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Contents

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Editorial

UP to now the campaign in the South Atlantic, *OPERATION CORPORATE*, has not featured in the Journal. This is not because of lack of interest! It is because it was considered better to allow some of the euphoria, which manifested itself immediately after the surrender, to die down so that a more balanced report could be presented.

It is the intention to publish a number of major contributions. The first five, in this issue, cover the "Hostilities" phase; the second series, to be published in March 1983 will deal with the "Rehabilitation". Articles on the "Reconstruction" will be published as and when appropriate. Additional articles dealing will specific incidents and giving more detailed accounts of the various facets of the work of the Corps will be published as they become available and will be the "flesh" to be added to the framework of the major articles. It is considered that this approach will result in a more objective report on what happened and that history will be less distorted for the researchers of the future.

The Sapper is publishing a series of splendid articles which are designed to keep the Corps up-to-date on what is happening. Members who do not subscribe to *The Sapper* are "missing out" on some exciting accounts. (See page 271).

Throughout all the contributions received so far, and indeed from most of the reliable media reports, the one thing that stands out is that the sheer professionalism of our soldiers, sailors and airmen, together with their will-to-win, made a formidable combination. The professionalism includes not only the obvious ability of fit fighting men, but the staff work, the planning, and the direct and indirect support to the fighting men by those both in and out of uniform. Tri-service co-operation on this scale has not been tested in anger for a long time, it passed the test with flying colours.

Mistakes must have been made, with hindsight there may have been better ways of doing certain things, the lessons learnt will be digested, but the concept of *SERVICE* has been vindicated. At a recent meeting of the British Legion a Toc H speaker said "Service is the rent we pay for our room on earth". Many Servicemen in the South Atlantic have paid their rent in full, as many others in many places have done before them; many more are still paying and will continue to pay for the rest of their lives. We should be proud of them and their willingness to pay.

In the campaign nine members of the Corps were killed and twenty-four were wounded or injured.

The following awards have been made to members of RE units and formations and to "Sappers" serving with non RE units:

For Gallantry

DSC WO2 J H Phillips

CGM SSgt J Prescott (posthumous)

MM Sgt R H Wrega and Cpl J A Foran

MID Majs R B Hawken and R Macdonald; Lts R C Hendicott and C R Livingstone; SSgt T Collins; Sgt I Roy; Cpls D Ford and S D Iles; LCpls R Gillon, J D Maher, B J Randall and W A Skinner

For Meritorious Service

OBE Lt Col (QM) P J Saunders; Mr M J Beynon (Civ)

MBE Maj C M Davies; WOI R G Randall

BEM SSgts E G Bradbury, M J Dent and P Rayner; Sgts R J Brown, D R Pasfield and A Worthington; Cpl N J Hall; Pte D J Hunt (ACC); Mr R Ford (Civ)

C-in-C Fleet's Commendations

Lt P M Naylor; WO2 T R Andrews; SSgt D A Hornby; LCpl K A Durose; Spr S P Robinson

Operation Corporate

HQ ENGINEER-IN-CHIEF

Background

On 19 March 1982, in what in retrospect was an act of provocation, a small party of Argentinian scrap metal merchants landed and remained illegally at Leith on South Georgia to dismantle stores from an old whaling station. Events during the next two weeks, culminating in the fall of the Falkland Islands on 2 April and the invasion of South Georgia on 3 April, are now history. Thereafter United Kingdom reaction was swift and decisive. On 5 April, within three days of the fall of the Falkland Islands, a Naval Task Force including HMS *Hermes* and HMS *Invincible*, together with elements of Third Commando Brigade (3 Cdo Bde) sailed from the UK. HMS *Fearless* sailed a day later on 6 April and *Canberra* and *Elk*, having been taken up from trade, sailed with the main body of 3 Cdo Bde and 3 Para on 9 April. This included 59 Commando Squadron (59 Cdo Sqn).

Operation Corporate, the military operation to re-possess the Falkland Islands, had started.

Planning and Deployment

The mounting of *Operation Corporate* probably produced the most intense activity in the Ministry of Defence (MOD) since Suez. The Sapper effort was spearheaded by HQ E-in-C who grappled with the immediate problem of "what assistance can we give to 59 Cdo Sqn in the few days before they deploy with 3 Cdo Bde on an operation for which there is as yet no operational concept, against a largely unknown enemy in largely unknown terrain, 8000 miles away with no friendly base en route other than Ascension Island, itself some 4000 miles distant from Britain, with shipping space for stores likely to be at a premium?". It was very much a matter of planning for the worst possible case.

Experienced heads were put together and in the first three days, with the support of the Military Works Force and Engineer Resources, a "package" was selected and assembled for 59 Cdo Sqn which included a limited amount of Harrier Support equipment, Airfield Damage Repair (ADR) equipment, Emergency Fuel Handling Equipment (EFHE) including the Ship-to-Shore element, general engineer stores, Combat Engineer Tractors (CET) and bomb disposal kit, plus a geographic/resources brief on the Falklands. In addition, the Squadron was reinforced by a wide selection of specialists, eg, Clerks of Works for EFHE and ADR, two bomb disposal engineers and CET crews/fitters. The equipment was supplemented on later sailings.

With the Carrier Task Force embarked for Ascension attention was concentrated on operational planning problems, in particular that of engineer resources and engineer information on Ascension, the Falklands and South Georgia. The Corps started with more information than any other part of MOD since, during the previous eighteen months, we had rebuilt the jetty at South Georgia (*Project Stilt*) and produced a Detailed Reconnaissance and Planning Report (DR and PR) for the rebuild of the Royal Marines accommodation at Moody Brook Camp. Never has a DR and PR been put to better use! Over forty Falkland Islanders were traced in the UK and interviewed by the HQ E-in-C team. Amongst those consulted were the Governor, the Head of the Public Works Department, members of the Island Council, pilots, engineers, and people with specialist knowledge of the area such as Lord Shackleton and various scientists who had carried out local field studies. With the assistance of Military Survey, this information was used to produce a Task Force Planning Map showing terrain, going, potential Harrier/C130 sites and beach landing sites. The map was supplemented by dossiers on each Settlement on the Islands giving details of facilities, resources and buildings. All this information was

flown to the Task Force at Ascension and was to prove invaluable in operational planning. The engineer operations room in MOD was also able to answer vital questions on Stanley airfield using the expertise of a member of the Engineer and Railway Staff Corps (TA) who was able to provide original drawings and construction details. As a consequence of this accumulation of fact and analysis, members of HQ E-in-C were called upon to brief, amongst others, the Commander in Chief Fleet, the Chief of the Air Staff, the Chiefs of Staff Committee and 3 Cdo Bde off Ascension. This activity continued at the same level with the planning for the deployment of 5 Infantry Brigade (5 Inf Bde) in early May. The Sapper element was to be RHQ and Workshop 36 Engineer Regiment, 9 Parachute Squadron (minus) plus a Troop of 20 Field Squadron and 61 Field Support Squadron. In the meantime a Troop from 9 Para Sqn had deployed with the 2 Para Spearhead Battalion Group and 11 Field Squadron had deployed to provide Harrier Support for the Force. CO 36 Engr Regt was nominated Force CRE and engineer adviser to Commander Land Forces Falkland Islands (CLFFI). Operational planning was not to be finalized until the Task Force reached the South Atlantic which was frustrating for an engineer planning cell in MOD trying to envisage what the Sappers might require on the ground 8000 miles away. The same principle was therefore adopted with 5 Inf Bde as had been done with 3 Cdo Bde, ie, first, assume a worst possible case, since it was apparent by now that the Falklands would yield precious little in the way of engineer resources, and second, split your resources between ships just in case a merchant ship was lost.

Resources

"You must give us more space on the Atlantic Conveyor" urged the Colonel GS down the phone. "Don't you realize engineer stores are as important to Sappers as ammunition is to the Gunners." Reluctantly we were allocated 40 tons extra for construction materials.

It has been said often by those who ran the campaign, that the operation was a logistic triumph. This is a brief description of the part played by Engineer Resources, and others, in contributing to that triumph.

As so often during the spring and summer of 1982, Cabinet decisions took place late in the day and usually on a Friday. The initial mounting of the South Atlantic Task Force set the pattern. Mounting 59 Cdo Sqn was relatively easy compared to later problems but the timings were the shortest. Contingency plans for the operational deployment of 3 Cdo Bde were dusted off. The Special Task Stores (STS) for Emergency Fuel Handling Equipment (EFHE) were outloaded as if for a sudden exercise. At HQ E-in-C, the Director of Engineer Services staff worked out a package of equipment for airfield damage repair based on Harrier matting equipment and "Bostick" for rocket and cannon scab repairs.

Much midnight oil and urgent telephone calls—but the stores caught the ship. Twenty-four hour manning started at HQ E-in-C, the RE Branch at the Logistic Executive (Army) and Engineer Resources. It went on until well into July.

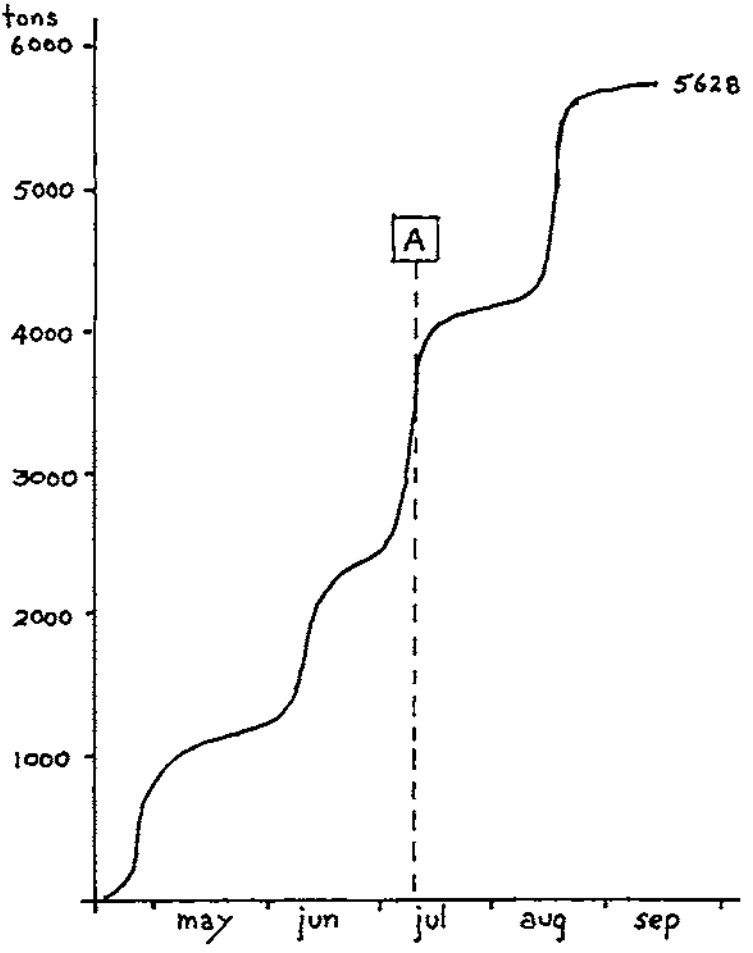
The next peak of activity was the deployment of 36 Engr Regt in late April/early May. Contingency planning had started at HQ Military Works Force (MWF) to identify suitable sources for hutting and the associated utility services. CRE Airfields also started the first investigations into the feasibility of producing an expedient airbase capable of operating Phantoms and Nimrod.

The more immediate problem was the departure of 5 Inf Bde and the key decision whether Harrier would be required to operate from a shore strip which meant more calculating and planning, picking and packing. Associated with Harrier came the need for more EFHE. We now had three sets of this, one for 3 Cdo Bde (already shipped), one for 5 Inf Bde and one for the Harrier requirement, but all capable of mixing and matching to meet any subsequent losses and the actual sites chosen.

On the plant side the problems were the purchase of peat tracks for the Caterpil-

ANNEX A

OP CORPORATE—OUTLOADING FROM LONG MARSTON



Note: This is only an indication. Most major orders for materials and equipment were delivered direct to dockside.
Broken line, marked A, indicates national rail strike. 1560 tons were outloaded by RCT in four days—naturally over a weekend!

lar D6 dozers and obtaining—via the use of an Urgent Operational Requirement of more Thwaites Giant Dumpers. We knew from previous projects in the Cairngorms that these had excellent cross country mobility and that they were small enough to be helicopter portable. They subsequently proved their worth.

We obtained the 40 tons of shipping space for the Falklands consumable stores, as mentioned above—and then scratched our heads as to what to put into it. Timber, fastenings, corrugated iron, PSP— some RSJs (but what size)? In the end it all got on board.

5 Inf Bde left and we caught our breath again. In the meantime Ascension Island had to be turned into a staging post and this in turn needed engineer resources. Not enough fuel could be got to, or stored on, the airfield so 3½ miles of aluminium victaulic pipe, six×30000 gallon pillow tanks and three mainline pump sets were flown

out in specially chartered heavy lift aircraft. The first air conditioned hutting was also bought in a rush and dispatched in a similar fashion. A RE Troop from 51 Fd Sqn was conjured up like magic and the tasks finished in record time.

May saw more major decision making. Would it be necessary to have Phantoms and Nimrod in the long term? Could the RN cope on its own with Harrier? How long would it take to construct the expedient airfield, what would be the cost, what would be the lead times from trade and how soon could work start?—all this before HMS *Sheffield* had been sunk. This first glimpse of reality concentrated a lot of thinking. The Task Force, for better or worse, was on its way and there was little that logisticians could do to influence day-to-day events, except react to urgent operational demands. This was successfully achieved by air drop. Even the sinking of *Atlantic Conveyor* with all of 11 Fd Sqn's G1098, not to mention plant and much EFHE and Harrier equipment, could only be met with concern but little practical help. A G1098 was extracted from a UK Sqn and flown to Ascension Island, it eventually caught up with 11 Sqn after Stanley had been taken! But fortunately, our policy of splitting resources between ships meant that we still had an operational capability.

The beginning of June saw Ministerial decisions, the declaration of a Military Works Area and the major procurement scramble began. 5000 tons of AM2 aluminium matting was procured from the USA. Hundreds of tons of high alumina cement were specially drummed. Over 300 pieces of plant and ECP from seventeen different sources were dispatched. Miles of geofabrics were produced. One company produced two years output in two months to meet our needs. Indeed one of the most heartening aspects has been the unstinting support we have received from civil industry. Without this "mobilization" of trade we really could not have achieved our aims.

Within four weeks of the Ministerial decision, two large ships had left UK with the project stores for the airfield and further ship-loads of hutting left in July and August. The procurement of stores was accompanied by a crash programme of unit briefing and training, including AM2 training in the USA and quarrying techniques. The response from the Engineer Resources organization, reinforced by Sappers from the remainder of the Corps in UK, was magnificent. The chart, Annex A, shows just how much was outloaded from Long Marston alone.

It has been very hard work, but also a very stimulating experience. What we did was "for real" against exacting time scales. If we got it wrong there would be real, not "chinagraph", penalties. In the event the system proved efficient and coped magnificently.

Operation Corporate—The Military Survey Involvement

LIEUT COLONEL J S HIMBURY RE, B Sc

During Op Corporate the Author was serving as SO1 Svy 2 in the Directorate of Military Survey with responsibility for land maps and air chart production and distribution.

Previous to assuming this appointment in Dec 1980 he had served for 2½ years as Geographic Officer in AFNORTH after attending the NATO Defence College, Rome.

THE BACKGROUND

Op Corporate, the code name for the UK response to the Argentine invasion of the Falkland Islands. The Falkland Islands? Where are they? How Big? How Far?—look it up on the map—what Map? Such must have been the questions asked in

MOD UKLF and CINCFLEET during the night of 31 March/1 April until impending confusion was replaced by rational thought. Early on 1 April Military Survey was alerted to start what turned out to be a challenging and immensely stimulating operation involving all elements of the Survey Service. Mindful of the date the Directorate Duty Officer was at first a little cautious but map requests for outlandish places are not uncommon, moreover the Falkland Islands had been in the news and he knew how to respond. What he did not at first expect was the speed with which both the quantity and area coverage required would increase, but by then further staff and units had been alerted.

Military Survey works to priorities given by its operational taskmasters, the three Vice Chiefs of Staff and their subordinate operational staffs, tempered by input from CINCFLEET, UKLF and Strike Command. The Falkland Islands and its Dependencies were in the lowest priority area, consequently Military Survey had done little work in the area and no stocks were held in the War Reserve Depot. Fortunately, some twenty years ago the Directorate of Overseas Surveys (DOS), as part of their responsibility to the Ministry of Overseas Development, had produced a 1:50 000 map series covering the Falkland Islands in 29 sheets, together with a two-sheet 1:2500 series covering Port Stanley. Military Survey, as a routine activity, had taken small stocks of these series. When these became depleted over the years it was their routine re-printing in October 1981 by 42 Svy Engr Regt that led to a press report in the Times Diary of 15 April 1982 that "not everybody was unprepared for the present crisis"!

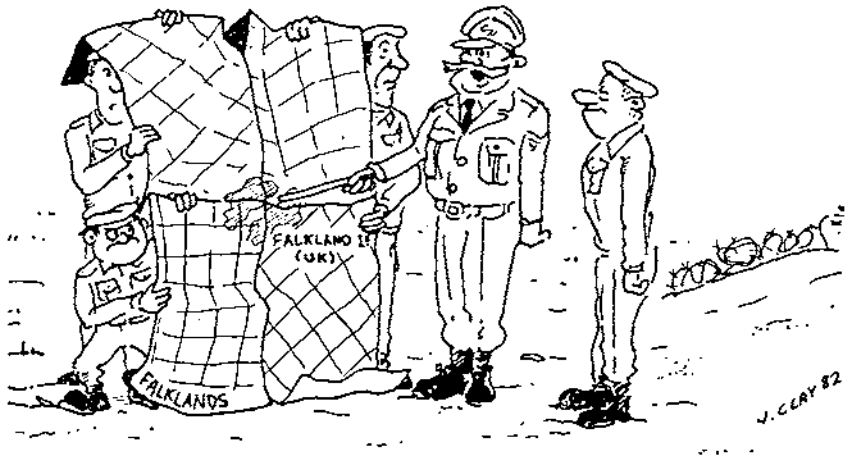
THE OPERATION STARTS

Thus when the crisis broke on 1 April, and immediate map requests came flooding in, Military Survey was able to respond with limited quantities of the somewhat outdated DOS map from the shelves at 8 Map and Air Chart Depot. It was fortunate that the rate of change in the Falkland Islands is rather slower than in Western Europe or a twenty year old map would certainly have been of little value.

Faced with demands for large quantities for the first elements of the Task Force, a Directorate Operations Room was established on full twenty-four hours manning and immediate reprinting of the existing products at both 42 Svy Engr Regt, Barton Stacey, and the Mapping and Charting Establishment (MCE RE), Feltham, was started. By 2 and 3 April units were able to collect their initial requirements in full from 8 Map and Air Chart Depot at Guildford and the War Reserve Map Store at 42 Svy Engr Regt.

It is well known that any battle always occurs on the junction of four map sheets. What is not so well known is that it also occurs across a grid zone junction. The Falkland Islands is no exception, and worse, DOS had drawn their civilian product to show by margin ticks only the eastern grid Zone 21 extended westward, thus avoiding the inconvenience of the junction. Military Survey in 1967, as part of a joint production programme with the United States Defense Mapping Agency, had correctly shown both zones of their 1:250 000 Joint Operations Graphic (JOG) but had not the resources to convert the DOS 1:50 000 mapping to the full Military Grid. Thus the classic operational nightmare had occured of two maps series of the same area with conflicting grid zones. After urgent consultations with HQ Cdo Forces at Plymouth on 5 April the solution adopted was to show both grids in the western grid zone (Zone 20) area with prominent warning notes describing the purpose of each: eg one for use with the JOG and one identical to the initial map issues. This solution gave compatability between DOS sheets already in use by the first elements of the task force as well as the earlier resident RM Detachment, part of which was still avoiding capture on the Falkland Islands, and to new products now being issued to the main Task Force and Air Forces who would use the 1:250 000 JOG in lieu of the preferred 1:500 000 air charts cover which had not been produced.

Not only standard maps and charts were required. In the first few days copies of many items such as large scale plans of Stanley Airfield and its buildings were



NEXT TIME WE HAVE A CRISIS LET'S MAKE SURE IT LANDS IN THE MIDDLE OF ONE DAMN MAP AND GRID ZONE!

obtained from numerous contacts and printed to supplement the meagre information available to the intelligence and operational branches.

DOS air photography was made available to the Joint Air Reconnaissance Intelligence Centre (JARIC) who in turn supplied copies to a variety of military users. Meanwhile as well as reprinting the 1:50 000 map to include the full grid, both 42 Svy Engr Regt and MCE RE had been extracting all additional information they could from the original DOS air photography as well as the more recent helicopter photography obtained from HMS *Endurance* via the Hydrographic Department. This data was subsequently used to make new editions in the form of Topographic Information Overprints (TIOs). Military Survey Procurement Officers throughout the world were also searching out new material and throughout *Op Corporate* new information was frequently incorporated into still further new editions.

Although operations were focused on the Falkland Islands, maps and air charts were also supplied for other areas of interest ranging from South Georgia to the British Antarctic Territories, as well as for contingency plans elsewhere. Unlike the main Task Force these contingency plans did not require such large map stocks but they called for a large amount of work in colour copying original maps obtained by Military Survey Procurement Officers from a wide number of sources, the preparation of TIOs and the printing of limited quantities. Other activity was the supply of sets of coloured slides and photographs obtained from commercial firms, Falkland Islanders in the UK, repatriated personnel and so on.

THE REQUIREMENTS INCREASE

Being used to the restraints of NATO Standardization Agreements the influence of *Op Corporate* was in many ways refreshing.

Having produced the standard series of map cover Military Survey were soon presented with additional requirements and for a change were able to say "Yes"! Examples of these requirements are:

1:25 000 Scale

The first requirements for cover at this scale came from MOD on 22 April for DIS use in assessing the Argentine deployment around Port Stanley. A new survey was impossible and the solution of enlarging the 1:50 000 series to new sheet lines over the required area with the incorporation of a TIO update was adopted. The first product "Port Stanley and Environs" was issued on 24 April and led to further requirements from CINCFLEET for similar products over Fox Bay, Port Howard,

Port San Carlos and Darwin Settlement. This was followed by a very urgent request for cover of Pebble Island. This was issued to CINCFLEET on 3 May. The success of the subsequent raid perhaps owes something to the first call on an open line alerting Military Survey to the requirement. By the conclusion of *Op Corporate* this series had been extended to cover most of NE Falkland Islands between Port San Carlos, Darwin Settlement and Port Stanley.

1:100 000 Scale

The Staff Officer who requests a map of the right size to fit his wall is well known in Military Survey. Perhaps it is not a fair comparison but in *Op Corporate* complaints were received from the Planning Staffs that the 29 sheets at 1:50 000 scale were proving difficult to handle in Operations Rooms and the 1:250 000 scale did not give enough space to plot detailed positions. The answer was to produce a new planning map with the same grid density as the 1:50 000 series by enlarging the 1:250 000 Joint Operation Graphics covering the Falkland Islands into a 5 sheet series at 1:100 000 scale. This series incorporated a TIO as well as the more detailed grid and proved a most successful map. The task was initiated on 29 April and completed as a joint effort by 42 Svy Engr Regt and MCE RE on 3 May.

1:12 500 Scale

Having produced a 1:25 000 series and filled in the gap between 1:250 000 and 1:50 000 how about the gap between the DOS 1:2500 and the new 1:25 000 scales? What better than a new 1:12 500 series!

Perhaps this was gilding the lily but the DOS 1:2500 did not cover much area and lacked contours. There was a need for a new map to cover detail of the final assault, which really came much quicker than many expected, as well as a large scale town plan for the future redevelopment of Port Stanley and it's airport. To provide this a new survey at 1:12 500 scale was undertaken as a contract task by DOS and the Hydrographic Department. This made full use of the original DOS air photography as well as the more recent Hydrographic Department HMS *Endurance* helicopter photography and their latest large scale harbour plots. Work started on 21 April and the first two sheets covering Stanley and airport area westwards towards Two Sisters were issued on 1 May. By the end of *Op Corporate* the series had been extended westwards to Mount Kent and northwards to Berkeley Sound. The extensive resurvey work was completed by Air Surveyors from 42 Svy Engr Regt being attached to DOS working shift about with their civilian counterparts. The importance of this series in the development of the Falkland Islands later resulted in further extensions as a preliminary to development plans for a new airfield, roads and harbour installations.

GOING MAPS

Information on the topography of the Falkland Islands was scarce and, in MOD, HQ E-in-C (A) Engr 1 had taken the initiative in collecting soil and "going" information from a variety of sources, including the debriefing of Falkland Islanders and RM personnel returned from the Falkland Islands via Argentina. Three NCOs from 42 Svy Engr Regt had been attached to Engr 1 to help in the presentation of data and on 13 April, 42 Svy Engr Regt was alerted to complete production of the collated data on a 1:250 000 scale composite based on the inevitable four standard sheets of the Joint Operations Graphic cover of the Islands. The first edition was issued on 16 April and a 2nd Edition incorporating yet more information was published on 26 April. Both editions suffered from difficulty in reading the overprint information under poor lighting conditions and to improve this aspect a 3rd edition of the immensely popular "RE Briefing Map" was issued on 4 May. The demand was such that a later re-print was required. Some demands received were for the "re-briefing" map which caused some confusion in 8 Map and Air Chart Depot!

