thousand pound breaking strain rope. The decking boards splintered beneath us as the great craft flexed and twisted in the cauldron. With no engine, we were trapped in the hole, being pounded by mountains of brown water that spun us around so that one lost all sense of direction. Suddenly, we were thrown clear to drift into slack water. It was a great relief, but behind us the second Avon dingy had also gone in and I had just time to see my old friend, author and Sandhurst lecturer, Richard Snailham's bearded face aghast with horror as he held on for dear life. Barclays Bank, the second big boat on which Corporal Brian Sanders of 48 Field Squadron was a helmsman, managed to avoid the hole, but the David Gesteiner, went straight in. We watched as momentarily she stood on her bow. "She's going over," I gasped, but miraculously she fell back into the pit and escaped. Next day, we employed the local talking drums to send a message offering a reward for the recovery of various pieces of kit lost in the accident. The messages were passed quickly and efficiently and even our Signals Officer was full of admiration for the work of the drummers. They claimed that they could communicate at up to 50 km by night and 30 km by day. Perhaps they might be useful to the GPO!

The final cataract of the Stanley Falls was right in front of the city of Kisangani (formerly Stanleyville). Here, thousands of people crowded on to the banks to cheer the fleet through. As each boat slipped over the 6 ft drop into the heaving waves, a great shout went up from the shore. The Avons were hurled high by their impact with the waves, but the big rafts seemed able to amble through, all except our Royal Marine skippered *David Gestetner*, who delighted the crowd by demolishing one of the 15 ft high fish traps that stood in mid-river. It was a great day for the expedition for we had reached our half-way mark. The local brewery kindly saw to it that the occasion was suitably marked. A gesture greatly appreciated by Ernie Durey's sappers, who had been running a "bridging gallop" for several hundred miles to get our supply column round the Stanley Falls.

Now a thousand miles of wide slow flowing river faces us. Stanley had fought many battles here, but in 1974 the Zairois were overwhelming us with their traditional hospitality. It was as well that our relations with them were so good for Green Howard, Major Roger Chapman's life was probably saved by General Mena, the Area Commander and, one time, Defence Attache in London. On hearing that Roger was seriously ill, the General commandeered a passing airliner to evacuate him to Kinshasa. With Roger went my personal assistant, Miss Pamela Baker, who having nursed previously in Zaire and speaking fluent French, was able to arrange immediate medical help. Nevertheless, he was lucky to be alive and had we not had excellent surgeons on hand, the story might have been very tragic.

Around Kisangani rose the dense Ituri Forest, through which Stanley had marched to rescue Emin Pasha in 1888. In this dark land lived the Pygmies and the strange Okapi, a type of giraffe with a backside like a zebra and a body like an antelope. It is peculiar to this part of Zaire and was only discovered around 1900. I was very keen to see the beast and accompanied by photographers, drove 350 miles east towards the Mountains of the Moon. There we found two fine bulls in captivity and were privileged to meet the Pygmies, who hunt these strange creatures for the Government Conservation Department. In olden times the skin of the Okapi was much sought after and indeed was reserved for chiefs. Apparently the reason was that it was sup-

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posed to bring an endless supply of pretty young girls to those who sat on it! With the Pygmies, we tried to find and film the animal. Marching deep into the twilight forest with our tiny near-naked friends, we searched for days and although I was not lucky enough to see one myself, some members did get within twenty metres of them. The only creatures I met were far from genile. On one of our hunts two Pygmies, a Sandhurst trained Zaire officer, Miss Valeric Jones, a lady jockey from Scotland and I were moving along a narrow game trial in thick jungle. Suddenly the leading Pygmy bounced passed me like a little chocolate coloured rubber ball, close behind him was Lieutenant Bongo, who yelled, "Run"! and behind him came a very angry jumbo, ears flapping and trunk raised. I leapt aside and just in time, remembered to warn Val. Four irate elephants crashed passed her. They looked rather small and it was only later that I discovered that they were the dangerous pygmy variety that inhabit the Ituri forest and are much feared by the natives. The pygmies were quite superb and very tough. One hunter had a "negligent discharge" with his bow and shot himself in the foot. Luckily it was not a poison tipped arrow and be marched on for seventeen miles, leaving an impressive blood trail!

Also working in the forest was a former sapper officer, Dr Ken Joysey, lean and enthusiastic director of Cambridge University Zoological Museum, who was in hot pursuit of the West African Otter Shrew. There are no live specimens of this creature in captivity. With pygmy bowmen and Gurkha soldiers, Ken and our other zoologists probed deep into the Ituri. In the same party was an officer with a reputation for collecting reptiles, who managed to surpass himself by getting a lethal 42 in Gaboon Viper, one of the most dangerous snakes in the world, Back on the river our botanists were hard at work, studying amongst other subjects, the spread of the notorious water hyacinth. Outwardly a pretty violet and green plant it was introduced into the river from South America in 1954 and is now threatening to block parts of the waterway.

Meanwhile, under command of my deputy, Captain Mike Gambier (late of the Royal Marines), the fleet was rapidly approaching Kinshasa, where we now faced a host of problems. Our casualties were growing alarmingly as malaria, in spite of



Photo 2. Hamilton Jet boat on reconnaissance in the Kinsuka Rapid. (Kenneth Mason-Daily Telegraph)

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regular doses of paludrine, took its toll. Dysentery, hepitatis, sundry fevers and car complaints were reducing our force daily. At one time, it had been suggested that we had too many people on the expedition. Now I found myself with too few to carry out the necessary tasks that would get us to the Atlantic. Contrary to a report in the press, morale was sky high and it was as well that it was, because ahead of us were the most difficult rapids yet.

Another problem was that having left groups in Kisangani and Kananga, our communications were now stretched to over a thousand miles. The sets were simply not designed to cope with this nor had we got enough radios to do it. Nevertheless, the Royal Signals team battled on bravely and somehow we always managed to get through. Our transport, which had served us so faithfully, was now virtually worn out. The Committee in London announced that in spite of our economies, they had been forced to raise an overdraft, and this we knew would take at least eighteen months of writing, lecturing and selling special philatelic souvenirs to repay, once we returned to Britain.

Christmas never feels quite the same in the tropics, but the European families, wherever they met us, threw open their houses and did their best to entertain us. It was our only rest day in four months for all, except Durey's engineers, who were busy rebuilding the main road from Kananga to Kisangani in order to extract our Medical Research team.

On New Year's Day a crowd gathered on the island of Mimosa near the capital to watch our fights with Kinsuka, first of the thirty two cataracts of the Livingstone Fails that cover more than 200 miles between Kinshasa and the Atlantic. Assisting on much of this stretch were the two Hamilton water jet boats. Designed in New Zealand and built in Britain these 220 hp fast and highly manoeuvrable craft had already been down river to make a detailed reconnaissance of the route. Skilfully driven, these powerful boats were to be a vital part of the forthcoming operation. Indeed, we were so impressed with these craft that I believe they would merit consideration for use as RE work boats or tugs.

At 1100 hrs La Vision passed easily through the narrows and running down a smooth tongue of water, skirted the line of tossing 20 ft waves that rose and fell in the centre of the river. Acting as rescue boats, the Jet craft lay in the lee of a weed covered boulder. David Gestetner, her white ensign fluttering bravely appeared next. As the boat crossed the first fall, her stern engine struck a submerged rock which hurled it upwards off its wooden transom. The flaying propeller sliced through the neoprene fabric of the stern compartment, which deflated immediately. Aboard the Jet we could not tell what the cause of the trouble was, but we could see the great raft being swept out of control into the angry wave towers that we knew must be avoided at all costs. In a second, our skipper had opened the throttle and driven the 18 ft boat straight into the bounding mounds of coffee coloured water. I could see Mike Gambier in the water, his white crash helmet and red life jacket showing clearly as he bobbed amongst the flying spray. Our sister Jet was already making for him with its scramble net over the side. The roar of water and engines drowned all command. Everyone was acting instinctively now. David Gestetner's skipper was trying to pass us a line. His face contorted as he yelled against the din. Suddenly an enormous wave flung the crippled vessel forward and upwards. It towered above us and then came crashing down with a great "plonk" right across us. For a second we were locked together in the tempest and then managed to wriggle from beneath and circle our quarry once again. This time we managed to take a line and soon were dragging the craft like a striken whale towards an island where we beached her for repairs. Eighteen hours later we were on the move again.

In the days that followed we shot more rapids and navigated the most ferocious waves and water I've ever seen. For every cataract the drill was the same, air reconnaissance by Beaver, then the Jets would take the skippers ahead to examine the heaving inconsistent stream and the swirling whirlpools that went up to thirty metres across. On either side vertical cliffs of red rock rose for hundreds of feet and



Photo 3. The David Gestetner, damaged stern after the mishap in Kinsuka cataract. (Kenneth Mason-Daily Telegraph)

fish eagles shrieked their yodelling cries as we passed. Meanwhile, our support group was working day and night to get fuel and supplies into us over the deeply rutted tracks. The old cry of "Never enough Sappers" was often heard, however, Lieutenant Dick Festorazzi dia n outstanding job in supporting us. On 6 January we reached Isangila, the falls that had forced Stanley to abandon

his boats and march over the mountains to the sea. Here I decided to move the giant rafts overland as far as the Yalala Falls and let the Jets and the Avon dingies tackle the ferocious stream alone. In no time one of the reconnaissance dingies was ripped open from stem to stern on razor sharp rocks and several men were hurt. Amongst those injured was Jim Masters but thankfully he was on his feet again in no time. It was late afternoon when our jets entered the relatively clear passage that should take us through the Isangila cataract. We were half-way down when I saw two gigantic waves converging on our bow. With a crash like thunder they struck us simultaneously, hurling the 3,000 lb boat upwards. I fell across the skipper knocking him momentarily from the wheel and the rest of Tac HQ almost went over the side. Then as we hit the water again we saw another huge wave towering ahead of us. For a moment I thought we were done for. The wave smashed over us but somehow we were still afloat, although the engine had died. Ahead a line of rocks like dragon's teeth rose on the lip of the fall. We were being swept straight towards them by the racing current. The skipper tried desperately to start the engine and fortunately on the third go it fired. However, it only spluttered for a short while, but it was just long enough to take us into slack water.

Finally, even the jets were halted at the Inga rapids, but with two more short portages and some excellent warping with long ropes, we got the amazing Avon boats through to the foot of the biggest obstacle on the entire river, Yalala. A mile of water boiling over terraces and through jagged rocks at frightening speed. Meanwhile our giant rafts had been carried by Zaire Army lorry to within 4 km of the river. Here we re-grouped. Some of us had marched over the hills just as Stanley's men had done. We had experienced the same elephant grass, endless rolling hills and

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ridges and sharp suet-coloured quartz rocks underfoot. We too had stumbled and fallen on the slippery boulders at the river's edge. Finally we all came to the Yalala Falls where our engineers were already building a road for us to get the giant rafts back to the river. For three days we toiled in the blistering heat with pick, spade and crowbar and even some highly unstable dynamite, to clear the boulders and get the bulbous inflatables to within a 1,000 metres of the river. Supporting us during this operation was an FST under the command of an American Army officer, Captain Tom Mabe. Tom and his colleague Sergeant John Connor had come with us throughout the journey. Serving with the US Special Forces, they were extremely useful members of our team, although I fear at times we must have driven them mad. Finally with sixty porters beneath each huge boat, we moved them like great caterpillars down a thousand foot slope to the water. Here we joined up with the Avon dingies that had been portaging and lining down the rapids towards us. Now only three rapids barred our way to the sea, but with twelve million gallons of water a second pouring through a gorge that had narrowed the river from nine miles to barely 400 metres the power can be imagined. Indeed the depth here was probably about 140 ft at high water. The river seemed to be alive with enormous boiling bubbles of water rushing up to the surface from the depths and then as quickly as they came, they were replaced by whirlpools.

Our porters, many of them Angolan refugees and possibly freedom fighters, came with gifts of sugar cane wine and fruit to see us off. But the river was not going to let us get away unscathed yet and in the final rapid, one of our gallant Avons was capsized by a fifteen foot wave. The upturned boat with its crew of three clinging to it, was swept towards a yawning whirlpool and whilst spinning on its periphery was bravely rescued by its sister boat in the nick of time. (For this brave act Corporal N Rickard RM has been awarded the Queen's Gallantry Medal.) A few seconds later the upturned craft was sucked down in the vortex and swept a thousand metres underwater before it bobbed up on the tail of the cataract. Two days later at dusk, the strange fleet that had set out almost four months before in the centre of Africa



Photo 4, JB-S, Richard Snailham (beard) take to President Mobutu at the end of the expedition. (Kenneth Mason-Daily Telegraph)

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sailed into the setting sun. Our Army Padre in cassock and surplice, held an improvised cross and beneath the flags of the nations represented in our team, he conducted a simple service. Under our hulls the water heaved gently, strangely it no longer tugged and pulled at us, there was no current, we were now in the Atlantic.

There had been many difficulties in the years that it had taken to plan and execute this expedition. Manpower had been extremely hard to find. The RAMC could not help with MO's and to get our complement of doctors we had even to fly, at a considerable cost, a surgeon from New Zealand! Regiments were naturally loath to release good men at such a time and with the Army fully committed in Ulster. Money was almost non-existent and we had had a long struggle in the early days persuading our Zaire friends that we were not a bunch of mercenaries. However, in the end, it had all been overcome and we had managed to prove Stanley wrong when he had said, after his expedition, "There is no fear that any other explorer will attempt what we have done in the cataract region. It would be insanity in a successor". However it was a miracle that none of our team had been killed.

On return to Kinshasa we were privileged to be invited to the Presidency. There we met and talked with our patron, President Mobutu about the problems that his country faces. We were able to thank him for the considerable hospitality and kindness that we had received in his land. All he asked of us was that on our return to our homes, we should tell people of his hospitality and do what we could to get people to understand Zaire and its difficulties. This we shall gladly do because on no expedition that we have undertaken, had we received such wonderful treatment from the ruler, government and people of a country.

The Zaire River Expedition was an example of a worthwhile project, with a good mixture of science and adventure, showing that the spirit of adventure is not dead and that Britain still leads the world in this field. It had been a great battle, fought against one of the most incredible rivers of the world, surrounded by the most testing terrain. Servicemen of many Regiments had been involved, as had the best civilian scientists and experts we could find. I believe that in the end we had won because of thorough preparation, good equipment, especially the giant rafts, and because above all else, we were a team. Nevertheless, I hope that I may be excused a small pang of pride when I say that in the forefront of the fight and in every echelon of the expedition there was always, as Kipling said, "Her Majesty's Royal Engineer, with the rank and the pay of a Sapper!"

Ottawa Honours Lieut-Colonel John By, RE

BRIGADIER-GENERAL J L MELVILLE, CBE, MC, ED, CD

ON 23 May 1975, in hot humid 90 degree weather, the City of Ottawa paid tribute to the builder of the Rideau Canal and founder of Bytown, subsequently renamed Ottawa the Capital of Canada.

A fountain which originally played in Trafalgar Square, London, England had been erected and re-installed and was now re-dedicated.

