THE ROYAL ENGINEERS JOURNAL

Vol LXXXIII SEPTEMBER 1969 No 3

CONTENTS

THIS REALLY COULD SAVE YOU MONEY

The new Victaulic Grooved System of pipework installation is a money-saver because it costs less to install.

The unique simplicity of its housing, bolts and ring allows installation at least five times faster than any other system.

A fitter or anyone armed with a spanner can easily assemble it, and, with the specially provided grooving tool, prepare the pipe ends on site.

The leak-tight joints allow for expansion and contraction, eliminating costly expansion joints.

The Victaulic Grooved System of piping and fittings offers a comprehensive range up to 24" diameter.

Read all about it in our new booklet. We'll send you a copy.

THE NEW VICTAULIC GROOVED SYSTEM

VICTAULIC VIKING

The Victaulic Company Limited · 46 Wilbury Way · Hitchin · Herts.
Telephone: Hitchin 4452 · Telex: 24606 · Telegrams: Victaulic Hitchin.
Northern and Tubes Group—British Steel Corporation

THE COUNCIL OF THE INSTITUTION OF ROYAL ENGINEERS

(Established 1875, Incorporated by Royal Charter, 1923)

Patron—HER MAJESTY THE QUEEN

President

Major-General T. H. F. Foulkes, CB, OBE, MA, FICE 1965

Vice-Presidents

Brigadier H. W. Kitson, CBE, MA, MBIM 1965

Major-General R. L. Clutterbuck, OBE, MA, FICE 1968

Elected Members

Major L. T. Allen 1967

Brigadier A. E. Arnold, OBE, BA 1967

Brigadier R. A. Blakeway, OBE, BA 1967

Brigadier D. R. Carroll, OBE 1967

Colonel C. A. A. Crouch, OBE, BSc, MICE 1967

Colonel W. C. S. Harrison, CBE, ERD, FICE, MIHE.. 1967

Colonel P. J. M. Pellereau, MA, FIMechE, MBIM 1967

Brigadier B. G. Rawlins, MA, FIPlantE 1967

Major J. J. Wright 1967

Colonel B. A. E. Maude, MBE, MA 1968

Colonel J. R. de G. Pilkington, OBE, MC, BSc, MICE 1968

Brigadier F. W. J. Cowtan, MBE, MC * 1969

Brigadier A. F. Leslie, MBE 1969

Colonel R. F. N. Anderson, OBE, MC, MBIM 1969

Colonel M. J. A. Campbell, MBE, MC, BA 1969

Ex-Officio Members

Brigadier M. L. Crossthwait, MBE, MA, MICE, MBIM .. .. D/E-in-C

Colonel M. G. Stevens, MBE .. .. AAG RE

Brigadier W. M. Inglis, CBE, BA .. .. Comdt RSME

Brigadier A. Walmesley-White, MA, FRICS .. .. D Survey

Colonel R. R. Crooks .. ..D/Comdt RSME

Brigadier A. G. C. Jones, MC, BA .. .. Comd, Trg Bde RE

Brigadier C. H. Cowan, BA, MICE .. .. Brig Engr Plans

Corresponding Members

Lieut-Colonel B. W. Brighouse
New Zealand Military Forces .. .. 4 September 1968

Brigadier C. F. Flint, OBE
Australian Military Forces .. .. 18 October 1968

Brigadier-General E. W. Henselwood, DSO, CD, *Canadian Forces* .. 4 November 1968

Secretary and Editor RE Journal

Brigadier J. H. S. Lacey, CBE, BA .. .. 15 December 1958

Bankers

Lloyds Bank, Ltd, Cox's and King's Branch, 6 Pall Mall, SW1

THE ROYAL ENGINEERS JOURNAL

Authors alone are responsible for the statements made and the opinions expressed in their papers

VOL. LXXXIII

CONTENTS

SEPTEMBER, 1969

1969 Annual General Meeting Address by Engineer-in-Chief

AT the Annual General Meeting of the Corps on 2 July 1969, the E-in-C gave a talk on the state of the Corps, accompanied by slides. Below is a summary.

PERSONNEL

The quality of the officers in the Corps is as good as it has ever been, and that of its other ranks better.

(*a*) At no time since the war have we been without at least one of the five to six military members of the Army Board, and this remains so.

(*b*) Of the ten General Officers who were Royal Engineers, eight are serving outside the Corps. In each of the four main departments (VCGS, AG, QMG, and MGO) one of the two or three Directors is a Sapper Major-General.

(*c*) Of the now much-reduced number of Infantry and Armoured Brigades in the Army, one is already commanded by a Sapper and a second one shortly will be.

(*d*) We have some excellent COs, and the quality of the better half of our majors is at this moment higher than that in any other arm.

(*e*) Many more Sandhurst cadets give RE as their first choice than we could accept. Our average place in the order of merit is almost invariably higher than that of any other arm. Although slightly short of officers, we are in a position to go three or four short voluntarily rather than accept any who we do not think measure up to our standards.