LARGE SCALE SITE PLANS

The ability of Military Survey Air Surveyors to take accurate measurements from air photographs was not overlooked and the Air Surveyors at 42 Svy Engr Regt

were tasked with providing large scale profile plots extending the Port Stanley airfield runway alignment. Also, on 10 June, a large scale plot of the summit of Mount Kent was produced to facilitate planning the installation of radar equipment.

GAZETTEERS

With the Argentines calling the Falkland Islands the Malvinas and the area of interest extending from the Antarctic to South America the location of names soon presented problems. To help overcome this difficulty two gazetteers were produced. The first covering the Falkland Islands and Dependencies, which was produced by MCE RE on 11 April literally overnight, involved collecting and sorting approx 1500 names. A second edition was printed on 27 April using the resources of the School of Military Survey as at that time other unit presses were heavily committed on other work. The second gazetteer was copied from an existing US publication covering Argentina and was printed at MCE RE on 17 April.

DIGITAL TERRAIN MODEL

Military Survey had been extensively engaged in Digital Terrain Model (DTM) production in Europe, and inevitably on 23 April a request for a digital terrain model of the Falkland Islands for use in support of radar location and radio wave propagation studies was received. The answer that none had been produced would not do, so work was immediately started, based on the 1:250000 scale map contours. Data for the NE Falklands was provided on 30 April with the remainder a week later. The terrain model around Port Stanley was later refined using the new contours from the 1:12500 mapping.

Although full visual simulation is a thing of the future one important by-product from the Falkland Islands DTM were Computer Terrain Views (CTV) showing the ground shape as seen from any selected view point. The technique was developed within a few days and several requests from CINCFLEET for CTVs looking towards Port Stanley from various vantage points were met.

AIR CHARTS

The role played by Air Forces in *Op Corporate* was vital both operationally and in maintaining a constant flow of supplies. To back this up Military Survey was called upon to provide en route and navigation charts to and in the South Atlantic as well as the larger scale air charts required for operations over the Falkland Islands

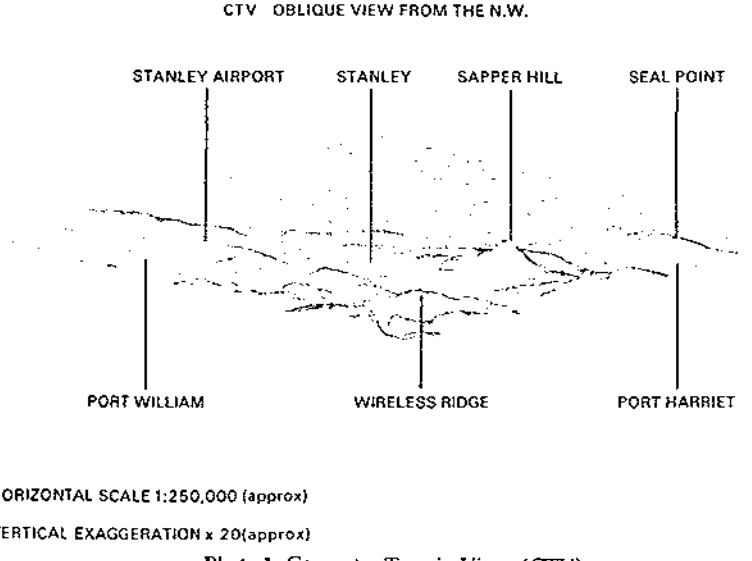


Photo 1. Computer Terrain Views (CTV)

and other contingency plans. This was a major commitment which has continued, although to a lesser extent, well after *Op Corporate* ended. In addition to these requirements the RAF called for the rapid production of a Moving Map Display filmstrip for RAF Harriers as well as a series of Maritime Patrol Air Charts covering the South Atlantic for use by RAF Nimrod aircraft operating ASW patrols.

THE MAP SUPPLY PROBLEM

There are many adaptions of the old adage about an Army marching on its stomach, but certainly without a map it marches nowhere and a major concern throughout *Op Corporate* was to ensure that forces deployed were aware of the new products and that these were quickly supplied.

During the early stages of the operation a WO1 was deployed to Ascension Island to ensure the safe delivery of later editions being produced in the UK for issue to the Task Force as they passed the island. He was also able to rescue from oblivion and forward to the RAF stocks of the US produced 1:1M air charts covering the Falkland Islands and Argentina which under US/UK joint production arrangements had been flown to Ascension Island by the US on 8 April in response to an urgent request. The US speed in delivering stocks to Ascension Island and the UK, together with reproduction material enabling Military Survey to print further stocks, was most heartening.

The expert presence of the Svy WO proved invaluable in the initially difficult period, but as the system of notifying commands and units of new products by a Map Availability Signal supplemented by the publication of a map catalogue was established, he was returned to the UK and delivery via the conventional WANTA-MAP Signal and movement by the Standard Priority System (JSP 336) became fully effective.

Statistics are notoriously unreliable but some indication of the size of the task faced by Military Survey in meeting the geographic requirements of an Amphibious Task Force operating in a remote area for which no up-to-date contingency plans existed is not amiss. By the conclusion of *Op Corporate* some 410 different products had been made available, some ¾ million maps had been printed and over 300 000 copies issued. Contrary to initial belief the commitment did not reduce after the departure of the Task Force but increased as new users were identified, new material became available and new editions were produced covering increasingly wide areas of operational interest. Throughout *Op Corporate* operational branches were seldom able to state specific requirement dates. Copies were invariably required "NOW" for planning, even if the bulk stocks for units would not be required until a few days later. As a result the majority of products were given very short production times with a degree of compromise between time and content; again almost invariably all were followed up by later editions.

THE FUTURE

The end of hostilities has not seen the end of Military Survey commitments.

New work in support of contingency plans has continued as well as extension of the 1:12 500 series as part of the development plans for the new airfield, roads and port installations on the Falkland Islands. One Officer and four Surveyors, complete with a TACIPRINT equipment, have been deployed as part of the Falkland Island Garrison to undertake field survey revision tasks and to provide facilities for the rapid overprint of information such as minefield clearance for distribution to both the military and civilian populations on the islands. It is anticipated that as well as completing revision of the basic map cover there will also be a requirement for training area maps for the future permanent garrison.

THE LESSONS TO BE LEARNED

Everyone is anxious to take advantage of the lessons learned in *Op Corporate*. Detailed reports are still being analyzed and it will take some time for these to be implemented. But the main conclusions now being reached are that the range of scales and products required is greater than previously considered and that, once again, to start collecting data when it is needed is too late, it must be actively col-

lected in peace even for the most unlikely areas and even then, without an efficient control organization and flexibility in the employment of production resources, the speed of response will be a limiting factor. In supporting *Op Corporate* both major Military Survey production units were fully committed and on occasions recourse, although limited, had to be made to the School of Military Survey and Ordnance Survey printing capacity. It now appears a reasonable assumption that in spite of the lack of preparation the geographic support provided in *Op Corporate* was successful; but NATO and the Rest of the World is a far bigger area to cover and such operations could not be supported without sustained preparatory work in peace.

THE ENEMY

Newspaper reports stated that the Argentine forces had spent £2000 on purchasing DOS maps of the Falkland Islands from a London dealer early in 1982 to support their operations. When captured General Menendez had in his possession a DOS 1:50000 map, still ungridded; and other captured Argentine mapping compared most unfavourably with our own. Perhaps Military Survey did contribute significantly to our victory in the South Atlantic!

Operation Corporate—Sappers on Ascension

MAJOR P M R HILL RE, MA(H), C Eng, MICE

The Author, Major Peter Hill, was sent to Ascension because he is one of the few "double-jointed" Officers in the Corps, having survived both Camberley and Professional Engineer training. Before his present post as Senior Instructor Design in the Civil Engineering Wing of the RSME, he commanded the Corps Support Squadron in BAOR. The 3 months in Ascension followed shortly after a month in the USA on the staff of the HQ of the Multinational Force now in Sinai, which shows that even a "desk job" at the RSME can have its surprises.

Ascension Island is half-way between the UK and the Falklands and its use as a vital staging post during *Operation Corporate* was well publicized. The island is British but the airfield is leased to the US as a base for satellite and missile tracking stations. The British residents are employees of the BBC Overseas Service, the Government Communications Service and Cable and Wireless. In other words, the main crops of the island are radio aerials and radar dishes, the volcanic rock being unable to support much else. As one would expect on a small island isolated in the middle of the Atlantic, the pace of life could best be described as relaxed, with the airfield normally handling two flights per week and called *Wideawake* after a local sea bird and not for alertness. Ascension had been used by the French as a base for the Congo rescue operation so the islanders were not surprised when RAF planes began to arrive forty-eight hours after the invasion of the Falklands.

First in were the signallers, the aircraft ground crews and a Naval detachment. The task was to receive the stores and men that had "missed the boat" in the rapid mobilization of the Fleet, and get them onto the ships as they came past. An ad-hoc unit, British Forces Support Unit Ascension, was formed under RN command but the Naval element was soon swamped by the RAF contingent, when Wideawake

Operation Corporate Sappers On Ascension Major P M R Hill RE MA CEng MICE

Photo 1. *Composite.* Wideawake Airfield on a quiet day

became the base for Nimrod maritime reconnaissance aircraft and their supporting Victor tankers. First Sappers in were a team from Military Works Force led by Colonel "Jungly" Drake and sent to plan the construction of a 3000-man camp, in case it was decided to base a brigade on the island. At this stage Ascension was very much under the Navy's thumb and offers of help from the Army were looked on as takeover bids. However, it became obvious that, though the Navy might manage by themselves, help was needed to support RAF operations as their demands for fuel, water and accommodation outstripped local resources.

"Go to Ascension and don't come back until I say so," was my directive from QMG. Unusually lucid for MOD but it sounded ominous until I found out that the "no return" clause was to try and prevent me being "returned to sender." The fiery RN Captain commanding the Support Unit was determined to cut numbers to match the water and accommodation available. Liaison officers, staff officers and visitors were definitely classed as "deadwood to be pruned" but the Army needed representatives on the island to advise on how we could help and to pass back information. I went as an Operations Staff Officer in an MOD advisory team but saw on my arrival on 25 April that there were enough engineer problems for me to re-role as a Sapper and become indispensible. RAF fuel bowsers were breaking up the roads, water stocks were dwindling, accommodation was over-flowing and the airfield apron was overcrowded. HQ E-in-C already had plans in hand to deal with these problems but a lot of detail had still to be sorted out.

The 3000-man camp was never built as the *QE2* filled that requirement. A plan for a Chinook helipad had been made and the stores assembled but horror stories from the local Americans about the emery paper effect of volcanic dust on turbine bearings kept the helicopters on the asphalt apron. To stop the roads failing under the traffic of the bowsers, a pipeline had to be built to move the aviation fuel 4·5km from the bulk storage tanks onto the airfield. Valuable cargo space was allocated and for thirty-six hours from 28 April, every RAF Hercules in came crammed with pipeline stores. It was with relief that I then welcomed a team from 516 STRE to identify and check the crates. The line had been planned from a map study and so needed a confirmatory walk along the route and some amendments to the plan. The US authorities insisted on a Government-to-Government agreement before work could begin, so I drew one up and signed it myself as the representative of HMG.

1 Troop 51 Field Squadron (Construction) under Lieutenant Martin Tucker arrived on 2 May to build the line under 516 STRE supervision. Vehicles and a couple of items of plant were begged and borrowed and construction began the next day. Despite the heat and the shortage of transport and the rugged lava terrain, the work went as planned and the line was ready for testing on the fifth day. An RAOC team flew out two days later to take it over and had very few operating problems.

One leak developed and though it was quickly repaired, the incident proved the need for a blow-off valve to allow expansion of the fuel in the line when the isolating valves were closed. A valve was flown out and quickly installed. The Dorman main line pumps suffered from vibration problems when throttled to lower speeds than usual to cope with a restriction in the rate of supply to the line but otherwise never faltered. Up to 300 000 gallons per day were pumped through and in three months over 10 million gallons were delivered to the airfield.

During the construction of the pipeline, the emergency bulk fuel installation on the airfield was rebuilt and enlarged to hold 180 000 gallons. One flexible tank fulfilled our doubts about its stability but only rolled as far as the perimeter fence. An outcrop of rock prevented levelling of the site and so the tank was re-sited. The lightweight Hamworthy pumps did not have the capacity or reliability to meet the demands of the Victor aircraft and Deutz stripper pumps had to be brought out to operate the bowser hydrants. The flexible tanks started splitting and leaking after six weeks constant emptying and filling in the tropical sun but the deterioration then slowed with the onset of cooler weather and a drop in usage. Only one tank had to be replaced though the rest required frequent patching.

As soon as men could be spared from pipeline construction, they were deployed onto a wide range of tasks to show the Navy what the Sapper can do and soon talk of sending the Troop back to UK stopped. The combat engineers began by erecting security fencing and defensive positions while the artisan tradesmen worked alongside the Cable and Wireless Works Department in re-wiring and re-plumbing abandoned buildings. In all, accommodation for 250 men was brought up to acceptable short-term standards. Much effort went into the renovation of a disused fever hospital which needed a complete refurbishment, as it was last used in the days of bucket latrines and tin baths. Wash basins, hot showers, a urinal and a WC were installed and a new drain laid to a septic tank seventy-five metres away. The building was allocated to the Troop for accommodation but they preferred the freedom of their tented camp to living among the local families. This refusal caused some unease among the RAF crews who were moved in instead but fears of an outbreak of plague soon faded and they soon made themselves at home, as a request for topsoil for a patio garden proved. The Sapper artisan tradesmen lacked practical experience, which resulted in a slow work rate and a reluctance to step outside City and Guilds methods and improvise. Close supervision by a Clerk of Works was found to be necessary. Inexperience also showed in their inability to think out and plan their work so that they made sure they had the stores they needed for the whole day.

The MOD were persuaded that RAF aircrew must be briefed in air-conditioned

Photo 2. Part of Emergency Fuel Installation

Operation Corporate Sappers On Ascension 2

Photo 3. Portakabin Bungalows erected as an HQ Complex

rooms rather than tents and six Portakabin portable bungalows were flown out. The Troop put these up, three on the US base for aircrew accommodation and three on the airfield for an Operations HQ complex. With a gusting wind and an inexperienced crane operator, we could not match the manufacturer's erection time of forty minutes per module. Indeed it took that long just to free the restraining bolts which had seized in the 90 degree temperature. The bungalows were placed on concrete blocks to prevent the sulphur-rich ground corroding the steel joists. As was to be expected when the buildings were delivered within twenty-four hours of the order, there was some slight mismatching of bolt holes and the odd missing item. The electricians never did find the wiring diagram for one model and to make things worse, had to crawl in and out through the air-conditioner hatch until we gave up the search for the doorkeys and cut out the locks. We were very envious of the Americans, who responded to the RAF pleas for something better than tents to live in by flying in fourteen planeloads of portable accommodation purpose-designed for their Rapid Deployment Force. In five days, a 25-man crew put up accommodation for 500 men, complete with air conditioning, flush toilets, hot showers and a laundry, all powered by a gas-turbine 750kW generator.

To power the bungalows with their air-conditioning, six of the new 40kVA generators were flown out. Since one set could supply all the bungalows, one suspects a decimal point slipped somewhere. By now, the 5 and 10kVA air-cooled sets brought by the RAF showed they were unfit for continuous running at high temperatures, so the supply of power to the whole of the tented complex around the airfield became an RE task. Two distribution boards were set up, each powered by one 40kVA generator. The other four sets were needed to keep two working, for the new generators had their fair share of teething problems and came without any spares backing or parts lists. Describing a wanted part to the Donnington Computer without referring to code numbers or diagrams was a good test of descriptive vocabulary and persistence. Many of the problems occurred in the sophisticated electronic control system which defied repair even by aircraft technicians, and some old faithful 27½kVA sets were quickly flown out as standby. The ears of the Officer, who decided that an isolated island 4000 miles away was a good place to try out new equipment, should have glowed each time the 40kVA sets cut out, the computers and transmitters went dead and abuse was showered on the nearest Sapper.

The shortage of water was always a constraint on the numbers allowed onto the island. All fresh water came from two desalination plants, one British and one American. To boost production on the UK side, an 8400 gallon per day reverse osmosis portable plant, crewed by a 2-man RE team, was flown out and installed alongside the existing desalination plant. This was a compact and efficient unit but had been quickly assembled as a special order and was not robust enough for continuous running. About 50 per cent availability was obtained, due to breakdowns caused by pump and pipe failures, plus the time needed to bring out replacement parts from the UK. In contrast, the two reverse osmosis units flown out to boost the US desalination plant's output had no mechanical problems but instead their osmotic membranes lasted only a few days. The membranes cost 800 dollars each and their frequent replacement meant that the cost of the water was very nearly one dollar per gallon. No membrane failures happened on the British unit, so clearly the designers of the two models of plant need to talk to each other. Attempts to ration water had little success, as the service population shared the local civilian facilities, and the consumption stayed at around 30 gallons per man per day, the planning figure in the *RESPB* on accommodation.

Considerable RE effort went into improving and enlarging English Bay Camp. This was a tented camp with blockwork latrines, ablutions and cookhouse. The camp had been used by the RAF and Royal Signals for communications and deployment exercises and could accommodate 200 men in reasonable conditions. For *Operation Corporate* it was expanded to hold up to 450 men and all the facilities were overloaded. First task for the RE Troop was to rewire the tents to avoid involuntary dancing in the showers when the lights went on. The cause was traced to Naval initiative in using 2-pin prick-through connectors into 3-core cable, thus making the camp earthing system live. The drainage system then required urgent attention as the cesspits overflowed, followed by an outbreak of mild dysentery. A central septic tank, sized for 500 men, was built and connected using cast iron water pipes for the sewers. The pipes were taken from a long disused water main laid in the last century to bring water from the mountain and using these for a sewer stirred up local preservationists. Concrete blocks for the tank and for additional latrines and ablutions were made locally by the Troop using beach sand, volcanic cinders and RN cement normally used for the emergency repair of ships.

A wide range of minor works and repairs was done. Improvized urinals and latrines were built at the airhead, with one Lance Corporal having to learn the hard way that deep trench latrines need to be deep but do not need a concrete floor to

Photo 4. 40kVA Generators on the Airhead

pumps and filters were running most of the day, every day, and numerous mechanical failures occurred. A lot of hoses split as well. Our Water Purification Units were the one item of equipment which did not really show up well.

In contrast, one equipment which was a great success was the Combat Support Boat (CSB). These were used to assist the Work Boat in manoeuvering dracones, for diving support, for liaison work, but mainly for the high speed movement of personnel and stores from ship to shore. They were invaluable as general purpose harbour craft. There were no other small boats capable of carrying passengers. Major movements to the accommodation ships were carried out at set times by landing craft. But the Sappers took it upon themselves to run a harbour "taxi" service twenty-four hours a day. Without the CSBs life would have been unbearably frustrating for those living or working on ships.

Although not under my command, we maintained close links with Major I Winfield and his detachment from 20 PC Sqn. They did sterling work as soon as the ship-loads of mail started to arrive. They handled mail for the entire force, eventually persuading the Navy to produce some Regulators to assist with ships mail. The timely arrival of mail was probably the most important single factor in the maintenance of morale. As soon as we had taken Stanley and mail was air-dropped and later airlanded, mail was arriving in as little as three days. Before this, however, there were delays of several weeks.

Our final major task before the arrival of the first two roulement Squadrons was to offload some 9000 tons of airfield construction stores and plant from the *Strathewe* and *Cedar Bank*. 11 Sqn took this on and by working round the clock for two weeks (quite literally) managed to get most of the stores ashore by the time they left for home. This was no mean feat as amongst the stores were four enormous rock crushers. It was a very tense moment as the first crusher was dragged off the LCU by a recovery vehicle with the CET pushing from behind, and up and over 3 Sqn's new Class 60 slipway. Touch and go. But, as throughout the campaign, good basic combat engineer skills and experience coupled with the resourcefulness and initiative which most of our officers, NCOs and soldiers have in full measure, carried the day.

Photo 5. Service of Dedication of Cross on Sapper Hill in Memory of the Sappers who fell in the campaign

the workload and recruit more labour. The last of the Troop left on 2 August, the day after the PSA assumed responsibility, but an Officer stayed on for three weeks to act for the PSA until their staff arrived.

When the Sappers arrived, we were none too welcome but, by the time we had to go, the other Services were pleading for us to stay. Alas, the demands from the Falklands for more men had priority—there are never enough Sappers! We learned no new lessons but relearned many old ones. Chief amongst these was the need for the Sapper tradesman to be sufficiently practised at his trade to have enough confidence to improvise when text-book solutions do not apply.

Operation Corporate—The Falkland Islands Campaign

LIEUT COLONEL G W FIELD MBE RE

The Author was commissioned from Sandhurst in Dec 61. After a "short course" at RMCS Shrivenham he had tours as a Troop Commander in 38 (Berlin) Fd Sqn and 9 Indep Para Sqn separated by a short tour as a Party Officer at 1 Trg Regt. He then spent two years as AI Fieldworks at the RSME before going to Singapore as 21C 59 Fd Sqn. He returned to the UK with the Sqn on its redesignation as 59 Indep Cdo Sqn. A more successful year at RMCS was followed by a year at the Australian Staff College. Since then he has been in MGO Secretariat, has commanded 59 Indep Cdo Sqn and has been a DS (Management) at RMCS where he was responsible for Division III of the Army Staff Course. He is now Commanding 36 Engr Regt.

Introduction

I became involved in *Operation Corporate* when it was decided to reinforce the Task Force with 5 Infantry Brigade. Simultaneously, it was decided to appoint a 2-star Land Force Commander, Major General Jeremy Moore. Headquarters Commando Forces RM, augmented by Service advisers, became Headquarters Land Forces Falkland Islands (HQ LFFI). I was appointed CRE.

This article is about Royal Engineer operations during and immediately after the campaign. It records events as I saw them. My knowledge of the period from the initial landings until the arrival in theatre of HQ LFFI, nine days later, is second hand and I have drawn on an account written by Major Roddy Macdonald, OC 59 Indep Cdo Sqn as well as the SITREPS we received on board *QE2*.

Mounting

On 2 April 1982 Argentine Forces invaded the Falkland Islands in prosecution of a long standing claim to sovereignty. The United Kingdom's immediate response was to despatch a Naval Task Force to the South Atlantic. The Task Force, including 3 Cdo Bde RM and the Spearhead Battalion, 3 PARA, sailed three days later. This was a tremendous achievement from a standing start and with no contingency plan-

Operation Corporate The Falkland Islands Campaign
Lieut Colonel G W Field MBE RE

ning. Needless to say, vehicles, equipment and stores were piled into ships in great haste and in the order in which they happened to arrive at the docks. Some general consumable engineer stores were loaded although the bulk of the stores consisted of Emergency Fuel Handling Equipment (EFHE) and Harrier stores. PSA (Prefabricated Surfacing Airfields) panels were being thrown on to the RFA *Stromness* right to the very last minute. What a contribution these stores were to make to the campaign!

The Task Force spent some two weeks off Ascension Island. This gave a much needed opportunity to cross-deck and repack equipment and for limited training and rehearsals to be carried out. The appreciations and planning for the landings were finalized; CINCFLEET, Vice Admiral Sir John Fieldhouse and CLFFI having flown to Ascension to discuss the situation with the Task Force Commander, Rear Admiral Sandy Woodward, and Comd 3 Cdo Bde RM, Brigadier Julian Thompson. The San Carlos area on East Falkland was chosen from a number of possible options because it had a sheltered deep water anchorage, the surrounding hills gave a measure of protection against air attack and it was not heavily defended.

Colonel Tony Mornement and Major Nick Hawkins, both from HQ E-in-C arrived in Ascension during this period bringing with them a going map which HQ E-in-C had prepared and dossiers on many of the Settlements throughout the Falkland Islands. These had been prepared by de-briefing Islanders who had been expelled by the Argentines and from any other available source. The going map proved to be of limited value because we arrived at the end of the driest and warmest summer in living memory which invalidated much of the information. In any case, wheeled vehicles moved by sea or by helicopter and the tracked vehicles—BV 202 E, CVR(T) and CET—all coped well with the ground conditions. The Settlement briefs were of interest to Special Forces. I found the most useful information of all was the airstrip data overprinted on the going map. Argentine air operations, particularly those involving transport aircraft, were of great interest to the Commander and the intelligence staffs. The characteristics of all the airstrips in the Falklands had been discussed in considerable detail with one of the Falkland Islands Government Air Service (FIGAS) Islander pilots and so one could advise with a fair degree of confidence on the feasibility of enemy aircraft operating from various locations. The information was useful, too, in chosing sites for Harrier Forward Operating Bases (FOBs).

On 30 April the Task Force, now augmented by 2 PARA Group which included 2 Tp 9 Para Sqn, sailed South. OC 59 Indep Cdo Sqn gave his orders on 17 May and on 18 May further regrouping and cross-decking was carried out. Ships were loaded far in excess of their peacetime limits for the assault. In addition to the Command Ship, HMS *Fearless*, there were LSLs, the civilian car ferries *Norland* and *Europic Ferry* and the *Canberra*. Not the ideal Task Group with which to mount an amphibious assault—but it worked!