Two identical fountains were built in 1845 from a design by Sir Charles Barry, architect to the British House of Parliament. These fountains, which had been slightly damaged by bombs during WWII, were replaced by larger ones in 1947 and donated by a national arts group to the National Gallery of Canada.

In 1955, through the co-operation of the National Capital Commission, the Engineering Institution of Canada and the Military Engineers Association, one fountain was erected on the Driveway near the Rideau Canal. The fountain subsequently was removed and stored owing to the development of the National Arts Centre.



In 1975 a \$50,000 concrete base and basin were constructed by the Commission in a magnificent location in Confederation Park. With the co-operation of civilian and military engineering bodies the fountain was installed and re-dedicated at a well attended ceremony. The forty-piece Canadian Air Transport Band entertained the spectators and greeted the guest of honour by playing Wings.

An interesting and very smart participant was Lieut-Colonel P W Lawrence who as a Corporal RE was posted to the Military Garrison at Halifax in about 1898. In 1906, when the Corps of RCE was formed, he transferred and attained his present rank before retirement.

Any before redrement. A representative company gathered for lunch after the ceremony in the National Arts Centre and Doctor Robert F Legget, OC, the Chairman, gave an inspired address quoting from correspondence between John By and Colonel Durnford RE, Portsmouth. In one letter By said, "The King appeared to remember me, asked how long I had been absent, and if the canal was finished."

> Otawa Honours Leiut Colonel John By RE

Presentation to US Corps of Engineers

THE US Corps of Engineers was formed in June 1775. To mark the Bi-centenary the Corps of Royal Engineers has presented them with a solid silver miniature replica of a Bailey Panel.

The presentation was made on behalf of the Corps by Brigadier J I Purser, Commandant of the Royal School of Military Engineering, to Lieut-General William C Gribble Jr, Chief of Engineers, at an impressive ceremony held at Fort Belvoir on 22 May 1975. A large audience consisting of members of the staff, headed by Brig-General James A Johnson, Commander of the US Army Engineer Centre and Commandant US Army Engineers, and a great many young student officers were assembled in the Humphrey Hall at Fort Belvoir, together with the 75th Army Band.



The presentation was preceded by a lecture given by Brigadier Purser on the history and activities of the Royal Engineers. Afterwards, in handing over the silver presentation piece to General Gribble, Brigadier Purser expressed the wish that this replica of a Bailey Panel—a piece of bridging equipment as familiar to American as to British Engineers—would symbolize the close ties of friendship and co-operation that now existed between the two Corps, and on behalf of the Royal Engineers wished the US Corps of Engineers and all its members as successful and illustrious a future as it had enjoyed for the past two hundred years.

fature as it had enjoyed for the past two hundred years. General Gribble, in thanking the Corps for this very magnificent gift, said how much he choed the sentiments expressed by Brigadier Purser, and in particular said how much his Corps valued this close association with the Royal Engineers. He in his turn would like to make a presentation to our Corps; and in handing over one of the special Bi-centennia Plates, he asked Brigadier Purser to convey to the Corps of Royal Engineers. JIP

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Presentation To US Corps of Engineers

Some Sapper Presidents

LIEUT-COLONEL K H TUSON, C Eng, F1MechE, FIEE, M Cons E

THE Corps of Royal Engineers has provided the army with a great many generals and at least its fair share of field-marshals. Their names are familiar and many of their portraits hang in the Chatham Mess to inspire future generations. No one can doubt the provess of the Corps in the profession of arms. But what of the other profession for which it exists—engineering? How many of its members have carned the distinction which other engineers bestow—election to the Presidential Chair of one of the senior engineering institutions. (The term Institution will be used throughout although some started as Institutes). How did they achieve it? It may be that these men—a handful only—are not as well known in the Corps as they deserve; if so perhaps this account of some of them may redress the balance.

There have been eight in all. Six—Bateman-Champain, Webber, Crompton, Edgecumbe, Purves and Lee—were Presidents of the Institution of Electrical Engineers or its predecessor the Telegraph Engineers. Two—Sankey and Davidson—were Presidents of the Institution of Mechanical Engineers. Crompton, whose service career began in the Navy in the Crimean War, is of international renown and the subject of at least one full length biography. Edgecumbe, Purves and Lee were trained in industry and subsequently held territorial or other commissions. Champain and Webber entered the Army in the ordinary way through Addiscombe or Woolwich, as did Sankey and Davidson. For reasons of space this article will tell only of the achievements of these four.

COLONEL SIR JOHN BATEMAN-CHAMPAIN, KCMG President Society of Telegraph Engineers 1879

Champain—he added the prefix Bateman on succeeding to an Irish estate in 1870 was born in 1835 of an Irish family, his father having served in the 9th Foot. From Cheltenham he went to Addiscombe for service in India, passing out head of his term with the Pollock Medal in 1854. The Mutiny broke out soon after he joined the Bengal Engineers, and he played a conspicuous part in the operations, first as regimental adjutant and later in command of the Sappers during the march to Agra and Cawnpore. He was present at the siege of Lucknow and many other engagements.

The absence of a telegraph service to India was sorely felt during the Mutiny. Submarine cables had been laid between Malta and Egypt and from Suez to Bombay by private enterprise with Government support but they were a failure, and in 1862 it was decided to try again. The route selected was to the Persian Gulf by landline, submarine cable to the head of the Gulf, and thence via Baghdad to Constantinople, with an alternative loop through Persia. Major Patrick Stewart R E was in charge of the project, with Champain as his assistant.

Submarine cables were in their infancy and diplomacy rather than engineering expertise was the requirement where land lines were concerned. In this Champain excelled. Although by the Convention only one English officer was allowed in Persia to supervise line construction Champain somehow took fifteen Sappers and six civilians with him, and was asked to stay when the agreed period was up. In 1865 Stewart died, Champain succeeded him and moved to Constantinople. The line was duly connected throughout but signals were bad, mainly because of the section through the Balkans. There was however a good line through Persia to the Russian frontier, and Champain was sent to Moscow in 1867 to negotiate a circuit through Russia and Eastern Europe. By 1870, when Champain was put in sole charge of the Indo-European Telegraph Department this route was serviceable, and a privately owned cable route from Falmouth to Bombay was also operating.

Thereafter until his early death Bateman-Champain was continuously employed on communications, superintending cable-laying (and being shipwrecked in the process), representing Britain at conferences where he had to fight and overcome much opposition, negotiating a new treaty with Persia, and frequently visiting India. He took an active part in organizing a relief fund for the Persian famine in 1871. He married in 1865 and died in 1887, leaving six sons and two daughters. All accounts speak of his charm of character, to which his diplomatic achievements also bear witness. The Addiscombe authorities denied him the good conduct sword, usually awarded to the head of a term, on the ground of his "excessive exuberance of spirits". The loss was a real one as in those days the sword was a vital weapon, and Champain had to write home during the Mutiny for a new one, complaining that his was "only fit for poking through soft substances". He had to wait until 1884 for the Addiscombe slight to be rectified, in which year the Shah gave him a magnificent Sword of Honour.

In 1879 the International Telegraph Congress met in London, and it was partly because he was the obvious choice of host to the foreign delegates that he was elected President of the Telegraph Engineers in that year. He seems to have taken little part in Institution meetings; his Presidential address said little of his own achievements, being a general review of advances in electrical engineering during the previous year.

MAJOR-GENERAL C B WEBBER, CB President I E E 1882

Webber and Champain were commissioned within a year of one another, Webber in 1855 at the early age of seventeen. Both had Irish connections; both served through the Indian Mutiny; both devoted much of their lives to telegraphy, though Webber enlarged his interests after retirement to power supply, and they must have been close friends until Champain's early death at the age of fifty two.

It is a wonder how Webber ever obtained any technical training as according to his memoir in the *RE Journal* he only spent three months at Chatham before going to Lough Swilly to build barracks and thence in 1857 with the 21st Company to India. He served with them throughout the Mutiny, returned to England in 1860 to design the Newhaven fortifications before going to the Shop as Instructor in Survey in 1861 for six years, He found time and opportunity during this period to act as an engineer observer in the Austro-Prussian War, and to play an active part in the International Universal Exhibition in Paris, where he supervised the erection of the buildings and conducted experiments in heating and lighting. Then back to the Army, purchasing mules in Asia Minor for the Abyssinian campaign, and service at the Curragh.

In 1870 Webber was posted to the Postal Telegraph Department where he remained for nine years, developing the British telegraph system and in 1871 playing a leading part with two other Sapper officers in the foundation of the Institution of Electrical Engineers, known in its beginnings as the Society of Telegraph Engineers. The full story can be found in Appleyard's *History of the IEE* and in Lieut-Colonel F T Stear's paper in the *RE Journal* of January 1967. The Corps may well claim to number the Institution among its offspring; if Bateman-Champain had not been fully occupied with Persian famine relief at the time he would no doubt have been among the founders.

In 1879 Webber returned to active service as assistant Adjutant and QMG in the Zulu War and in the same appointment in 1882 at Tel-el-Kebir in charge of telegraphs. He succeeded in informing the Queen of the result of the battle and receiving her congratulations within an hour of its ending. The period in Egypt did not prevent him being appointed President of the IEE and reading his address in that same year. The address was of a general nature, describing a recent electrical congress in Paris and the recently developed induction balance, which he referred to as "a great boon and benefit to soldiers suffering from gunshot wounds." His service in Egypt brought him the Companionship of the Bath.

The Sudan expedition of 1884 was Webber's last tour of active service, again in charge of telegraphs. In 1885 he retired with the honorary rank of Major-General to

participate in the rapidly expanding field of electrical engineering and the affairs of the Institution. He was the first managing director of the Brush Electric Light Corporation and consultant to that firm and the Chelsea and City of London Companies. He was very active and outspoken in the affairs of the IEE, never hesitating to criticize when things were, in his opinion, going wrong and sticking to his own view when in control. All the same he was elected an honorary member and was the first RE officer to become a member of the Civils. He was the author of several papers.

Webber died in September 1904. His funeral at Brompton Church was attended by many of the pioneers of electricity-Swan, Fleming, Thompson, Morse, and others.

CAPTAIN H RIALL SANKEY CB, CBE President I Mech E 1920, 1921

Sankey was a man of so many interests that a full length biography is needed to do him justice, A member of all three institutions, President of one, Vice-President of another (and probable President had he not died unexpectedly), he contributed to many branches of engineering. His work on the theory and practice of heat engines was of lasting importance.

Sankey also had Irish connections, being born in 1853 at Nenagh. He entered Woolwich in 1871 top of his batch and passed out two years later head of his term with the Pollock Medal and Sword of Honour. His talents were quickly recognized, and on leaving the SME he was loaned to the historic Royal Commission on Railway Accidents to carry out tests on air brakes. The Commission's Report resulted in the nearly universal adoption of the Westinghouse brake by the world's railways.

In 1879 Sankey went to the RMC Kingston as Instructor in Fortification, and while there began his prolific output of papers and books with textbooks on electrical measurements and (as part author) on fortifications. In 1882 the Ordnance Survey was in difficulty with the electro-reproduction of map sheets, and Sankey was sent, to Southampton to find a solution. The process required the deposition of copper, current being derived from primary cells. These being an inefficient and expensive source of supply attempts had been made to use a dynamo, but failed because the fluctuating voltage from machines of that era caused variations in the thickness of the copper deposit. Sankey modified the dynamo and after many enquiries chose a Willans compound expansive engine to drive it, thus unwittingly determining his future. Comparative tests were successful, but securing their acceptance by the conservative minded printers required a little guile. Sankey labelled those plates deposited with current from the dynamo C and those with current from cells D. The men voted for the C plates and the battle was won. For a paper describing this work Sankey received the IEE Fahie Premium.

He stayed at Southampton until 1889, improving reproduction processes, substituting power driven for hand presses, and strengthening his friendship with Willans, the foremost steam-engine designer and manufacturer of his day. In that year Willans persuaded him to resign his commission and join his firm of Willans and Robinson, at first in charge of outside erection and later as a Director. Much trouble was being experienced with broken crankshafts; Sankey, who by some means had made himself a brilliant mathematician, investigated the problem and the application of his theoretical work solved the practical problem and carned him the George Stephenson medal of the Civils.

He stayed with Willans and Robinson until 1904, pioneering aspects of heat engines. When the firm expanded into new works at Rugby Sankey was responsible for the layout, which, even twenty years later when they were occupied by the English Electric Company, was considered a model. In 1904 he left the firm to practice as a consulting engineer—in those days success in the profession depended on personal ability and reputation rather than on the size of one's organization. He was soon fully occupied in more directions than there is space to mention—Director of and Consultant to Marconi's, writing papers on the heat treatment of steel, steel testing and gas engines among other subjects. He was happiest when attending or


Some Sapper Presidents

conducting boiler or engine trials. As if these activities were not enough he joined the Institution of Naval Architects, and translated Ritter's *Bridges and Roofs* from the German.

When the Great War broke out Sankey offered his services in an honorary capacity to the War Office and was appointed engineer adviser to the DFW as a Staff Captain(!) at the age of sixty one. He was never promoted, perhaps preferring to rely in his dealings with others on his stature as an engineer rather than on badges of rank, and used the title of Captain throughout his life. He paid many visits to France, devised schemes for the drainage of waterlogged trenches and for inundating certain areas to prevent German advances, being awarded the CB (Civil). At the end of the War he was one of a Valuation Committee of three determining the amount of compensation to be paid to firms which had converted their factories to war work. The Committee's lengthy and laborious task involved visits to 1,155 works and awards totalling £82 m.

Resuming his practice after the War, he was elected President of the Mechanicals in 1920, and, most exceptionally, confirmed in office for a second year. His presidential address was devoted to mechanical engineering works in France and England during the War, with little mention of his own activities. He remarks that it was not until 1916 that the authorities recognized the services that mechanical engineers could render to the war effort.

In 1924 Sankey was elected Vice-President of the Civils and would have succeeded to the Presidency had he not died suddenly in October 1925. He married in 1876 and left five children one of whom, C E P Sankey followed him into the Corps and was in turn followed by two of his sons; Captain P Sankey who died at Arnhem and Major A J P Sankey who is still serving.

The tributes paid to a man of so many parts were remarkable and widespread. All speak of his cheerfulness and sense of fun. Basil Mott, a distinguished civil engineer and President of the Institution, sums him up:

"One of the Institution's most able men. In addition to his great scientific attainments he was a man of the highest character; a soldier from his early days he retained throughout his life the highest ideals of a soldier. He was the very soul of honour, courage and helpfulness."

MAJOR-GENERAL A E DAVIDSON, CB, DSO President I Mech E 1935 Colonel Commandant RE 1940-48

It is difficult to do Davidson justice. Most of his service was devoted to mechanization and has not been published, while because of his taciturnity his remaining friends in the Corps know little about it. He was born in 1880, commissioned in 1899, and first saw active service in the Boer War, immediately becoming concerned with mechanization in 45 Steam Transport Co RE and later the London Electrical Engineers Searchlight Section. Further training at Thorneycroft's, possibly encouraged by meetings with Crompton in South Africa, followed, and then several years as Secretary to the Mechanical Transport Committee. Soon after arriving in France in 1914 he was posted to Transportation where he remained for the rest of the War in posts of increasing responsibility. Details of his work cannot be found, but its value can be judged by the award of the DSO in 1916, six mentions in despatches, and promotion to brevet Lieut-colonel.