(*f*) One of the reasons for this is the outstanding success of the ex-warrant officers who had been given short-service and special regular commissions. There have been virtually no failures amongst these, and the quality of WOs and senior NCOs coming up is even better than before. This makes it all the more necessary not to accept any young officers of doubtful quality.

(*g*) In its ranks, every unit has more corporals fit for sergeant and more sappers fit to be junior NCOs than it has vacancies into which to promote. Many sergeants now have A levels, and may sappers O levels.

The upshot of this is that the Corps is well placed to expand if necessary and is, in the meantime, able to take on many independent management tasks overseas, in addition to commanding its own men.

COMBAT ENGINEER EQUIPMENT

The position over combat engineering equipment is equally encouraging—

(*a*) The Medium Girder Bridge shows a 20 to 1 reduction in the man hours needed to put a tank bridge across a 100-ft gap compared with the Bailey Bridge. Considering that the Bailey itself was a revolution in its time, and left all other equipment bridges standing, this is a tremendous achievement by MEXE. In recent trials in BAOR the MGB proved itself better on every count than two other bridges against which it was competitively tested. There are now great hopes for the export of this bridge to the US, Australian and European Armies.

(*b*) Our Amphibious Squadron in Germany is now equipped with the German M2B, which had replaced the French Gillois. In terms of productivity the M2B shows an even more dramatic advance over the Bailey Pontoon Bridge. It is now possible to have a tank raft across the Weser within ¼ hour and a tank bridge in under an hour.

(*c*) The Class 16 Airportable bridge, carried wholly on land rovers, is a most versatile piece of equipment, able to be used for fixed bridges, floating bridges and ferries. Here, too, there is a considerable export potential.

(*d*) The new tank bridge on a Chieftain chassis is now in the prototype stage, and able to bridge a 75-ft gap—sufficient to cover over 90 per cent of the anticipated gaps in Europe.

(*e*) Also under development is the bar-mine and the bar-mine layer which can be towed behind the standard Armoured Personnel Carrier. This should greatly increase the speed with which we can lay down obstacles.

(*f*) The Light Mobile Digger has also proved tremendously successful in the rapid digging of trenches in the relatively rock-free North German plain.

(*g*) Also under development is the Combat Engineer Tractor, an armoured vehicle with a swimming capability which should be able to go anywhere the APC can go, and do a wide variety of tasks.

At the same time, in common with his opposite numbers in the infantry, every Sapper section corporal in BAOR now carries his section and his equipment with him in an Armoured Personnel Carrier and is in communication by radio with his OC and with the outside world. This has enormously widened his horizons and his understanding of what is going on in the battle. It is as if every section corporal now commands his own ship, and this is reflected by the spirit in which they tackle the task.

REORGANIZATION IN BAOR

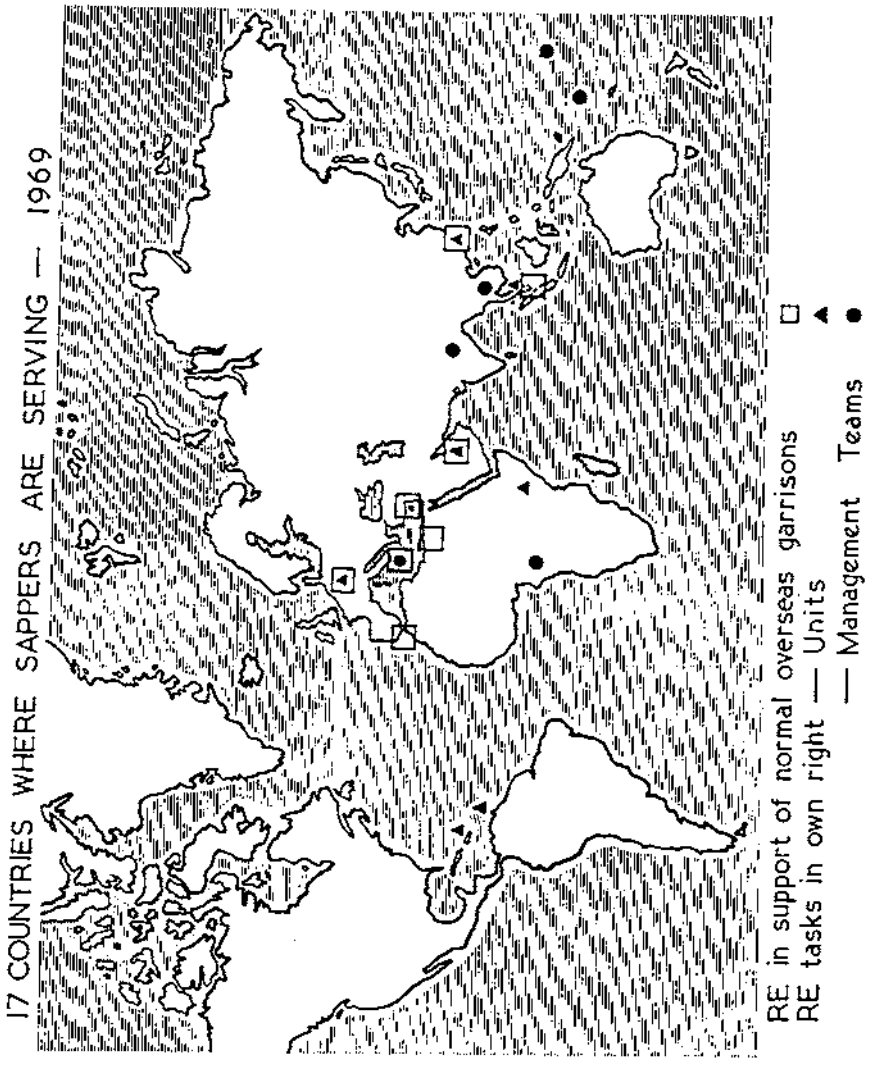
To match these developments, and in particular the greatly increased speed with which we can make obstacles and cross them—the Royal Engineers in Germany have been reorganized, so that there are now two field squadrons with their supporting elements, in every brigade. With every brigade HQ there is a lieutenant-colonel and a full colonel CRE at division. Thus, no matter how much the squadrons and troops need to be switched around to meet operational needs, the Divisional and Brigade Commanders will always have the same Sapper Adviser commanding these troops. This organization has now been operating for three months in Germany, and is working very well indeed. Other arms are realizing more and more how much they depend upon obstacles, and on their ability to cross them quickly, in their tactical thinking. The Sappers have never been so closely integrated into the all-arms battle groups as they are now, and their prestige has never been higher.