The Landing

The weather for the final run in was ideal. It was overcast with mist and fog patches. This denied the enemy the opportunity of hitting the Force at the most vulnerable time. In the light of the performance of the Argentine Air Force over the next seven days it was just as well. However, the landing took place against light opposition in the early hours of 21 May. An enemy Company (minus) held Fanning Head which dominates the Northern entrance to the Falkland Sound and San Carlos Water. This was destroyed in an advance force operation shortly before the main landing. 3 PARA with 2 Tp 9 Para Sqn took Port San Carlos (Green Beach), 45 Cdo with Condor Tp 59 Cdo Sqn took Ajax Bay (Red Beach), and 40 Cdo with 2 Tp 59 Indep Cdo Sqn took San Carlos (Blue Beach). 2 PARA landed at San Carlos and marched South to the Sussex Mountains. The bridgehead had been secured.

Daylight brought clear skies and enemy aircraft. The bridgehead and, in particular, the ships crowded into San Carlos water were subjected to continual air attacks

throughout the first day. The intensity and tenacity of these attacks was quite unexpected. Wave after wave of Mirages and Skyhawks came in, inflicting severe damage on the ships. Fortunately, the Argentine pilots were flying extremely low to try to evade the enormous weight of anti-aircraft fire being put up and, as a result, many of the bombs they dropped did not have time to arm. Had this not been the case we could have lost many more ships. As it was, some had miraculous escapes. HMS *Antrim*, for example, took a 1000lb bomb through the armoured hatch leading to the Sea Slug magazine in which a large number of 2¼ ton missiles were stored. The bomb missed a live missile by not more than one inch, bounced up and put a large blister in the flight deck, rebounded down through another deck, meandered around for a bit and ended up in a loo! Other ships had similar escapes. As a result, many ships finished up with Unexploded Bombs (UXBs) on board. It was in dealing with a UXB on board HMS *Antelope* that SSgt J Prescott lost his life and WO2 J H Phillips was severely wounded.

The Argentine Air Force paid a high price, however, in these attacks. It was not unusual for at least half the aircraft taking part to be destroyed. Every conceivable weapon was used against them from Harriers, Rapier, the GW systems on ships, Bofors, Brownings, GPMGs and LMGs, to SLRs converted to automatic using matchsticks! 11 Fd Sqn was credited with "splashing" a Mirage with LMG fire from the flight deck of *Sir Bedivere*.

The Sappers were hard at work as soon as they disembarked. Each Beach required a water point. Command Posts were dug in using the CETs. Beaches and exits had to be improved. Buildings were checked for possible booby traps. Sappers took part in the patrol programme. LCpl J P Hare, 9 Para Sqn, was seriously wounded on one such patrol.

OC 59 Indep Cdo Sqn's first task was to recce a site for the Harrier FOB. The two most likely sites were the existing Islander airstrips at San Carlos and Port San Carlos. The latter was chosen as it was much firmer and had the added bonus of a sporting ski jump at the Western end. The site was very restricted, however, and there was no question of building the "West Wittering" FOB which had been designed before we left UK. 59 Sqn started to get the stores for the Emergency Fuel Handling Equipment (EFHE) ashore on 23 May. But as we experienced on several occasions later the ship-to-shore movement of stores was agonizingly slow. The orig-

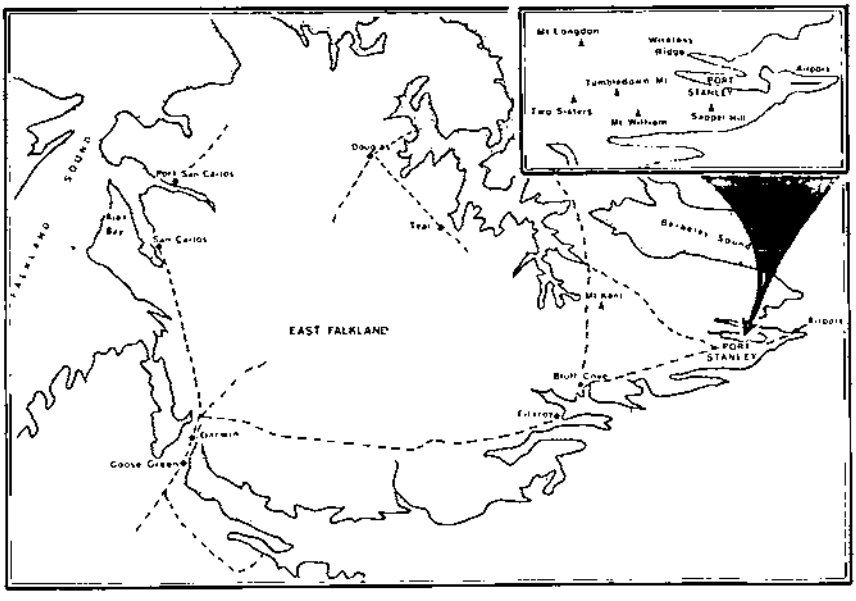


Photo 1. Dracone and Pipeline at Port San Carlos

inal design of the bulk fuel installation of a pump raft with two Deutz pumps in series pumping through a soft line to storage tanks on the hill above the beach did not work. The system was redesigned with a beached dracone, a single Deutz pump on the beach, and victaulic pipe instead of soft line. (Photo 1.) This worked well. It continued to work well throughout the campaign providing fuel not only for Harriers but also for the very large numbers of helicopters which were essential for tactical movement and logistic resupply. At times the Port San Carlos EFHE was delivering over 40 000 gallons of AVCAT per day. It is worth recording that the management and most of the operation of this system remained a Sapper responsibility throughout the battle, simply because no one else seemed prepared to grip it. We monitored stock levels, called in the fuel tanker when a refill was necessary, filled the dracone, moored it and pumped the fuel to storage. We even refuelled helicopters at times. It was not until two months after the campaign ended that we managed to pass the management of bulk fuel systems to those whose responsibility it was.

On 24 May 11 Fd Sqn landed at Port San Carlos to build the Harrier strip. The stores for about half of "West Wittering" (500 tons) together with all 11 Sqn's vehicles and G1098 were embarked in *Atlantic Conveyor* which was due to enter San Carlos Water on the morning of 26 May. Unfortunately at about 2000hrs the previous night the ship was struck by an Exocet missile, caught fire and later sank. This was a very serious blow since, in addition to the Harrier stores and G1098, the ship was carrying a large amount of trackway, 40 lighting kits and ten 27½kVA generators, 3 LWT (Light Wheeled Tractors), 6 Thwaites Dumpers, 4 Combat Support Boats, 10 tons of Bostik (scab repair), water supply equipment, EFHE, ECP (Engineer Construction Plant) etc. The problem was compounded by the loss of much of 59 Sqn's G1098 and vehicles on the *Sir Lancelot*, abandoned with two UXBs on board. (Most of this equipment was later recovered.) The immediate problem of the loss of the Harrier stores was overcome by using the PSA which had been embarked in *Stromness* to give 59 Sqn a bomb damage repair capability and for the construction of VTOL (Vertical Take Off and Landing) pads. This equipment was brought ashore at Green Beach and hauled up through Port San Carlos Settlement to the airstrip using civilian tractors and trailers. No sooner had the runway been laid, by 11 Fd Sqn, when a Chinook landed beside it; the down-draught

lifted the strip several feet in the air and buckled it. No repair panels were available when the runway was built and so it was necessary to strip back much of what had been laid and then to re-lay it. This happened on a number of occasions both during the campaign and after it. Perhaps in future we should pin the runway down at the sides as well as the ends. The frustration of this incident was forgotten when the first Harriers used the strip on 5 June. Every day thereafter two Sea Harriers and two Ground Attack (GR3) Harriers came ashore from the Carrier Battle Group at first light and operated from the FOB throughout the day. Over 150 operational sorties were flown in the period 5–14 June. Until the Port San Carlos FOB was established aircraft had to fly 200 miles or so from the carriers before engaging their targets. Land based aircraft had a greatly improved response time and their endurance dramatically increased. This was of tremendous significance in winning the air battle.

The Break Out

By 27 May the build up of the force in the beach-head and the stocking of the BMA had reached the point where the advance towards Stanley could begin. San Carlos had many advantages as a site for the initial landing. But it had one major disadvantage—it was 50 miles as the crow flies from the key objective. Given the difficult terrain and the routes chosen it would not be unreasonable to double or even treble the distance for men marching cross-country. The Sappers had particularly heavy loads to carry and the very highest standards of fitness and stamina were demanded of those who eventually walked all the way to Stanley. 3 PARA with 2 Tp 9 Sqn headed for Teal Inlet Settlement and 45 Cdo with Condor Tp 59 Sqn for Douglas Settlement, neither of which, as far as we knew, was occupied by the enemy. 42 Cdo, with 2 Tp 59 Sqn, were eventually flown forward after several days delay due to bad weather on to Mount Kent which had been partially secured in an earlier operation. 2 PARA moved South to carry out Battalion raids on Darwin and Goose Green which were thought to be held by an enemy force of some 500. (By the time they got there it had been considerably reinforced.) HQ 3 Cdo Bde moved by BV 202 E to Teal Inlet once this had been secured. A forward BMA was established here later. 40 Cdo remained in the San Carlos area to secure 5 Inf Bde's point of entry and to act as the Bde reserve. As the last troops were climbing the hills out of San Carlos an enemy air attack came in during which Spr P K Gandhi, 59 Sqn, was killed.

The "raid" on Darwin and Goose Green turned out to be the most dramatic action of the whole campaign. Lieutenant C R Livingstone, who commanded Recce Tp 59 Sqn during the battle, will, I hope, describe his Troop's part in graphic detail. The Troop grouped a four-man recce section under the command of an Officer or Senior NCO with each of the 2 PARA Companies. They cleared routes and fought as infantry throughout the battle. Their performance was outstanding. Cpl M Melia regrettably was killed by machine gun fire early in the action. The mine clearing operations in Goose Green gave us the first hard intelligence concerning enemy mines of the campaign. This was to prove very important.

Reinforcement

As we have seen, the immediate response to the Argentine invasion had been to launch a Task Force, the land element of which was 3 Cdo Bde RM reinforced by the Spearhead Battalion (3 PARA) and the leading Spearhead Parachute Battalion Group (2 PARA Gp). The Argentine Forces on the Falkland Islands were thought to number about 10000–11000 including nine Infantry Battalions. It was by no means certain that a five-Battalion Landing Force would be sufficiently strong to overcome the enemy, particularly as the Falkland Islands were within range of enemy land based aircraft. In any event a reserve was needed and had to be available at a good deal less than the twelve days or so it takes to get to the Falkland Islands from UK by air and sea. It was decided, therefore, that the Landing Force

should be reinforced by an additional Brigade. 5 Inf Bde, whose Priority 2 role is out-of-area intervention operations, was chosen. Two of the three Battalions of the Brigade—2 PARA and 3 PARA—had already deployed and these were replaced by 1 WG (Welsh Guards) and 2 SG (Scots Guards), both public duties Battalions. 36 Engr Regt, which is under command of 5 Inf Bde, was ordered to deploy with RHQ, 9 Para Sqn, 61 Fd Sp Sqn and Wksp REME in the first phase. 50 Fd Sqn (Const) was to deploy later. An advance party of CRE Works was warned to move in Phase 1. Major General Moore was appointed as the Commander Land Forces. His Headquarters, HQ Cdo Forces RM, was augmented by Service advisers and their staffs—CRA, CRE, RAFLO—and by additional intelligence and communications staffs.

The reconstituted 5 Inf Bde dashed down to Sennybridge—not unlike the Falklands and a good deal closer to Aldershot—for a training period and an FTX in order to work the formation up to a reasonable standard of collective training before deployment. 9 Sqn had a particularly hectic time of it. They were recalled from leave on a Sunday afternoon; moved to Lydd two hours later for two days intensive live firing of all weapons; then moved to Wyke Regis for a few days combat engineer training; up to Sennybridge for the Brigade FTX; back to Wyke Regis; and finally to Aldershot. All without a hitch! Then after a couple of days leave the Brigade sailed from Southampton on *QE2*. HQ LFFI remained at Northwood for as long as possible and then flew to join *QE2* at Ascension Island. No stopping for training or cross-decking or tactical loading this time—30 knots all the way! Two hundred miles off South Georgia we rendezvoused with HMS *Antrim*, a light cruiser, and transferred CLFFI, Comd 5 Inf Bde and the key members of their staffs, including the CRE and OC 9 Para Sqn, for a fast run in ahead of the main force. It was essential for the "R" Groups to get to the Falklands as early as possible in order to catch up with the rapidly developing situation and to see the ground. Communications had not been good on board *QE2* and we were not fully up to speed with events on the ground. At the edge of the Total Exclusion Zone (TEZ) we linked up with HMS *Hermes* and while CLFFI went aboard for a meeting with R Adml Woodward the remainder of the staff transferred to HMS *Fearless* which was to be the Command Ship for the operation. Also embarked in HMS *Fearless* was Commander Amphibious Warfare (COMAW) with whom we were to have the closest possible links over the coming weeks.

HMS *Fearless* re-entered San Carlos Water in the early hours of 30th May. CLFFI assumed command of all land forces. I assumed command of all Sappers (less the Posties!). We went ashore shortly after first light and were briefed by Comd 3 Cdo Bde on the situation. It was decided that his Brigade should continue to develop its operations on the Northern flank while 5 Inf Bde, once established ashore, would exploit to the South through Fitzroy and Bluff Cove linking up with 3 Cdo Bde in the area South of Mount Challenger. 2 PARA were to revert to under command 5 Inf Bde.

It is appropriate to mention here Command and Control. In writing Land Force SOPs at Northwood I envisaged placing 9 Para Sqn in support and under command for movement of 5 Inf Bde; of leaving 59 Indep Cdo Sqn in support of 3 Cdo Bde; and of designating the RHQ, 11 Fd Sqn, 61 Fd Sp Sqn and the Wksp REME as Force Troops. HQRE would remain embarked in HMS *Fearless* and the CRE would exercise command through the RHQ 36 Engr Regt. This worked except that, for most of the time, Brigade operations were allowed to develop independently against a broad directive given by CLFFI and so, effectively, the two Field Squadrons were under command of their Brigades. Communications difficulties from the Command Ship over the extended distances we were working made it impossible for the CRE to command these Squadrons in any case. The Force Troops units remained grouped in the San Carlos area and command was not a problem.

The main body of 5 Inf Bde arrived in San Carlos Water on 2 June. They had an

extremely difficult and frustrating offload. The landing craft and helicopter assets which had been available entirely to 3 Cdo Bde now had to be shared between the two Brigades. They were inadequate. Helicopter support was still needed by 3 Cdo Bde for resupply and for tactical movement when a chance to exploit forward presented itself. The operation of landing craft and Mexeflotes was not, in my view, a great success. They were not as tightly controlled as they might have been and the mechanical handling facilities on the beaches were woefully inadequate. The offload problems were compounded by the way in which the ships had been loaded in the UK in a great rush. Many important vehicles and equipment did not see the light of day until after the surrender because they were loaded behind other non-essential freight. It is one facet of the operation which went badly wrong and which will need very careful planning and control in the future.

The plans for moving 5 Bde forward changed and changed again. In the end, the Commander hijacked (retasked, as he put it!) a Chinook and pushed forward about a Company's worth of 2 PARA from Goose Green to Fitzroy and Bluff Cove, having earlier discovered by telephoning the Settlement Manager that the area was clear of enemy. Plans to fly the rest of the Brigade forward were frustrated by a lack of helicopters and by poor weather. It was decided, therefore, to move by sea. This was achieved over the nights of 5/6, 6/7 and 7/8 June after a joint 9 Sqn/SBS recce had proved the beaches and exits. It was on the final day during the offload in Fitzroy Creek that the *Sir Galahad* and *Sir Tristram* were attacked by Skyhawk and Mirage aircraft. Cpl A G McIlvenny and Spr W D Tarbard died in this attack and eight members of 20 Fd Sqn, attached to 9 Para Sqn, were wounded. This, for me, was the blackest moment of the campaign. We had been caught off guard. We had underestimated the capability of the Argentines to mount an attack on this scale after being decimated in the attacks on San Carlos Water. There had been sporadic air attacks during the week before the *Sir Galahad* incident but all the indications were that the threat had diminished markedly. There was, it must be said, absolutely no doubt about the need to get 5 Bde forward with the utmost speed. 3 Cdo Bde were enduring extremely harsh conditions, hanging on to positions on Mounts Kent, Challenger and Estancia. Cold injuries were mounting and the fighting efficiency of the Brigade would have diminished had it remained in the mountains for much longer. Nevertheless, it was a painfully high price to pay.

The Battle for Stanley

With 5 Bde now forward the scene was set for the assault on Stanley. 3 Cdo Bde were in a position to strike first and were reinforced by two Battalions from 5 Inf Bde (1 WG and 2 PARA) for the attack. Extensive patrolling of the objectives—Two Sisters, Mount Harriet and Mount Longdon—was carried out in the days preceding the attack. 59 Sqn Sappers played a key role in this patrol activity, identifying minefields and marking safe lanes through them. Without this detailed recce mine casualites would undoubtedly have been higher during the assault. The Brigade night attack, supported by five Batteries of Artillery (with 400 rounds per gun) and Naval gunfire from four ships on gun lines to the North and South of the objectives, was a brilliant success. By shortly after first light 3 PARA with 2 Tp 9 Sqn had secured Mount Longdon against fierce opposition which included Argentine Regular Marines, 45 Cdo with Condor Tp 59 Sqn had secured Two Sisters and 42 Cdo with 2 Tp 59 Sqn had secured Mount Harriet and Goat Ridge. Cpl S Wilson of 2 Tp 59 Sqn and Spr C A Jones of Condor Tp 59 Sqn unfortunately lost their lives in these attacks.

Positions on these objectives were consolidated and the recce and planning took place for the next phase of the battle. 9 Sqn carried out some excellent minefield recces which enabled safe routes to be chosen for 5 Inf Bde's advance. The Brigade was to have assaulted Tumbledown Mountain and Mount William on the night after the 3 Cdo Bde attack but it was decided that there was insufficient time for proper battle procedure to be carried out, partly because the 3 Cdo Bde objectives had not

been fully secured, and so the attack was postponed by twenty-four hours. The objectives were held by a Battalion of Argentine Marines. They were in extremely well prepared positions in the rocks and crags on top of the mountains. A diversionary attack, guided by Junior NCOs from 9 Sqn, was launched on an enemy position to the South of Mount William. During this attack LCpl J P Pashley was killed. The main attack, supported by 3 Tp 9 Sqn, went in at 0100hrs with the same level of fire support enjoyed by 3 Cdo Bde two nights earlier. It took all this support and a good deal of determined and courageous hand-to-hand fighting to dislodge the enemy. By first light 2 SG had secured the Western end of this feature. Meanwhile to the North 2 PARA, under command 3 Cdo Bde, with Recce Tp 59 Sqn were attacking Wireless Ridge brilliantly combining massive fire support from CVR(T), Naval guns, Artillery, mortars and direct fire anti tank weapons. By first light Wireless Ridge had been secured and 2 PARA were advancing on to Moody Brook Camp completely outflanking the Argentines on Tumbledown. And then they cracked! By 0900hrs Tumbledown was secured. As 1/7 GR (Gurkha Rifles) prepared to attack Mount William, Argentine resistance crumbled under the enormous weight of Artillery and direct fire support. Soldiers abandoned their trenches and started streaming back down towards Stanley. The Gunners had a field day. Then the white flags went up in Stanley and it was all over. The sense of euphoria and relief was terrific!

The Surrender

In Force Tac HQ at Fitzroy it seemed during the night that the attack was getting bogged down. I went to bed, missed the end of the battle and was then wakened by my driver to be told that our Rover was about to be flown to Stanley to act as a rear link during the surrender negotiations. At about 2230hrs (ZULU) Major General Moore, the CRA (Col Pennicott) and I climbed aboard a "Pinger" (Passive Night Goggles) Sea King helicopter and flew into Stanley. It was a memorable experience. Until I had actually flown in a "Pinger" I had fondly imagined that they were fitted with magic night flying aids. Not on your life! When I saw the pilot put on his goggles, my heart sank. I had a marked feeling of vulnerability when we landed in Stanley since, although our troops held the outskirts, the town was still full of armed Argentine soldiers.

The surrender ceremony took place in the Secretariat building at midnight. A rather sleek-looking and very clean General Menendez headed the opposition team of five Generals. A tired, but nevertheless very crisp Gen Moore headed ours. It was a very civilized and proper affair. They had been routed; we had achieved a resounding victory; the detail of the ceremony and the article of surrender were not terribly important. There was a definite Gilbert and Sullivan School Concert atmosphere about it. We knew it had to be a solemn affair but none of us had rehearsed it. We acceded to their request to delete "unconditional" from the surrender document in order, apparently, to safeguard their "military honour". Gen Moore did not agree to their request to put "Islas Malvinas" in brackets after "Falkland Islands" on the surrender document. This was firmly, and none too politely, refused! Then we all had a cup of tea. What else!

Sapper Tasks in the Battle

By far the most important task for Sappers during the battle was minefield recce and breaching. Most of the recce was carried out by Junior NCOs and Sappers from 9 Sqn and 59 Sqn. Their performance, often close to Argentine positions and under heavy direct and indirect fire, was magnificent. The Infantry became very mine conscious once they started taking mine casualties and would go nowhere without having "Holdfast" close at hand—preferably a few steps in front. As most of the minefields were unmarked they were usually discovered the hard way. Lieutenant R C Hendicott of 59 Sqn, who was supporting the Welsh Guards on the last day of the battle, tells a story of the entire Battalion being stuck in a minefield after taking

two casualties in quick succession and of how his Troop breached the WG out. It was good to hear Infantrymen singing the praises of the Sappers when the battle was over.

Two bridging tasks were completed. Fitzroy Bridge had been blown as the enemy withdrew destroying one pier and creating a gap of about 60 feet at the Eastern end. The area was mined. 9 Sqn cleared the mines and then repaired the bridge by constructing a timber trestle pier and by using scrap RSJs welded up to the required length. All the materials had to be salvaged from local sources since those sent forward from San Carlos were lost in the *Sir Tristram*. Initiative and resourcefulness carried the day. (Photo 2). The Murrel Bridge on the other "main route" into Stanley collapsed as a Samson recovery vehicle was being driven over it. The only Airportable Bridge (APB) which was readily available was at Fitzroy with 9 Sqn. This was not complete as we had lost several parts on the *Sir Tristram*, including the launching nose. I tasked 9 Sqn to build it on the ground at Fitzroy and fly it forward to 59 Sqn at Murrel Bridge. This worked very successfully. The Chinook pilot experienced a few problems in the high winds and turbulence in the mountains but found he could cope by keeping his speed below 40 knots and by hovering from time to time when the bridge started to oscillate. The only problem was how to fit a 12·8 metre bridge (all we had) into a 13 metre gap. This was solved by constructing a new abutment using timber from the old bridge. Before the APB could be lifted into place the existing bridge had to be properly demolished and the Samson had to be Chinooked out of the gap.

Aftermath

Although there had been no fighting in Stanley itself, Argentine positions on the outskirts of the town had been shelled by Naval guns for days before the final attacks. This shelling had caused a great deal of damage to the town's public utilities. Many of the overhead lines had been cut, the generator in the power station had been damaged and the water treatment plant at Moody Brook had been put out of action by a direct hit on the final night of the War. The cast iron water main leading from Moody Brook to the town reservoirs was fractured in several places.

The highest priority was given to restoring the water supply. With the population of Stanley now increased four-fold it took only two or three days for the 400 000 gal-

Photo 2. Fitzroy Bridge Repaired

lons in the reservoirs to run dry. Working under the direction of CRE Works, and in conjunction with PWD tradesmen, Sappers from 61 Sqn carried out repairs to the rapid sand filters whose cast iron pipes had been shattered. The worst damaged parts of the plant were bypassed and an Argentine generator brought in to provide power. Men from 9 Sqn carried out repairs to the fabric of the building to enable the tank to de-frost. It was not until we started pumping that we realized how badly damaged the main pipeline was. This was very difficult to repair as the Argentines had burned down the PWD plumbers store on the day of the surrender. With improvisation, ingenuity and using the manufacturing capability of the *Sir Bedivere* the pipe was eventually repaired after several attempts. Gradually the water level rose in the reservoirs and the town supply was restored stage by stage. During the week or so it took to repair the system we set up several water points in the town using standard and lightweight purification units. We were very short of equipment since most of it had been used to establish water points throughout the island or had been lost. We discovered a water dracone at Navy Point and brought this into use. We towed it out to *Fort Toronto*, a bulk water carrier, filled it and then moored it alongside the public jetty. From there we pumped into a 2500 gallon tank on an improvized oildrum tower. We continued to operate this system for several weeks to enable water bowsers to be filled. We also provided water for the *Sir Bedivere*, now being used as an accommodation ship, in the same way.

Many parts of the town were without electricity when we arrived. The damage to the generators was not serious. The overhead lines, in contrast, were in a bad way. Electricians from 61 Sqn, again supervised by CRE Works, spent a couple of weeks restoring the lines, forced by a shortage of material to make good as much damaged cable as they could. The restoration of power and water made life in Stanley almost tolerable. As a by-product, it also provided an unrivalled opportunity for tradesmen to practise their trades. It may serve, too, to silence those who see little need for tradesmen in Field Squadrons (I am, I must admit, a converted critic!).