Between the wars Davidson was Chief Inspector of RE Stores for four years and DDFW at the War Office for one before returning to mechanization in various posts until 1931, when he returned to the War Office as Assistant Director. At this period fixed defences were under construction at Singapore and elsewhere and power supplies had to be provided for 15 inch and smaller guns, ammunition hoists, searchlights, heating, ventilation and other purposes. Davidson decided to standardize on two ranges of engines, the vertical VCR range of Ruston and Hornsby for the larger outputs and for the smaller the Lister design giving about 8 hp a cylinder. This engine was used in hundreds during the War to serve AA guns, radar and searchlights and proved utterly reliable under all conditions of use and misuse. A better choice could not have been made.

In 1936 on promotion to Major-General he was appointed Director of Mechanization and was in that post at the outbreak of war. Inevitably he was in the thick of the argument when the shortcomings of our pre-war tank designs became apparent, and he retired in August 1940. These designs were the work of committees, which bodies have seldom if ever been successful in such a task; many who knew him will think that if Davidson had been allowed a freer hand most of those short-comings would have been avoided.

It was in 1935 that he was elected President of the Mechanicals. He took "Adventure" as the theme of his address, a surprising choice for one so reticent in day to day contacts. He said that in the task of using science in industry mechanical engineers came face to face with adventure, and illustrated his theme with examples of engineering in India and elsewhere. A prominent member of the Diesel Engine Users Association, his presidential address in 1950 was a fascinating survey of fifty years of oil engine development and included descriptions of several WD power stations.

Davidson's principal hobby was rowing. Even in his sixties he used to scull from Putney to Richmond and back—seventeen miles—for a Sunday afternoon's exercise, meeting again Captain C E P Sankey who was secretary of the London Rowing Club. He was sympathetic and helpful to engineers many years his junior, though he disliked being thanked for his kindnesses and on occasions his shyness made him appear almost rude. Notwithstanding his reserve he and Mrs Davidson are remembered with affection by many friends. He died in 1962.

THE FUTURE

When will the next Sapper President emerge, and by what path will he reach that position? Will he follow in the steps of Bateman-Champain the diplomat, Webber the organizer, Sankey the brilliant engineer, or Davidson, the quiet man who devoted his whole career to the Army? Probably none of these. The sequence of mutual acquaintance is now broken. Champain and Webber were contemporaries; Webber and Sankey, fellow members of the Electricals, who often joined in discussions at the Institution, on one such occasion comparing their experiences of running alternators at a distance in synchronism-now commonplace but in 1902 a matter for debate. Sankey and Davidson met through their common interest in heat engines. But Davidson died in 1962 and future Presidents will not have known him. Sankey began his distinguished career by passing top into the Shop and first out of it, but that is no guide to future greatness. Others have done the same, some by merit and some by chance. He retired early and later set up a consulting practice; here again a few Sappers have followed suit but without approaching his heights. But the four we have considered had one thing in common; a singleness of purpose so that each followed his chosen path regardless of well-meant advice to diversify his activitiesthe great danger which besets the Corps of becoming Jacks of all trades.

The present climate is favourable to Presidential aspirants. Many officers now obtain a degree, and many more are members of one or more of the Institutions than was the case between the Wars. Some words of the Engineer-in-Chief at the end of his annual review in 1974 gave encouragement to those with E and M leanings and indicate a reversal of the attitude prevailing in the thirties. It would be fitting if our next President could attain the chair of the Civils that Sankey so nearly reached. And to indulge in a flight of fancy, why not an "annus mirabilis" in which the three Presidents are provided respectively by the Royal Engineers, the Royal Electrical and Mechanical Engineers, and the Royal Corps of Signals?

Acknowledgements

My thanks are due to Brigadier H E Hopthrow whose interest sparked off this

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Demob '45

From our own correspondents! MAJOR D CROUCHER-SMITH RE AND MAJOR A J HARRIS RE

OLD soldiers never die, but these are fading away. Their pastime was in war; city upon city, nation upon nation, they set free from the tyrant; from beach head to victory they fought, forced and otherwise fiddled their way. But now, surfeited with glory, they lapse from the alarms and excursions of Mars to the lax beguilements of peace. Horrid in casque and harness, arms were then their ornament and many a bastion and hornwork trembled at their bloody braggadocio. But now, decorous in the urbane bowler, they are to babble, unheard, in suburban ale houses, of the storming of towns; to mumble of the past clangour of arms over their fish and chips.

Wherefore we bid our friends attend on Saturday the eighteenth day of May to eat a little, to drink and to be merry, to raise the voice in cheerful tones and make festive this happy metamorphosis. The wine vat will be tapped at these our winter quarters at HILTRUP (which lies to the South of and a little removed from the important if dishevelled town of MUNSTER) at the hour of 1900, or seven of the clock. Accommodation is offered for man and beast; albeit while floor space is ample, bedding is scarce, and the fastidious may find the distinction over nice. Those, therefore, who are disinclined to imitate the wise virgins of Scripture by staying up all night will doubtless, in bringing their own bedding, emulate the prudence of those holy maidens.

Our friends may be content, however, that there the parallel will cease; there is no need for spare oil; there is no lack of that with which to keep the lamps burning brightly nor shall we rest content until each vessel glows inwardly with rosy fire and the genial gods of wine and song descend to grace this festive farewell to arms.

Memoirs

The Civilianization of the RE Works Services and its EES 1959-69

LIEUT-COL (RETD) R W OBBARD, MA

INTRODUCTION

This paper deals with the civilianization of the RE Works Services and subsequent reorganizations as seen through the eyes of a RO3 at the RE Manning and Records office during the period 1959-1969. It does not deal with officers or with the large civilian staffs already working with the RE Works Services prior to civilianization as these were not the responsibility of RE Records.

The story actually starts in 1957 when it was recommended by the Weeks Committee, and agreed by the Army Council, that the RE Works Services as such should cease to exist. Their responsibilities were to be taken over by the Civilian Works Organization but 315 ORs were to be attached to the Organization and known as ESSE (Engineer Specialist Services Establishment) so as to provide and maintain the nucleus of trained works personnel for emergency and war.

Subsequently in 1963 the Civilian Works Organization itself became part of the MPBW (Ministry of Public Buildings and Works) and ESSE was reorganized and split into MES (Military Engineer Services) Units, Clks Wks with Civil Firms and MES (Trg Elem) with MPBW. Finally in 1970/71 a further reorganization took place and further cuts were made in EES (Establishment for Engineer Services) and in 1971 the MPBW itself disappeared and became part of the DOE (Department of the Environment).

HAND OVER PLAN

Instructions were issued by the E-in-C in Mar 59 for the handover of Works Services to the Civilian Works Organization and for the employment and relief of Military Personnel.

The handover was to be as follows:-

Home Commands	Handover Period	Deadline date for last posting in
Western Command Eastern Command Northern Command Scottish Command Southern Command NID Overseas Commands	Mar 59–May 59 Oct 59–Jan 60 Jan 60–Mar 60 Apr 60–June 60 May 60–Aug 60 Feb 60–Mar 60	1 Feb 59 1 Aug 59 1 Nov 59 1 Feb 60 1 Mar 60 1 Dec 59
MELF Gib & Caribbean FARELF BAOR Malta	Apr 59–Sept 59 Oct 59–Nov 59 Dec 59–June 60 July 60–Nov 60 Not yet decided	1 Feb 59 1 Aug 59 1 Oct 59 1 May 60

In general the handover periods were far too short-the handover in MELF due for completion in Sept 59 had still not been completed by Sept 60!-but the civilian side had pressed for handovers to be shown on paper as early as possible. This was hardly surprising in view of the very rapid promotion involved on their side!

FORMATION OF ESSE

Negotiations with the WD Works Directorate had, by Sept 59, reduced the 315 ORs originally approved to 294, out of which 246 were to be Clks Wks attached to the Civilian Works Organization. The distribution of these Clks Wks was laid down by the DDFW, (Deputy Director of Fortifications and Works), and no further changes of any kind were envisaged.

In the event the reduction of Clks Wks (E) and (M) posts with ESSE in the UK was to lead to new disaster and finally necessitate the complete reorganization of ESSE.

However by Sept 60, when the ESSE establishment was finally approved, the number of Clks Wks attached to the Organization had been further reduced to 195 out of which the numbers in UK Commands totalled only 87, subdivided as follows:-14 WOI and 58 WO2/SSgt

Cik Wks (C) Cik Wks (E) Clk Wks (M)

3 WOI and 8 WO2/SSgt (Reduced from 15) 3 WOI (Reduced from 4) and 1 WO2/SSgt (Reduced from 14)

It will be noted that civilianization was practically completed BEFORE the ESSE establishment was approved and this enabled the Work's Organization, which had been desperately hanging on to Clks Wks whilst the going was tough, to cut down on the numbers allocated to them in Sep 59.

It will also be seen that the Organization considered that either the prospects of having to find Clks Wks for emergency duties overseas were slight or that they could tackle such emergency duties themselves.

REDUNDANCY PLANS

The overall plans necessitated making and of all Clks Wks redundant-approximately 200 out of 600. In addition the following rosters were to be disbanded, EC & S (Éngineer Clerks and Storekcepers), Engr Dimn (Arch), Engr Dimn (Mech) and OSA (Quantity Surveying Assistants).

Those on disbanding rosters who were selected for redundancy or were due to run out could remain on their rosters until the final closure date in Mar 61. All others on the EC & S roster were transferred to the Clerical roster except for a few stores specialists who were transferred to the General roster. Those on the Engr Dtmn and QSA rosters were transferred to the General roster (QSA's to opt for training in any other RE trade) and were given the opportunity to take Clk Wks courses, though in the case of senior NCOs this involved serious losses in seniority as SSgts when they qualified.

The disbanding rosters held about 600 EES personnel when civilianization commenced and of these about 40 per cent were made redundant and the balance transferred on 1 Sept 69 or ran out prior to 31 Mar 61.

ACTUAL HANDOVER

Three to six months before civilianization was due to start in a Command, a meeting was always held at RE Records attended by the E-in-C's Liaison Officer and representatives of the civilian side (WDA). As soon as possible after the meeting lists were prepared and issued to all concerned to show details of Clks Wks (C), (E) and (M), Dtmn (Arch) and Dtmn (Mech) selected to fill ESSE posts and how the balances of Clks Wks and Dtmn and all EC & S and QSA personnel were to be disposed of.

Thereafter when once civilianization was well under way posting details for EES personnel were issued quarterly. In all cases the initial posting plot prepared by RE Records would be discussed at a conference held at the MOD and attended by representatives of the Civilian Works Organization. This conference was held seven months before the start of the quarterly posting period and at it the Commands and Regions in the UK to which available Clks Wks were to be posted, were agreed. Thereaster it was the responsibility of Chief Engineers to arrange with Regional Directors the actual stations in which Clks Wks could be employed most satisfactorily and to decide on the units to which such Clks Wks should be attached for administration.

In general the initial handover when off surprisingly well despite difficulties in MELF and the lack of a firm establishment. Similarly there were few troubles over subsequent posting plots despite the failure of BAOR to appreciate that posts held by Ciks Wks must be varied. It was the E-in-C's policy that the civilian side should be given all possible assistance during and after the handover and the co-operation between them and RE Records was always very good.

BREAKDOWN OF ESSE

Emergency Duties

As stated earlier, the final establishment of WO2/SSgt Clks Wks with ESSE in the UK had been reduced to 58 Clk Wks (C), 8 Clk Wks (E) and 1 Clk Wks (M).

These reductions proved disastrous as during the three years from Jan 60-Jan 63 the numbers of Clks Wks who had proceeded overseas on emergency duties or were under warning for such duties were

35 Clk Wks (C) ie 60 per cent of the entire ESSE UK establishment of WO2/SSgt Clk Wks (C)

16 Clk Wks (E) ie 200 per cent of the entire ESSE UK establishment of WO2/ SSgt Clk Wks (E)

16 Clk Wks (M) ie 1,600 per cent of the entire ESSE UK establishment of WO2/ SSgt Clk Wks (M)

ESSE couldn't possibly hope to produce Clks Wks for such a mass of emergencies and the result was that RE Records had to scrape the barrel throughout the UK. By Dec 63 there was not one single additional Clk Wks (E) or (M) who could be made available.

Thus the guarantee that Clks Wks would do a normal tour of duty with ESSE without being disturbed had already become a very sick joke.

Dual Role of Clks Wks

It had become abundantly clear by 1962 that Clks Wks with ESSE could not, as laid down, be expected to do two jobs at the same time, ic, their temporary duties overseas and their full time civilian duties in the UK. However, the main troubles about reshaping ESSE were that if it was converted into CRE Wks and Wks Sections then the rank structure of EES would be destroyed. The first plan produced by MOD E5 and considered by RE Records in Jan 63 showed a reduction of 45 WOI appointments! Another plan produced by RECDS in Apr 63 showed an overall reduction of 30 per cent in EES.

REORGANIZATION FINAL PLAN

The reorganization — accelerated by the take-over of the Civilian Works Organization by MPBW in Apr 63—was now placed firmly in the hands of E5 and a final draft plan was received in Oct 64. However this was by no means the end of the story as although RE Records had been notified that the Oct plan was considered firm for overseas posts with MPBW and had acted accordingly, the whole establishment was thrown back for revision by higher authority.

A revised establishment was finally approved in Jan 66 and this included 40 more military personnel than had the previous proposals. The establishment now included, in addition to the MES (Trg Elem) with MPBW and Clks Wks with Civil Firms, 2 Cs RE (Constr) and 3 Specialist Teams RE (STs RE) (Constr). The new units which held a higher proportion of WOsI than had the old CsRE Wks and Wks Sections, were expected to take over the great majority of world wide emergency duties.

There was a considerable overall cut of 25 per cent Clks Wks (\tilde{C}) and this reduction would have been even greater (40 per cent), had not the problem of roulement been stressed and agreed, ie the necessity of allowing for alternate home and overseas postings. Despite this cut redundancy was not permitted and so for a period of

several years there were surplus Clks Wks (C) and the speed of promotion to WOI was affected. There was however a small increase in Clks Wks (E) and a 20 per cent increase in Clks Wks (M)—increases which were to cause trouble later on as all posts could not be filled and as a result priorities had to be laid down.

Finally a further reorganization took place in 1970/71 and this reduced existing Clk Wks (C), (E) and (M) vacancies by 19 per cent, 15 per cent and 9 per cent respectively, but this was after I had handed over my posting and establishment responsibilities and so is outside the scope of this article.

CAREER AND PROMOTION PROSPECTS OF CLKS WKS AFTER CIVILIANIZATION

The career prospects of Clks Wks after civilianization were as good as ever and care was always taken when new establishments were under consideration that percentage rank structures should remain unchanged so that promotion prospects were not altered.

In general the special considerations and difficulties for Clks Wks with ESSE and MES (Trg Elem) were:-

(a) Clks Wks once posted in were due to serve a full tour.

The trouble here was that emergency duties had to be met and in any case tours of duty for Clks Wks in UK and BAOR were only about two years.