With all the BAOR field squadrons now in divisions, we rely to an increasing extent on the TAVR for Corps and Army troops. All our TAVR units have a direct operational role, which they know, and for which they train. As a result, their training has great purpose and this is reflected in their morale. Every third year most units go and train in BAOR for this role.

As a reflection on this new status of RE units in the TAVR, a new regiment has just been formed, which is a happy situation in view of the cuts that are going on elsewhere.

EMERGENCY RELIEF TASKS IN UK

Another field in which the Corps has earned a lot of praise in recent years is in Military Assistance to the Civil Community, both overseas and in the remoter parts of Scotland; also in response to emergency demands, such as floods, at various places in the United Kingdom. During the past twelve months there was the major flood disaster in SW England, in which forty bridges were swept away overnight, and the Corps replaced those on the main trunk routes within two or three days, and several others within a week. Chief credit for this goes to Brigadier Tickell, Commander of 12 Engineer Brigade, and to 36 Engineer Regiment. By happy chance, 71 Engineer Regiment (TAVR) from Scotland at that moment arrived at Wyke Regis to spend their annual camp in bridging and watermanship training. Instead, they deployed immediately onto real bridges and, a few days later, they opened three main routes with their own piper leading the way at opening ceremony. This was a superb indication of the operational reliability of the TAVR, and of its morale.


17 COUNTRIES WHERE SAPPERS ARE SERVING — 1969
RE in support of normal overseas garrisons
RE tasks in own right — Units
— Management Teams

In Scotland, during 1968, no less than 68 projects were done in aid to the civil community, of which forty-six were by RE units. These included several airstrips and roads, water supplies for remote villages, and youth training centres in the mountains.

OVERSEAS PROJECTS

Overseas, we are currently doing development projects in seventeen different countries. In some of these, such as Germany, Gibraltar, Malta, Cyprus, the Gulf, Singapore and Hong Kong, the projects are a part-time activity of the Sapper units present in support of normal garrisons of all arms. Their tasks include the formation work for a most impressive airfield in Germany, road development in Bavaria and Norway, and roads, wells and accommodation in other places where they are needed. These are in addition to their normal combat engineer training and their exercises with other arms in their brigades.

In Libya and the Persian Gulf much valuable work is going on in support of the RAF, a role which the corps undertook in 1965. This includes extensions to the airfield at El Adem in pavement-quality concrete.

In other parts of the world Sappers are carrying out development projects in their own right, independently of other arms, usually on behalf of the Overseas Development Ministry, who share with the host country the extra cost of keeping the troops there, over and above what it would cost to keep them training in their own home bases. Some of these tasks are being done by RE units, and others by management teams employing local labour.

The unit tasks have included the airfield just opened on Beef Island in the British Virgin Islands, and the well-publicised tasks being done by the Sappers on Anguilla, which include a new five-building school, and improvements to the roads and water supplies. In Kenya three field squadrons took turns in opening up forty miles of road to give access for 10-ton lorries to new wheat-growing settlements opened for Masai tribesmen on the 9,000-ft Mau Escarpment south-west of Nakuru. At the same time a magnificent team of seventeen soldiers under Major Russ Theobald was working in the remote North East Desert of Kenya with two deep well-drilling rigs, which they used to such effect that this arid desert can now support an additional 12,000 camels, which will have a great effect on its economy. While they did this, they trained a complete replacement for themselves amongst the Sappers of the Kenya Army, who will now continue the good work with the equipment, which we left behind for a nominal charge.