As soon as the battle was over we started to grapple with the mine clearance problem. We knew that many minefields were unmarked and that most of the mines were undetectable. Shortly before the battle ended SSgt P A Thorpe lost a foot clearing mines in the Murrel Bridge area. Despite this, 59 Sqn continued to attempt to clear mines on the routes into Stanley for almost a week. Unfortunately Cpl B R Morgan and LCpl J W Mollinson also had feet blown off and we had to concede that the mines problem could not be solved without new equipment and new techniques. 59 Sqn had, very sensibly, isolated a group of thirty-five Argentine engineers and marines who had been involved in laying mines. These prisoners were used to help in identifying minefields and to assist in their clearance. When we decided to abandon further attempts to lift the minefields we continued to use the prisoners to mark and fence them. 9 Sqn had taken over the task by then. In the course of the next few weeks virtually all the known minefields in the Stanley area had been marked or fenced. An Argentine prisoner had a foot blow off during this operation. The most serious problem, to which I can see no solution, is that whereas the minefields laid as part of the initial obstacle plans are reasonably well-defined, those laid in haste when the Argentines realized we were coming over the hills and not over the beaches are not marked at all. Nor are the protective minefields laid by most units in the battle area. At least one of these was laid by throwing the mines from behind cover. Much research is being carried out to solve the mines problem. We sent back a selection of mines on the first C130 to leave Stanley together with WO2 Ellis who was able to give HQ E-in-C a first hand account of the problem. Mine dogs have been trained. Special photographic and IR systems are being trialled. New detectors are being developed. A flail mounted on an armoured D6 has been trialled in the Falkland Islands with little success. My personal view is that it will be a considerable time before we are in a position to start clearing these minefields without exposing our soldiers to an unreasonable risk of death or serious injury. The impact on the lives of the Islanders will increase with

time. Already they are worried about the limitation on peat cutting imposed by minefields and booby traps on Stanley Common. This area is high on the priority list for clearance.

The runway at Stanley Airport had been cratered by Vulcan and Harrier raids. The five craters had been backfilled by the Argentines to enable them to fly in C130s. This they did on most days despite the blockade. However, to enable Hercules to land safely with sufficient fuel on board to fly back to Ascension should a landing not be feasible a better crater repair solution was needed. There was a fair quantity of Argentine AM2 (Airfield Mat) lying around which proved extremely useful not only for crater repair but for a hundred and one other uses from radar bases to sheet piling. The craters were cut square using compressor tools, compacted with Bomag rollers and then capped with AM2 laid flush with the runway. This was pinned down with Harrier pins. Sealing the gap between the AM2 and the runway proved difficult with the materials we had. Bostik was tried first but this cracked every time an aircraft ran over the patch. Bitumen proved a better solution but even this was not entirely successful, especially when Harriers started to clear ice off the runway with their jet efflux. The patches stood up well to daily use by Hercules landing at around 150 000lb AUW (All-up Weight) although by mid-August when we started laying the new AM2 runway the large Vulcan crater was beginning to sag.

A second Harrier FOB was constructed at Stanley Airport. The runway was sited immediately to the North of the existing runway, halfway between the proposed Rotary Hydraulic Arrester Gear (RHAG) positions on the future AM2 runway. Taxiways and dispersals were constructed for up to thirteen aircraft, albeit in a rather restricted site. To achieve some dispersion we installed a culvert over the main drainage ditch. This is probably the world's most expensive culvert as the only materials we could find were a couple of empty Exocet containers! Rubb (Photo 3), Spandrel Orbit and inflatable shelters were erected but 50 per cent of these were later destroyed in a storm with winds gusting to around 70 knots. An EFHE was constructed. Like the Port San Carlos system this used a beached dracone, a pump on the beach, an 800 metre victaulic pipeline and six 30 000 gallon tanks. We had just tested the system and were pumping from the first dracone when a strong North Easterly blew up. The beach is very exposed from this direction and, in the surf which soon built up,

Photo 3. Harriers and Rubb Shelters—Stanley Airfield

Photo 4. Destroying an injured cow in the EFHE Beach minefield

the dracone broke loose from its moorings and was washed up on the beach. Here it lay for a week or more with seventeen twists along its 260 foot length. Remarkably, it was still serviceable when it was finally refloated. This particular dracone did sterling service for it was used on the second EFHE at San Carlos and then brought round to Stanley, still part full, in the dock of HMS *Fearless*. We could get no fuel ashore until the weather abated five days later. Then the Harriers came ashore. The Admiral could now send HMS *Hermes* home; this was a considerable relief as he had been applying considerable pressure to get the FOB operational.

To get the pipeline up from "EFHE beach" we had to breach a minefield. This was done in the classic way—basic breaching parties, prodders, etc. Even so, and after countless feet had trodden the path, a CET and a D6 ran over anti-personnel mines and, later, over anti-tank mines. We assume that mines were being washed out of the minefield and into the "safe lane" by high tides. When the CRE and CO start breaching using shovels you know there is a threat!

Numerous other small tasks were going on at the same time, many of them in support of the PWD or in maintaining public utilities. Most artisan trade skills were called on. A good example was the restoration of the house previously owned by the head of the Argentine airline that used to fly between the Falklands and Buenos Aires. This was converted into CLF's residence. Carpenters, plumbers, bricklayers, electricians and painters, first from 9 Sqn and then from 3 Sqn, working under the supervision of a Clerk of Works from CRE Works, completed this task to an excellent standard. Part of one side of the house had been demolished by a 4·5 inch shell but after the restoration this hardly showed. The increased population of Stanley proved more than the electricity supply could cope with. Two 250kW Dale Generators were connected into the town supply to provide about one eighth of the total requirement. This mini power station is still running. Similarly, the water supply system could not cope. A military waterpoint was set up at Moody Brook supplying 25 000 gallons a day into the town supply. This was not a straightforward operation because of the very peaty nature of Moody Brook. It took some time to get the correct mix of chemicals for good flocculation and to adjust the PH value. It was noticeable that our equipment did not stand up well to prolonged use. The

pumps and filters were running most of the day, every day, and numerous mechanical failures occurred. A lot of hoses split as well. Our Water Purification Units were the one item of equipment which did not really show up well.

In contrast, one equipment which was a great success was the Combat Support Boat (CSB). These were used to assist the Work Boat in manoeuvering dracones, for diving support, for liaison work, but mainly for the high speed movement of personnel and stores from ship to shore. They were invaluable as general purpose harbour craft. There were no other small boats capable of carrying passengers. Major movements to the accommodation ships were carried out at set times by landing craft. But the Sappers took it upon themselves to run a harbour "taxi" service twenty-four hours a day. Without the CSBs life would have been unbearably frustrating for those living or working on ships.

Although not under my command, we maintained close links with Major I Winfield and his detachment from 20 PC Sqn. They did sterling work as soon as the ship-loads of mail started to arrive. They handled mail for the entire force, eventually persuading the Navy to produce some Regulators to assist with ships mail. The timely arrival of mail was probably the most important single factor in the maintenance of morale. As soon as we had taken Stanley and mail was air-dropped and later airlanded, mail was arriving in as little as three days. Before this, however, there were delays of several weeks.

Our final major task before the arrival of the first two roulement Squadrons was to offload some 9000 tons of airfield construction stores and plant from the *Strathewe* and *Cedar Bank*. 11 Sqn took this on and by working round the clock for two weeks (quite literally) managed to get most of the stores ashore by the time they left for home. This was no mean feat as amongst the stores were four enormous rock crushers. It was a very tense moment as the first crusher was dragged off the LCU by a recovery vehicle with the CET pushing from behind, and up and over 3 Sqn's new Class 60 slipway. Touch and go. But, as throughout the campaign, good basic combat engineer skills and experience coupled with the resourcefulness and initiative which most of our officers, NCOs and soldiers have in full measure, carried the day.

Photo 5. Service of Dedication of Cross on Sapper Hill in Memory of the Sappers who fell in the campaign

Conclusions

A great deal happened in a remarkably short period. I flew to Ascension to join *QE2* on the day of the 3 Cdo Bde RM landing; the Argentines surrendered twenty-five days later. It is perhaps a little dangerous to draw too many lessons for the future from such a short, although intense, campaign. Three points, however, stand out in my mind as important.

First, do not rely on all your equipment being available. We lost more than two Squadron's worth of G1098 and hundreds of tons of engineer stores through enemy action, the pace of battle and theft. We had to make do with what we had and to improvize.

Second, individuals must be fit, determined and resilient. The Squadrons I commanded were. The Parachute and Commando Sappers were, in my view, the fittest soldiers in the theatre except, perhaps, the Special Forces. They needed to be extremely fit to march, as some of them did, from San Carlos to Stanley, over peat bogs and through the mountains carrying heavy loads of personal kit, ammunition and explosives, medical stores and G1098. They needed to be determined and resilient to endure the appalling weather conditions for days on end on Mount Kent and elsewhere. These qualities, however, were demanded of all Sappers, not just those in 9 and 59 Sqns.

Finally, Sappers have to be good soldiers. They must be able to survive in combat, to handle their weapons confidently, and to look after themselves in arduous conditions. All this—and be good combat engineers and tradesmen too!

Ubique

Sappers were, quite literally, everywhere during the campaign. They were right up the front in every battle clearing mines; some were serving with or took part in Special Forces operations; they offloaded ships and provided water transport; they dealt with UXBs on ships; they built Harrier strips and bulk fuel systems for the Royal Navy, the Army and the Royal Air Force; they ran power stations and water treatment plants; they repaired buildings; they built bridges; and they fought as infantry. There is no doubt in my mind that the Arm which displayed the greatest flexibility, resourcefulness and initiative was the Royal Engineers. We proved that we could perform most other Arm's roles at least as well as they could. I was tremendously proud of the achievements of the Sappers during and after the campaign. And we, as a Corps, can be proud too.

Op Corporate—I Had The Privilege

MAJOR C M DAVIES MBE, RE, B Eng

The Author was commissioned into the Corps as a Direct Entrant in 1971. After a tour as Tp Comd in 9 Indep Para Sqn he went to 26 Engr Regt as Training Officer. A period as Adjutant of 40 Army Sp Regt was followed by a year in command of 21 Army Sp Sqn before going to Camberley in 1979. The Author commands 9 Para Sqn.

Introduction

To command a Field Squadron in the Corps of Royal Engineers is an honour. To command a Field Squadron in War is a privilege which is denied most who fill the post of OC. Having had that privilege in the recent short Falklands War I suppose I am, therefore, one of a select band of Officers. Indeed at the risk of prompting much correspondence, because the British Army has been a little short of wars for a few years, Bruce Hawken (11 Fd Sqn), Roddy Macdonald (59 Cdo Sqn), Taffy Morgan (61 Fd Sp Sqn) and myself may even claim to be a "Gang of Four" amongst Serving Officers. In any event I do not believe it makes a ha'p'orth of difference. It so happens we were fortunate to be in the right place at the right time. I am sure there are many more worthy Squadron Commanders in the Corps but, thankfully, the experience fell to us. Having had the experience it is relevant that we pass on our thoughts for what they are worth.

I cannot claim that the thoughts expressed here will be my final thoughts. I have discovered in the short time since I returned from the Falklands that, when prompted, I can wax lyrical for hours (who said *ad nauseam*!). Nor can I claim to have discovered something sensational. There is seldom anything new in life and "our war" was really too short to overturn the hard-learned lessons of other, longer campaigns. However if these timely reminders serve to help any Officer in preparing for the next operation they will have fulfilled their purpose.

Some Lessons

Physical Fitness

Wellington said that "Wars are not fought in grassy meadows on sunny afternoons." How right he was! If the reader goes no further in this article he should hoist in one thing: I cannot stress too much the importance of every man being very, very fit. The shortage of transport forced us to walk a lot with heavy packs in the Falklands. This apart, if you need to sprint up a hill under shellfire or swing from a bridge while cutting explosive charges off it: if you need to crawl through a minefield, to patrol extensively, dig in, or do all kinds of manual work: if you need to work long hours and stay alert to keep alive, *YOU NEED TO BE FIT.* Rank and age are no excuses: I had to do all of these things myself: even more was required of my men. Got the message?

Flexibility

"Flexibility" is always to be found in Staff College briefs and always to be heard in discussions on tactics. But what does it mean? It means being prepared to seek an immediate, perhaps unorthodox, alternative to your own well-thought-out and lengthily-planned solution to a problem. When the G1098 you have waited for urgently finally arrives in the harbour and then is bombed out of sight in front of your eyes: when a troop you have needed for days finally arrives and you receive its men in your arms burnt, black, bleeding and suffering: when the gap in the bridge is 66 feet and the longest RSJ you have is 19 feet: when the logistic resupply system breaks down and you need ammunition and rations: then you need to think again. I have always thought that Brigadier Dicky Dowdall, when he was CRE of 4 Div, summed it up well in his two precepts for successful operations: "Keep it Simple" and most of all "Make it Work." We did that and despite these and many other unforeseen problems I believe I can truthfully say we were never found wanting. I hasten to add my task was made immeasurably easier than it might have been by having officers and men of the high quality we have in the Corps and, in particular, in having officers and soldiers full of what those in the 9 Squadron family would call "Airborne" drive and initiative. Of course to be flexible one needs the capacity to be flexible. Thanks to those in the UK HQ's, Parks and Depots who loaded extra items on to ships "just in case," and to the wide range of "useful bits n' pieces" to be found around the settlements we had this capacity. You can do a lot with not much, but you cannot do anything with nothing!

Determination

The pundits would call it "Maintenance of the Momentum." Soldiers call it "getting stuck in." It is all about not being deterred by difficulties. For those who have not seen the peat bog, the tussocks and the rock runs of the Falklands it is, perhaps, hard to imagine just how difficult it was to walk across that country, especially carrying the loads that had to be carried. Imagine the mud of Dartmoor in Autumn combined with the scree of Cader Idris in winter together with the miserable dampness of Sennybridge almost anytime and you have the general picture. Those who walked to Goose Green, or to Teal Inlet and onwards to Stanley needed grim determination. Those who led the Infantry on patrols and attacks through minefields, those who repaired the Fitzroy bridge in the teeth of a biting gale or who guided the CET in the dark over treacherous, unfamiliar ground for miles; they needed it. So did those who spent their nights looking for enemy positions, the Signallers (RE) who made our communications the envy of the Brigade and the so-called "renfs" of the QM staff who overcame logistic chaos by "hijacking" any form of transport to get much-needed stores forward to us. At times it seemed as if everything was attempting to frustrate progress or the completion of tasks. It was at such times only the determination to succeed which overcame all. The message is: once committed there is no room for slackers and no chance of free-wheeling. Get stuck in and *WIN*—as soon as you can.

Training

There is no substitute for hard and realistic training. Again, there is nothing new in this, I have always believed it. I mention it here because those who pay lip service to this precept were quickly found out—regrettably at cost to themselves and sometimes to others. We were fortunate to have had time for some high-pressure revision training before we deployed. Thanks to the Range Staff at Lydd and Hythe and especially to Phil Church and his staff at Wyke Regis, who gave us tremendous assistance, this was a most valuable period. We managed to fire all our personal, alternative and Squadron support weapons (including the 66mm) and to cover a wide range of Combat Engineer and Infantry skills in a very short time. We covered Bridging (dry, floating and improvized,) "Sticks n' Strings", Minelaying and Breaching (in particular), Watermanship, Field Defences, track laying, construction and repair, concreting, water supply, helicopter drills, personal survival, Artillery target indication, first aid and Infantry skills. In the event we had missed nothing out. We were called upon to use our skills in all of these fields during the campaign. We had no time for Artisan training. Thank goodness both for the standard of our men in the Corps and for the standard of Artisan training they receive. In the aftermath of the Campaign we needed every tradesman we had in the Squadron (and could have done with more) in order to put Stanley and the Settlements back into working order. All of our training was valuable but I would like to draw attention to two areas I regard as particularly valuable: First Aid and Infantry Skills.

(a) *First Aid.* I would probably put this just after physical fitness in order of importance. In addition to teaching every man the usual "Breathing, Bleeding, Breaks and Burns" doctrine I insisted that every man knew how (and when) to administer Morphine and how to use an intravenous drip. Every man carried a syrette of Morphine and one in three an intravenous drip set (1 litre or ½ litre). Both measures proved to be of inestimable, life-saving value.

(b) *Infantry Skills.* We pride ourselves on being "Soldiers first and Sappers second." Regrettably (I am sure for a host of good reasons) when Sappers arrive in units from training they are lousy soldiers and, apparently, incapable of looking after themselves in the field. They have to be taught when they arrive in Squadrons. I am fortunate to have a Squadron of "frustrated Infanteers." Nevertheless we had to revise many basic skills. Most Sappers in Field Sections had to accompany Infantry patrols, some were there in the assault, many had to fire their weapons "for real." (Even the Author claimed to have "splashed" a Skyhawk—but so did the

other couple of hundred men who shot at it!!) All had to occupy defensive positions. To simplify "Defence" I had three golden rules drummed in; they paid off. These were, in order of precedence on arrival in a new position, as follows:

(1) *Dig In.* The importance of this should be self evident—it rapidly becomes so when things start flying about!

(2) *Range Card.* This covers interlocking arcs, mutual support, depth and all the other things which orientate the defender to his piece of ground and enable him to dominate it.

(3) *Change Socks.* Although no soldier would agree at first, his feet (as a pair) are probably his most important appendage! In the mud and cold of the Falklands they were more vulnerable than ever. I extended this heading to cover all personal administration necessary to make the body healthy and comfortable: shaving, washing, putting on dry clothes etc. I believe it is significant that we did not have a single man evacuated due to trench foot, frostbite or other weather injury.

Kit

It is SOP in my Squadron that in addition to personal kit (and there seemed to be lots of that in the chilly Falklands!) every man carries 5lbs of PE and items of the Troop G1098 (handtools, mine detectors etc.) Never was the wisdom of this better proved than in this campaign. The vagaries of the weather and the non-availability of trucks or helicopters, not-to-mention the results of enemy action, usually meant that what you could not carry you never saw. It meant that when ammunition was added we all had to carry far more than we would have wished. (Back to the importance of physical fitness!) However when asked to blow the rear doors off the ill-fated *SIR TRISTRAM* to gain access to the tank deck, or to go hunting for enemy guns and radars in order to destroy them, or even to provide a substitute for hexamine to one covert patrol (!!), we had the means so we provided a service. Had we had to wait for PE to come through the system I suspect we might still be waiting. Similarly the albeit limited number of tools in our "bergens" did enable us to do some useful work while our G1098 was buried under non-essential stores in ships' holds.

Command and Control

It will come as no surprise to the reader of this Journal to hear that a Sapper Squadron Commander probably has a greater span of command and responsibility than any other commander of his rank in the Army. (Armed Forces Pay Review Board please note!!). To command soldiers working throughout the length and breadth of the Brigade (and sometimes Force) TAOR (Tactical Area of Responsibility) one needs to be pretty nimble. At the same time one is the Brigade Commander's adviser and not only in Engineer matters. My Commander relied heavily upon his Gunner and his Sapper for advice and the exchange of ideas on all manner of things. (As the Gunner had been my DS for a term at Camberley it was an exhilarating, harmonious inner quorum.) I was never bored! I will be happy to discuss command and control of Squadrons in War *ad infinitum* (or at least until the beer runs out!) with any reader. Briefly I commanded; my 21C controlled. I deployed forward (sometimes backwards and sideways), kept my finger on the "Sapper needs" pulse by reconnaissance and liaison with units and the Staff; my 21C controlled by being the Squadron centre of gravity and the hub of the communications wheel. He kept my reserve very close to him for swift deployment. I made sure I always had such a reserve: I often needed it to cope with the unforeseen. I do not believe it is always right to put a Troop with an Infantry Battalion. This often achieves only the frittering away of valuable Sapper manpower. I gave each Battalion a recce party of a Sergeant and two men: they also acted as my eyes and ears. If a Battalion needed more Sapper effort this Sergeant could say so, ask for it and I could provide as much as needed (a half-Section, a Troop, two Troops, or whatever.) In the event I was satisfied with the way this worked especially after the bombing of the *SIR GALAHAD* effectively wiped out one of my Troops and

my resources became even more at a premium. Putting a Troop "in support and under command for movement" is a flexible arrangement. At one stage my 3 Troop provided concurrent support to three Battalions without being too stretched. To have had a Troop with each of these Battalions would have been an inefficient use of my available manpower. I suppose the two most important "old" lessons I learned under this heading were:

(a) *The Level of Engineer Support.* The Squadron had sufficient strength to cope with most of 5 Brigade's requirements. A larger unit would have given the Commander a very much bigger logistic and movement headache for marginal improvement in service. In our situation I was happy that we could cope with the Brigade's needs and I was satisfied with the support available to me from the RHQ and the Field Support Squadron at Force level when I needed it.

(b) *The Field Squadron Orbat.* The orbat of a Field Squadron has been evolved over many years and with the benefit of the experience of many campaigns. I believe it is about right. It was sufficiently flexible (that word again!) for all we encountered. If a task requires two men or a half-Section (eg recce patrols or leading through minefields;) a Troop (eg bridging) or a Squadron (eg as an Infantry Company) the bill can be met without re-organizing. There is no need to form special squads or "private armies" within the Squadron. Increased specialization leads to reduced flexibility. If a Squadron is to cope with the enormous range of tasks which come its way it must remain . . . (that word again!)

Conclusions

I offer no conclusions. The experience is too recent for me to have finished mulling it over in my mind. Perhaps when I am old enough and senior enough to write my Memoirs I will offer dictums. For the moment I invite the reader to draw what he wishes from my experience: I drew from many others in finding the strength and inspiration to see me through what was a most remarkable experience.

* * * * * *

Early Days

MLC

On the face of it, there should be no prize for distinguishing between the Battle of Tel el Kebir in 1882 and the Battle of the Falkland Islands in 1982. However, and unlikely though it may seem, contemporary accounts in 1882 have a very familiar ring!

Government policy (over Egypt) had, so it was said, allowed things to drift "until mischief which might have been quenched at the beginning" threatened, if not national humiliation (as in the Falklands) at least "national disaster". Generals (in Egypt) had "set at nought the Constitutional authorities". Government policy for intervention (in Egypt) "was thoroughly endorsed by the great majority", although there were many who had misgivings about a go-it-alone policy. Newspapers "failed to provide an outside view, but only what HQ allowed". Indeed, it was alleged that the daily dispatches (from Egypt) did not much vary from the final official report, and the "benefits of secrecy were somewhat dearly purchased by the lack of unbiased and independently acquired news of correspondents." Concern was even expressed, that despite the efforts of the Opposition to "obtain some indication of the policy of the Government in Egypt, there was no distinct information as to what they were fighting for and no declaration of War". And so on!

It remains to be seen whether, this time, the Government "Will wish to deprecate anything like a searching criticism", by, as was then averred, an indiscriminate shower of honours on all concerned. "Peerages, crosses, ribands and medals were

distributed with an alacrity which suggested an eagerness to hurry history out of sight!"

But there was at least one thing on which opinion, in both cases, seems to have been favourable. In 1882 there was much praise for the speed with which the expedition was launched, and the skill with which the campaigns (which lasted about ten weeks) was conducted. Although even here commentators differed. Reasons for success were variously attributed. To good generalship (UK), to good luck and utter want of cohesion in the Egyptian Army (Germany) and to well distributed bribes (France)! However, in 1882 even those who were willing to detract, were able to praise cordially the "power of endurance and the habits of discipline displayed by the British troops". The expedition, incidentally was paid for by raising Income Tax by 1½d in the pound. May history at least repeat itself here!

The RE Journals of 1882 were, in a way, saved by the events in Egypt. Up until all attention was devoted to Egypt, the Journals followed the pattern of previous years. Some articles of undoubted interest but, seemingly, far too many closely printed columns on some very obscure subjects. If one assumes that the Editor was not merely concerned to fill his pages, why should interminably long extracts from, for example, "The Military Journal of Colonel St Pierre, Royal Dragoons, and other manuscripts relating to the War of the Spanish Succession, 1703–1713" have occupied the pages of so many successive issues? Was there much of direct Engineer interest? Frankly, no. Perhaps the Corps was largely composed of military historians? Probably not. Was the Editor himself vastly interested and supposed others would be too? Could be! Or was it that Journals of that time were expected to print long erudite and dull articles (like the sermons from fashionable pulpits in the mid Nineteenth Century)? A very possible explanation! But to return to Egypt.

Basically, the troubles were caused by a rebellion by Egyptian Army Officers, led by Arabi Pasha, against the legitimate Government. The movement had much National Support. Egypt for the Egyptians! As Arabi proclaimed, "the Army represented the people; it was trusted by the people. Egypt was sick of European control and its highly paid, often incompetent officials." But this was dangerous stuff for European financiers and bond holders, and was a sure recipe for internal instability. Serious anti-European rioting in Alexandria led to the massacre of many hundreds of Greeks. Law and order had to be restored, and the security of the Canal maintained. The European Powers, were very content to leave the matter to HMG!