The short tours were due primarily to the very high proportion of overseas tours, for example 42 per cent of Clks Wks were overseas in 1962/63 as opposed to only 18 per cent of the Corps as a whole), and secondly, to the very large number of unaccompanied tours when once the withdrawal from overseas commitments had started. By 1967 the chances of a Clk Wks being posted overseas on an accompanied tour were 7 to 2 against for Clk Wks (C), 2 to 1 against for Clk Wks (E) and 3 to 2 against for Clk Wks (M).

(b) Every Clk Wks had to spend a proportion of his time in an integrated post. The proportion varied in accordance with the type of Clk Wks and whether serving during the ESSE or MES (Trg Elem) periods.

The distribution of posts was as follows:-

_	ESSE period	MES (Trg Elem) period
Cik Wks (C)	75 per cent with ESSE	55 per cent with MPBW
Clk Wks (E)	50 per cent with ESSE	35 per cent with MPBW
Clk Wks (M)	25 per cent with ESSE	30 per cent with MPBW

Clk Wks (E) and (M) sometimes queried why they had spent less time in integrated posts than had Clks Wks (C). The reasons were easy to explain.

(c) It was the responsibility of Chief Engineers in consultation with Regional Directors to ensure that Clks Wks were

- (i) Kept fully employed on interesting jobs
- Used for work connected with new construction rather than on routine maintenance
- (iii) Given a fair distribution of comfortable and uncomfortable posts as between military and civilian staffs

Clks Wks who considered they had spent an excessive time on maintenance work or in a bad stations sometimes failed to appreciate that this was the responsibility of Chief Engineers and not RE Records—though RE Records assisted if possible.

(d) Whilst in integrated posts Clks Wks were also worried that:-

(i) Their annual CRs might inhibit their promotion prospects.

This was not the case as great care was always taken to ensure that at least one Military Officer who knew the Clk Wks was in the chain of reporting and that whenever possible reports were completed by Chief Engineers of Commands.

(ii) They would find it difficult to take ONC and HNC examinations. Sitting for these exams involved a posting to the UK for two to three years and being granted time off for study in a technical college. In general, except during the period of excessive emergency duties, Clks Wks in integrated posts were in a better position to sit for these exams than were Clks Wks in units. The exams, though desirable, were not essential for Army careers.

CONCLUSION

It can, I hope, be seen from this article how the initial impact on EES of the civilianization of the RE Works Services was serious, as it involved the disbandment of the EC & S, Engr Dtm (Arch), Engr Dtm (Mech) and QSA rosters and the redundancy of one third of all Clks Wks.

However the civilianization programme itself, in which the E-in-C's policy of maximum co-operation was strictly adhered to, and any subsequent reorganizations affecting the Clks Wks rosters went off very well despite the following problems and difficulties:-

(a) The very short period allotted for the initial handover to the Civilian Works Organization especially in unpopular Commands such as MELF.

(b) The reduction in vital Clk Wks (E) and (M) posts in the UK when the ESSE establishment was finally approved in Sep 60.

(c) The impossible dual tasks of Clks Wks with ESSE in the UK.

(d) The excessive number of emergency duties.

(e) The reduction, without redundancy being permitted, of Clk Wks (C) posts and the increase in Clk Wks (M) posts, when MPBW took over.

(f) The number of unaccompanied tours necessitated by the run-down of overseas commitments.

The special worries of the Clks Wks remaining after civilianization was completed that their career and promotion prospects would be adversely affected proved groundless due to the maintenance of rank structures and the interchange of posts. Their subsidiary worries over CRs and examinations were fully appreciated and dealt with satisfactorily.

My only regret is that due to the posting and promotion of EES being only a small part of the multifarious duties of my Seniority Section, I was unable to get to know, even better than I did, all the Clks Wks concerned and their personal problems.

They carried out an absolutely magnificent job under extremely difficult circumstances and certainly earned the respect of the civilians with whom they worked. I can only thank them for their co-operation in the past and wish them all the best in the future.

* * *

Into the Silent Land

SURVEY Photography in the Canadian West 1858–1900, A Public Archives of Canada Travelling Exhibition will interest Members who live in Canada.

The exhibition includes some fifteen photographs, loaned by the Institution of Royal Engineers, of the Boundary Commission 1858–62 and a brief account of the survey work in Canada of the Royal Engineers. The exhibition will be in Ottawa June—October and will then go on a tour of art galleries, archives and museums covering much of the territory originally covered by the photographic explorers and surveyors—Winnipeg, Saskatoon, Calgary, Edmonton, Banff, Burnaby and Victoria Bc. It will also be seen later at the McCord Museum in Montreal.

Nuclear Cratering in the 80's

MAJOR K F NEEVES RE, MA, MSc

SOME years ago the *RE Journal* looked forward to 1975 and a "nuclear island" on which the Sappers had carried out several nuclear projects.¹ 1975 has come and we are no nearer the realization of this dream. What of the future?

Underground nuclear explosions can be utilized in two different ways, depending on the depth at which the device is fired. A sufficiently deeply buried shot forms an underground cavity which is rendered stable by the subsequent collapse and bulking of rock fragments inside. This is known as a contained event. Such contained

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HOTE: SCALED DEFTH OF BURST = TRUE DEPTH OF BURST FOR A YIELD OF Intoni-Fig 1. Craters produced by detonations at various depths of burst.

explosions have been used recently in USA to stimulate natural gas fields experimentally and in USSR to tackle two gas well fires which had defied all attempts to extinguish them by conventional means. Many other applications have been proposed and several feasibility studies completed. Some of these have been described in another previous article.² All are necessarily major engineering tasks.

When an explosion occurs at a much shallower depth a crater is formed. Cratering is a tool primarily for the civil engineer or in war for major demolitions. It has the great attraction in times of high energy prices of moving very large quantities of earth comparatively cheaply and at a cost per cubic metre which decreases rapidly as the size of the project increases. Nuclear explosives have the added advantage of compactness over conventional HE—much used by the Russians for large excavations. The 40 kton nuclear shot "Rulison" fired in the USA in 1969 was contained in a cylinder some nine inches in diameter. Compare this to only 9.2 ktons of HE detonated in China which probably occupied some 7,000 cubic metres, making the emplacement alone a major engineering and logistic task.

This article will be confined to nuclear cratering only as this has a greater relevance to military engineering. The factors which affect crater formation will be discussed and possible applications suggested.

CRATER SIZE

The size and shape of a crater formed by an explosion depend on three main factors: the depth of burial of the charge; the physical properties of the medium in which it is fired and the energy yield of the device employed.

Depth of burial

The effect of burial depth is illustrated by Figure 1. For a 1 kton device:-

(a) shallow burial below, say, 5 m gives a saucer shaped depression caused largely by erosion,

(b) deeper burial, to some 65 m, produces a conventionally shaped ejection crater,

(c) if the depth of burst is increased further, either the debris falls back into the hole largely refilling it or, particularly in harder rock, the bulking of the fragments overfills the crater leaving a mound of rubble known as a "retarc" (some reflection will reveal the derivation of this Americanism),

(d) deeper burial still, below 95 m, produces a crater once again but of a different kind, referred to as a subsidence crater or "sink". The surface is not disturbed by the explosion but at an interval after the detonation a funnel shaped depression appears



abruptly. For depths of burst less than about 150 m the sink will form almost immediately but at greater depths a delay of days or even years may occur.

Figure 2 illustrates the approximate crater radius which might be produced by a 1 kton shot fired at various depths.

The medium

The effect of the medium is illustrated by Figure 3. This is based on the limited published data presently available and is entirely empirical. Much is conjectural and this is indicated by broken lines. Although certain physical properties of earth and



NOTE - SCALED DEPTH OF BURST = TRUE DEPTH OF BURST FOR A YIELD OF 1 Kton



rock are known to influence crater formation, no satisfactory mathematical model has yet been established. Water content (including water of crystallization, (OH) groups in minerals, etc) is particularly important and the presence of oil, gas or organic matter generally increases the size of craters.

The lowest line of Figure 3 indicates the effect of material strength varying from hard rock to loose sand on the containment depth. Immediately above this is the region of subsidence craters with delayed sinks appearing in weak material at greater depths of burial. In the centre is the zone of retarcs and refilled craters. The former are more likely to occur in hard rock. The upper part of the diagram shows that the optimum depth of burial for ejection craters varies little in different media.

The vield

The illustrations so far have assumed a yield of 1 kton. A larger yield increases the crater size but not in direct proportion. The relationship is found empirically to be

$L \propto W^n$,

where L is any linear dimension of the crater, such as its radius,

W is the yield of the explosion in ktons,

n is an exponent which varies with depth of burst.

The following approximate values of n have been observed:

for surface bursts	n	=	$\frac{1}{2\cdot 4}$		(3)
for optimum depth of burial	n		$\frac{1}{3\cdot 4}$	(a figure generally accepted by Western writers)	
in the sink region	n	=	$\frac{1}{2\cdot 5}$,	(3)

APPLICATIONS

There are, of course, difficulties in using nuclear explosives for engineering purposes; radioactive fallout is the main one. It is well known that ejection craters produce fallout-many readers will probably have drawn those large radiac lozenges on maps down wind of imaginary nuclear events. This radiation hazard can be minimized by optimum design of the nuclear explosive device but, as far as is known, never eliminated. There is no "clean" ejection crater.

The reason is that a fission device must produce radioactive fission products. These mix with and contaminate the surrounding material, which is then blown out by the explosion. The fusion reaction on the other hand does not itself give rise to fission products but it does require a fission device to set it off. The nuclear explosive is therefore not entirely "clean" as the fission products from the trigger will always be present.

Fallout severely curtails the possible peacetime use of nuclear cratering. The Partial Test Ban Treaty of 1963 prohibits explosions which cause radioactive debris to pass over national boundaries. This effectively limits the signatorics to using nuclear devices well away from their frontiers unless at some future date the Treaty is amended to permit peaceful nuclear cratering explosions. Where the level of fallout might endanger the civil population the cost and unpopularity of evacuating any significant number of people further restricts nuclear projects to desert areas and the like.

In addition to fallout there are other problems, notably seismic shock and possible damage to the ecology. These have the same effect of limiting nuclear cratering to remote and undeveloped regions.

Because of these limitations nuclear cratering is believed to be currently in progress only in the USSR. The Russians have published details of fifteen nuclear explosions of which five were cratering shots. In addition at least eighteen unreported events, apart from weapon tests, have been detected and the Soviet nuclear explosive programme is thought to have experienced a great acceleration in the last

few years.4 A current major project is one discussed since Tsarist times: to divert water from the river Pechora (which flows into the Arctic ocean north west of the Urals) south to the Volga and hence to the Caspian, the water level of which has been steadily falling. Very recently the Russians have given details of a row cratering experiment on one possible route for a canal to accomplish this task. Three 15 kton nuclear explosives were emplaced at a depth of just over 127 m with a spacing of about 165 m in saturated alluvium. Their simultaneous detonation produced a channel 700 m long, 340 m wide and 10 to 15 m deep. This was almost certainly the explosion of 23 March 1971 recorded by many seismic stations.4

USE BY ROYAL ENGINEERS

Could Sappers ever hope to use nuclear craters? Without the endless wastes of Siberia it might seem that our opportunities in this field were minimal-limited perhaps to taking a minor part in some large project in USA or Australia.

Subsidence craters

There is, however, one aspect which has received no attention so far and which could make nuclear cratering relevant to NW Europe. This is the use of subsidence craters or sinks. These have the supreme advantage of releasing no nuclear fallout as the ground surface is not broken. They have a different profile to ejection cratersflatter and wider. Whereas a typical ejection crater has a radius to depth ratio of two or less, the corresponding figure for a sink is three or more. Figure 4 illustrates this and photograph I shows an aerial view of a large sink.

For some, but not all, applications the best sink is less useful than a normal crater:

(a) for the same yield it gives a slightly smaller radius and about } the volume of an ejection crater,

(b) it is better used in the softer rocks-in hard rock the bulking effect probable reduces the sink volume,

(c) it requires a relatively deeper emplacement hole,

(d) it effectively moves earth downwards and not sideways.

Nevertheless, the sink is fallout free and might be used where ordinary cratering could not. It has an additional advantage that the crater slopes are thought to be inherently stable with no scattered surface debris. It should have only minor adverse ecological effects and would be limited in use only by the damage due to seismic



FIGURE 4 CRATER PROFILE VERSUS DEPTH_OF BURST

NUCLEAR CRATERING IN THE 80'S

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Photo 1. The Hutch subsidence crater at the Nevada test site—900 ft in diameter and 200 ft deep. This shot was fired on 16 July 1969 at a depth of 1,800 ft

shock which would be similar to that from a contained explosion. The Americans have shown that the relatively minor damage caused by a contained 40 kton nuclear shot and the cost of the resulting compensation can be acceptable in peacetime in a suitable area away from towns.⁶ Military uses

Possible military applications of this technique using sub kton devices include demolition of major river bridges by forming a sink under an abutment and one major pier with no hazard to friendly forces or civil population. It could also be used for some civil engineering work in rear areas for which ejection cratering was unsuitable for safety reasons. Emplacement of low yield devices would be within the competence of military engineers using commercially available equipment. A Specialist Team RE (Nuclear) would be an appropriate unit to carry out this work in view of some of the special skills needed and the requirement to work to fine limits to obtain the optimum crater while maintaining safety.

CONCLUSIONS

Nuclear ejection cratering is a potentially valuable tool for large scale earth moving or in war for demolition. Safety and political considerations restrict its use in peace to remote regions though in war some small scale work might be considered elsewhere. The use of subsidence cratering however introduces a less efficient but still useful technique which could be employed in peace or war with far less restriction. More detailed study of these possibilities is called for and the author hopes to be

alive to see the first Specialist Team RE (Nuclear).

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Our Arctic Campaigns Archangel 1918–1919: Narvik 1940 Part 2–Narvik 1940

BRIGADIER R S G STOKES, CBE, DSO, MC, HON FIMM

THE controversial story of the Narvik Campaign has been covered by many historians and popular writers, but no account has appeared in the *Royal Engineers Journal*. A tale of misfortune for the British troops, commonly misrepresented, it does not lend itself to the light touch with which personal memoirs are customarily presented in these pages. Too many things went wrong. *The History of the Irish Guards* goes so far as to declare that "All the battles in Africa, Italy, Holland and Germany, longer and bloodier though they were, could not efface the memory of Narvik as the worst of all experiences." Success came too late to be of any *direct* value to the Allies. The honours on land fell to the heavily preponderating French, Polish and Norwegian forces. One section of a Field Company RE was the only British unit to enter Narvik.