Another project of great significance is going on at Bukit Mendi in Malaysia. Here, in co-operation with the Federal Land Development Authority, the Sappers are opening up access with roads and bridges to an area of jungle which the Malaysians are clearing, and in which they are planting oil palm. The difference is that instead of building themselves a normal army camp to live in the Sappers are building a settler's village, consisting of sixty settlers houses on the standard Malaysian design and the necessary public buildings such as schools. The Sappers will use these as living accommodation, dining-rooms, etc, while they work, and they will then move out, leaving a settlers' village ready for occupation on the new oil-palm estate.

MANAGEMENT TEAMS

With our enormous management potential (to which reference was made earlier) perhaps the most cost-effective Sappers we have at the moment are those being used in our Management Teams. If the seventeen Sappers in Kenya achieved a dramatic dividend, perhaps the four who have just left the Congo achieved an even more dramatic one. Supervising Congolese soldiers and civil labour, they reconstructed no less than eleven large Bailey bridges damaged or destroyed during Civil War, and have earned the most glowing reports both from the Congolese and from the British Ambassador. Three others in the Solomon Islands, and two in the Gilbert and Ellis Islands, have each also organized and directed the islanders in opening a new air-

field in their respective islands, and are going on in each case to open a second one on neighbouring islands. Technically, the most interesting of our Management Team tasks is that of the Specialist Team RE in Malta. Under the Robens plan a large programme of construction work has been undertaken to create 14,000 new jobs—7,000 in the tourist industry and 7,000 in factories—to make up for loss of employment in the British base. Since the contractors are willing to pay the engineers and technicians they need as much as is necessary to secure their employment, it was clear that the PWD was going to find it difficult to recruit the necessary staff to plan and supervise this work. By agreement between Lord Robens and my predecessor, General Bowring, a team of two RE majors (chartered engineers) and eighteen technicians was seconded to the PWD to assist them in this task. This team is at present providing site engineers on two factory estates, one (nearing completion) of six factories and another (just starting), of forty-two factories, with their road system, electric power, water supply, sewerage, etc. Other members of the team are using directly employed labour to construct a motorway flyover outside Valletta and others are supervising the building of a panoramic road along the cliff tops on the south-west coast of the island. This kind of work offers the best possible training for the chartered engineers officers and technicians who would be needed to provide works services in war in the communication zone in Germany.

Next month the Sappers are returning to Thailand, with a team of twenty-eight, to find water in a particulary arid area, and then to help the Thais to construct model villages with essential services to house the influx of inhabitants who will undoubtedly throng to where the water has been found.

Other projects are planned in Canada, the Carribbean, Ethiopia and other countries. The seventeen countries on the map which have Sapper blobs may change, but there will still be about seventeen of them.