The Campaign started in July 1882, with a naval bombardment, and subsequent "naval" landing, at Alexandria. It was followed by the seizure of Port Said, and a major landing in the middle of the Canal, at Ismailia. An India based contingent of about brigade strength landed at Suez, and later joined the main force east of Ismailia at Kassassin. This latter force consisted of the First and Second Divisions and a Cavalry Brigade. The RE Units were 24 Field Company (1 Div); 26 Field Company (2 Div); a Pontoon Troop; C Telegraph Troop; 8 (Railway) Company; 17 Company; 18 Company; 21 Company, a Field Park; together with two Companies of Bangalore Sappers and Miners. The expedition was commanded by Sir Garnet Wolseley.

The main impression made by reading the accounts of the campaign in the Journal is the boldness with which the troops were handled, and the speed at which the various phases were carried out. From the Sapper point of view, the provision of water and the opening of the railway and the telegraph westwards from Ismailia, were of great importance. Since roads, other than tracks across loose sand, were largely absent, the number of railway engines operating was a crucial factor, and one which figured prominently in the C-in-Cs dispatches.

Ismailia was seized, largely unopposed, by a landing force of blue jackets and marines. Arabi's forces were taken by surprise by the speed of the advance to Ismailia, through the Canal. The main means of transport to Ismailia from the west

was by rail, and enemy attempts to bring up troops by this means were frustrated by naval gun fire—with observation posts perched in the fighting tops!

Major Fraser, RE, operating under Naval Command, was much commended for his tactical sense, and for organizing and siting the defences of Ismailia. Fraser, on his part, was quick to praise the "efficient and willing manner in which the marines and blue jackets did the work of entrenching." The inference rather being that no one in their right mind would gladly wield a pick and shovel!

There was still some feeling in the Army at that time, that Engineer Officers (and Artillery, too, for that matter) should not be given the command of troops. There was a virulent attack on Major General G Graham (late RE), the Commander of the "Advanced Brigade" of I Division, who, a few days before the main battle at Tel el Kebir, and in a much exposed position at Kassassin, beat off an attack by a vastly superior force under Arabi. In a leading article in the *Army and Navy Gazette*, the writer criticized Graham—"in terms of unmeasured censure"—for recklessly exposing his force at Kassassin. This attack was apparently only because he was an Engineer Officer, and could be (and was) compared to the unfortunate Colonel Durnford RE, who, readers may remember, was the Senior Officer present at the disaster at Isandlwhana, in the recent Zulu War. The article caused much indignation in the Army in Egypt, and many saw fit to comment disapprovingly of the animosity shown in the Gazette.

The Egyptian defences at Tel el Kebir stretched for about 7000 yards north of, but with its southern flank astride, the Sweet Water Canal. The position was heavily entrenched and plentifully supplied with guns, although there was little depth. It was manned by about 26000 men and 70 guns. The British force consisted of about 13000 men with 60 guns. Since there was no escaping a frontal attack, and when the advancing British force was in bivouac about six miles off, Sir Garnet decided on an immediate night attack. Thus the troops were faced with a long approach march in the dark, to be followed by deployment and the assault. Direction was maintained entirely by the stars (and, on the left of the position, by a line of telegraph poles, erected on the evening of the battle by the Telegraph Troop. This stretched for two miles in front of the foremost British positions, and indicated at least the initial direction of the night approach). The actual fighting on the lines of entrenchment lasted less than an hour, and the final rout of the enemy was well and truly brought about by a massed Cavalry attack, rolling up the enemy line from the left.

During the period of the campaign, an RE Officer, Captain W G Gill, together with two companions, Professor Palmer, (Professor of Arabic at Cambridge) and Lieutenant Charrington RN were given, by their Bedouin captors, the desperate choice of either being shot or jumping over a precipice. The Professor, so it is described, covered his eyes with his hands and leapt. The others chose to be shot.

The incident happened in the desert between Suez and Akabar. The trio were bound on an intelligence mission; Gill to put out of action the telegraph between Port Said into Palestine, and Palmer to assess the mood of the tribes and their willingness to provide camels in quantity, for use by the Indian contingent during their advance from Suez to Cairo via Tel el Kebir. Gill, an Officer of considerable private means, had already made a name for himself as traveller and explorer.

Besides reporting in detail on the events in Egypt, and despite the inclusion of many closely written columns of little interest, as already mentioned, the 1882 Journals covered some familiar ground. The Duke of Cambridge, never one to mince his words at the annual presentation at the RMA of prizes and Commissions, warned the Cadets about "taking up too many subjects merely to win marks". A few subjects, pursued thoroughly were, it seems, much to be preferred! The Cadets were also warned about the "evil of not working hard enough at the start of their studies, but hoping to pull up by extra exertions at the finish". The Cadets were bidden "to work hard every day and to be especially careful about small matters". Quite so—but as regards the former complaint, history does not relate why the

authorities, who tolerated the system, were not at least as much to blame as the mark grabbing Cadets!

In the March exeat, the top Cadet (a Sapper) with 45495 marks, was compared with the bottom Cadet (a Gunner) who got 20376. Was it to be believed, so questioned the Inspecting Officer, that the former was really "two and a half times as intelligent as the latter?" The Duke, perhaps wisely, refrained from drawing any general conclusions as to the intellectual capacity of the Royal Engineers as compared with the Royal Artillery!

The Channel Tunnel continued to get the occasional mention in 1882—as it had in previous years and continued to get in the years to come! In 1882 it was a subject which was "exciting a great deal of attention". The Commandant of the SME, Colonel Sir Andrew Clark, recorded his opinion, as quoted in the *Standard*, that if a French Commander were charged with the invasion of the UK, it was extremely unlikely he would give much priority to a tunnel, when steam transports were available! Nor did Sir Andrew give much credence to a coup-de-main force of about 2000 men, which, so it was alleged, could suddenly appear via the tunnel. But then Sir Andrew assumed that such a force would appear with their arms in uniform. "Surely the police or railway officials would get some hint of it and give due warning!" Even supposing the 2000 did succeed in seizing the tunnel, the subsequent difficulty, so speculated Sir Andrew, of passing the main body, with their guns and horses through the self same narrow passage, would be insuperable! In any event, what would the Royal Engineers be doing in allowing the tunnel to be used by an enemy without being damaged? A demolition tunnel driven from Dover Castle (no need to fear that this tunnel entrance could be seized by surprise) to within a few feet of the main tunnel, could ensure the proper emplacement of demolition charges. "The objections against the tunnel", so concluded Sir Andrew, "cannot be sustained"!

On the other hand a letter in *Engineering* by another RE Officer, Major Buckill, asserted that Sir Garnet Wolseley and Lord Dunsany had expressed their firm conviction, that the tunnel would be a source of danger to England. Others, quoted in the same letter as being in support of Sir Andrew, thought that the tunnel "if ever it should be completed"! would prove no danger if the Militia were alert. But, as the gallant Major continues, in War everything goes wrong. "Assume that atheistical pamphleteers and lying demagogues plunge the country into seething rebellion. Might they not arrange to seize the tunnel and to bring in the Reds of France to their assistance?" But Buckill wished to have it both ways. Just as an invading force, he goes on, would have a great advantage with a perfectly good railway for his L of C, so also would such a force be well served in its retreat by the self same railway, and would be that much more encouraged to make good its departure. In fact, the sooner an invading force arrived the sooner could they leave!

Year by year one can be sure that there will be some mention in the Journal on the theme of "perhaps the soldiers were not sufficiently engineers nor the engineers sufficiently soldiers" (to quote a passage from the 1882 Journals). In the April 1882 issue an article (from Germany) ends with the words "it is absolutely necessary that the officers of the field pioneers should devote themselves to the tasks of field warfare, and in every way do their best to connect themselves more closely with the field army". The author had previously asserted, in mild terms, that the Prussian Pioneers tended to lead too separate an existence from the rest of the Army. There had, to illustrate the point further, been bitter criticism of the French Engineers, after the debacle of 1870, to the effect that they had abjectly let the French Army down by this very separateness.

As already suggested, the balance between "tradesmen and soldiers" will presumably be a subject that will continue to excite passions. Or, looking back on 1982, will it be judged that we have got it just about right?

Royal Visit to Mill Hill—16 July 1982

LIEUT COLONEL D SWANSON RE

The Author was commissioned into the Corps as a Direct Entrant in 1962. He has commanded postal units with 11 Inf Bde, 16 Para Bde, 4 Div and HQ Northern Ireland. Two Staff appointments in postal Branches at HQ 1 (BR) Corps and HQ BAOR leave only appointment as OC Postal Wing and his current appointment as OC Training Wing. Promoted Major in 1968 and Lieut Colonel in 1981 he is a keen, and still active, sportsman.

SOME five years ago I was sitting in my "pigeon hole" in HQ BAOR and I can remember the interest that was building up in the Postal & Courier Service for the Forces Postal Service Centenary on 22 July 1982. I actually calculated it would be a Thursday and thought it would probably be the biggest day in our Service for many a year. I was correct, 22 July did turn out to be a Thursday, but in my latter forecast I was six days adrift. 16 July 1982 was to prove the highlight of our Centenary Year.

Returning to Mill Hill in June 1980 one found people in the appointments they would hold in July 1982. "Centenary" was in the air and in the cloud marked "hope" was "a Royal Visit". Some plans had been made and others were drawn up. Work started to complete the necessary tasks by whatever means we could.

During December 1981 one or two senior members of the organization were exchanging knowing looks but saying nothing. It was not until 22 January 1982 that the Commandant PCD (Colonel R N R P James) announced that our Colonel-in-Chief was to visit the Corps at the Postal and Courier Depot on 16 July 1982. At the same time I was told that I was to be the co-ordinator for "The Visit". Suddenly all the plans had a realism that was initially hard to grasp, but the news gave a new momentum to our efforts for our Centenary Celebrations. Layouts for the garden party were discussed. Wet weather plans considered. Maximum numbers were calculated. The Barracks were inspected and necessary works listed.

By the first Friday in February we had a pretty clear idea of what was to happen on 16 July and what was required to achieve the necessary standards for the day. This was our best planning day so far. But it was to prove a tragic weekend. At 0450hrs on Sunday 7 February, Major F S Poulter passed away. The Corps lost one of its great Quartermasters. We had lost a friend and a most valuable member of our team. I feel I must pay a tribute to Freddie and the work he did in helping us prepare for, and the part his efforts played in, the visit in July.

The outline plan for the day was prepared and the layouts for the various events established. On 19 February the Chief Royal Engineer (Lieut General Sir David Willison), accompanied by the Regimental Colonel and the Corps Secretary, met with the Director Postal and Courier Services (Brigadier D J London) and the Commandant to discuss the visit, walk the proposed route and decide a final plan for the day. I was to attend and make notes. Making notes at lunch is a hazardous business—for the first time in my life I had but one glass of wine—and left half of it!

Royal Visit To Mill Hill- 16 July 1982 Lieut Colonel D Swanson RE

In the eleven pages of notes I can still pick out the Chief Royal Engineer's edicts—"must be lively, a charade, movement, unusual, amuse Her Majesty, must have fun, a simple meal, meet as many as possible, invite TA, stage manage, and impact for TV and Press".

I was now able to list tasks to be completed and collect together members of the unit who were to be most involved in the preparation. The first of the co-ordinating meetings took place on 25 February and the list of work presented to each. The work was listed in order of the timetable of the visit for ease of checking. It also meant that every time we met all went through the programme for the visit. Eventually the detailed programmes were ready for submission to the Palace.

The programme for the day included a Reception and Luncheon, an Unveiling Ceremony and a Garden Party to which we could invite guests. The remainder of Her Majesty's visit was to be spent touring some static displays and the Sorting Office. Guest lists had been drawn up and the time consuming task of checking titles, decorations and addresses began. By 14 May all invitations were issued.

The first security conference was held on 20 May attended by RMP, Int Corps, local and MOD police. One of our local Chief Superintendents had worked at Buckingham Palace and his experience was invaluable. From this the Unit Security Officer (Major E J Lyons) wrote the security instructions for the day—which had to be approved by Her Majesty's Police Officer.

Moving into June one saw a tremendous change in tempo. Work was actually taking place on several projects at once and the Barracks were beginning to look as we wanted them to be for the visit. At the end of June Her Majesty's Private Secretary made his visit and was welcomed by the Chief Royal Engineer. This was an excellent day where questions were answered and minor changes made to the programme. The final visit from the Palace was that by Commander Trestrail, Her Majesty's Police Officer. He came on 6 July and he proved a charming, helpful person. He agreed our security plan and allayed a few worries over details of drivers, cars, umbrellas and escorts.

Three rehearsals were held on 7, 12 and 14 July. The final and full practice was made in the presence of the Chief Royal Engineer. Each rehearsal was important as we were able to make minor alterations and corrections, but they also gave officers and soldiers practice, and confidence, in their role when Her Majesty was to be present.

Friday 16 July 1982 dawned early and it looked hopeful for a bright, dry day; but the forecasters had promised showers "later in the day". The Commandant decided on the dry weather programme. The Officers Mess looked marvellous, with splashes of colour from the flower beds. The lawn, with the large white marquee and small candy-striped VIP tent, was immaculate, bedecked with shrubs and flowers in profusion. All hands set too for a final "tidy" around the Barracks before we all changed into our "best" uniforms.

At 1225hrs the Luncheon Guests were assembled in the Officers Mess Ante Room, the Vice Lord Lieutenant of Greater London (General Sir Hugh Beach) waited outside the Mess with the Chief Royal Engineer and Lady Willison and Brigadier and Mrs London. 1230 came and passed, by 1235 nervous jokes were being made—like "are you sure it's this Friday?" At 1238 two gleaming Rolls Royces glided up to the front of the Mess and in the front one, sitting in her customary right hand seat, was Her Majesty The Queen. The visit was under way and it was too late to change anything—just enjoy the day. As Her Majesty was being escorted around the Ante Room and all the guests presented, I discovered the reason for the late arrival. The crowds of children and burgesses lining the Royal Route through the Borough of Barnet had been so great that Her Majesty had slowed the cars and accepted flowers from children. Police reinforcements were needed outside the Barracks. The expected 200 spectators was actually 2000. What a wonderful start to the day.

Lost time was made up at the Reception and we moved to the Dining Room on

Photo 1. Her Majesty with the silver scales. *l to r* Sapper McGrory, Chief Royal Engineer, Commandant PCD, and 2nd Lieutenant L A Cooper

time for lunch. The Corps Trumpeters played the Fanfare and we were joined by the VIPs, less Her Majesty and the Chief Royal Engineer. When all were in position the Orchestra played "Roast Beef of Old England" and Her Majesty, escorted by the Chief Royal Engineer, entered the Dining Room. The Corps Grace said, we all sat down to a sumptuous, yet light, meal of "Foie gras a la truffe" followed by roast lamb—from Wales naturally—and fresh cherry tartlets. It was with considerable pride that I watched our staff, of mainly postal and courier operators, serve the meal. Mr Jim Ginders of the ACC Training Centre had done a wonderful job in his week at Mill Hill in training the girls to provide "silver service." I well remember chortling one day when I asked for a bar lunch in the Mess and was escorted to the Dining Room for silver service of pie and chips!

After luncheon Her Majesty retired with Her Lady in Waiting, Lady Susan Hussey. The remainder of the guests made their way on foot to the area of the statue for the Unveiling Ceremony. When Her Majesty returned I had my moment of glory inviting her to sign her portrait and our Visitors Book. Before leaving the Mess Her Majesty thanked the senior members of the staff for a "lovely meal". As the Royal cars drew away from the Mess the remainder of the staff were by the side gate to cheer their Royal Patron.

In welcoming Her Majesty to the Unveiling Ceremony the Chief Royal Engineer said "It is often said that an Army marches on its stomach, our Army can do with Forces mail alone for substantial periods—or so it has been reported". He then invited Her Majesty to unveil the statue entitled "Letter From Home", sculptured by Jill Tweed and Mike Smith. The statue is of a World War I soldier reading a letter from home and represents the role of the Service. The base and plinth were made by 59 Commando Squadron and the plaque by E&M Wing at RSME.

Driving through the Quarters area towards the Sorting Office the Royal Entourage were cheered by over 3000 children and parents. We had invited eight local junior schools to send their children into the area to see their Queen. The Commandant greeted Her Majesty at the Static Displays and escorted her around them. 2nd Lieutenant L A Cooper, dressed in 1882 Post Office Rifles grey uniform, was in charge of the 1882 Field Post Office as used in Sudan. Sapper McGrory, our

youngest tradesman, also in 1882 uniform, presented a silver set of scales—a replica of those used in 1882—to Her Majesty.

It was then into 1982 and a Forces Post Office manned by Captain C Ruggiero and three of his TA soldiers. A philatelic cover, addressed to HRH Prince Andrew with the Task Force, was presented by Lance Corporal McGinley. Her Majesty in turn handed the cover to Sapper Lassetter, the Army and Combined Services Junior Cross Country Champion, who ran with it to the sports field where it was put in a bag with other mail for HMS *Invincible* and loaded onto a helicopter with the Task Force mails en route via Brize Norton to the South Atlantic. 2 Postal and Courier Regiment were at the time providing postal support with the Task Force and on Ascension Island. The next display showed the diverse nature of their role. Lieutenant P J McNulty presented his team in front of an FPO and explained the kit used by his men in their AMF (L) role.

No Postal and Courier display would be complete without the mobile display caravan. Her Majesty watched the helicopter depart from the steps of the caravan before walking around and admiring the display. Descending the steps at the other side the youngest members of the community from the playgroup, were awaiting the Royal Visitor. A bouquet of flowers was presented by Teresa Horsburgh, dressed in 1900 dress, and escorted by Stuart Spence in Corps Pageboy's uniform. Both are children of serving senior NCOs.

As living proof that romance does blossom in uniform we have eighteen serving married couples in the unit. Sixteen of these were on parade, with the wives to the fore, for Her Majesty. She spoke to several couples before entering the Sorting Office VIP Lounge. Major W F Whiting was presented and he escorted Her Majesty around his empire with a just degree of pride. During the tour Her Majesty chatted to several of the fifty operators on duty. She showed particular interest in Naval mails and of course the Task Force sorting area. During the preparations for the visit, and since, the Sorting Office has been despatching some 2 tons of letters per day and 2 tons of parcels per week to the Task Force. In the parcel office Mr Terence Cuneo, the artist, was clicking away with his camera to catch the scene for his painting to mark the occasion. It will show Her Majesty in front of a full chute of

Photo 2. A bevy of artists at the Garden Party. *l to r* Jean George, Jill Tweed, Ken Howard and Terence Cuneo

Royal Visit To Mill Hill 2

Photo 3. Major D E Pryce, Director of Music, can make everyone laugh. *l to r* Commandant PCD, DPCS, Chief Royal Engineer, General Sir George Cooper, Lady Cooper, Mr Dearing (PO Chairman), Major Pryce and Captain M E Faulkner

parcels with soldiers, servicewomen and VIPs in the scene. I wonder where the mouse will be?

The last call in the tour was to the Philatelic Bureau where the variety of the display truly matched the event. Her Majesty particularly admired WO2 Donavan's collection of Royal Wedding philatelic covers. As a keen philatelist she appreciated the display of 1882 postal items and chuckled at the hard tack biscuit posted in France during World War I, complete with postage stamp and address. WO2 Donavan presented a magnificent historical album to the Colonel-in-Chief. The album depicts the history of the Forces Postal Service, with each page bearing the cap badge of the time, a campaign/service medal, a postal cover of the time and a short history of each period. Not forgetting the recent Royal birth, Her Majesty was given an album of Royal Wedding covers for Prince William.

Leaving the Sorting Office Her Majesty returned to the Officers Mess. On arrival she was greeted by Gen Sir Hugh Beach who presented a group of local dignitaries before Lieut General Sir David Willison and Colonel James escorted Her Majesty around the Garden Party. The 450 assembled on the lawn was made up of past and present members of the Corps, their friends and families from military and civilian life and from the TA and local units. It was indeed a wonderful spectacle. I found it quite incredible that one person could make so many so happy. Her Majesty joined a small group for tea before taking her leave of her hosts. She bade Generals Beach and Willison goodbye as Colonel James called for "Three Cheers for Our Colonel-in-Chief". As the Royal cars drew away from the Mess, the day was reflected in those remaining, they were so happy and had enjoyed themselves so much. The end to a day to remember for ever.

16 July 1982 really was the most remarkable day of our Centenary yet in the next two weeks our cup did overflow with memorable events. The Centenary Banquet on 22 July was a great event. On 24 July the Postal and Courier Depot accepted the Freedom of the London Borough of Barnet on behalf of the Corps. And, for me, the 28 July was the cream in my coffee when we won the Army Minor Units Athletics Cup. I wonder what it will be like in 2082!

A Design Proforma for Improvized Bridge Design

MAJOR R H SMITHERMAN RE, B Sc (Eng), MICE, MIE Aust

Introduction

This is the second part of a two-part article (Part 1 was published in September 82 *RE Journal*). A Flow Chart based method of designing improvized bridges was demonstrated in the first article. The article used decking and moment graphs which were produced from the Australian Steel and Timber Structures Codes, but which could have been drawn from any code. The article suggested that for any design method to be suitable for use by combat engineers it should:

(1) Be simple.
(2) Be based on a flow chart or design proforma.
(3) Use tables or graphs drawn from up to date Codes of Practice.
(4) Have any assumptions clearly stated so that valid engineering judgements can be made when site conditions do not exactly match theory.

In this article the design of an improvized bridge with timber roadbearers is used to demonstrate how a complicated design procedure can be reduced to a design proforma. This article is not intended to imply that the method demonstrated should be adopted by the Corps. It is appropriate to Australia because of some of the quirks of the Australian Timber Code which would not be necessary in the UK.

Summary of Simple Theory

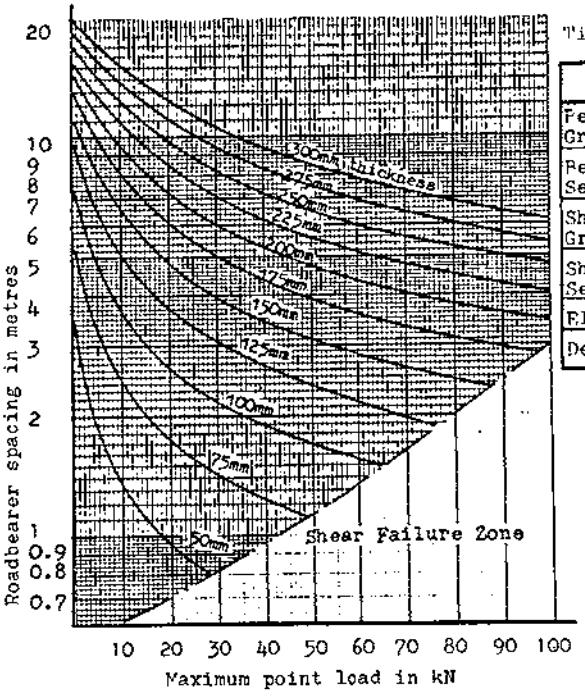
The live load bending moment (LLBM) and shear force (LLSF) is found in the same way as in the previous article with one minor difference. The change is that an assumed value of the distribution factor (DF) of 1·3 for two-way bridges and 1·6 for one-way bridges is used to start with. The DF is calculated correctly once the number of beams has been decided.

In the earlier article the roadbearers were selected from the moment graph. Such a graph can be constructed for steel beams because the allowable stress in a steel beam only depends on its shape and its effective span. The Australian Timber Code specifies that the allowable stress is found by multiplying a basic stress by up to thirteen modifying factors (K_1 to K_{13}). Some factors depend on dimensions that are only known when the design is complete—such as the number of beams (N_b) and the length of the bearing. It therefore makes sense, with the Australian Code, to design to limit deflection and then to check for strength; rather than the other way round as was done in the steel design.

A Rapid Method of Calculating Deflections. The formulae used to calculate the maximum deflections due to live loads are normally complicated. However the calculations may be simplified by using a calculator to do the difficult sums and by plotting the results on a graph—the deflection chart. The basis of this technique is that the deflection caused by each load is compared with that caused by a uniformly distributed load (UDL) of the same size. The ratio of one to the other is called the conversion factor (C) of the real load. Thus C for a point load at the centre of the span is found by dividing the deflection at centre span due to a point load, W, at centre point $= \frac{WL^3}{48EI}$, by the deflection at centre span due to a UDL of $W = \frac{5WL^3}{384EI}$.

$$\text{Therefore } C = \frac{WL^3}{48EI} \div \frac{5WL^3}{384EI} = \frac{384}{48 \times 5} = \frac{8}{5} = 1{\cdot}6$$

Figure 1 shows that C can be calculated for a wide variety of loads and load distributions. The quantity WC fully defines the deflection due to each load. When dealing with combinations of point (wheeled) loads it is necessary to position the combination to cause maximum deflection. For the deflection check it is sufficient



Timber Properties

Property	$N/_{mm^2}$
Bending stress in Green Timber	14
Bending stress in Seasoned Timber	17
Shear stress in Green Timber	1.25
Shear Stress in Seasoned Timber	1.45
Elastic Modulus E	12,500
Density 1200 kg/m^3	

Figure 4. The Decking Graph.

(2) For a given depth d in mm the total width of beam cannot be less than $\frac{12\times I_{min}}{d^3}$ which can be calculated, rounded up to the next sensible whole number and entered in column (b) next to the depth in column (a).