In March, 1940, Sapper General P J Mackesy was selected to work out plans in concert with Admiral Sir Edward Evans for any Narvik expedition to be organized in aid for Finland or as a factor in that dream-project, the occupation of the Swedish iron-fields. On April 9 came the invasion of Norway at six coastal points from Oslo to the Arctic. Two thousand men of a Mountain Division under General Dietl, were carried in destroyers to Narvik, gaining easy possession, thanks largely to Quisling influences weakening the defence. The strength of Dietl's force was increased by about 2,000 seamen able to scramble ashore from the vessels sunk by the Royal Navy on April 10 and 13, who were soon equipped from a Norwegian military depot. Three expeditions for Norway were hastily organized at the same time, with inevitable confusion, changes of plan and disapproval from the BEF. The troops finally available to General Mackesy for Narvik were the 1st Scots Guards, 1st Irish Guards and 2nd South Wales Borderers, forming the 24th Guards Brigade; two Field Companies, 229th and 230th of the 49th Divisional Engineers, under Lieut-Colonel F L Colley, and a big contingent of details for unpredictable Base duties. Brigadier H G Pyne joined as Chief Engineer a month later, when this "Rupert Force" was raised to Corps status. My own position was that of "Colonel, CE Detached Forces", appointed by the CIGS to serve on Mackesy's staff without routine duties; a follow-up from the Archangel Campaign.

On April 12, Mackesy sailed in the cruiser *Southampton* with a small staff and an advance party of two companies of Scots Guards—a body of 350 fine young men, but wholly unprepared and unqualified to act as a spearhead in an opposed landing. Mackesy was under instructions to establish his base at Harstad and plan with the Norwegians for the ejection of the enemy from the Narvik region. These formal instructions were enlivened by a personal note from the CIGS urging boldness of action should some favourable opportunity arise in consequence of Naval successes.

The superlatively senior Admiral Lord Cork and Orrery, replacing Sir Edward Evans at the last moment, followed in the cruiser *Aurora* with the main convoy—the rear half of which, in mid-ocean, was switched to Namsos in spite of a "violent protest" from the CIGS. This meant the loss of the 146th Brigade, whose commander was bottled up with us *en route* to the Arctic. Gunners sailed without guns. Troops were burdened with a vast surfeit of Arctic kit. Ships were not tactically loaded. The over-hasty despatch was to be followed, inevitably, by a jumbled unloading at points without any considerable port facilities. "Thus", in Churchill's own words, "this ramshackle campaign began."

Early on April 14, the Southampton reached the small island port of Harstad, with troops hidden between decks. Friendly contact was made with military and



civil authorities. The two companies of Guards were sent forward to Sjovegan on the mainland to link up in defensive reserve with the Norwegian troops.

CONFLICTING PLANS

On April 15, General Mackesy met Lord Cork for the first time. Personal antagonism developed in a matter of minutes. On the previous day, Cork had tried to organize a small landing party of Scots Guards and Marines to take advantage of the temporary demoralization of the garrison by Admiral Whitworth's bombardment on the 13th; fortunately, communications failed. Cork continued to press for immediate attack. Mackesy would not agree, a decision strengthened by later reconnaissance. The clash gave serious concern to Colonel A Dowler,¹ Chief of Staff—as diplomatic as the General was blunt. On the crucial tactical issue, Dowler was in full accord with his Chief's decision.

Cork was in daily communication with Churchill by private cypher and, on April 20, was put in Supreme Command. Captain L E H Maund, Naval Chief of Staff, openly expressed his view after the war that such an appointment was bound to fail; that the Army should have been the "predominant partner" in combined operations of this character. But Churchill wanted to gain firmer personal control and hoped that Mackesy would be led to adopt "bold tactics because his measure of responsibility would be less". Cork became less bold and Mackesy retained full military responsibility, though penalized by loss of direct communication with the War Office.

On April 24, it was agreed, as a sop, to lay on a three-hour naval bombardment aiming to drive the Narvik garrison to surrender. Optimism was high enough to bring Sappers into the picture. Under detailed operation orders, a section of the 229th Field Company embarked on HMS *Vindictive* to land with the Irish Guards when surrender was assured; responsibility for collection of prisoners was to be left to the navy. In the long bombardment, casualties were inflicted and military damage done, but no white flag or sign of panic could be observed.

Upon the collapse of the Southern expeditions at the end of April, Churchill looked for success at Narvik to offset the humiliation, and pressed again for immediate action. Thus, on May 3, Lord Cork issued an order-significantly the firstfor an attack on or about May 8. The two battalions of Guards were to be landed on beaches along the north shore of the Narvik peninsula. Brigade and battalion commanders reconnoitred the Rombaksfiord area with Captain Hamilton RN, in the Aurora. All condemned the plan with a unanimity emphatically confirmed in a letter I have currently received from Brigadier H L Graham, commanding the Scots Guards at the time. Colonel Trappes-Lomax, acting Brigade Commander in the absence of Brigadier Fraser (in hospital, slightly wounded on reconnaissance) was dissatisfied with the reaction of Mackesy and Fraser to the tenor of his severely critical "appreciation". He was so strongly convinced of the hopelessness of the plan that he insisted upon taking his protest direct to Cork. Trappes-Lomax, for five years Chief Instructor at Sandhurst, knew well enough the danger of such impetuous action and, at one phase, was prepared to risk Court Martial in order to prevent disaster. The actual landings had commonly been considered the easiest part of operations in any attack on Narvik, but Captain Hamilton declared that the Navy could not serve, with available means, the only beaches found suitable for the effective assembly of any sizeable body of troops. The Naval Chief of Staff supported him and the attack was called off, with doubtful "reluctance". A bad picture of the affair must have been conveyed to Churchill, who, although duly informed of the Naval objections, wrote later :- "The orders sent to commanders were of such a clear and imperative character . . . that they should have been obeyed".

Mackesy remarked to me that he had been the first commander ever to have had to face the threat of a mutiny in the Guards, spoken without the gravity that the occasion might have been expected to invoke; for now his plans for an attack on Bjerkvik, only a few days later, could be pushed ahead. The troops to be used would be the much stronger and better equipped French and Polish forces, recently streaming in. These included Chasseurs Alpins who were believed—vainly, it turned out to be well qualified to cooperate with the Norwegians in the severely "Arctic" mountainous area to the north-east of Narvik. Another factor governing the disposition of our polyglot forces was the need to hold the Guards Brigade in readiness to meet the dangerous situation looming up in the South.

It is up to this point in the Campaign that many writers have sought to discredit the early command with charges of inertia or lack of boldness. Strangely, even the editor of the *History of the Scots Guards*, 1939–1955 added a footnote:- "It is hard to resist the conclusion that a swift bold landing on 14th or 15th April would have had a good chance of decisive success", an opinion which no officer in the Regiment would have supported. The assertion can only give the reader a false impression of some opportunity culpably lost. No troops, ready for any attack, bold or otherwise, were available on those critical dates, when Dietl's Mountain troops were falsely supposed to be too shattered by the naval bombardment on the 13th to be able to put up a fight.

The soundest exposition of early events appears in the Journal of the Royal

United Services Institution (1970), under the title "Churchill on Narvik". This was written by Piers Mackesy, son of the General, now a professional historian at Oxford —with service in the Scots Greys to his credit. If anything, he leans back too far in the moderation of his masterly defence of the early command, desiring to escape the influence of natural bias.

FRENCH CONTINGENTS

About the end of April, General Bethouart arrived with nine battalions of Chasseurs Alpins, Polish Mountain troops and Foreign Legion on his heels—a rousing occasion comparable to the appearance of General Saddleir-Jackson at Archangel in 1919, with his relief Brigade; both men were equally full of dash, self-confidence and "polish", the Frenchman playing a bit unfair by wearing on occasion an elegant blue cape. Mackesy and Bethouart got on well in their planning in spite of some considerable differences of view; they both spoke the same Army language. The Norwegians established close liaison with the French. This cordiality contrasted with a marked coolness toward the British, due to the bad news from Namsos and the growing intensity of unopposed enemy bombing.

Sapper hopes of activity in the field, getting to a low ebb, were raised by discussion with French Staff. This was about as far as we got. Reconnaissance of one road to be used by light tanks disclosed a dangerous weakness in most bridges, but, in the end, no worthwhile help was sought. The attitude of the Legion was one of selfsatisfied independence. They would deal with difficulties as they came to them. An officer recorded in his memoirs how a sergeant, in charge of tractors, had negotiated fifteen miles of "impassable" road in four days, cutting down trees to strengthen bridges. He was commended as a "true Legionary" and sent off for a shave.

The Chasseurs Alpins were better acquainted with the drill and one of our Field Companies did some good bridge-repair work for them in operations on the approach road to Ankenes. The competence of the Chasseurs to meet the severe conditions in the mountainous Northern area, flanking the Norwegians, proved disappointing, in spite of Alpine training. The proportion of ski-troops, even for reconnaissance and communications, was too small. They made poor progress through the snow and suffered severely from first-bite.

The Poles—Chasseurs de Montagnes—included few trained "mountain" troops in spite of their designation, but many had seen something of modern war and all were fired by bitter hatred of the enemy. The Foreign Legion's morale was maintained at a high level through their traditional and well-advertised love of military adventure. When alerted for the attack, they protested loudly: they were not used to snow or forests or lack of darkness or landing from open boats under fire. Objections, duly registered, were then shrugged off and they did remarkably well.

CONTROL OF WATER TRANSPORT

Local fishermen, with their hundreds of small craft-"puffers" to us-were indispensable for the complex movement of troops and stores around the fiords. When bombing increased, their services became more unreliable, although the Luftwaffe did not waste much time on such unrewarding targets. General Auchinleck brought out with him an ADTn who introduced some military discipline into the control. Previously, naval improvization had got things done with the unorthodox assistance of a young Sub-Lieutenant RNVR who had been enrolled for his intimate knowledge of local waters. He is to be remembered more for his "cheek" than his achievements. He managed to attend the "historic" first meeting between Cork and Mackesy. When he heard the Admiral's plan for immediate attack, he interjected his opinion that a landing from ship's boats and an attack through the snow would be madness and with untrained troops, murder. "Out of the mouth of babes. . . . " In this case, the simple truth, unencumbered by argument. How the peppery old Admiral of the Fleet reacted (if he noted the interruption) was not disclosed but the young man, upon evacuation, was one of the few junior officers to sail as passengers in the Flagship. Queer things happen in these distant and irregular campaigns.

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ARCTIC SNOW

Heavy falls of snow persisted later in April than we had reason to expect from the records of a local meteorologist. Static living and working conditions were agreeable enough but operational mobility for the inexperienced was reduced to a minimum. Lord Cork, on assuming supreme command, tested the snow obstacle by setting a party of marines some exercises on flats and slopes, gaining conviction. Experience in North Russia had shown that defences wired in deep snow were well-nigh impregnable in any attack without field-guns or mortars, though an enemy there could approach unseen through the dense forest close to his objective. Around Narvik, he could be seen from the start and scattered machine-gun positions had yet to be spotted. The Scots Guards advance party, on arrival, viewed "with borror" the snow down to sea level. The South Wales Borderers, posted to the Ankenes peninsula to check the German advance, reported "Road covered with 18 in of slush and it is impossible to operate off it, snow being 4 ft deep. Our troops, untrained and unequipped, were all but immobilized".

OPERATIONS TO THE SOUTH

Soon after the collapse of the Namsos and Aandalnes Expeditions, the Guards Brigade was alerted for action in the south where a German Mountain Division was being organized for the relief of Narvik. "Independent Companies" of commando type were sent over from England in support of the Norwegians still holding precariously a position south of Mosjoen. Any faint hope of effective resistance was smashed by the daring seizure of Hemnesberget far to their rear, using for transport of troops a small coastal tripper which might well have been named the "Narvik Belle", her home port.

On May 12, three companies of Scots Guards—not the full battalion, to the displeasure of the command—and one section of the 230th Field Company (Lieutenant L M Ward-Walters) were landed at Mo. They passed *en route* the Hemnesberget position, at which shots were fired by escorting destroyers.

Major R K Millar,2 OC Field Coy accompanied the section in the capacity of



Photo 1. Dals River Bridge, South of Mo, blown on 16 May.

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CRE Force HQ. He was hoping to be joined by his Coy HQ and No 2 Section, following with the Irish Guards in the Polish luxury liner *Chobry*. The ship was attacked by air and a bomb fell through the Officers' Quarters killing six senior officers of the Guards, including the Commanding Officer. Captain A Truelove, RE was also lost and his junior officer wounded. The *Chobry* was soon ablaze. The discipline and courage of all troops, Guardsmen and Territorial Sappers alike, parading on deck with arms and personal equipment to await transfer to a destroyer, has been praised in all the many accounts of the disaster published.

Three days later, the cruiser *Effingham*, carrying the South Wales Borderers by a new route to evade enemy bombing and submarines, grounded on approaching Bodo, and had to be abandoned and sunk, with further loss of stores and equipment. In these disastrous sinkings, our only three light tanks (3rd Hussars) were lost.

Major Millar had to carry on with meagre resources, the compressor-truck being, for most of the way, his only reliable transport. The Scots Guards first engaged the enemy at Stien, on May 16, gaining time and good defensive positions from the demolition of the River Dalselva bridge. The gap was held under fire and casualties inflicted. From Mo, near which more bridges were blown, the 110 miles of narrow road to Saltfiord snakes up one river valley and down another, with a long stretch of high snow-covered water-shed between. During the retreat, the Company blew some twenty girder, one stone-arch and ten suspension bridges, with only one failure. Their achievements are highly commended in the *History of the Corps*. General Millar today passes on much of the praise to R S M Finlay, one of two Warrant Officers volunteering for Norway whom I had been allowed to bring from Chatham for special service. He writes: "Finlay spent most of his time helping NCO's with his guidance or carrying out demolitions himself; he was worth his considerable weight in gold". The long strain put upon the Sapper party can be deduced from the record below, showing an average speed of enemy advance of nearly 12 miles a day:

	Progressive	Occupied by		
	Miles	enemy		
		May		
Stien	0	18		
Мо	8	20		
Messingletten Bridge	38	21		
Krokstranden	47	72		
Viskiskoia	71	24		
Pothus	94	26		
Fauske (Saltfiord)	119	20		
Bodo	152	31		

The Sappers, three weeks on the move, had their one day's rest at Krokstrand. At Pothus the Irish Guards took over from the Scots and fought a delaying action only ten days after the *Chobry* disaster, under a Captain—their senior officer. Demoltion of bridges had played a big part as in the Scots Guards first engagement, but things did not go as well here owing to orders being given direct to the Engineer sub-unit of an "Independent Company". The troops at Pothus had the unique experience of enjoying brief protection—and entertainment—from the surprise visit of a single Gladiator, soon to be destroyed with two others on the ground at Bodo.

BODO WITHDRAWAL

Our forces were building up around Bodo and a strong defensive position was to be taken up about twenty-five miles to the East, near the head of the Saltfiord. For the first time, the Brigade could have been concentrated in full strength. The fates were still against them. On May 26 secret orders for withdrawal came through. The Norwegian Command, also getting reinforcements for the battle, had to be kept in the dark and witnessed our unhalting trek to Bodo in angry bewilderment.

The embarkation of all troops was completed on the night of May 31---to the surprise of the Navy without misadventure. Four days previously, enemy bombers

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had reduced the little town to ashes. The Sappers, last to leave Bodo, had been involved in operations from start to finish. Their War Diary describes their own activities without complaint or criticism in a wider field; a rare merit in the records of that time. Only one grievance was registered. On embarkation at Bodo, they had to destroy their compressor-truck—as solemn an occasion as the putting-down of a faithfui old war-horse.