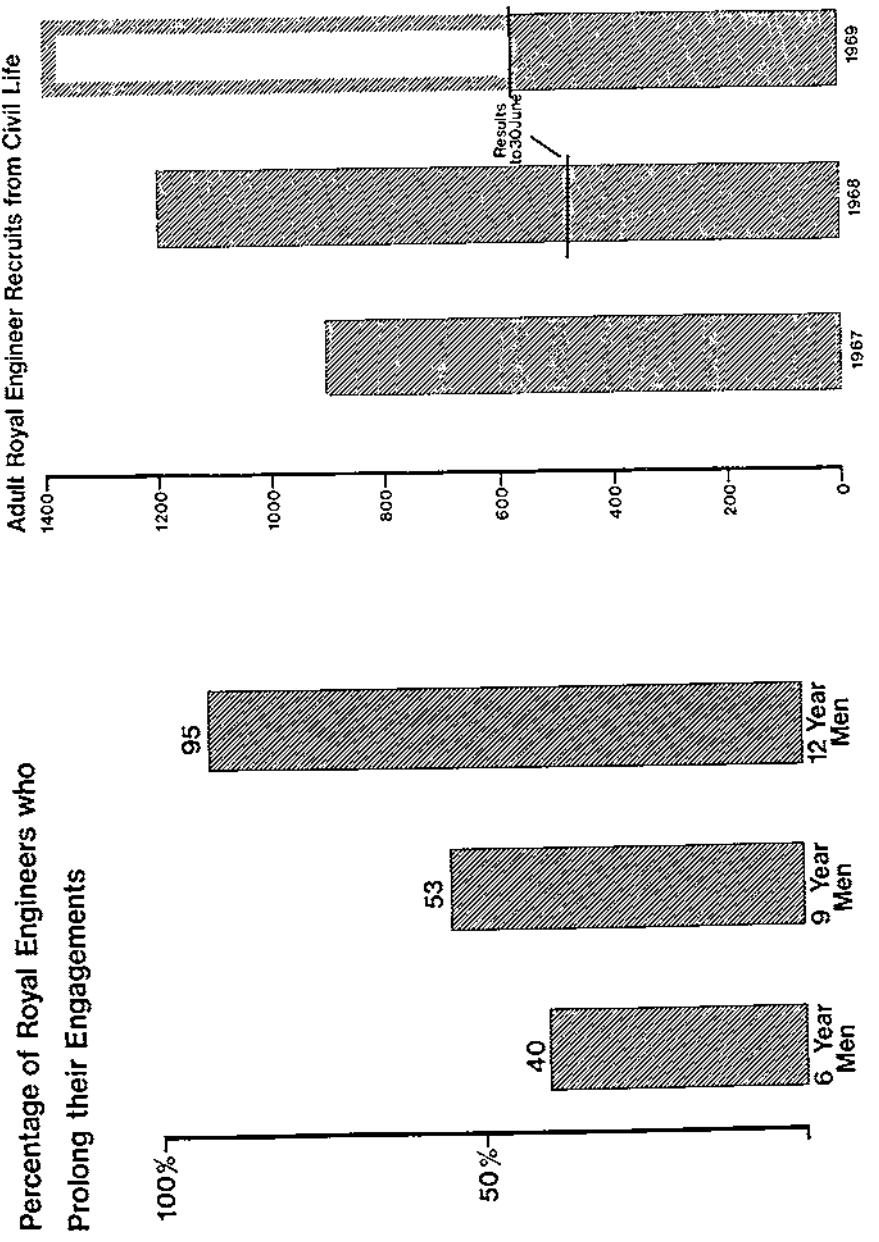
OTHER ARMS

One very satisfactory development which we are encouraging is the increasing interest of other arms in joining with us in these activities. Leaders in this field are the Royal Highland Fusiliers and the 2nd Battalion of the Royal Anglian Regiment, both of whom have done and are doing projects in their own right, sometimes with Sapper assistance. We hope that this will continue, with infantry companies in far-off places doing their own projects with a sapper sergeant or corporal as the "CRE". Our NCOs are well up to this, and it gives them a wonderfully independent spirit. At the same time, we are taking soldiers of other arms with us on our own projects—we had men from the Royal Anglian Regiment and the Royal Artillery with us on the Mau Escarpment in Kenya, and we are taking men from the SAS and the RAC with our team to Thailand.

RECRUITING

Perhaps because the public is becoming increasingly aware of the rewarding projects which we do in UK and overseas, and the great advances in our equipment in the combat role, our recruiting is going very well. In 1968, while the strength of the Army was going down, we recruited 30 per cent more men than in 1967, and so far, in the first six months of 1969, we are 18 per cent up on 1968. I must, however, sound a word of warning. The Army has now introduced a three-year engagement. We cannot offer to train a man in two trades within three years, so, apart from certain single trades (such as driver and clerk), we are only prepared to train our three-year men as combat engineers, with the promise of a second trade after they have signed on for six. This may mean that we lose a number of our potential recruits to Corps where they only need one trade. We must not therefore let up on our recruting.

Our re-engagement rate gets higher the longer a man is with us. At the six-year point over 40 per cent of our men sign on for more, at nine years over fifty per cent, and at twelve years over ninety per cent. This is encouraging, but here also we must avoid being complacent. Because our recruiting of six and nine-year men was very


Adult Royal Engineer Recruits from Civil Life
1400
1200
1000
800
600
400
200
0
1967
1968
1969
Results to 30 June
Percentage of Royal Engineers who Prolong their Engagements
100%
50%
40
53
95
6 Year Men
9 Year Men
12 Year Men

high as 1962–3, we have now a very large normal wastage, and we need this high re-engagement rate to hold our own.

The state of our officer recruiting is not quite so healthy, By insisting on high quality we are sacrificing numbers in our intake. The cure for this is that we must get more young men of high quality trying to get into the Royal Engineers, either through Sandhurst, or by direct entry from universities, or with university cadetships, or on short-service commissions. The linking of short-service commissions with industry is a particularly promising development and we must exploit it. We must also encourage more Army scholars to opt for the Royal Engineers and, once they have done so, to establish contacts with them, invite them over to see us, and take them on overseas training exercises, etc. We are falling behind certain other arms in this very active approach to PR—particularly the Brigade of Guards and the Green Jackets.

TELLING THE WORLD

The greatest contribution that members and ex-members of the Corps can give is to spread the facts about the good life we lead and the good prospects for anyone joining us. We have a wonderful story to tell. We must tell it around the universities, the schools and amongst the public from whose families our future offices and other ranks will come. We must tell them about the dramatic developments in our equipment. We must correct the growing and false impression that we only serve in Europe. We must tell them about the exciting and rewarding projects we are doing in seventeen countries overseas; and assure them that the demand is such that we will continue to do so; and we must remind them of the great contribution that our soldiers make in this country both in the development of remote areas and in dealing with floods and other national emergencies. We must tell them particularly about the tremendous responsibilities given to relatively young officers in our management teams all over the world—in the Congo, Thailand, Malta and in the Pacific Islands. Such independent responsibility is rare in industry. Moreover, industry is realizing more and more that they have no parallel to the Army's system of selection and management training, and that the Army officer joining them in his twenties, thirties, forties or even fifties, is immensely valuable to them as a manager. Every officer and soldier, whether he leaves the army at 24 or 55, has a second half of his working life to come. The army offers him better training for this than almost anything else he could do and gives him a knowledge of the world which is wider than he could get in almost any other way.