(3) For a total width calculated as shown the number of beams (N_b) each of width (b) cannot be less than $\frac{\text{Total Width}}{b}$.

Condition (1) gives the smallest practical d which is then increased in 25 to 50mm jumps. Given that about 12 beams is the most that could be put in in a short build condition (3) gives the smallest value of b which is also increased in 25 to 50mm steps. N_b is calculated for each combination of d and b. N_b is rounded up to the next whole number when the final beam selection is made. A programmable calculator can be used to speed up the beam selection. A 33-step program for a Texas Instruments TI59 calculator is shown in Figure 5. The most efficient combination is that in which N_b has the highest fractional part. The section modulus resisting bending is:

$$Z=\frac{N_b\times b\times d^2}{6}$$

The area resisting shear is: $N_b\times b\times d$

Part 5. Modification Factors. The detail of how the various modification factors are calculated is not relevant to this article as it requires a thorough knowledge of the Australian Timber Code. It is sufficient to know that the end product of Part 5 is $\Pi x_{bending}$ and Πx_{shear}. Both have already been described. $\Pi x_{bending}$ has carry forward box [L] and Πx_{shear} has carry forward box [N]. The basic stresses in the timber can be found in the timber code. $F_{bending}$ has carry forward box [M] and F_{shear} has box [O].

Part 6. Strength Checks. The strength checks, Steps 9 to 13 in the logic diagram, ensure that the actual bending and shear stresses in the selected beams do not

to calculate the deflection at the centre of the span with the loads positioned to cause maximum bending. A method of positioning loads in this way is described in *Military Engineering Volume III part IA* (on p 128), and in the earlier article as Step 8 of the Specimen Calculation. Thus to calculate the deflection due to any load combination it is necessary to:

(1) Position the load combination to cause maximum bending.

(2) Find the sum of the products WC of all the live dead loads (ΣWC).

(3) Multiply WC by $\frac{5L^3}{384EI}$ to calculate the deflection taking care that consistent units are used in the calculation.

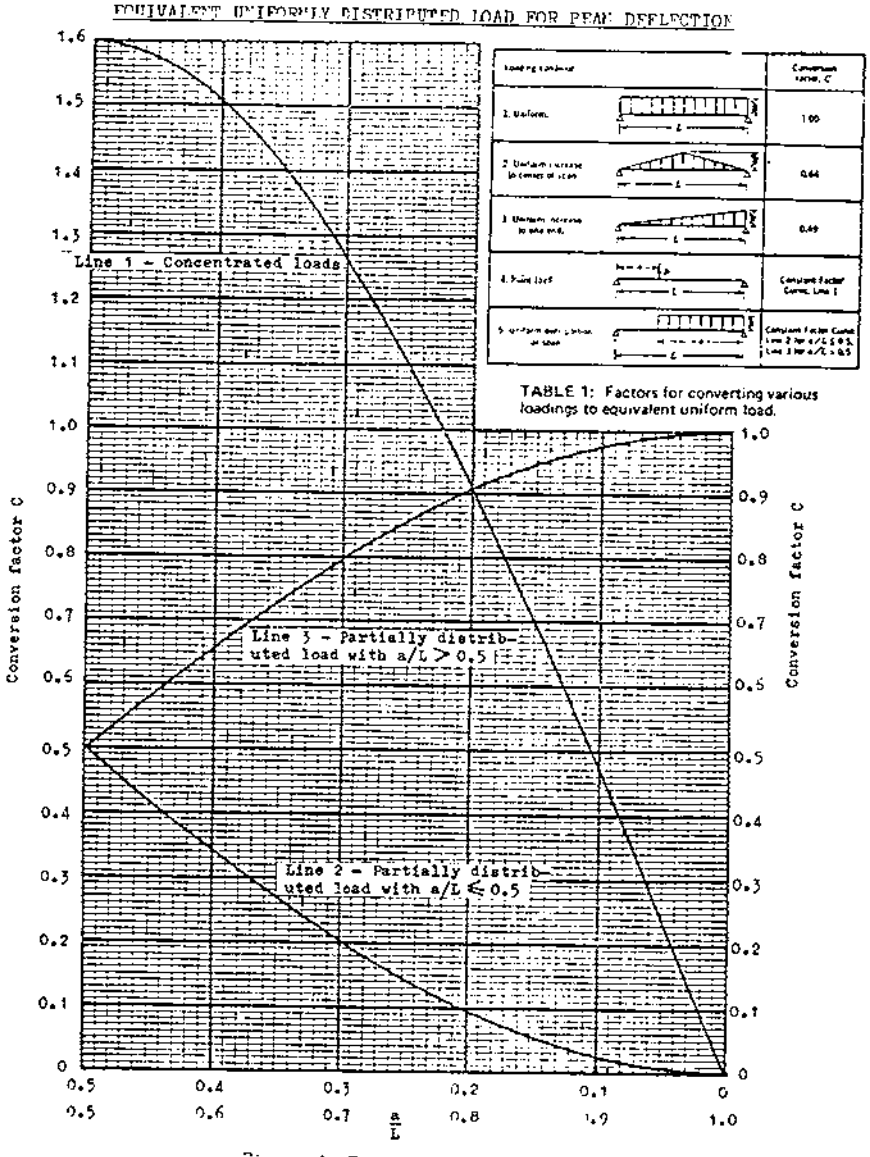


TABLE 1: Factors for converting various loadings to equivalent uniform load.

Figure 1. The Deflection Chart.

Bending Moments and Shear Forces. The equations for the bending moments and shear forces are:

(1) LLBM = No of traffic lanes (N) × Unit Bending Moment (UBM) × Impact Factor (IF) × Distribution Factor (DF) × Span

(2) LLSF = N × Shear Force × IF × DF

(3) $DLBM = \frac{\text{Total weight of bridge } (W_T) \times \text{Span } (L)}{8}$

(4) $DLSF = \frac{W_T}{2}$

Load Carrying Capacity of Decking and Roadbearers. The total bending moment a number of beams (N_b), each b mm wide and d mm deep, can carry is:

$$BM_{max} = \frac{N_b \times b \times d^2}{6} \times \text{the allowable bending stress } (F'_{bending})$$

The total shear the beams can carry is:

$$\text{Shear} = N_b \times b \times d \times \text{the allowable shear stress } (F'_{shear})$$

The allowable Stresses ($F'_{bending}$ and F'_{shear}) are determined by multiplying the basic stresses ($F_{bending}$ and F_{shear}), which are a property of the type of timber being used, by up to thirteen modification factors (K_1 to K_{13}). Thus for bridges:

$F'_{bending} = (K_1 \times K_4 \times \ldots\ldots\ldots \times K_{12}) \times F_{bending}$ which is shortened to $\Pi K_{bending}$

$F'_{shear} = (K_1 \times K_4 \times \ldots\ldots\ldots \times K_9) \times F_{shear}$ which is shortened to ΠK_{shear}

The thirteen modification factors envisaged by the Australian Timber Code are:

K_1 a duration of load factor.

K_2 a creep factor which is applied only to dead loads in deflection calculations.

K_3 a creep factor which applies to tension members only.

K_4 a partial seasoning factor which applies when unseasoned timber is used but is not loaded until the moisture content is less than 25%.

K_5 a factor used when the equilibrium moisture content (EMC) of the timber is greater than 15%.

K_6 a temperature adjustment factor used in tropical latitudes.

K_7 a factor which depends on the length and position of the bearings.

K_8 a factor which allows for the effect of parallel support systems.

K_9 a factor for grid systems.

K_{10} a factor which applies to flexural members and depends on beam shape. It is 1·0 for rectangular beams.

K_{11} a size factor for flexural and tension members.

K_{12} a stability factor, which incorporates a material constant, and which allows for the resistance of a beam to sideways buckling.

K_{13} an effective length factor which applies only to columns.

Description of Design Procedure

As can be seen from the logic diagram, Figure 2, the design is carried out in thirteen Steps. The thirteen Steps can be reduced to a design proforma, Figure 3, in six Parts:

Part 1. Live load Effects. The LLBM and LLSF resulting from the imposed load are calculated as described in the first article in this series. The span (L) must be measured on the reconnaissance and must make due allowance for the bridge abutments. The UBM and Shear are taken from Tables 26(M) and 27(M) respectively in *Military Engineering Volume III Part 1A*. The IF is usually taken as 1·15 for military loads and 1·25 for civilian loads. The DF is taken as 1·3 for two-way and 1·6 for one-way bridges to start with and then calculated when the number of beams is known. To save space on the proforma some results are given a carry forward letter which is used in the equations in later parts. Thus:

(1) The LLBM is given carry forward letter [A].

(2) The LLSF is given carry forward letter [B].

The above calculation equates to Steps 1 and 2 in the logic diagram at Figure 2. The first bit of Step 3, calculating the maximum point load, is also done in Part 1.

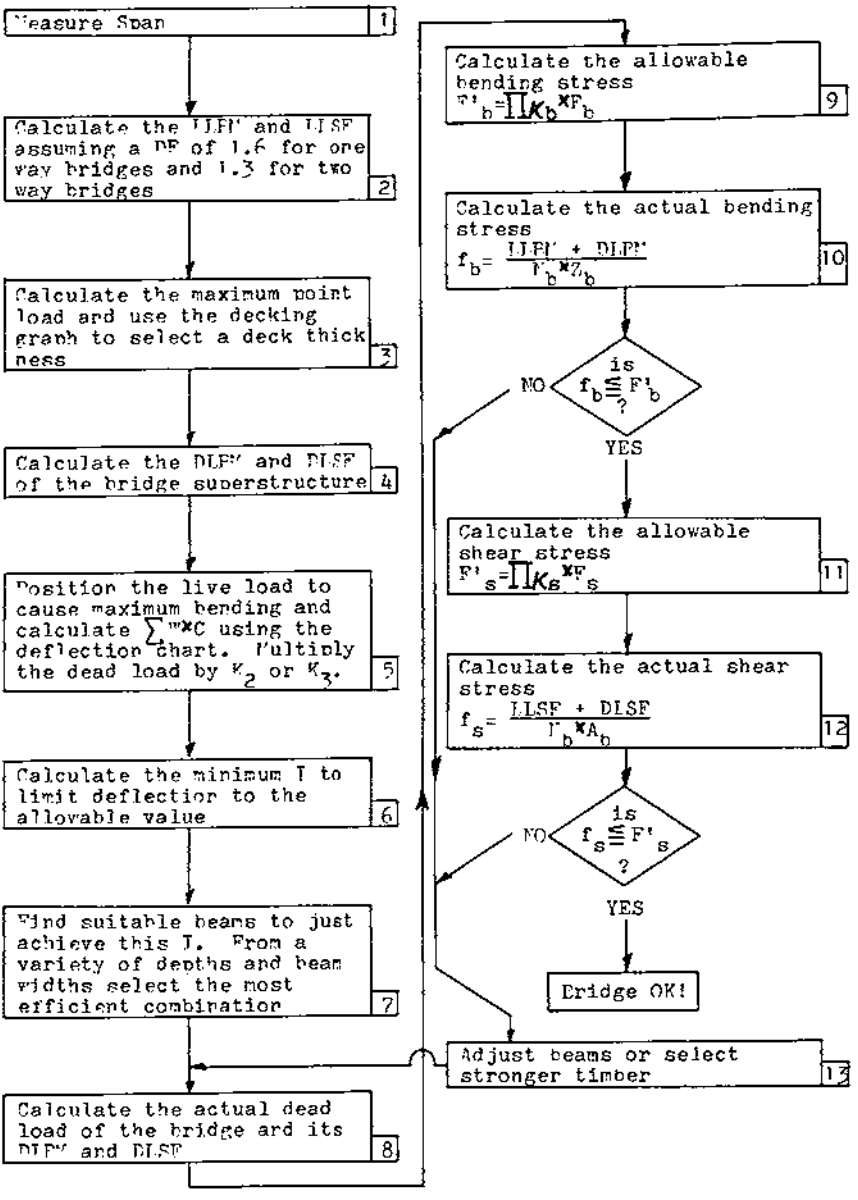


Figure 2. Logic Diagram for Timber Beam Design.

Part 2. Dead Load Effects. This part of the form is used to work out the DLBM and DLSF caused by the self weight of the bridge. First a suitable deck thickness is chosen from a decking graph such as that in Figure 4. This choice completes Step 3 in the logic diagram. The timber density (γ_t) and its elastic modulus (E_T) are also selected from the decking graph. They are recorded in Parts 2b and 3c(1) of the proforma. The length of a decking plank depends on; the number of traffic lanes

(N), the width of a vehicle, the dimensions of any kerbs and any allowance for the minimum space between adjacent vehicles or pedestrians. The superstructure weight (W_s) is the product of the area of decking and kerbs, the timber density and the bridge span. The weight of beams (W_b) cannot be calculated first time round because they have not been chosen at this stage. Therefore guess a value of say 1·5 to 2·5 times W_s to use in the first calculation and check the actual weight of the selected beams to see how it compares with the guessed weight. W_s is given carry forward box [C] and W_T is given carry forward box [D]. As long as the guessed value of W_b is greater than the value calculated once N_b, b and d are known there is no need to repeat Parts 3 and 4 although the design can be made more efficient by doing so. Efficiency in this context means less wasted dead weight.

Part 3. The Deflection Calculation. The way deflections are calculated has already been discussed. The point loads are tabulated and the quantity $\frac{a}{L}$ calculated for each point load W. The conversion factor C is read from the graph at Figure 1. ΣWC is calculated for each load. ΣWC is given carry forward box [G]. Permanent loads (ie UDLs) are multiplied by a creep factor (K_2 or K_3) to allow for the fact that timber assumes a permanent deflection with age. The quantity $K_2 \times W_T$ has carry forward box [H]. Given [G], [H] and the allowable span to deflection ratio (R), the minimum I required to limit deflection to $\frac{L}{R}$ is:

$$I_{min} = \frac{5 \times (N \times [G] + [H]) \times L^2 \times R}{384 \times E_T}$$

If [G] and [H] are in kN, L is in metres and E_T is in N/mm^2 (or MPa) then the result must be multiplied by 10^9 to get I in mm^4. Part 3 is equivalent to Steps 5 and 6 in the logic diagram.

Part 4. Beam Selection. Beams are selected to satisfy the following conditions:

(1) The total width of beam ($N_b \times b$) cannot be greater than the distance between the outside of the kerbs which is put in the box [ ] in the heading to column (b). See Figure 6.

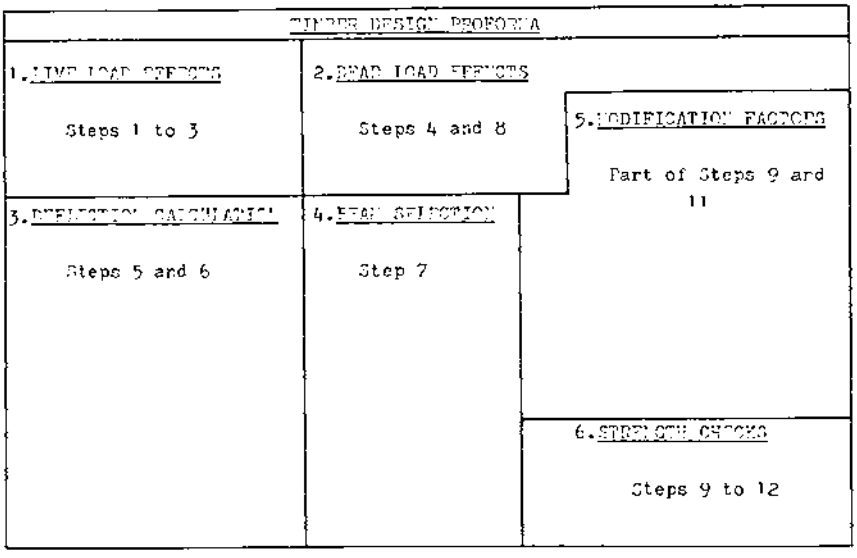


Figure 3. Layout of Timber Design Proforma.

exceed those allowed. The allowable stresses are; $\Pi x_{bending} \times F_{bending}$ (L×M), and $\Pi x_{shear} \times F_{shear}$ (N×O). Actual stresses are:

(1) Bending stress $= \frac{(LLBM + DLBM)}{Z}$ ie $\frac{A + E}{K}$

(2) Shear stress $= \frac{(LLSF + DLSF)}{A}$ ie $\frac{B + F}{A_b}$

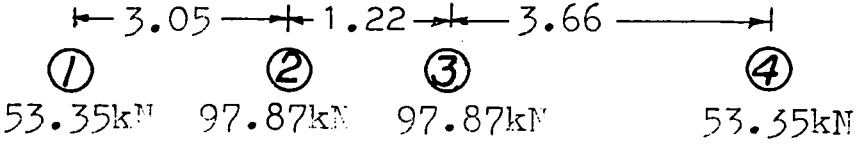
Enter I_{min}	000	76	LBL	
in Store 00	001	11	A	
and	002	01	1	CUE: "1"
PRESS: A	003	95	=	◇ ENTER: d
	004	91	R/S	
	005	45	y^x	
	006	03	3	
	007	95	=	
	008	42	STO	
	009	01	01	
	010	43	RCL	
	011	00	00	
	012	65	x	
	013	01	1	
	014	02	2	
	015	55	÷	
	016	43	RCL	
	017	01	01	
	018	95	=	Minimum total width is
	019	91	R/S	◇ displayed. Round up to
	020	42	STO	the next whole number and
	021	02	02	PRESS: R/S
	022	02	2	
	023	95	=	
	024	91	R/S	CUE: "2"
	025	55	1/x	◇ ENTER: b
	026	65	x	
	027	43	RCL	
	028	02	02	
	029	95	=	
	030	91	R/S	I_b is displayed
	031	61	GTO	◇ For another b PRESS R/S
	032	00	00	and repeat
	033	22	22	

Figure 5. Calculator program for Part 4.

Specimen Calculation

Problem. Design an improvized bridge, using timber roadbearers, to carry a one-way Class 30 wheeled load across a 7m span.
Comment: N=1 and L=7

Vehicle Data. The following data has been taken from *Military Engineering Volume III Part IA:*
Width is 2·44m
Maximum point load is 60kN
Axle loads and spacings are as shown below:



Comment: The vehicle is 7·93m long, ie longer than the span. Therefore max bending and sheer is developed when only axles 1, 2 and 3 are on the span.

PART 1. LIVE LOAD EFFECTS. (Steps 1 to 3)

			Comments
(a) Span (L)	7	m	
(b) UBM (Table 26(M))	42	kN	
(c) Shear (Table 27(M))	200	kN	
(d) Impact Factor (IF)	1·15		military load
(e) Distribution Factor (DF)	1·6		one-way guess
(f) LLBM=UBM×Span×N×IF×DF	540·96	[A] kNm	
(g) LLSF=Shear ×N×IF×DF	368.0	[B] kN	
(h) Max Point Load (Table 4 (M))	60	kN	

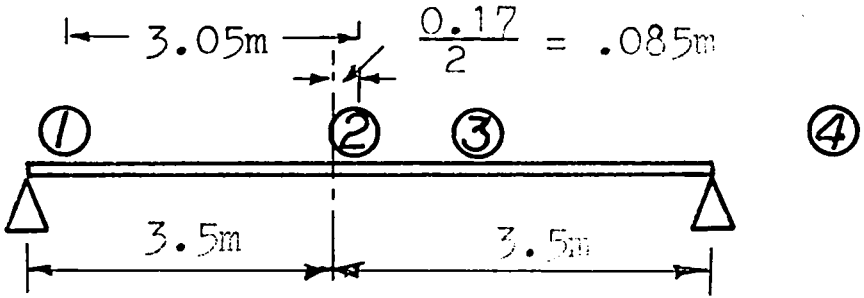
PART 2. DEAD LOAD EFFECTS. (Step 4 and 8)

			Comments
(a) Deck Thickness (from decking graph)	100	mm	
(b) Timber Density (γ_t)	11·8	kN/m^3	1200kg/m^3=1·2×9·81=11·8kN/m^3
(c) Deck Length 2·44+(2×0·15)+1·5	4·24	m	
(d) Decking Area incl Kerbs (A_d)	0·47	m^2	
(e) Superstructure Wt (W_s)=$\gamma_t \times A_d \times L$	38·8	C kN	
(f) Area of Beams (A_b)=$N_b \times b \times d$			Not known at this stage
(g) Total Wt of Beams (W_b)=$\gamma_t \times A_b \times L$	100	kN	values based on guessed beam wt. (see Design Procedure Part 2)*
(h) Total Dead Wt (W_T)=W_s+W_b	140	D kN	
(j) DLBM=$W_T \times L \div 8$	122·5	E kNm	
(k) DLSF=$W_T \div 2$	70	F kN	

* *Eventual Selection from Part 4* (f) A_b=6×0·375×0.275= 0·62 m^2
(g) W_b =51·2 kN
(h) W_T =90 kN D
(j) DLBM =78·75 kNm E
(k) DLSF =45·0 kN F

PART 3. DEFLECTION CALCULATION (Steps 5 and 6)

The figure below shows the Class 30 wheeled vehicle positioned to cause maximum bending on a 7m span. $\bar{x}$ is 2·88m RIGHT of axle 1. 3·05−2·88=0·17m



(a) *Point Loads*

W (kN)	a/L	C	Equiv UDL W×C (kN)
(a)	(b)	(c)	(d)
53·35	0·535÷7=0·076	0·37	19·74
97·87	3·585÷7=0·512	1·60	156·60
97·87	4·805÷7=0·686	1·31	128·21
		ΣWC=	304·55

G

Comments

Values of C are read from figure 1

(b) *Uniformly Distributed Loads (UDLs)*

Creep Factor×W_T (or W_s) — 140 — H

The Australian Code requires creep factor (K_2) of 2 to 3. For short term mil bridges creep can be ignored. Take K_2=1·0. W_T is from guess in Part 2 therefore this figure is a guess*

(c) *Minimum I*

(1) Elastic Modulus of Timber (E_T) — 12,500 N/mm²

(2) Span to Deflection Ratio (R) — 360

Use R=360 as no impact has been allowed for in Part 3a.

* as H is a guess, J is a guess

$$I_{min}=\frac{5\times(N\times\boxed{G}+\boxed{H})\times L^2\times R}{384\times E_T}$$ — $8{\cdot}17\times10^9$ — J

$$I_{actual}=\frac{N_b\times b\times d^3}{12}\ \therefore\ b_{min}=N_b\times b=\frac{12\times I_{min}}{d^3}$$

* *Eventual Selection* UDL =90kN — H

I_{min} = $7.249\times10^9 mm^4$ — J

PART 4. BEAM SELECTION (Step 7)

$d_{min}=3\sqrt{\frac{12\times I_{min}}{3240}}=311{\cdot}6mm$. So start at d=325mm

Assumed Depth d (mm)	Min Width ≯ 3240 (mm)	Beam Required b (mm)	N_b	
(a)	(b)	(c)	(d)	
325	2860	200	14·3	
		250	11·44	
		275	10·4	
		300	9·53	(1)
350	2290	200	11·45	
		250	9·16	
		275	8·33	
		300	7·63	(2)
375	1860	200	9·3	
		250	7·44	
		275	6·76	
		300	6·2	(3)

Selected Beam Combination is
6 beams 275mm wide 375mm deep

$Z=\frac{N_b\times b\times d^2}{6}=$ $\boxed{3{\cdot}867\times10^7mm^3}$ [K]

$I_{actual}=\frac{6\times275\times375^3}{12}=7{\cdot}251\times10^9mm^4$

Comments

Total weight of beams $W_b=\gamma_t\times A_b\times L$

Selection (1) with 10 beams
$W_b=11{\cdot}8\times((0{\cdot}325\times0{\cdot}3)\times10)\times7=80{\cdot}53kN$

Selection (2) with 8 beams
$W_b=11{\cdot}8\times((0{\cdot}350\times0{\cdot}3)\times8)\times7=69{\cdot}38kN$

Selection (3) with 7 beams
$W_b=11{\cdot}8\times((0{\cdot}375\times0{\cdot}275)\times7)\times7=59{\cdot}62kN$

W_b from Selection (3) is much less than $W_b=100$ assumed in Part 2g. So try 6 beams as Selection (4)
$W_b=11{\cdot}8\times((0{\cdot}375\times0{\cdot}275)\times6)\times7=51{\cdot}2kN$
and go back to Part 2

The deflection condition is satisfied because this is $7{\cdot}249\times10^9$ in Part 3.

PART 5. MODIFICATION FACTORS

(a) K_1 — 1·25

(b) K_4 — 1·0

(c) K_6 — 1·0

(d) K_7 — 1·0

(e) K_8 — 1·28

(f) K_9 — 1·0

(g) K_{10} — 1·0

(h) $K_5 = 1 - \frac{(EMC - 15)}{10}\left(1 - \frac{F^1 \text{ green}}{F^1 \text{ seasoned}}\right)$ — 0·88

(j) Factor $r = \frac{\text{Temporary Loads}}{\text{Total Loads}}$ — 0·77

(k) Material Factor ϱ — 1·09

(l) $R_1 = \frac{D}{B}$ — 1·37

(m) $R_2 = \frac{L}{B}$ ay — 12·8

(n) $\varrho \times s_1 = \varrho \times 1{\cdot}35 \sqrt{R_1 \times R_2} \sqrt{\left(1 - \left(\frac{1}{R_1}\right)^2\right)}$ — 5.09 — 10

(o) K_{12} — 1·0

So $K_{12} = 1{\cdot}0$

(p) $\Pi x_{bending}$	1·408	L	$F_{bending}$	14·0 M
(q) Πx_{shear}	1·408	N	F_{shear}	1·25 O

Comments

These Modification Factors have been calculated from the Australian Timber Code. The purpose of this article is to demonstrate the derivation and use of a design proforma, and not to demonstrate or advocate the use of the Code. A detailed description of the derivation of these numbers is not relevant.