General Auchinleck, who visited Company Headquarters upon return of the RE Section, wrote in his final despatch "Although effected with great thoroughness... such demolitions as were carried out had surprisingly little result in stopping the enemy". This disappointment was a tribute to the outstanding efficiency of the enemy's bridging column and reflected the weakness of our rear-guard actions in covering the demolition gaps. The enemy, with unchallenged control of air and flanks, harassed our troops with certain knowledge of every position and movement. "At one point" a Regimental history relates "a certain amount of demoralization set in." This was not a pattern into which the Sapper activities could be fitted with great advantage; but the short delays gave invaluable periods of relief to the jaded troops, without kit, exhausted and utterly unready for this tough ordeal.

without kit, exhausted and utterly unready for this tough ordeal. Twenty years later, Brigadier Graham declared in *The Scots Guards Magazine* that the Brigade was "completely untrained and unsuited for mountain warfare." He could then afford to look back without reproach and even with touch of levity. He recorded his own departure from England "armed with fishing rods and tackle of every description as we knew that the salmon fishing would be in its prime in the Norwegian rivers; in fact, the salmon were running just right, but unfortunately it turned out that we were running even faster from the Germans who, in the end, got all our beautiful rods". A new conception of "combined operations", highly refreshing after all the bitterness of controversy in Narvik records.

THE NARVIK ASSAULT

The first phase of the assault was the capture of Bjerkvik, leading to the occupation of the dominant Oyjord peninsula. The Bjerkvik-Elvegaard area was favourable for the newly arrived landing-craft and light tanks. A preliminary naval bombardment



Photo 2. Narvik peninsula, pictured from high ground above Ankenes. Beyond Narvik, Rombaksfiord and Oyjord peninsula, from which main attack was launched. In distance, Herjangsfiord.

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Photo 3. French light tanks, after the thaw, used in the attacks on Bjerkvik and Narvik. (From "The Narvik Campaign, 1940," by J Waage).

opened at midnight when a battalion of Foreign Legion was carried in landing craft and tow boats from naval vessels in the Ofotfiord and was landed with very little opposition. A second battalion followed and met with a stronger resistance put up by machine-gunners around the Elvegaard military depot. This hard core was dealt with by the tanks which a French officer, in his memoir, described as "frisking around like young puppies, firing all the time". A body of Polish troops, anxious to be in at the kill, marched to Bjerkvik during the night without awaiting orders from higher command. The Norwegians continued their advance from the North under severe arctic conditions, driving back the over-extended enemy to shortened lines impinging on the head of Rombaksfiord. General Auchinleck watched the action as an observer before taking over military command from Mackesy the following day. Captain Maund had jotted down in his note-book "There is little doubt that Mackesy timed this operation well". He had been consistently opposed to an unprepared offensive, at variance with his own chief. About a year later I had a three-day Sunderland flight to the Middle East with Maund-getting an inside view of his difficult position during the campaign when convinced of the soundness of Mackesy's planning. In 1949, Maund published his Assault From The Sea, to which writers have given inadequate consideration in the Narvik context. The final attack on Narvik itself was deferred for several days by Lord Cork.

The final attack on Narvik itself was deferred for several days by Lord Cork. Landing-craft were tied up servicing Sorreisa, the quay for Bardu Foss airfield; and the Hurricanes had not arrived.

At midnight on 27th/28th, two battalions of Foreign Legion and one Norwegian, under Bethouart's command, embarked from a point screened from observation, on the north shore of Oyjord peninsula. A very short run, but it was some hours before all troops could be landed and the high ground overlooking the town had been firmly gained. A strong counter-attack, in which Bethouart's Chief of Staff was killed, was beaten off with difficulty. Support was given by field-guns firing across the fiord. General Auchinleck stated that the operation had been carried to success with the "barest margin of safety".

Throughout the day, three Polish battalions, in the sector south of Beisfiord, taken over from the South Wales Borderers, had also been engaged in some stiff

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fighting—beaten far back in counter-attack at one critical time. Late in the day, they captured Ankenes and joined up with the French on the coastal road from Narvik. Naval vessels were endangered in heavy bombing raids until fighters from Bardu Foss, fogbound in early morning, were free to give protection.

It was some days before the Norwegian troops, preparing to push the enemy back to the Swedish border, learned of the disasters on the western front and of our consequently unavoidable evacuation. Disentangling from their mountain positions, they got back to the Bardu area for demobilization on June 9, closing the longest period of resistance put up by any neutral country during the two World Wars.

SECRECY OF EVACUATION

The British Governments order for total evacuation, on May 24, was passed immediately to Bethouart, but withheld from the Norwejans for over a week, driving us to the odious task of deceiving friends and allies in the course of binding the enemy. Conflicting rumours and orders were circulated by senior officers in the know. Brigadier Pyne went through the motions of laying out a new RE Park in Harstad and I used the Divisional drilling equipment on mythical underground accommodation for Base HQ. Colonel G White, then Colley's FE 2, recalls his visit with two other young officers to see what was happening:—"We found, to our surprise, a Staff Colonel, Warrant Officer and two Sappers on the job. We watched for a while until the Colonel get fed up with his audience of gawping Lieutenants and asked us to collect more explosives. That meant commandering a 'puffer' to get to the storage barges. Later on I was given the task of sinking the two explosives' hulks—no one suggesting that more might be needed for other projects."

Most of the troops, before embarkation, were misled as to their destinations, but the sappers could not be so easily deceived when their duties commonly pointed the way. Our offensive operations were, of course, the most important factor in securing a safe withdrawal, as had been the case in North Russia in September, 1919. The



Photo 4. Norwegian troops assembling for an attack in the mountainous region north of Narvik. Their General Fleischer declared operations to be a "test of endurance which few soldiers other than those from Northern Norway could have stood up to."

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enemy was kept in ignorance of the five-day evacuation until the fourth day, June 7. Had the situation been realized earlier, the battle-cruisers, *Scharnhorst* and *Gneisenau*, able to out-gun any ship under Lord Cork's command, would have done vastly more damage than the sinking of the *Glorious*, her two escorting destroyers and an empty troopship.

NARVIK AFTER CAPTURE

Major Giblin,³ on CE Staff, was ordered to report whether more could be done to destroy port and railway facilities, further to the vast damage effected by the Germans themselves and by our Naval guns. He sends me today these reminiscences:—"I first inspected the railway line and a tunnel, where a German rail-mounted gun was under cover; the gunner was dead. Further up the line, which was demolished as far as I could see, the Foreign Legion were still in action. The iron-ore wharves were a scene of wild desolation. No more need be done.

"Later I came across Captain France,⁴ RE commanding a section of 230th Field Company. I was most impressed by their confidence and efficiency in picking up mines laid by the Germans and doing other jobs. On the Bluff, I saw a German Bofors battery and got clear evidence of two factors—the accuracy of the Naval gunnery and its ineffectiveness. The low trajectory shells had scored the ground and gone on their way.

"The Bluff, upon which alone an attack could have been made in mid-April, was immensely favourable to the defence. I formed the opinion then and hold it more firmly today, that such an early attack would have been a disastrous failure. So many factors against success and none (except perhaps emotional heroics) in favour.

"The Norwegians told me all about the German panic at the time of the Naval attacks. But people like those Mountain troops recover quickly.

"My last memory was a thrilling picture of a squadron of those wonderful little flying machines, the 'Walrus', rising like fat mallard ducks from Harstad harbour in a Vee to pass over Narvik on their way to bomb the enemy along the Swedish border. The challenge could be fully appreciated only by those who knew their small bomb capacity and vulnerability."

AIR-FIELDS FOR FIGHTER SQUADRONS

Enemy bombing occurred daily throughout the campaign—but it was after the collapse of the southern expeditions that the air-raids grew to alarming severity in spite of a good inflow of anti-aircraft artillery. The demand for airfields to serve land-based fighter squadrons gained top priority. Cork reported that in May "operations took second place". A poignant comment appears in the *History of the RAF 1939-45:—*"The saltiest of sea-dogs could now read the writing on the wall".

The Sapper contingent was at first not well organized to meet these demands. The appointment of a "CRE Airfields" (Lieut-Colonel E N Clifton) had promised well, but he had no unit under his command. Only two sites warranted attention; the small military airfield at Bardu Foss, fifty miles north of Narvik, and Skaanland, twenty-five miles from Narvik—to most a forlorn hope—where a stretch of arable land had at least the qualifications of favourable extent and contours.

The RAF appointed a young airman of exceptional drive and ability—Schneider-Cup winner Wing Commander Atcherley⁵—to finalize decisions and direct the work. His first task was diplomatic—inducing the Norwegian Command to hand over Bardu Foss for our use. Terms, uncomplimentary rather than restrictive, were imposed and the desperate race against time started on May 3.

The gravelly and sandy soil conditions were fairly stable, except for areas of clay, needing replacement by gravel. The two existing run-ways about 700 yds in length, one needing extension to over 1,000 yds. Clearance of heavy snow, the breaking up of the typical Arctic layer of sub-surface frozen soil and the digging of a drainage system were the labour-exhausting tasks. Work on ancillary services—taxying lanes, blast-proof pens, shelter for men, etc, kept pace.

Hundreds of Norwegian territorials and civilians under RE, RAF, and Norwegian officer control, got through with the essentials in less than three weeks, benefitting from almost continuous daylight. Good pay for the volunteers was flown over by Walrus and dropped at Atcherley's headquarters. This wild flinging around of big bundles of cash was indeed a disturbing episode in the orderly life of "Pay", who had, a week before, vetoed the expenditure of twenty kroner on some trivial need. Once, a "down-tools" was threatened by the volunteers. A demand for danger money was settled by immediate capitulation, progress alone being of the very slightest account.

On May 21, No 263 Gladiator Squadron flew in from the carrier *Furious*, losing two aircraft by mountain crashes on the way. Within a few days the squadron gained air ascendancy, bringing down a number of enemy bombers and driving others to jettison their loads or aim wild.

The Skaanland task fell to Major Pocock, 229th Field Company, who took a poor view of the ground. The No 46 Hurricane Squadron could not wait for any guarantee of serviceability. Too early in RE judgement, a Gladiator from Bardu Foss made a test landing, with bad results. A covering of coir-matting and chain-linked wirenetting was then put down (against RE advice) and tested on May 26, not by a single Hurricane but by the best part of a Squadron, and with a further damaging of aircraft. CRE Airfields had pleaded for greater caution. The squadron had consequently to be diverted to Bardu Foss to share accommodation with the Gladiators.

'The final work of denying occupation to the Luftwaffe for as long as possible fell to Captains Woods and Simpson—the latter sending me this note of reminiscence:— "The runways for the two squadrons had to be kept going to the very last; that entailed some frenzied work by our small detachment of Sappers from about 23.00 hours on June 7 until well into the morning. The demolitions comprised cratering the airfield immediately after the air-craft had flown off to the ill-fated *Glorious*, the destruction of petrol and ammunition stores and blowing off the breech-sections of ten Bofors. RA personnel dealt with their heavier AA weapons by firing a round with instantaneous fuze. Our RE demolition party was amongst the last troops to embark on the 8th."

I visited Bardu Foss on June 7 and 8 to find Atcherley satisfied with final arrangements, but provision had not been made for destroying two lonely Bofors and a dump of lubricating oil in short supply to the enemy, standing near the jetty at Sorreisa where the last detachment was to be collected for transit to the *Southampton*. This little demolition on my way out was the last "act of war" in the Narvik land campaign, almost as trivial as the first, when, on April 14 a "Q" orderly fired shots at a dive-bomber over Harstad.

The Southampton was now the Admiral's Flagship, with Generals Auchinleck and Bethouart on board to share the Admiral's concern for the safety of his convoy, carrying 25,000 men without the protection of a battleship. The absence of the *Renown* and *Repulse*—another element of controversy—was made good by the action of Glasfurd's heroic destroyer, *Acasta*, which scored a miracle torpedo-hit on the *Scharnhorst*, forcing her back to Trondheim for repairs. I was fortunate in meeting the Admiral on deck when clear of danger, and found him, in his element, friendly and communicative; even a bit waggish in his view that, if a man's number was up, he could not have found a better end than going down in so fine a ship.

On the following day, in port, the Admiral struck his flag for the last time. The regrettable inability of Cork and Mackesy, from the very start, to work together in personal harmony has tempted many writers to "take sides" and over-estimate the military importance of their antagonism. Staff relationships were still excellent, although the formation of joint HQ had been detrimentally ruled out. No personal considerations would have led Mackesy to depart from his responsible military decision—to avoid disaster and plan for an early success; and there was no rational middle course.

MAJOR-GENERAL P G MACKESY, CB, DSO, MC

I feel that this contribution should not close without reference to the condemnation of General Mackesy appearing in Churchill's Memoir, *The Gathering Storm* and to the unjust punitive treatment to which he was subjected upon recall.

Pierse Mackesy was commissioned in the Royal Engineers in August, 1902. In the First War, he served with distinction with the 15th and 1st Divisions: with V1 Corps as GSO 2 and then at GHQ. After the war he served in Murmansk before joining the Military Mission to Denikin in the Black Sea region. In 1935, he commanded the 3rd Infantry Brigade in Palestine. In the light of his known qualifications and varied experience he was selected (with Churchill's approval) for the command of any expedition to the Narvik region.

When the force was raised to Corps status on May 13, Mackesy was superseded by Lieut-General Auchinleck, who knew him well and admired his great qualities. But his retention was no longer feasible and he was sent home. Mackesy duly reported to the War Office, but was not received and subsequent telephone calls elicited no orders. On June 14, he was informed that he had been put on unemployed pay and on July 16 his retirement was gazetted. Mackesy then appealed to the King against the decision, but was asked to withdraw on the grounds that the retirement had no link with Narvik. The CIGS was unable to confirm that this was true, so the appeal went forward. It was rejected. Later on, Mackesy was engaged in the offices of the War Cabinet on some work for which he was highly qualified. When Churchill, then Prime Minister, heard of this employment he abruptly put a stop to it, severely rebuking those who had been responsible.

In his classical *Memoir*, appearing eight years later, Churchill sought to justify his condemnation of Mackesy's command. He describes the Narvik venture, in homely terms, as his "first love" and his "pet"; Namsos and Aandalnes, no doubt, being the ugly sisters. This partiality seems to explain, though not excuse, his interference in the conduct of distant military operations. The sections dealing with Narvik show a significant lapse from the high standards, factual and rhetorical, set elsewhere in Churchill's work. Repetitions to gain emphasis, contradictions and inaccuracies point to the weakness of his case. Mackesy is represented as an unsoldierly man of words "using every argument to prevent drastic action", without recognition of the firm support he held, from Brigade and Regimental commanders and from influential members of the Naval Staff, in his military judgements. Mackesy detested all the arguing forced upon him in defence of decisions for which he was wholly responsible. Orders he understood. No doubt there was some intolerance at times in his attitude to the strange form of higher authority imposed upon him; he was ill-equipped to deal placidly with such badgering in the field.

Within a week of disembarkation, Lord Cork, whose "vigorously offensive spirit" Churchill "never doubted", was appointed sole Commander of Naval, Military and Air Forces, thus bringing Mackesy directly under his command. Cork was expected to order the immediate attack on Narvik for which he had persistently pressed. No such order followed. Churchill tried to explain away this inaction by observing that "naval officers are chary of giving orders to the Army about purely military matters". Such diffidence was not in the character of the old Admiral, who had in fact realized the necessity to await more favourable conditions.