So the message of this talk is to urge members to go out and tell the story of what we are doing, so that more young men of high quality will volunteer to come and join us. We can then go on picking the best.

Official Opening of the new Ordnance Survey Headquarters at Southampton by Her Majesty the Queen on 1 May 1969

HER MAJESTY THE QUEEN, accompanied by His Royal Highness the Duke of Edinburgh, arrived at the new Headquarters by car at 2.45 pm in brilliant sunshine. They were met by the Rt Hon Anthony Greenwood, MP, Minister of Housing and Local Government, and other dignitaries.

The Royal party was then conducted to the Reception Hall, where the Director-General, Major-General R. C. A. Edge, CB, MBE, gave a short speech of welcome in which he said:

Your Majesty:

On behalf of every member of the Ordnance Survey, I welcome you and His Royal Highness on this great day in our history. Since its foundation in 1791 the Ordnance Survey has always laboured to make its maps in improvised offices: first in the Tower of London, then in a converted Military Asylum in Southampton, and finally in scattered temporary buildings erected during the last war. Today the opening of these splendid premises marks the end of our refugee status.

On this day we recall with gratitude the personal interest which Your Majesty's ancestor, King George III, took in the surveying operations which led to our foundation. We also remember with pleasure that Your Majesty's father visited us in 1930 when he was Duke of York. But never before, since the Ordnance Survey was formally constituted, have we been honoured by a visit from the reigning Sovereign. No occasion could, I believe, be more appropriate for the visit of Your Majesty and His Royal Highness than this opening ceremony; and nothing could honour the Ordnance Survey more, nor give us greater pleasure.

Your Majesty, I now invite you to open the building.

In her gracious reply the Queen said:

General Edge:

Thank you for your kind welcome on behalf of all the members of the Ordnance Survey.

I am glad to be here today to see something of your work. No important development can take place either in town or country without reference to an accurate and up-to-date map or plan. Thus, from a modest and mainly military beginning more than 170 years ago, the Ordnance Survey has grown, in step with its ever-increasing responsibilities, to become the considerable and largely civilian organization which serves the community so well today.

I congratulate the Ministry of Public Building and Works on completing this building for you, and I now have great pleasure in declaring the Headquarters for the Ordnance Survey open."

Her Majesty unveiled a plaque commemorating the official opening. The Trumpeters of the Royal Engineers sounded a fanfare and the Director-General presented the Queen with an album containing maps and photographs of the Royal Palaces and their environs.

The Royal party, after being shown a model of the new building by the Ministry of Public Building and Works' Architect, was taken on a tour of the buildings and demonstrations of production work, which lasted an hour and a half. The Royal Party left by car at 4.45 p.m

During the afternoon the Chatham Band of the Corps of Royal Engineers, under its Director of Music, Captain P. W. Parkes, LRAM, ARCM, played a selection of music.

Photo 1. The Director-General of the Ordnance Survey presents Her Majesty with a copy of the New Forest Tourist sheet, hot off the press.

Photo 2. Her Majesty viewing a flat bed proofing press on the reproduction floor, accompanied by the Royal party. Major-General R. C. A. Edge, CB, MBE and Captain S. E. G. Frazier, RE in attendance.

The two photographs are reproduced by courtesy of Southern Newspapers Ltd.

Amongst the distinguished guests who attended the ceremony were, General Sir Charles P. Jones, GCB, CBE, MC (Chief Royal Engineer) and Lady Jones, Major-General R. L. Clutterbuck, OBE (Engineer-in-Chief) and Mrs Clutterbuck, Major-Generals R. Ll. Brown, CB, CBE, L. F. de Vic Carey, CB, CBE, and A. H. Dowson, CB, CBE (former Directors-General of the Ordnance Survey) and their wives, and Brigadier B. St G. Irwin (Director of Military Survey and Director-General of the Ordnance Survey designate) and Mrs Irwin.

Official opening of the new ordnance survey headquaters at Southampton 2

The Director, MEXE, presents the mace.

Official opening of the new ordnance survey headquaters at Southampton 1

Presentation of the Freedom of the Borough of Christchurch to the Military Engineering Experimental Establishment

MANY regiments and corps of the Army have been granted the freedom of a city or borough, but never has an experimental establishment been so honoured. It was, therefore, a unique occasion on Tuesday 6 May 1969 when the Freedom of the Borough of Christchurch was conferred upon the Military Engineering Experimental Establishment (MEXE), which this year celebrated the fiftieth anniversary of its formation at Christchurch as the Experimental Bridging Company, Royal Engineers In 1925 it was renamed the Experimental Bridging Establishment, and in 1946 it adopted its present title.

The location of MEXE, on the bank of the River Stour, is the site of a barracks which has been in existence since 1793, when a squadron of cavalry stationed there assisted excisemen to suppress smuggling. Little of the old barracks remains, and there is now a series of well-equipped workshops, laboratories and test facilities.