PART 6. STRENGTH CHECKS (Steps 9 to 12)

Comments

(a) *Bending*

(1) Allowable Stress $\boxed{L} \times \boxed{M}$ — 19·7

(2) actual stress $\left(\frac{\boxed{A}+\boxed{E}}{\boxed{K}}\right)$ — 16·02 ← 4

$$\frac{(540{\cdot}96+78{\cdot}75)\times 10^6}{3{\cdot}867\times 10^7}=16{\cdot}02\ \text{N/mm}^2$$

(b) *Shear*

(1) Allowable Stress $\boxed{N} \times \boxed{O}$ — 1·76

(2) Actual Stress $\left(\frac{\boxed{B}+\boxed{F}}{A_b}\right)$ — 0·66 ← 4

$$\frac{(368+45)\times 10^3}{6\times 275\times 375}=0{\cdot}667\ \text{N/mm}^2$$

The complete design is shown in Figure 6. It fits on to one sheet of A4 paper.

Figure 6. TIMBER DESIGN PROFORMA

Note: "times" is indicated by * where typed

1. LIVE LOAD EFFECTS (Steps 1 to 3)

a.	Span (L)	7	m
b.	UBM (Table 26(M))	42	kN
c.	Shear (Table 27(M))	200	kN
d.	Impact Factor (IF)	1·15	
e.	Distribution Factor (DF)	1·6	
f.	LLBM = UBM*Span*N*IF*DF	540·96 [A]	kNm
g.	LLSF = Shear*N*IF*DF	368·0 [B]	kN
h.	Maximum Point Load (Table 4(M))	60	kN

2. DEAD LOAD EFFECTS (Step 4 and 8)

a.	Deck Thickness (from decking graph)	100 mm	
b.	Timber Density (γ_t)	11·8	
c.	Deck Length = 2·44 + 2*0·15 + 1·5 =	4·24 m	
d.	Deck Area including Kerbs (A_d)	0·47 m^2	
e.	Superstructure Weight (W_s) = $\gamma_t * A_d * L$	38·8 [C]	kN
f.	Area of Beams (A_b) = $N_b * b * d$	0·62 m^2	
g.	Total Weight of Beams (W_b) = $\gamma_t * A_b * L$	51·2	kN
h.	Total Dead Weight (W_T) = $W_s + W_T$	90 [D]	kN

2. (contd)

j.	DLBM = $W_T * L * 8$	78·75 [E]	kNm
k.	DLSF = $W_T * 2$	45·0 [F]	kN

3. DEFLECTION CALCULATION (Steps 5 and 6)

a. Point Loads

W (kN) (a)	a/L (b)	C (fig 1.) (c)	Equiv UDL W.C (kN) (d)
53·35	0·535 ÷ 7 = 0·076	0·37	19·74
97·87	3·585 ÷ 7 = 0·512	1·60	156·60
97·87	4·805 ÷ 7 = 0·686	1·31	128·21
		∑W.C =	304·55 [Q]

b. Uniformly Distributed Loads (UDLs)

Creep Factor * W_T (or W_s) 90 [H]

c. Minimum I

(1) Elastic Modulus of Timber E_T =

(2) Span to Deflection Ratio R = 360

$I_{min} = \frac{5*(N*[Q]+[H])*L^2*R}{384*E_T}$ = 7·249 * 10^9 [J]

$I_{actual} = \left[\frac{N*b*d^3}{12}\right]$ ∴ $b_{min} = N_b * b = \left[\frac{12*I_{min}}{d^3}\right]$

4. BEAM SELECTION (Step 7)

Assumed Depth d (mm) (a)	Min Width ≥ 3240 mm (b)	Beam Required b (mm) (c)	Beam Required N_b (d)
325	2860	200	14·3
		250	11·44
		275	10·4
		300	9·53
350	2290	200	11·45
		250	9·16
		275	8·33
		300	7·63
375	1860	200	9·3
		250	7·44
		275	6·76
		300	6·20

Selected Beam Combination is: 6 beams 275 mm wide and 375 mm deep.

$Z = \left[\frac{N_b * b * d^2}{6}\right]$ = 3·867 * 10^7 mm^3 [K]

5. MODIFICATION FACTORS

a.	K_1 =	1·25
b.	K_4 =	1·0
c.	K_6 =	1·0
d.	K_7 =	1·0
e.	K_8 =	1·28
f.	K_9 =	1·0
g.	K_{10} =	1·0
h.	$K_5 = 1 - \frac{(EMC - 15)}{10}\left[1 - \frac{F'green}{F'seasoned}\right]$	0·88
j.	Factor r = Temporary Loads / Total Loads	0·77
k.	Material Factor ρ	1·09
l.	$R_1 = \frac{D}{B}$	1·37
m.	$R_2 = \frac{L}{Bay}$	12·8
n.	$\rho.S_1 = \rho * 1.35\sqrt{R_1 * R_2}\sqrt{\left[1 - \left[\frac{1}{R_1}\right]^2\right]}$	5·09
o.	K_{12}	1·0
p.	$\prod K_{bending}$ 1·408 [L] $F_{bending}$	14·0 [M]
q.	$\prod K_{shear}$ 1·408 [N] F_{shear}	1·25 [O]

7. STRENGTH CHECKS (Steps 9 to 12)

a. Bending.

(1) Allowable Stress = [L] * [M] = 19·7

(2) Actual Stress = $\left[\frac{[A]+[F]}{[K]}\right]$ = 16·02 ✓

b. Shear.

(1) Allowable Stress = [N] * [O] = 1·76

(2) Actual Stress = $\left[\frac{[B]+[F]}{A_b}\right]$ = 0·667 ✓

The specimen calculation illustrates how a design proforma can be used to present a complicated procedure simply. As in the previous article the solution converges quickly to an efficient one.

The Importance of Logic Diagrams

The design proforma follows the logic diagram and cannot be devised without it. In fact a logic diagram is a useful starting point for describing any design process because:

(1) The fact that a logic diagram has been drawn for a proposed design method confirms that the method is logical and that it leads to the desired conclusion.

(2) The logic diagram gives firm guidance as to how the design method should be described.

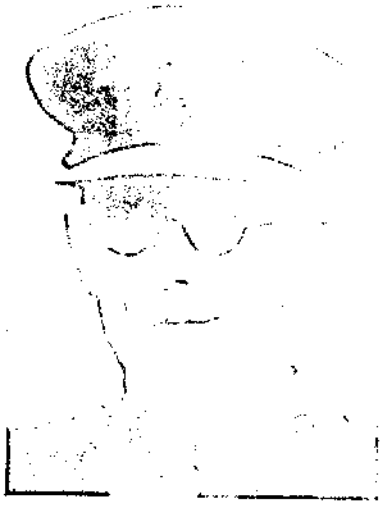
(3) The logic diagram is a guide for any design proforma that may be drawn up.

(4) A logic diagram is easy for any user to follow and can be written so that it refers directly to any graphs or charts that may be used.

There are very few logic diagrams in the current crop of Military Engineering Volumes even though there are many design methods described in them. The disparity is something that all pamphlet writers should make every effort to reduce.

Onward Christian Soldiers

BRIGADIER H E HOPTHROW CBE, C Eng, FI Mech E



The Author enlisted in the Regular Army in 1915 and was posted to a "Wireless Boys" Coy at St Mary's Barracks Chatham. He was a Wireless Operator in GHQ BEF and in the trenches in the battles of 3rd Ypres, St Quentin, Lys, Flanders and the ensuing pursuit. Commissioned in Supplementary Reserve (RARO) in 1925 he raised, trained and commanded 107 Coy RE (SR). He transferred to Class 1 RARO in 1935. In WW2 he was in turn ADW GHQ & Comd Post BEF (1939–40), Dep CE Home Forces and Air Defence Great Britain (1940–41), Dep Controller Mil Wks Svcs, DDFW and DFW between 1941–45.

In civilian life between the wars he was a Civil and Mechanical Engineer with ICI and after WW2 he returned to ICI as Asst Secretary of the Company. Between 1960–68 he was Hon Sec and a Vice-President of the Royal Institution.

Recently there has been correspondence in the *RE Journal* about Sappers who attained command of fighting formations. I cannot venture into that field but I had a brief experience of command of a kind, unusual, even for a Sapper.

On mobilization in 1939 I left a very vigorous bridging exercise with 7 Field Company RE at Wouldham to join a Base Depot in Aldershot as a reinforcement. As the CO, on old cavalier recalled from retirement, had been carried off his first parade and not seen again, I reported to the Second-in-Command, a retired Cavalry Major. I asked the time of the morning parade—his reply, "I like to see my Officers not later than 11.00am"! Compared with the peace time rigours of Wouldham, war seemed a soft alternative.

More reinforcements came in almost hourly, a fascinating mixture; two Majors, a Sapper and a Gunner, who had seen no service or training since 1918 and whose spoken military idioms were a puzzle and amusement to some young Sapper Subalterns. Then there was a 1918 vintage Captain who could not be parted from his sword until he threw it overboard on our cross-channel passage.

These were small diversions compared with the arrival of forty-three Chaplains of all Christian varieties. They included four monks, one of whom in recent years was Abbot of Buckfast. Another, found to be a wine connoisseur, was detailed on arrival in France to buy wine for the Mess; consequently he could be seen in the course of his duties, like the Abbé Coignard, "with a bottle in one pocket as a precaution and one in the other for the sake of equilibrium". There was an Irishman who had been awarded a Military Cross as a combatant Officer in Flanders; in 1945 he was elected to Parliament to represent an Irish constituency, adding to legal and Parliamentary history by being unseated under the Act which debars clergy of the Church of England from the Commons. Yet another had been a Regular RSM before becoming a Clerk in Holy Orders; he was bothered, and bothered others, as to whether he would receive his Warrant Officer's pension as well as his Chaplain's pay. Most of us were billetted in an hotel in Farnborough but by some manoeuvre or mischance he was living in the Mess of a busily mobilizing Royal Tank Regiment Battalion. As he seldom appeared on the few parades we had, the ACG (Assistant Chaplain General) put him under arrest, a sore embarrassment to his hosts which was relieved by his resignation and return to parochial duties.

Very few of the Chaplains had any experience or knowledge of military matters. Many arrived in their clerical clothes carrying a civilian respirator in a cardboard box slung from the shoulder by a piece of string, and a belief that they would be issued with uniform. However, there were tailors in Aldershot ready to clothe them but not enough buttons and badges. Some hasty research established that police buttons and Wiltshire Regiment badges painted black would suffice.

Now clothed, issued with service respirators, instructed in their use and having attended lectures on Army Administration, how to distinguish between a Quarter Master General and a Quartermaster Sergeant and which to salute, the ACG ordered their presence for inspection on a barrack square in Aldershot, an order passed to me for execution.

The ACG's treatment of the ex-RSM emphasized his reputation for discipline and military bearing, and his probable displeasure if his newly clothed shepherds were left to find their own casual way to the correct square in Aldershot. I gave them about fifteen minutes instruction on a minimum amount of footdrill and marched at the head of my new command from Farnborough to Aldershot. Most of them loved it but a few budding "barrack room lawyers" grumbled that it was an improper way to treat Chaplains, others suggested they should sing *Onward Christian Soldiers.*

We arrived in good order, the inspection went well and to my relief the ACG agreed to their being "dismissed from parade."

So ended what proved to be my last "Regimental" Command.

The Sapper

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Memoirs

BRIGADIER A E ARNOLD CBE, B Sc

Born 24 November 1920, died 4 March 1982, aged 61

ALAN EDWARD (TUBBY) ARNOLD was commissioned in 1939. This is a personal tribute to a man who was an inspiration to all who came in contact with him and who was held in high regard and affection by all.

It was as CI Tactics and then CRE Borneo (1965/6) that his undoubted qualities really received the wide recognition that they deserved.

He was an easy man to work for, and with, because he would listen, encourage and support, and then very gently suggest a different approach to those aspects he thought wrong or injudicious. He always left you feeling that you had done a good job and, with his gentle persuasion, you had.

His appointment as CRE Borneo was well timed, coming at a time when force levels had reached a peak and the campaign had developed from an emergency basis into something more permanent. It required a man of Tubby's experience, wisdom and grasp of the practical requirements of soldiers in the field to bring about the improvements that were required in Engineer Support which covered the whole spectrum from combat to construction engineering. He was the architect of the system which was the forerunner of the Military Works Area concept. This together with his gift for improvization and his understanding of how to defeat bureaucracy, made a major contribution to our military effectiveness in Borneo. It was early in this tour that a routine medical check showed that he had contracted diabetes. He lost much of his weight but such was his charisma that the name "Tubby" was never abandoned. For his work in the Borneo campaign he was appointed an OBE.

Later, when he commanded the Engineer Support Group (1969–72) he enhanced his reputation. Many considered him to be the leading modern manager in the Corps. He brought a new professionalism to the management of Engineer Resources which was after all "Big Business". In 1971 he was appointed CBE.

He retired from the Active List in 1975 on the completion of a tour as Projects Director DGFV to take up a senior appointment with Fairey Engineering Ltd. To his second career he took wisdom gained from wide experience, a perceptive discrimination and an ability to size up a situation or a problem quickly and effectively, sincerity and a sense of humour.

It was always elevating to meet Tubby from time to time; calm, courteous and always interested in you, your family and your progress. His contemporaries and indeed all his colleagues, mourn the early separation of an excellent Sapper, a wise counsellor and the most genuine and loyal of friends.

To his wife Judy and daughter Adrienne we offer our deepest sympathy.

DHB, CHC, HRDH, GWAN, EEP, MGS

Brigadier A E Arnold CBE B Sc

COLONEL H M TAYLOR

Born 6 December 1899, died 22 April 1982, aged 82

HUGH MOSTYN TAYLOR died in April mourned by many true and sincere friends. At heart he was an extremely kind and generous man but this was balanced by a quick and critical wit, an impish sense of fun, a sharp and sardonic tongue and mild delight in the discomforture of others which did not always make him an easy companion, especially as he expected a high standard of both duty and behaviour.

He was educated at Charterhouse and the RMA, just missing service in World War I. He was first posted to Hong Kong and after a tour of duty there he served at Aldershot. Then he qualified as an interpreter in Italian and was employed in trying to break the Italian codes, an occupation for which his intuitive and deductive skills as a bridge player probably made him very suitable.

While Second-in-Command 9 Field Company at Shorncliffe, he met and married Bettine Drabble in 1934. Her death in 1975 left him a lonely man.

After a further tour of duty at Aldershot as 2IC 11 Field Company, he was posted in 1938 to Singapore to command 41 Fortress Company. He became Commander Fortress Royal Engineers, Singapore in 1940 with two AA and two Coast Defence Companies under command. As these were virtually permanently deployed to their battle stations there were no Sappers available for miscellaneous defence tasks. When the two AA Companies were disbanded in August 1941 (the Gunners took over the responsibility for the "lights") he formed a small RE unit including a Bomb Disposal Section. In the last days of the campaign Hugh was placed in command of an RE unit made up of four Companies which held part of the line near the Alexandra Hospital.

As a Prisoner-of-War he succeeded in remaining at Changi and, as the senior RE Officer there, was responsible in 1944 for the erection of the huts round the gaol for 9000 or so prisoners. As the comment of the Officer carrying out this construction under those difficult circumstances is similar to those of others who served under Colonel Taylor, it is quoted, "I will remember him for his kindness, helpfulness, interest and humour under a deceptive air of nonchalance and slight boredom."

Unfortunately three and a half years as a Prisoner-of-War interrupted his career at a critical time which was a lasting disappointment to him and he perhaps did not reach the rank to which his abilities entitled him. Further, he had the misfortune to be employed on a number of projects of post-War Imperial planning which came to naught such as the Suez Canal Base and the Mackinnon Road.

He retired in 1954 and was an RO2 at Bordon for some years. Later he chose to live at Odiham in an area where he could easily pursue one of his main interests—Racing—at which he had a flair for picking a winner!

Hugh and Bettine had two children. Their married daughter died two years ago leaving only his son, to survive him.

FLF, JRCH, JLN, FWS, PAW

Colonel H M Taylor

MAJOR GENERAL L E C M PEROWNE CB, CBE, K St J, C Eng, MIEE

* *Born 11 June 1902, died 24 March 1982, aged 79*

LANCELOT EDGAR CONNOP MERVYN PEROWNE was educated at Wixenford Preparatory School, Wellington College and "The Shop". He was commissioned into the Corps in 1923 and attended the general basic course in Engineering and in Survey at the SME Chatham 1923–24.

Many of his friends have collaborated to add a note of appreciation to the brief and factual Memoirs published elsewhere. Lance Perowne was one of the more remarkable and colourful personalities to grace the Army and the Royal Engineers. As a Sapper, his record in his early years was distinguished enough. A fully professional engineer with wide experience in construction and survey, but specializing in matters electrical and mechanical, he was closely involved in the development of the techniques and tactics of searchlights and anti-aircraft defences, in furtherance of which he flew with the RAF over Germany and with night fighters over England.

But it was in command of "All Arms" that his main distinction lay. Having played a gallant part in commanding an improvized unit (Perowne's Rifles) in the retreat to Cherbourg in 1940, he held a succession of Brigadier's Commands which for number, variety, and unorthodoxy, (including a Chindit Brigade), must surely constitute a record, as testified by the display in his house of nine Brigade Commander's pennants.

As a Major General in 1951 he was the last commander of the British Military Mission to Greece, and conducted its withdrawal with great goodwill from the Greek hierarchy.

Lance Perowne must be credited with much of the foresight that in 1947, on partition of the Indian Empire, inspired the War Office to incorporate Gurkhas in the British Army. Many people hold the opinion that but for Perowne's imagination the whole of the Indian Army's Gurkha contingent would have either been returned to Nepal or swallowed up by the Army of the Independent India. Many had a hand in this negotiation but the *idea* came very largely from Perowne. It is not surprising therefore that the culmination of his career came in 1952 when he was appointed Major General Brigade of Gurkhas and Commander 17th Gurkha Division during the emergency in Malaya. He brought to this command his romantic view of soldiering, and a panache, wholly appropriate to a Knight of St John. His tall erect figure, with eagle eye and monocle, missed no detail. He would not countenance half-measures or sloppy answers. Everything had to be right. Indeed he gave the motto *PROPERLY* to the Brigade. But at the same time he was highly practical, with a restless enquiring brain, and a lively sense of humour. His command saw the development of the Gurkha Engineers and Gurkha Signals, which he inspired and nurtured, and which have proved highly successful and efficient.

The 17th Gurkha Division included a number of British units, and he continued the process of adapting the Gurkha units, with their Indian Army background, to a British Army environment. He enhanced the high morale, standards and *esprit de corps* of the Brigade of Gurkhas, while at the same time conducting intense jungle operations against the communist terrorists.

Major General L E C M Perowne CB CBE K Sc J C Eng MIEE

Shortly after his retirement in 1955, he became the first Colonel, The Gurkha Engineers, and to this appointment he brought his usual meticulous attention and wisdom, and guided the Regiment in its formative years. He thoroughly enjoyed his time as Technical Adviser to David Lean in the making of the films "Bridge on the River Kwai" and "Lawrence of Arabia", after which he was involved with various high-technology companies to which he brought fresh air and originality.

He was a fine writer who produced a number of prize-winning technical papers, and his contributions to the History of the Royal Engineers and his history *Gurkha Sapper* of the Gurkha Engineers' first twenty-five years, show a style remarkable for colour, readability and balance, supported by thorough research and attention to detail. He was bitterly disappointed when the printing of the *Gurkha Sapper* was produced so badly by the Hong Kong printers—it did not come up to his standards.

It was not easy to get to know Lance Perowne intimately; he seemed to live on a higher intellectual plane than most of us. He was more erudite, more thoughtful and better informed than most men. He was an immediately impressive, even frightening, figure but those who worked with him found him to be immensely human and understanding with a warm, subtle, almost impish, sense of humour.

He will be much missed by his many friends and former comrades, not least by the Brigade of Gurkhas, who will always remember the unfailing kindness, hospitality, and friendship of Trudy, his wife for fifty-five years.

Truly a knightly figure, *sans peur et sans reproche.*

JHSB, MJAC, MCAH, WGFJ

Correspondence

Major A I M Gregor Macgregor
Scotts Farm
Scotts Grove Road
Chobham, Surrey, GU24 8DP

Water Supply at Pergamum

Sir,—Recently I revisited the ancient city of Pergamum, which was built on an acropolis standing more than 1000ft above the plain below. Being a Sapper, I naturally took an interest in those matters that Sappers the world over from time immemorial have always enthused about. The water supply in the Falkland Islands may cause concern, but how did they manage in Pergamum so high up?

The learned professors and knowledgeable guides immediately said there was no problem—it was a matter of siphon action from water sources high up in the hills some miles away. The aquaduct many hundreds of feet below Pergamum was not going to help much in transporting water by gravity from the higher sources. They again came up with the easy answer which was clay pipes, about 20–25mm in diameter, and that the aquaduct was in fact a bridge for these clay pipes.

I was not convinced. Assuming the aquaduct was only 500ft below, that certainly meant a pressure of about 200psi. Would the clay pipes withstand that sort of constant pressure? Would the joints have withstood the forces? It is doubtful even if they were lead lined. There were no pumps in those days that could cope with the head or volume, but Pergamum certainly enjoyed an excellent and plentiful water supply.

I was wondering if any of your readers knew the answer or could suggest a possible solution. The only thought I had was what would happen if one of the clay pipes did spring a leak in the valley below, and how this could be dealt with.—Yours faithfully. A I M Gregor Macgregor.

General Sir Victor FitzGeorge-Balfour KCB, CBE, DSO, MC
The Old Rectory
West Chiltington, Sussex.

At Arnhem—September 1944

Sir,—I have read Brigadier Myers' article "At Arnhem—September 1944" published in the *RE Journal* of September with considerable regret and, with particular distaste, the disobliging comments which he makes on the performance of XXX Corps of which I was at the time GI Ops.

It is not unusual for those who have undergone an extreme trauma to react emotionally by seeking to place blame on others, particularly when it is patently obvious, as in this case, that they were in no way to blame for their own misfortunes. It is indeed perhaps even excusable. After some thirty-five years when emotions should have been got under control and when the facts are readily available, there is no excuse.

Brigadier Myers bases his strictures entirely on generalization. It would therefore be impossible, even if my memory was good enough, to refute them in a detailed and specific manner. I think, however, it is important that your readers should be aware of the facts as seen by XXX Corps and I believe it would be right that before they reach any conclusions they should read Chapter VII of Lieut General Sir Brian Horrocks' book, "Corps Commander". (Published by Sidgwick and Jackson 1977.)

It will clearly be for your readers to decide for themselves the validity of two opposing views—those of Brigadier Myers and those of Lieut General Sir Brian Horrocks. Your readers may wish to give consideration to the following points:-

(a) Your readers may feel that the views of a Corps Commander of Sir Brian Horrocks' stature and long experience in this particular level of command, together with his obviously far wider knowledge of the facts and factors involved, should carry more weight than those of a CRE of a Division and particularly of a Division which was, as it happened, at the time divorced from the main thrust.

(b) Your readers might care to take account of the track-records of HQ XXX Corps and of the two Divisions concerned—Guards Armoured Division and 43 Wessex Division. It would take too much space to give these in any detail but anyone interested would have little difficulty in obtaining the information. HQ XXX Corps was, from Alamein onwards, repeatedly chosen to control operations which required flexibility, speed and aggressiveness. Guards Armoured Division were if anything inclined to be an excessively adventurous Division, and perhaps too ready to take chances in the interest of speed. 43 Wessex Division was rather more staid and stolid—periodically it required a nudge which General Horrocks was very expert at administering; once nudged the Division invariably reacted by pursuing its objective with extreme determination and tenacity. The track-records of the formation Commanders concerned are equally distinguished. If on this particular occasion—for all the formations concerned, one battle among many, even if a very major one—XXX Corps displayed no real sense of urgency as Brigadier Myers alleges then its behaviour was totally out of character and this must surely be regarded as inherently improbable.

(c) Brigadier Myers writes: "as a result of a most gallant assault crossing of the river Waal at Nijmegen by a Combat Regiment of 82 Air Borne Division, the road and railway bridges there were captured intact on the afternoon of 20 September." The facts are that the road bridge was captured by 2 Grenadier Guards, two of whose tanks (from a group commanded by Lord Carrington) managed most gallantly to make a dash across the bridge after which Guards Armoured Division Sappers defused the demolition charges, which for some incredible reason, the Germans had failed to detonate. Certainly 2 Grenadier Guards would in no way dispute that their action could not have been successful without the diversionary effect produced by the American Regiment whose gallantry and coopera-

tion Guards Armoured Division fully acknowledged with gratitude and admiration. It is true that Brigadier Myers does not say that the road bridge was captured by the American Combat Regiment but this appears, to me, to be implied. Certainly nowhere in the article is there, in connection with the capture of the Nijmegen road bridge, any mention of 2 Grenadier Guards or even of Guards Armoured Division. This must arise either from ignorance (inexcusable), or as a manifestation (perhaps subconscious) of prejudice; it can certainly do little to enhance the credibility of Brigadier Myers' views as expressed in his article.