Through delay in attack, Churchill had claimed, "the Guards Brigade will be wasting away, losing men by sickness." The men were gaining health in an invigorating climate, not even suffering from frost-bite. Delay was also said to mean "a greater effort when the time came". Time was overwhelmingly on our side, with nine fresh battalions, landing-craft, field-guns and other elements of strength soon to arrive, and the Germans, over-extended and ill-provisioned, getting stale.

In his own defence, Churchill puts on record this deceptive picture:—"We had in April some 4,000 of our best regular troops and marines against half that number of German defenders". Our available strength in fighting men was little over 2,000 and at least 1,000 of the tough German scamen, saved from the destroyers, should have been included in the enemy count. The fictitious ratio of 2 to 1 in our favour was claimed because "an attack with this superiority would have been a fair proposition in the previous war and *no new operational factors* were at work". A wild misstatement. Troops without any appropriate training or experience; a succession of landings from tow-boats under fire; wading through Arctic waters; assembly on small scattered becaches; no true darkness; slopes or guilies to be climbed through snow; an advance through more snow against unlocated machine-gun positions; no support from field-guns or mortars, but only from naval guns with flat trajectory having to cease fire when most needed; no air-support to give encouragement and all ranks, from the start, unhopeful of success. What precedent could be found for such conditions?

Dealing with the campaign as a whole, Churchill again distorts the facts in this sweeping indictment:—"A mixed and improvised German force, barely 6,000 strong, held at bay some 20,000 Allied troops for six weeks."

For the first two of the six weeks, the figures given are quite imaginary. During the second two weeks, Mackesy and Bethouart captured Bjerkvik, with newly arrived troops and during the third two weeks—the British troops all proceeding south—the main attack was launched successfully. The sneer might seem to be cast at Cork, in supreme command or at Bethouart, in command of most of the fighting men for most of the time. But, in fact, the sting was intended for Mackesy alone, in the context of this unqualified condemnation:—"The Narvik attack was paralysed by the refusal of the military commander to run what was admittedly a desperate risk". (No longer the "fair proposition".)

Against this illogical judgement—success being taken for granted in spite of the "desperate risk"—I would turn to an objective appreciation by Major-General G L Moulton, appearing in his book Norwegian Campaign of 1940 (1966). Moulton sums up incisively:—"After the opportunity offered on 13 April and remaining open perhaps for a couple of days thereafter had been lost" (on the 15th and 16th, the unready troops were disembarking from ocean-liners) "direct assault on Narvik was impracticable, especially for troops not trained for amphibious operations or snow warfare, and inspired by a tradition, while glorious, was not noted for its flexibility".

"Pat" Mackesy had seen that an unprepared and unsupported attack would lead to disaster. Because he was right in his military decisions and boldly upheld them in spite of both threats and cajolery, his Army career, during war, was vindictively broken.

REFERENCE NOTES

¹ General Sir Arthur Dowler, KCB, KBE (died 1969)

- ² Major-General R K Millar, CB, DSO
- ^o Colonel H W Giblin
- 4 Brigadier R L France, CBE, MC
- ⁵ Air Marshal Sir Richard Atcherley, KBE, CB, AFC (died 1970)

An 'Overlord' Deception

LIEUT-COLONEL P F WHITE OBE

Author's note: The events described below took place in July and August 1943, that is thirty-two years ago. As they were then Top Secret, I kept no notes except an occasional entry in my diary as to where I went on certain days. I feel sure I have forgotten many details, and have probably made some errors.

By the summer of 1943, the four Pioneer Corps companies of 24 Airfield Construction Group felt they knew all there was to be known about making airfields out of wire netting. When I took over as C R E in early July, I was told this in no uncertain terms. Consequently I was delighted that, when I reported to the D C E Airfields, I was given a Top Secret job for the Group which had nothing to do with wire netting.

We were to carry out trials with Dummy Landing Craft which were intended to be used in the Cover Plan for "Operation Overlord". The idea was to simulate a movement of such craft from West to East along the South coast of England. The first batch would be assembled and launched in Cornwall one night. The Navy would tow them to an anchorage up some inlet, and leave them there for a few days. They would then be brought back and dismantled. That same night a second batch would be placed in an inlet in Devon, and in due course removed; and so on, along the coast. An American unit was responsible in Devon and Cornwall, while we followed at Poole, Buckler's Hard, Hampshire, and West Wittering, Sussex. These trials were timed to coincide with an invasion exercise which was taking place in the Channel. It was hoped that German aircraft might come over and take photographs.

Having selected two companies for the job, their officers and N C O's met at a garage in Hammersmith, where, in a large shed, we were shewn pieces of light tubular scaffolding, some oil drums, and some canvas. The craft would be full size L C T's. The frame was made from light tubular scaffolding, each piece of which was numbered. This frame floated on oil drums and was covered with a skin of canvas. A funnel and superstructure was fixed on top. A deck was arranged so that a man, if he was very careful, could walk on it.

Our next meeting with the equipment was on the lake at Virginia Water, where the companies spent about a fortnight erecting, dismantling and re-erecting until they could do it very fast in the dark. Competitions between companies and teams rapidly reduced the time taken to build a craft.

Mean-time I and my Field Engineer went to meet our American opposite numbers. What a cheerful crowd they were! They were a bit diffident about dealing with senior British Naval Officers, so I went with them to explain our wants to the S N O's at Falmouth and Plymouth. It was there that I met those magnificent Admirals of the Fleet and retired Admirals who, masquerading as Captains and Commanders were manning the Staffs of these Ports. I rather thought that they did not much approve of our escapade; but they gave us all the help we needed. It was in Plymouth that we stayed for a night in a hostel run by two charming American ladies. Here I enjoyed listening to American banter, and learnt a lot about inter-state rivalry in the USA.

I then went to reconnoitre our own sites. In Poole harbour we used a yacht basin with a high fence round it. At Buckler's Hard we found a field behind the Master Builder's House. Here, when we were clearing a way down to the water, we found what must have been part of the "hard" from which some of the Trafalgar men-ofwar were launched some 150 years before. A very romantic thought! At Wittering there was a sandy beach just inside the harbour entrance. One Pioneer company manned Poole and then leap-frogged to Wittering over the second company at Buckler's Hard.

I think we launched twelve craft at each place. Our method was to assemble four scaffolding skeletons by day, and put on the canvas skins and superstructure after

dark. As soon as the launch of one craft cleared a space, we started to build another. We were responsible while it was on land, and the Navy took over as soon as it was afloat. The problem was "when was it afloat?". The launching was effected by a pull from the Navy and a push from us. Our craft were long and had very little lateral rigidity. The tides at Poole were strong. We only just avoided disaster on more than one occasion when part of a craft was afloat and being swept sideways by the current while the other part was firmly on land. We were thankful for the skill of the Royal Navy. A landing craft with a bend in it would not have looked very real on a photograph from the air. Moreover we could never wait for the slack of the tide because we had to use all the hours of darkness of a July night to float as many as possible.

Security was, of course, of paramount importance, and gave the G1(I) at Southern Command quite a headache. He was satisfied with the fence at Poole; but evacuated from Buckler's Hard and Wittering the very few people who had not previously left. We had our guards out to spot anyone approaching our building sites. We decided that very little information could be gleaned from the skeletons we built by day; but when, thanks to the RAF, I flew over the sites (although I could not make sense out of the scaffolding) the shape of a boat was clearly outlined by the tracks of the men walking round it. Poole was all right because we were on shingle. At Buckler's Hard on grass and at Wittering on sand we had to keep a party raking and to make deliberately criss-cross tracks all over the site. Even so the outline was never quite obliterated.

During the days when the craft were at anchor, we sent parties aboard to make it look as though the craft were manned. They did any necessary repairs. A wind could easily loosen a piece of canvas or blow a funnel askew.

In the event our whole operation was a success; except that, I believe, no German aircraft flew over us. We learnt later that at the time of the "D" Day landings a Sapper unit operated them on the East coast. The success of that Cover Plan is now well known.

There were many lighter incidents, and some more serious ones. At Poole, difficulties caused by the current delayed our launchings. One night, at about an hour before dawn, we decided that we had completed more boats than we could possibly launch in the dark, so there was a wild rush to dismantle the superstructure and canvas of two craft. We could leave the framework and re-clothe it next night. I well remember the G1(I) madly unlacing canvas ties alongside every officer and man who could be spared from launching those we thought we could get afloat in time. All was well in the end!

It was at Wittering that, for the launching of the last craft, a bottle of beer was broken over its bows. It left the beach with the OC Pioneer Company, wearing a WRNS hat, standing at the salute on deck, with all available electric torches shining on him. It was a successful launch and a suitable hilarious climax to our exercise.

It was at either Poole or Wittering that this Company was accommodated by the Navy at HMS *Turtle*. Throughout the Normandy campaign a lifebelt hung outside the company office bearing the inscripion "HMS Mock Turtle". It was in their Mess, too, that a party was held to celebrate the 50th birthday of the Company Commander and the 21st birthday of his junior subaltern. What a grand crowd they were.

Correspondence

Lieut-Colonel D H Bromley 52 Wyong Road Mosman, NSW Australia 2088 1 March 1975

INDIAN RAILWAYS CONSTRUCTION—GAUGE PROBLEMS

Sir,—I am assisting a colleague who is currently undertaking post-graduate research studies at the University of New South Wales on gauge problems during the construction of the Indian Railways. The particular areas of study concern the controversy over the selection of gauge which took place in the early 1870s, the standards of railway construction adopted and cost aspects affecting railway extension in India at that time.

It occurs to me that some officers of the Corps who were seconded to the various Indian railway companies may have data which would assist in this study, particularly in relation to the Parliamentary Select Committee hearings on the Indian Finance Bills 1870-74.

Any information would be most welcome.-Yours sincerely, D H Bromley.

Major C Spottiswoode RE, BSc, C Eng, MICE, AMBIM Property Services Agency Farnborough East District Works Office Redvers Buller Road Aldershot, Hants

GARRISON ENGINEERS

Sir,—Lieut-Colonel Cole raises the question of finding a more appropriate title for Garrison Engineer. Many will wish to retain the nomenclature for nostalgic reasons, but however reactionary we feel it is true that it causes confusion outside the Corps. So if we are to find an alternative I would offer "Construction Engineer Officer", or the lengthier, though more widely recognized "Building and Civil Engineering Officer", both of which have convenient abbreviations matching E & M Officer.—Yours faithfuily, C Spottiswoode.

> Fibrocem Limited Portland House Stag Place London SW1E 5BJ

GLASS FIBRE REINFORCED CEMENT

Sir,—Readers of Captain Summers' article in the June 1975 issue of the Journal will be interested to know that extensive use has been made in the USA of a technique similar to that described under the heading "Rendering". The principal difference in the States is that a premix of cement, sand, some admixtures and glass fibre is applied by trowel. Premixes for this purpose are being developed in this country and some work has already been carried out by Service units in Northern Ireland. Whilst full details of this work are not yet available to the writer, we have been told that the application is economical and easy and we understand that the small buildings completed were perfectly satisfactory.—Yours faithfully, K H Brittain.

Memoirs

BRIGADIER R E BAGNALL-WILD, CBE, MA Born 6 November 1902, died 13 March 1975, at age of 72

RALPH EVERARD BAGNALL-WILD, Wellington, RMA was commissioned into the Corps in 1922. He was "Tn" and most of his service was in the transportation and movements branches of the Army. He spent all of WW2 in the Middle East. From 1947–49 he was Deputy Director of Movements at the War Office and from 1952–55 was Brigadier A/Q Scottish Command. In 1955 on leaving the Active List he became Bursar and Treasurer of Oriel College, Oxford. In 1959 he was elected a university Councillor on the Oxford City Council. He retired from the Council in 1966. CAL writes;

"My memory of Bagnall goes back to the 1920's when we served together at Longmoor at a time when the Railway Training Centre was being resuscitated from the moribund state into which it had fallen after the close of the 1st World War. The railway was completely renovated, track relaid, signalling improved and extended, locomotives overhauled, workshops rebuilt and enlarged. The 10th Railway Company, which had been reduced to 'a box of records', was reformed and took charge of the running of the railway and workshops. The civilian railways co-operated magnificently by raising a number of Supplementary Reserve Units which came to Longmoor each year for military training and technical exercises in the application of their civilian skills to military requirements. During this period, Bagnall was a tower of strength to all of us. He rapidly acquired a thorough knowledge of military railway operation and maintenance which he imparted fluently to those whom he had to train, whether Regular or SR; but to us who served with him, his great qualities were his cheerful personality, his high integrity and his fearless stand for all that was good and right."

JFML writes:

"Bagnall and I served together at Longmoor, on the Nigerian Railways 1928–29, for two years in the Tn Branch in the War Office and later in the early stages of the War in GHQ Cairo. He was a great companion, serious minded but with a keen sense of humour. He possessed a very fertile brain and always showed great ability in tackling whatever job he had to do. He rarcly, if ever, lost his temper and was never unkind to anyone. Sailing racing dinghies was his main pastime. He held office in a number of sailing clubs in Egypt and subsequently while at Oriel College, Oxford was Commodore of the Medley Sailing Club for three years." ECWM writes:

"There were only a few Tn officers who commanded a Field Company between the two World Wars, Bagnall was certainly one of the youngest. When, as a Captain, in the spring of 1937 he was posted as OC 42 Field Company at Moascar, Egypt, he regarded it as the greatest luck. We, his Field Company subalterns, soon did so too. '42' had recently returned to its peace-time station in the Canal Brigade after many months on active internal-security (including railway operating) duties in troubled Palestine. Presumably the powers-that-were thought it was about time our somewhat unprofessional railway operating procedures were regularized! Used to a light rein we initially viewed Bagnall's arrival cautiously. But, from the beginning, he trusted us to get on with our jobs; and under his quiet, yet cheerful, and wise, yet unassuming, leadership we remained an extremely happy unit. Bagnall was in his element sailing on the Suez Canal lakes. Many sapper all-ranks are indebted to him for his patient instruction. Those immediate pre-World-War-II years in Egypt were exceptionally happy ones for Bagnall and his wife Hilary. So they were for all those who worked with him and were privileged to know them both." CEMH writes:

"Bagnall and I, as his junior, shared the same room for two years in the War Office before the war. For most of 1942 we occupied a flat in Cairo with two or three others working in GHQ. He was never flurried in the office or away from it, and I never knew him lose his temper. Others with his huge intellect might sometimes be boring. He never was, and his sense of ordinary fun added to real wit made him a most enjoyable companion. On Sundays work started one hour later, and Bagnall often used to go to the early service at the Cathedral instead of getting up to a leisurely breakfast. He escaped from GHQ soon after Alamein, and joined 8th Army. Much credit is due to B-W for his spadework in the creation of the Movements organization that evolved when war came. Though only a Staff Captain in War Office, there was no one at the time who did more towards it. Circumstances and his aptitude kept him in Movements for much of his Army career. His practical ability in it was as effective as his understanding of its logistics was brilliant." VDGC writes:

"When in March 1954 I arrived at HQ Scottish Command as Chief of Staff, Bagnall-Wild was the Brigadier A/Q. Slightly older than myself, senior to me in the Army and with vastly more staff experience, he did all he could to help me in every possible way, and with no trace of resentment. He was a man with a strong personality and a clear, quick brain. He never seemed to be worried or upset, nor did he grumble about bad luck, of which he had more than his share. An extremely loyal officer, he did not hesitate to express his own views, regardless of their popularity. During the two years I came to have a great regard and feeling of friendship to him. I always knew I could consult him on any matter—military or private—knowing that one's confidence would be respected, and that one would get straight-forward, sound and honest advice and help. Can one ask for more from a true friend?" RWBB writes:

"It has long been the custom for Officers of the three Services to become Bursars and Treasurers of Oxford Colleges on their retirement from the Armed Forces. They bring to College life practical commonsense, skill in administration and a knack of what is known nowadays as man-management. They also contribute a breath of the outside world, having seen adventure in many lands. B-W, as we always called him, was no exception. Elected Treasurer of Oriel in 1956, he retired in 1970. He enjoyed Common Room life among his colleagues on the Governing Body, instructed them in finance and held his own when they were argumentative. On more relaxed occasions he regaled us with many a good story about his War experiences and endeared himself to us by his sense of fun and his unflagging good humour. His interests extended to many facets of college life, from the archives going back over six centuries to the activities of undergraduates in work and sport, in particular the College Boat Club, whose exploits on the river he encouraged from his own cabin cruiser and whose songs he sang with great gusto at Bump Suppers. He was popular as a good 'College Man' alike with dons, students and staff." PDGB writes:

"We met infrequently. At our last meeting he was confined to an electric wheelchair which he drove around with considerable *élan*. He was always an entertaining companion, with a keen sense of humour. In his younger years his collection of ribald verse was phenomenal."