MEXE is today responsible for research and development of a wide range of military equipment, including bridging, airfield surfacing materials, bulk fuel and water supply stores, power supplies, special "C" vehicles and mechanical handling equipment. The Establishment is also responsible for the service testing and evaluation of commercial engines ,"C" vehicles and engineer construction plant for all three services. In support of such projects MEXE carries out research on the application of new materials, including reinforced plastics. In addition, MEXE is a recognized test centre for commercial construction equipment and for freight containers. It has a staff of thirteen and almost eight hundred civilian personnel.

A ceremonial parade of some 300 officers and men took place on the sports ground on 6 May. There were contingents from the Corps of Royal Engineers, the Royal Corps of Transport, the Royal Army Ordnance Corps and the Corps of Royal Electrical and Mechanical Engineers. The Chatham Band of the Royal Engineers was present. Units providing the contingents were 3 Division Engineers from Tidworth, 380 Air Despatch Troop Royal Corps of Transport from Thorney Island, 47 Company Royal Army Ordnance Corps from West Moors, and the School of Electrical and Mechanical Engineers Regiment from Bordon. The parade was commanded by Lieut-Colonel P. M. Castle-Smith, MC, RE, a member of the Military Staff of MEXE.

The Worshipful the Mayor, Alderman Mrs D. Baker, JP, accompanied by the Director of MEXE, Mr R. A. Foulkes, was received with a general salute, and, following prayers by the Chaplain, the Town Clerk read out the Scroll conferring the Freedom of the Borough, which was inscribed as follows:

At a special meeting of the Council of the Borough of Christchurch held on the 28th day of January 1969, The Worshipful the Mayor, Alderman Mrs D. Baker, JP, in the Chair, IT WAS RESOLVED UNANIMOUSLY THAT, in appreciation of the close association of the Military Engineering Experimental Establishment (MEXE) with the Borough of Christchurch since the 28th February 1919, when the Experimental Bridging Company, Royal Engineers, was first formed and established on the site of the barracks which had existed since 1793, and in recognition of the highly important role of the Establishment in support of the Armed Forces of the Crown, particularly during the World War of 1939–45, THE COUNCIL OF THE BOROUGH OF CHRISTCHURCH do hereby grant to the MILITARY ENGINEERING EXPERIMENTAL ESTABLISHMENT (MEXE) at CHRISTCHURCH the HONORARY FREEDOM of the BOROUGH OF CHRISTCHURCH with the

right, privilege and honour of marching through the streets and highways of the said Borough on ceremonial occasions with bayonets fixed, bands playing, drums beating and colours flying.

GIVEN under the Common Seal of the Mayor, Aldermen and Burgesses of the Borough of Christchurch this 6th day of May 1969.

The illuminated Scroll, upon which the address was inscribed was, then placed in a casket made from old oak taken from the Priory Church and presented by the Mayor to the Director, who handed it to Captain J. A. Crow, RE, to be carried at the head of the parade. The Director, having thanked the Mayor, Aldermen and Councillors for this generous gift, presented the Mayor with a Mace, which had been made by apprentices under the guidance of master craftsmen in MEXE workshops. Following the National Anthem and final salute, the Mayoral party left for the Town Hall.

After the ceremony the parade exercised the right conferred by the Freedom of marching through Christchurch with bands playing, drums beating and bayonets fixed. Headed by an escort of the Royal Military Police Mounted Troop from Aldershot and the Royal Engineers' Band, the parade marched through the High Street, where the Lady Mayor took the salute at the Town Hall. She was accompanied on the saluting dais by the Director of MEXE, General Sir Charles Richardson (Master-General of the Ordnance), Major-General D. B. Wormald (Director-General of Fighting Vehicles and Engineer Equipment), Brigadier R. S. N. Mans (Deputy Commander, South East District) and Brigadier M. L. Crosthwait (Deputy Engineer-in-Chief). The marching column was followed by a cavalcade of some thirty specialist vehicles and equipments, selected to show the comprehensive nature of MEXE's activities in recent years. This formed a fitting and impressive finale to a ceremony which will be long remembered by all who witnessed it.

The Mayor, accompanied by Lieut-Colonel P. M. Castle-Smith, MC, RE and Captain R. Richards, REME inspects the parade.

The Freedom of the borough of Christchurch to mexe

The Mayor, Director MEXE, and Town Clerk take their places on the dais.

The RE contingent marches past the Town Hall preceded by the Freedom Casket.

The Freedom of the Borough of Christchurch to mexe

Cavalcade of MEXE vehicles.