I find Brigadier Myers' remark "to be fair to General Horrocks he kept on having to divert his attention to his narrow corridor between Eindhoven and Nijmegen" unbecomingly patronizing. What is more it is not even true and here, as General Horrocks' GI, it is more likely that my view is right than that of Brigadier Myers. What is true is that the staff of HQ XXX Corps were desperately worried and possibly distracted by the interruption of L of C; and rightly so, as became apparent when the front end started to suffer from a very serious and damaging shortage of ammunition. General Horrocks personally never for one moment allowed his attention to be diverted from his primary aim— as some of us at times thought he should perhaps have done.

I hope that in this letter I have avoided falling into the trap of disparaging the efforts of others. I in fact yield to no-one in my admiration for the performance of 1 Airborne Division at Arnhem or of the two US Air Borne Divisions involved in the operation. Nor, may I add, do my remarks about Brigadier Myers' article, detract from my admiration for his extreme personal gallantry of which I had first-hand knowledge at this particular time.—Yours sincerely, V FitzGeorge-Balfour.

Major General A G C Jones CB MC
"The Gatehouse"
Salisbury Road
St Margaret's Bay
Dover, Kent

At Arnhem—September 1944

Sir,—I suppose the Arnhem debate will run for ever; certainly there appears to be no lessening of interest as the years go by.

Did XXX Corps try hard enough? I can offer some observations only from the lowly level of a Troop Commander with Guards Armoured Division, the lead Division of XXX Corps. In accordance with our standard practice, my Troop was supporting 1st (Motor) and 2nd (Armoured) Battalions Grenadier Guards, and I was therefore closely involved in the fight for the Nijmegen bridges.

By 1944, in common with many other Regiments, the Guards were in growing difficulty with reinforcements and one could argue that they were not quite the force they had been earlier in the war. At that stage in the conflict we were scraping the bottom of the manpower barrel. The five Regiments of Foot Guards were not the easiest problem on the Manning Staffs list. For example it was not possible to put a Welsh Guardsman in the Coldstream and the problem had been compounded by giving the Foot Guards a variety of roles, including Sherman tanks, Churchill tanks, infantry and motorized infantry.

I remember talking to some Guardsmen in Nijmegen during the battle and finding they had been transferred to the Grenadiers comparatively recently from the RAF Regiment and Anti-Aircraft Artillery and were not much liking their new rather more dangerous role. The thought uppermost in their minds was not to be the bravest soldiers in the British Army, just the oldest, and they were not alone in that. After all, hopes were still running high that we could finish it all in 1944. However, the Grenadiers certainly fought hard in Nijmegen; for example King's Company of the 1st Grenadiers was reduced to Platoon strength during the battle

and the Company Commander was among those killed.

I remember with affection and respect the two CO's of the Grenadier Battalions. They were battle-hardened Commanders and had the confidence of their officers and men. One of them later became a four-star General, the other a Major General. With hindsight, it did take them a little time to establish sufficiently close working relationships with their opposite numbers in 82nd (US) Airborne Division, but this was to some extent typical of the hasty improvization which characterized the whole operation. British and Americans had never met prior to the moment when they were making key decisions in the heat of battle and ideally Commanders down at least to Battalion level should have been flown out to a joint briefing before the start, in an attempt to overcome the difficulties inherent between two Allies. Unfortunately, time did not allow of the ideal and therefore I remember the first plan to rush the Nijmegen bridges as a somewhat disjointed affair. The Americans did their thing and we did ours. One must also remember the pressure on Commanders to get on, and if the Intelligence assessment that resistance was likely to be light had been correct instead of being more than a little over-optimistic, the idea of a quick dash at the bridges would probably have worked. In the event we were seen off first time in Nijmegen and therefore a much more closely co-ordinated plan was made for the second attempt which, as we all know was successful.

The Engineer support at Nijmegen was in the hands of two famous Sappers, "Splosh" Jones as CRE and John Thomas as OC 14 Field Squadron. As a young Officer I was on the receiving end of numerous richly deserved rockets from both of them. I owe them a great deal and can testify from several painful educative experiences that neither in any way lacked a sense of urgency. I have a vivid memory of John Thomas charging at high speed round Nijmegen at the wheel of a jeep with a bullet hole through the windscreen slap in front of his eyes, put there by a trigger happy American Parachutist.

Brigadier Myers has written that, "As a result of a most gallant assault crossing of the river Waal at Nijmegen by a Combat Regiment of 82 US Airborne Division, the road and railway bridges there were captured intact from the afternoon of 20th September." I think it would be more accurate to say that the bridges were captured as a result of the joint efforts of the Americans and the Grenadiers. I have not seen the film, "A Bridge Too Far", but understand that Robert Redford, in the part of an American Commander, shoots his way on to Nijmegen road bridge. This is falsifying history. I was with the party of Grenadiers in Sherman tanks that rushed the road bridge, commanded by Peter Carrington with Sergeant Pacey in the leading tank. It is a fact that they were over the river before they met the Americans. I accompanied the party in a Humber light recce car and stopped at the northern end of the main span to look for the charges, while the tanks went on. Certainly no Americans were present at that time, as apart from ourselves the only other people on the bridge were some Germans who were only too ready to surrender.

The follow up from Nijmegen has been, and is, the subject of much criticism. I see from the history of the Guards Division (I was not personally involved) that the Irish Guards Group (2nd Armoured/3rd Infantry Battalions) moved through the Grenadiers at midday September 21st. One might ask why did they not move at first light, or why did we not attempt some movement forward during the night 20/21 September. Looking back, it is easy to sympathize with the view that with just eleven miles to go, everything should have been thrown into a last lunge at Arnhem. But it is also easy to forget the long single line of road back to Eindhoven which increasingly came under attack and along which all supplies had to reach the forward troops. Fire support, both artillery and air, was not on the same generous scale that had become the norm in North-West Europe, due to lack of forward landing grounds and shortage of ammunition. Perhaps most inhibiting of all, the advance was restricted to a one-tank front, as any vehicle attempting to leave the road immediately bogged down in soft going. Also the wide, flat Dutch landscape

afforded little cover for infantry or armour.

Two miles north of Nijmegen the Irish lost all three tanks of their leading Troop. They could not get off the road because of deep drainage ditches and the advance stuck. The Welsh Guards Group were also committed, followed the next day by 43rd Division and a Brigade of 50 Division. As is well known, in the face of stiffening German resistance none of these efforts was in the end good enough.

In 1945 I was drafted to Burma, and among other members of the draft was Eric Mackay, who commanded an Airborne Sapper Troop and fought most gallantly on the Arnhem bridge. Captain Mackay and Lieutenant Jones reviewed the *Market Garden* operation in several hours of discussion prior to and during the long voyage to Rangoon, and came to the conclusion that it would have been preferable to use the Airborne Army to open up Antwerp. I remember asking Eric, as a parachutist, how he rated the German heavy gunners on Walcheren as a target for Airborne troops and getting his reaction that they would have been on the soft side, to put it mildly. At the time of Arnhem supply vehicles took ten days to go from Normandy to the front line and back. We had captured a major port intact but could not use it. Instead of sticking our necks out still further, surely it was better to resolve our problems of supply and get the whole front moving again? The factor of ground also favoured this course of action, as Holland was ideal terrain for defence and our left flank could have been secured with the minimum of troops.

Eric and I did not realize then what has now been well documented, that Eisenhower and Montgomery were locked in argument over strategy, Montgomery the vigorous proponent of the single concentrated thrust of some forty Divisions across the Rhine into the Ruhr, and Eisenhower taking more account of political factors and holding out for advance on a broad front. As we all know Eisenhower won the argument (the senior Officer usually does) but he may well have given the Airborne Army to Montgomery as a consolation prize for finally backing down.

There seems little doubt that unfavourable Intelligence reports were disregarded or taken too lightly. Possibly there were two reasons for this. Montgomery's fanatical insistence on getting his own way and by hook or crook thrusting over the Rhine, and secondly the Airborne soldiers themselves. These were the elite, handpicked from units throughout the Army. Yet these same ordinary units had been steadily advancing without Airborne help. Brigadier Myers has written that some sixteen operations had been cancelled and I recall a figure being quoted some years ago of as many as twenty-one cancellations. Whatever the actual number, it was undoubtedly extremely frustrating to high quality fighting men of whom quite a number must have been thinking they would miss the last act of the show. The motivation to avoid yet another cancellation must have been very strong and therefore Intelligence may well not have been presented without distortion. One has the feeling that, no matter what the risks, the 1st Airborne Division would have gone anywhere, and would have dropped on Berlin itself if someone had asked them to go.

Brigadier Myers had given the casualty figures at Arnhem at 8000 out of 10000 in nine days fighting and there can be no question that the 1st Airborne Division's fighting ability was of the highest order. Yet the achievement of XXX Corps should not be forgotten, in that they had fought their way through from the beaches in Normandy and taken heavy casualties in sustained operations. I believe that there were instances where some Battalions had received 400 per cent reinforcements in the period from Normandy to the Rhine, ie four new Battalions' worth of men.

In the final chapter of his magnificent book, "Defeat into Victory", Field Marshal Bill Slim has made some penetrating observations on the use of special forces, including the remark, "Armies do not win wars by means of a few bodies of super soldiers but by the average quality of their standard units." He also said in the introduction to his book, "We all, even those among us who may have seemed to fail, did our best. Luckily our combined best proved good enough." He of course was talking about the war in Burma. Sadly, our combined best was not good

enough to win at Arnhem nor achieve victory in Europe in 1944. The thought of the "might have been", the marvellous success that came so nearly within our grasp and yet in the end eluded us, remains a bitter memory for all of us who were there.—Yours faithfully, A G C Jones.

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Sapper Reservists

Dear Sir,—I was interested in the article "TA Sappers—An Appraisal" in Volume 96/2 of the *RE Journal*. The central problem of the TA is, it seems, scarce resources. Despite the happy position of TA Sapper Units which we are told are "almost fully manned" there is still a grave shortage of experienced men and particularly of experienced Officers. This letter will attempt to identify a currently under-utilized source of this experience.

The demands made on a TA Officer in an Independent Unit are excessive. How can people actively pursuing a civilian career continue to give up three nights a week and two weekends a month to soldiering? The phrase "a second career" is fittingly used by Brigadier Willmott. With the planned increase in TA strength of 16000, where will the extra Officers be found?

The level of commitment certainly acts as a disincentive to ex-Regular Officers who might be encouraged to join the TA and provide a stiffening of leadership and experience. Sponsored Units could be the answer but when I, for example, made tentative enquiries with CVHQ RE about six years ago I was told they were overstrength and in any case they were looking for "somewhat younger men". As I was thirty at the time I found this reaction strange.

It is important that the "Military" recognize that the majority of employers, particularly in industry, have no direct military experience or military links. Ex-Officers are regarded with some suspicion in any case, and an individual who asks for consideration because he has joined the TA is likely to find his commitment to the company questioned.

Imagine that an early/mid-career switch *into* the Army was as easy as a switch *out* of the Service. What would the reaction of the average Commanding Officer (Managing Director?) be to a newly joined ex-accountant from British Leyland who formed up to ask for an extra two weeks holiday so that he could go accounting for his old firm and who, in addition, is known to spend at least one night a week and one weekend a month doing the same!

The Individual Reinforcement Plan seemed, when it was launched, to provide a partial answer to many of the problems inherent in depending on TA Units and Reservists to bring the Army to War Establishment. A "briefing" was promised as part of the process. Here surely was a chance to keep in touch—by the way, what *IS* an SO2 G1/G4, do we still have Brigades—didn't they go out of fashion—are they back??

In the event I for one have been bitterly disappointed on both reporting dates so far. No attempt was made to brief anyone or to capitalize on the fact that the majority of those who attended had given up a day's work to do so.

It has been simply a case of collect or check your kit, collect £70 and off you go for another year. As a taxpayer I found it a puzzling exercise from a Service short of money.

This is surely the first source which could be tapped for experienced and still interested Officers and SNCO's. I believe that nearly all those who attend the "kit check" would in fact be happy to take part in a couple of hours training—perhaps a re-familiarization with Small Arms, NBC Drills, Special-to-Arm training at a low

level. There need be no increase in the £70 bonus to achieve this. For Officers, why not go further and provide a briefing on the individual posting or even provide written material on weapons, systems, equipment and organization. There simply will not be time to do this after Mobilization and it would mean that in War the individuals might at least *recognize* the equipment on their own side.

The Individual Reinforcement Plan should be expanded to allow for "steps" of individual commitment. These could range from the once-a-year reporting day to a full commitment to a Sponsored or Independent Unit. The "steps" could consist of correspondence courses, weekend courses, long weekends at Arms Schools. If necessary an increased "bounty" could be offered at each level. This arrangement would allow individual Reservists to keep their Military knowledge in-date but at the level of a "hobby" rather than a "second career"—after all every ex-Officer already has the latter.

I suppose, in the end, I could always contact the CVHQ of some lesser Arm or Service—one which might not be looking for "somewhat younger men"—but you know what they say . . . "Once a Sapper . . .".—Yours sincerely, Robert Lynch

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75 Engineer Regiment (V) History

Sir,—There appears to be something amiss with the photograph and caption on page 190 of the September Journal, allegedly depicting 75 Engr Regt's first camp in W Germany in 1970. The white bell tents and the forage caps worn by the soldiers appear to be about 1905 and not much later than 1920. The trestle bridge in the foreground appears to be under construction rather than being prepared for preliminary demolition.

Perhaps the apparent anomaly has come about as a result of the habit in the past of giving the TA obsolete equipment and stores for training!—Yours sincerely, Lenox Jamieson.

Editor: It is indeed flattering when a Correspondent does not even contemplate that the Editor could be at fault! I would suggest the ingenious solution of reversing the captions! My apologies.

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TA Sappers of Cheshire, Lancashire & W Yorkshire

Sir,—The article by Major Burman and Captain Kirby in the September issue of the Journal is of great interest although, certainly in the case of the Engineer Units of West Lancashire, it contains a number of errors.

The facts are as follows.

In 1864 the 1st Lancashire Engineer Volunteer Corps was raised in Liverpool as Submarine Miners and they maintained this role until submarine mining was taken over by the Royal Navy. They then became the Lancashire Fortress Engineers with the task of manning the searchlights on the Perch Rock Fort in the Mersey and at Walney Island in the approaches to Barrow. They maintained this role between the wars and up to May 1940 when they handed over these duties to the Royal Artillery

and were converted to 580 Army Troops Company. In 1941 they took part in the Greek campaign where they suffered most severe casualties. Thereafter they remained in the Mediterranean theatre.

On the reformation of the Territorial Army in 1947 they became 580 Field Park Company as part of 128 Corps Engineer Regiment. In the 1950 reorganization of the TA they were transferred to 107 Corps Engineer Regiment.

The 2nd Lancashire Engineer Volunteer Corps were raised in St Helens (some thirteen miles from Liverpool) in 1868 by Major Rothwell and were trained in field engineering duties which at that time, of course, included signalling.

Both Corps sent volunteers to the Boer War.

When the Territorial Army was formed in 1908 the 2nd Lancashire Volunteer Corps became the Divisional Engineers of the 55 (West Lancs) Division TA and, with the Company numbers 252–5, served with the Division until the end of the Great War. It is interesting to recall that during this war TA units maintained their own Base Depots and recruiting stations at their peace time locations and Engineer Hall, St Helens was no exception.

The 55 (West Lancs) Division was reformed in 1922 and Divisional Engineers were stationed in two locations: 252 and 253 Field Companies in their old home in St Helens and HQ RE, 254 Field Company and 255 Field Park Company in Liverpool. The two latter Companies were formed from the rebadged 9th Battalion The King's (Liverpool) Regiment and occupied the Drill Hall of the parent unit. In the mid-20's 255 Field Park Company was disbanded and the Division left with three Field Companies only.

In 1937 the role of 55 Division was changed to that of a Motorized Division of two Brigades and, to conform, the role of 254 Field Company was changed to that of Field Park Company. The following year saw the decision to double the Territorial Army by forming a second line alongside existing units and a consequence of this further reorganization was that 254 Field Park Company was moved to St Helens and the 55 Division RE were under one roof again.

On the outbreak of war in 1939 253 Field Company went immediately to the BEF as part of 3rd Divisional Engineers and in October 1939 252 Field Company and 254 Field Park Company followed, initially to join "X" Force but subsequently to make up, with one Regular and another Territorial Company, the 5th Divisional Engineers. All three Companies stayed with their respective formations for the rest of the war.

Following Dunkirk the units were reformed and 253 Field Company took part in the invasion of Normandy and all subsequent operations. 252 Field and 254 Field Park Companies accompanied 5 Division to India in 1942 and, after a spell in PAIFORCE took part in the invasion of Sicily and Italy. After a gruelling spell in Anzio they were withdrawn with the Division to the Middle East for rest and refit. From there they went to NW Europe where they finished the war.

The post-war history of the Royal Engineer units in West Lancashire is as briefly summarized by Major Burman but it is worth adding that on 22 June 1966 the Freedom of the Borough of St Helens was conferred on 252 (St Helens) Field Squadron RE (TA).—Yours sincerely, S M Hollway.

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Restoration of Bridges and Waterways of the Rhine

Sir,—I would like to establish contact with individuals of the British Occupation Forces who participated in the restoration of bridges and waterways of the Rhine River immediately following WW2. I am interested in particular in exchanging cor-

respondence with people who had contact with Herr Hans von Schiller, who worked under the supervision of British authorities in clearing the Rhine channel of wrecks. When this work was essentially completed, he became the Port Director at Duisburg, for the port of Cologne, a position he held until his retirement at the age of sixty-five in 1956.

In earlier years, von Schiller commanded the airship *Graf Zeppelin* on many of its later transatlantic trips, and was returning from South America when the *Hindenburg* burned at Lakehurst. He was also by that time a member of the Quiet Birdmen Society (brass Membership Card No 4766), which fact itself might help generate contacts.

My wife and I visited with him and his wife at their home in Tubingen in September 1976, less than three months before he died. At that time he said to me, "So many people come to see me and ask about my experience with the Zeppelins. I wish someone would ask me about the clearing of the Rhine. I am more proud of that than anything I did with airships."—Yours sincerely, Franklin D Buckley.

Book Reviews

SMM FOR ONSHORE PIPELINE WORKS

(Published by Pipeline Industries Guild, 17 Grosvenor Crescent, London SW1X 7ES. Price £5·00)

THIS revised and expanded Standard Method of Measurement covers both welded and all types of mechanically jointed pipelines for both cross-country and densely developed urban areas. Although it is a "metric" document, with a little adaption it is suitable for imperial units.

EEP

THE ORDNANCE SURVEY ATLAS OF GREAT BRITAIN

(Published jointly by Ordnance Survey and Country Life Books. Price £12·95)

AN Atlas is normally defined as "a collection of maps in a volume; a similar volume containing illustrative plates etc or a conspectus of a subject". This book lives up to the second part of the definition.

The quality of OS Maps is probably unrivalled. The 126 pages of 1:250000 (the "motorists" scale) maps are superbly reproduced with ample overlap to carry over to the adjoining sheets. The 44 page Index, with some 32000 entries, each with a National Grid reference number, is of inestimable value and includes all the definitive names shown on the maps.

Without taking anything away from these contemporary maps and the unparalleled cartography of the OS the book is raised to well above expectations by the two additional sections which cover physical, historical, economic and human geography. With specially commissioned maps and text the authors sharpen the reader's awareness of the changes over the years and the diversity of the changes.

To take two examples of these special maps: "The Early Industrial Revolution" shows that the geography of early industrialization depended on the availability of coal or water for power, and on canals for communications, and how the concentration of industry into relatively small areas was fed by a dramatic movement of people from rural areas to the towns: "The Crisis of the 1930s" shows the results of a study carried out in the late 30's which revealed the excessive dependence of many towns on a single industry as a structural problem exacerbating the impact of the depression, and compares the distribution of these industries with the incidence of unemployment.

This book is unreservedly recommended to all.

EEP

DIEPPE 1942—ECHOES OF DISASTER

WILLIAM WHITEHEAD. Editor TERRENCE MACARTNEY-FILGATE

(Published by Richard Drew Publishing Co, Glasgow. Price £9·95)

In the early hours of 19 August 1942 an armada of almost 250 Allied vessels, carrying over 6000 troops and sixty tanks, left England for a dawn assault on Dieppe. Seventy Squadrons of fighters and bombers flown by pilots of eight nations provided the air cover. By the end of the day the Allied casualties were almost 4000 and we had lost all the tanks and over 100 planes.

This book asks the questions: How did such a massive short lived operation come about? What did it accomplish? Why was it such a bitter, costly failure? It does not pretend to add a great deal of historical fact to the accounts that have already been written nor provide any new answers; but is an impression based on the memories of those who took part. The book is largely a photographic record with a linking text including many quotes—in a sense it is a film documentary in book form reflecting the metier of the Author and Editor.

It is a fine tribute to all those who took part in the raid and in particular to nearly 3000 Canadians killed, wounded or taken prisoner.

EEP

BOOK NEWS FROM INSTITUTION OF CIVIL ENGINEERS

All books in this section are published by Thomas Telford Ltd and are obtainable from Marketing and Sales Dept, Thomas Telford Ltd, 1–7 Great George Street, London SW1P 3AA.

CIVIL ENGINEERING IN FRENCH

A Paulus: Price £10·00

This book is designed for the engineer with some basic knowledge of French (O Level). It will be especially useful for those who have qualified in the English language but are working in a French-speaking environment as it familiarizes the reader with the use, vocabulary and application of French in civil engineering. Limited interest.

ICE WORKS CONSTRUCTION GUIDES

Three additional Guides have been published. This series of short guides to basic construction practice are written by experienced engineers and are designed to aid young engineers in the transition from the academic environment to work on site, whilst also providing a basic introduction to the subject for newcomers. These "paper backs" are of interest to all RE Officers.

Concrete Materials Technology. J F Troy: Price £2·00

A concise introduction to the various materials used in the making of concrete and the effects those materials have on the type of concrete produced. References and a bibliography provide sources of further and more detailed reading.

Site Investigation. A D Robb: Price £2·00

This is written with reference to the new Code of Practice for Site Investigation and describes the many different techniques, including trial pits, borings and rotary drillings, and their relative advantages and disadvantages. Methods of reporting and interpreting the data are also discussed.

Site Handling Equipment. J R Illingworth: Price £2·50

Efficient construction is highly dependent on selecting the site handling equipment best suited to particular circumstances. In this guide the different categories of plant, the linear, one-dimensional and two-dimensional methods, as well as more unconventional methods are described. Cost effectiveness, correct operating practice, selection procedures, efficiency and safety are discussed.

ARTICLES AND CORRESPONDENCE FOR THE JOURNAL

YOUR Journal depends for its existence on articles and correspondence submitted for publication on historical, professional, technical and, indeed, on any subject of interest to Military Engineers.

ARTICLES

Articles may be of any length, but preferably not more than 6000 words. They should be typed in duplicate on one side of the paper only, double spaced with a one-inch margin. A third copy should be retained by the author for checking with the proofs.

Articles should be accompanied by a photograph of the author, suitable for reduction to two inches width, and a pen picture of his career to introduce the author to our readers.

Photographs to illustrate an article should be black and white prints on glossy paper. The size of the photograph does not matter as the size can be adjusted. Line drawings, maps etc must be in black ink and all lines, lettering etc must be bold and clear to allow for reduction in size when reproduced. Scales must be drawn and not worded.

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Payments for articles is at a rate decided by the Publications and Library Committee. An additional award of £20 is made at the discretion of the Committee for articles of particular merit published in each issue of the *RE Journal*.

Three further awards are made each year:—

The Best Article of the Year Prize (£50) open to all authors;

The Montgomerie Prize (a book to value of £25) for the best article on a professional subject by a Serving Regular RE Officer not above rank of Lieut Colonel;

The Arthur ffolliott Garrett Prize (to purchase or help purchase a piece of silver, value £25) for the best article on the technical aspects of logistic engineering or survey by a Serving Regular RE Officer not above rank of Lieut Colonel.

Articles may be submitted at any time but the following dates are *normally* the latest for inclusion in the issues shewn:

MARCH ISSUE	1 DECEMBER	SEPTEMBER ISSUE	1 JUNE
JUNE ISSUE	1 MARCH	DECEMBER ISSUE	1 SEPTEMBER

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

CORRESPONDENCE

Correspondence is the life blood of the *RE Journal*. Correspondence on published articles is particularly interesting as it provokes further thought and widens the discussions on controversial topics. It is important however that the initial reactions to articles published should be in the NEXT Journal to maintain the interest in the subject. For this reason the submission date for correspondence *referring to articles* is five weeks later than that for articles. On average this will give correspondents about one month to react.

The submission dates for Correspondence on published articles are therefore:

MARCH ISSUE	7 JANUARY	SEPTEMBER ISSUE	7 JULY
JUNE ISSUE	7 APRIL	DECEMBER ISSUE	7 OCTOBER