CGBG writes:

"He was kind and generous, a delightful companion and a perfect host. He got the best out of his subordinates with an innate sense of leadership and by example, driving gently but firmly. He had a studious and deliberate mind which helped him to become a very capable and dependable senior administrative staff officer and, in retirement, a successful Bursar. With a somewhat academic manner and approach and a penchant for a serious discussion from the depths of an easy chair, with a glass of port to hand, he fitted into the surroundings of his 'second' career most appropriately. I think that this was one of the happiest times of his life."

LIEUTENANT-GENERAL PREMINDRA SINGH BHAGAT, PSVM, VC

PREMINDRA SINGH BHAGAT, the first Indian soldier to be awarded the Victoria Cross in World War II, died in the Military Hospital, Calcutta, on 23 May 1975.

Born in 1918, he was educated at the Royal Indian Military College, where his unusual characteristics earned a remark from his principal, J G C Scott, "He will do well in the Army". At the Indian Military Academy at Dehra Dun he was trained to be a Sapper officer and on 15 July 1939 he was commissioned into the Corps of Indian Engineers and posted to the Royal Bombay Sappers and Miners. After a brief spell at the Headquarters of that Corps he was posted to 21 Field Company of the RBS & M and proceeded to North East Africa in 1940, where the Company became part of the Divisional Engineers of 5 Indian Division.

2nd Lieutenant P S Bhagat—Prem to his friends—won the Victoria Cross in Abyssinia. On the night 31 Jan/1 Feb 1941, he, and a detachment of his Company were set the task of clearing fifteen minefields over a stretch of fifty-five miles of road. Working at high pressure for four days, on two occasions his carrier was blown up under him and on one occasion he was ambushed, he persisted in this task. He refused relief in spite of the fact that one ear drum had been punctured on the grounds that he was the better qualified to finish the task.

After several appointments in India Bhagat was appointed CRIE to 4 Indian Division, stationed in Lahore, in 1947. After a short spell as GSO I at the Indian Military Academy he achieved an early ambition of becoming Commandant of his old Corps, which had now become the Royal Bombay Group of the Royal Indian Engineers. Here his enthusiasm and high standards, as well as an overwhelming interest in all "off duty" pursuits of the Group, earned him a high place in the hearts of all his officers and men. Bhagat left the Group in August 1953 to become Deputy Chief Engineer of a Communication Zone and shortly after was appointed Chief Instructor of the DSSC at Wellington. He was not to remain long in this appointment as he was soon promoted to Brigadier and was given command of a Brigade. A succession of appointments followed:-DMI, BGS XI Corps, Chief of Staff Eastern Command. He was then given the command of a Corps, followed by Command of Central Command, India, and finally the first GOC in Central Northern Command, India. For his initiative and drive during the calamitous floods of 1971 he was awarded the Param Vishisht Seva Medal for his work in directing relief.

Having reached high rank, Prem Bhagat's great ambition was to be appointed Colonel Commandant of his old Group and it was a bitter disappointment when this honour went to another, although he was appointed Colonel Commandant of the Sikh Light Infantry. At last this disappointment was made good and on 15 March 1971 Prem Bhagat achieved his ambition when he was appointed Colonel Commandant of the, now, Bombay Engineer Group. Bhagat retired from the Active List on 31 August 1974 and was appointed Chairman of the Damodar Dam Project, the post he was holding when he died. Whilst serving Bhagat had become an author. He rewrote a number of Army Exercises when at Wellington, and in addition he published two books *Forging the Shield* and *The Shield and the Sword*.

Those who knew Prem Bhagat will remember him for his enthusiasm, friendliness and deep interest in the activities and well-being of the Bombay Group, where he had served as 2nd Lieutenant, Commandant and Colonel Commandant and with whose men he had been working when he earned the Victoria Cross. No man was too junior nor was any activity of the Corps too minor to prevent him from taking a real interest. The death of Prem Bhagat, at the comparatively early age of fifty-seven, will be mourned not only by officers and men of his old Group but also by a wide circle of friends both in India and this country.

He leaves a widow and two married children.

MEMOIRS

PROFESSOR K C BOSWELL, OBE, TD, BA Born 10 July 1897, died 27 January 1975, aged 77

PROFESSOR K C BOSWELL was educated at John Watson Academy and Merton College, Oxford, he taught at both Wellington College and Greshams School before taking up an Instructors appointment at the Royal Military Academy, Woolwich in 1929.

I first met the Professor—Bos to all his friends—prior to my posting in 1957 as an instructor at the Royal Military Academy Sandhurst when I reported for the usual short Instructors Course held at Sandhurst at the end of each summer term. This little course was in fact Bos's brain child. He organized it and did most of the teaching himself, dominating all his officer students from the very beginning with a merciless application of erudition, a professional approach to instruction and a remarkable facility to use words to the maximum effect. I remember leaving the RMAS at the end of the course questioning very much whether Bos and I were going to see eye to eye during the tour that lay ahead. Once I had taken up my appointment, however, it did not take me long to realize how wrong I had been, and that within that dominating personality there was a great depth of understanding, humour and sympathy, and that here was a civilian lecturer whose every endeavour was devoted to the Army and to the officer cadet.

He seemed to me to stand out from his fellows; always to be seen in the Mess talking and discussing the many problems of the officer cadet with his military counterpart; always on the touch line of any game that might be being played; always striving to improve the standards of education and way of life within the RMAS. He was an outstanding teacher and with his experience of teaching at the Shop before the war his influence throughout the Academy was wide. It did not take Bos long to persuade me to become one of his many subordinate instructors of military history and it was as a result of working closely with him that I really began to appreciate and understand the character of this remarkable man.



If his affections and interests had a priority it must surely have been towards the Gunners with whom he served in the war rising to the rank of Lieut-Colonel. None the less his feelings for the Sappers ran a close second and I well remember his great delight when he was elected an Honorary Member of the Institution of Royal Engineers in 1968.

Although Bos and I left Sandhurst in 1959, he to retire to his picturesque and delightful home near Wey Hill, I to take up a new appointment, I have kept in close touch with him over the years seeing him at very regular intervals. Throughout the years of his retirement he maintained his interests in the Army and in those many officers with whom he had worked and in many cases had taught. A warm welcome awaited all those who called at his house, making a journey to the West Country a pleasure indeed. Bos was a wonderfully generous host, a raconteur of outstanding ability with an unending fund of apposite stories, and with his wide knowledge of many of ones friends, conversation was always stimulating. Without his presence the journey West is no longer quite the same, and I mourn his passing deeply.

HPC

COLONEL C P WORSFOLD MC Born 12 April 1897, died 21 June 1975, aged 78

CHRISTOPHER PEMBERTON WORSFOLD was born at Dover, the son of E W Worsfold Esq, JP. At Radley when the First World War broke out, he took the Army examination in the autumn, joined the RMA in December 1914 and was commissioned into the Corps in July 1915. After a short course at Chatham he went to France in May 1916 with the 7th Horsed Bridging Train. Transferred early in 1917 to 218 Field Company of 32 Division, a Glasgow Territorial unit of some distinction, which, under the command of Major Waters, gained two VCs in one day at the crossing of the Sambre et Oise Canal, he served with them for the remainder of the war.

After the Armistice his engineering education was completed at The School of Electric Lighting, Cambridge and SME. Four years at the War Office as Staff Officer to the Director of Fortifications and Works, and Secretary of the Corps Committee was followed by nomination to Staff College and Staff appointments at Chatham, Bermuda and in the TA Buildings Branch at the War Office.

The outbreak of the Second World War found him as CRE Highland Area. Almost at once he was sent to France in command of 1 Construction Battalion of "X" Force, a heterogeneous collection of Territorial Field Companies and Labour Units organized by the War Office to extend the Maginot Line to the sea. The organization was not a success and was broken up, 1 Construction Battalion being transferred to 2 Corps. When spring came the unit achieved great efficiency and was pouring concrete at more than 300 cubic yards a day on about eighty sites. On one site a complete pillbox of heavily reinforced concrete was completed in twenty-four hours. With their strong line outflanked the Battalion had to retreat to Dunkirk, their morale was strengthened by being entrusted with the defence of four miles of front from which they later withdrew in good order to the beaches. Arriving in England and after a vain effort to save the Battalion from being broken up, he was posted CRE Corps Troops in East Anglia building a defence line and training for the return to Europe. Three Works appointments followed, CRE at Chatham, DCE SE Command and DDW 21 Army Group, unfortunately after six months of hard planning his health broke down six weeks before D Day. On recovery he served as DCE Scottish Command and then CE North Midland Area from which appointment he retired from the Active List in 1946 to take up farming in Kent.

He was twice widowered and after the death of his second wife he lived in Kitzbuchel, Austria. In 1956 he married Irene, daughter of the late Reverend W H and Mrs Savile who survives him.
Book Reviews

SETTING OUT-A GUIDE FOR SITE ENGINEERS

S G Brighty

(Published by Crosby Lockwood Staples, Price £5.00)

There are many good books on Survey and most deal in some measure with setting out, but none, so far as I am aware, has been devoted exclusively to this topic. Mr Brighty has identified a requirement for a reference book simply written, clearly illustrated and containing a minimum of mathematical proofs and derivations (so daunting to the average site engineer), and has produced this book to meet that need.

The book is presented in three parts: Part 1 is a description of the theodolite, the level, linear measurements and survey processes (for example tacheometry); Part 2 deals with setting out with a chapter on each of the following major topics: Marks and profiles, road centre-lines, drainage works, building works, tunnelling works, marine works, bridge works; Part 3 is a review of modern aids to practice.

The author is to be congratulated on achieving his aim. Here in one compact volume is an invaluable source of information to the site engineer however experienced. The book is printed on good quality paper with clear illustrations. (One wonders if the plastic binding will keep the book together given the constant use it is sure to get.) The text is logical and simple without simplism. The index is comprehensive and gives quick access to the information required without the labyrinthine search common in seemingly more crudite works.

This book could have been produced only by an author made aware of the site engineer's requirements by personal experience. The ruling criterion is uniform good practice, so often lacking on construction sites, and this book ought to be required reading for any site engineer.

JFJ

GALLIPOLI

CAPTAIN E W BUSH, DSO**, DSC, Royal Navy

(Published by George Allen and Unwin Ltd, London: Price £7:25)

This very readable book, published to coincide with the 60th Anniversary of Anzac Day, 25 April, tells the story of the ill-fated Dardanelles campaign. The author was a fifteen-yearold Midshipman at the time and was in charge of one of the picket boats at the landing. The book has been written, however, after many years of patient work piecing together a fair picture of the whole campaign. It is the fact that the author was there (he was awarded the DSC, the youngest ever to receive it for his courage and endurance under shell fire), which brings the book to life, his vivid descriptions and anecdotes make it difficult to put the book down once started.

EEP

THE FIELD MARSHAL'S MEMOIRS John Masters

(Published by Michael Joseph Ltd, London, 315 pages, Price £3:50)

This novel can be reviewed as a John Masters' book or just as a book; in neither case can your reviewer be very enthusiastic. The plot is quite interesting. The Field Marshal decides to write the truth about a fictitious campaign—political pressure is brought to bear to prevent this as some of the truth could be embarrassing to the government—indeed some would be very embarrassing to the Field Marshal! The end must not be revealed but as the *jacket* states the novel is "of courage and cowardice, of duty and compassion, of love and betrayal". If the plot is interesting wherein lies the fault? The book has its quota of sex, of tilting at authority, of unrealistic situations. John Masters, when writing about India in particular, has always held my attention, on this occasion I was struggling to finish the book. It is an average novel but well below the author's previous standards. I regret having to write this but like the Field Marshal I must try to be truthful.

ADB

THE detailed answer to Problem 2, published in the March 1975 issue of the RE Journal is:

On Thursday, 30 October 1902, a tram car travelling down Westcourt Street, Brompton, jumped the points at the foot of the hill and over turned against the Dockyard Police Quarters killing four passengers and injuring fifty. The Services, including Sappers, played a big part in the rescue attempts.

The Police Quarters still exist. This should have given a useful clue to all who have been stationed at Chatham.

The risk of electrocution to would-be rescuers was such that a pair of heavy duty rubber gloves were lodged in the brick-built sentry box at the Wood Street entrance to Brompton Barracks (end of Brompton High Street), in case there was a second accident. The story is told that many, many years after the end of the "tram era" the gloves were still there and were solemnly "handed over" at each change of sentry! Alas the entrance is no longer there though the sentry box still exists!

There were no correct solutions to the Problem!-indeed there were no solutions!

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Telephone: Chobham 8084 and 8085 The Gordon Boys' School, a voluntary aided school, is con-veniently located 23 miles from London. It offers an excellent boarding education and boys who make the necessary progress are able to take the G.C.E. "O" level examination at the end of the course, at the age of about 16 years. Boys are also helped to take the G.C.E. "A" level examination subsequently, if they are able to reach this standard. The foces are moderate by present-day standards and fathers who are serving in the Armed Forces may draw the Service education allowance to help with the payment of the fees. The School has a very high proportion of sons of Servicemen and it is particularly sympathetic to their educational needs. It can be especially useful when fathers are liable to be posted overseas. The age of entry is 12 to 14 years. There is an entrance examination, which is held in the Spring and Autamn Terms, for admission to the School each September and January. Full details may be obtained by writing to The Head Master The Gordon Boys' School, West End, Woking Suray.

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