A Small Road but Mine Own

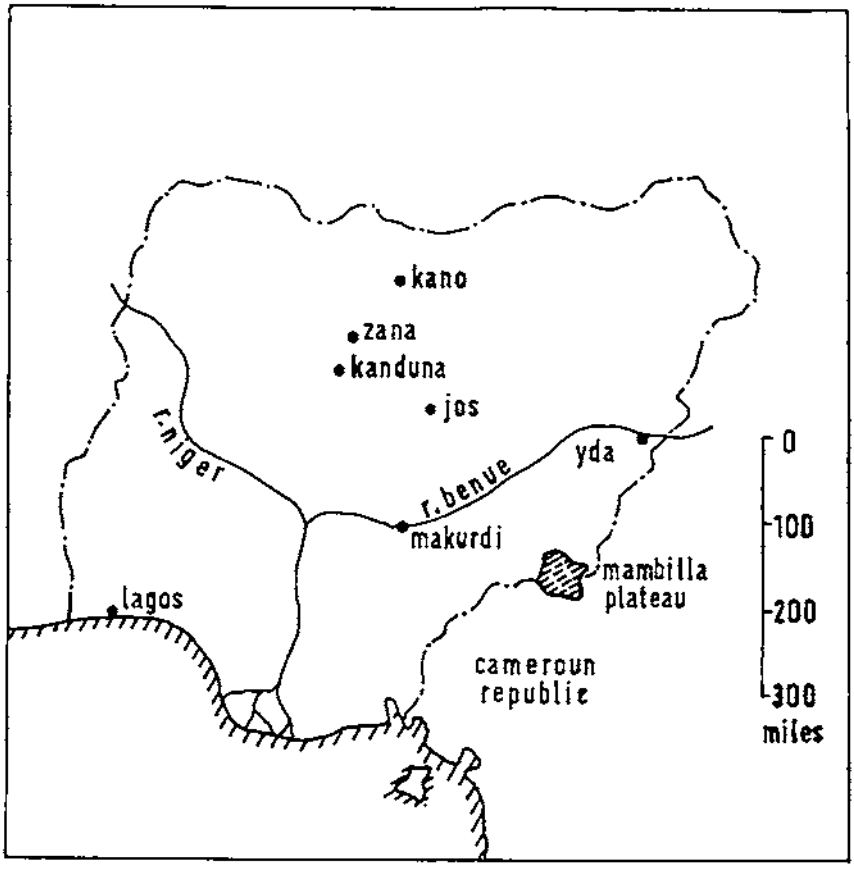
MAJOR A. D. CHARLESWORTH, MBE, RE, MA, MICE

WITH the increasing emphasis being placed on Civil Aid by the Military, the following account of one project may be of interest. No attempt has been made to give a complete technical account of the work, but rather to bring out points of interest and those which may be of value when working on similar projects in future.

In 1962–4 I was seconded to the Nigerian Army Engineers, based mainly in Kaduna, in the Northern Region. Here I worked for a year on routine Army tasks with one or two interesting small problems of bridging and civil aid—working out how to insert a very large transformer into a TV building whose architect had neglected to leave a large enough door for its entrance was one of them! During this time my wife introduced me to the secretary to the Northern Premier, who had been helping her organize her anthropological studies, and through him I came to hear of an area on the borders of Nigeria and the old Cameroons, known as the Mambilla Plateau. We discussed it in conversation both as a wild and beautiful area for anyone interested in hill walking, as I am, and also as an engineering problem. It had been the subject of several schemes for opening up the area, and the secretary, John Smith, had long considered that a road could and should be built there.

Back in the time of German West Africa, before the 1914 war, a road to the top of the plateau had been contemplated, and the Germans even got as far as digging out a small portion of it, a feat not to be repeated during the far longer years of British power. More recently, the Cameroons had voted to join Nigeria, and the necessity of access to this part had become more apparent. In the early 1960s a consulting firm carried out a survey of road lines north from the plateau, to link with the roadhead at Serti. They recommended a line, and estimated a cost of about £1 m, which was out of the question financially. The whole approach in that instance had been far too "Rolls-Royce" for the probable traffic density. The alternative was a very basic road, to be developed gradually as traffic grew, and the Native Authority (local council) did some preliminary cutting away of bush on a rough road line with the hopeful intention of gingering the Northern Government into taking over rather than with any real expectation of achieving a road link. Over several months a suggestion grew up that perhaps the Army could help with a compromise project. At first this was not greeted very enthusiastically, but I was given a couple of weeks' leave, with a landrover and one soldier interpreter, who came from the area, to make a preliminary survey. In the two weeks we had to drive the 1,800-mile round journey from Kaduna and, leaving the landrover at the roadhead, walk about 150 miles through mountains searching for possible alternatives for a road line.

The Mambilla Plateau is a stretch of high land, between 4,000 and 6,000 ft, with a pleasant climate and cool nights which mean that tsetse fly, the scourge of the nearby plains, is completely absent, and so cattle can graze undisturbed. The area is very sparsely populated, mainly by nomadic Fulani herdsmen. Their cattle are large and very sleek, as the country, with its rolling open hills, is ideal grazing land, though in some danger now of being overgrazed. The only other inhabitants are a number of small indigenous tribes living by subsistence farming, hunting and a little migrant labour. There is a small town on the plateau which is the administrative centre of the area, and there lived the District Officer, veterinary surgeon and an experimental coffee farmer. To reach this town, Gembu, one had to walk from the trackhead on the plains 3,000 ft below, and every commodity had to be taken the eighty miles on the heads of porters. The cattle had to be driven 400 miles through tsetse country to the nearest markets, losing much of their weight on the way, and the coffee, which proved to grow well in the area, was at that time stored still at Gembu for lack of



Nigeria: Location of Mambilla Plateau.

transport. The cost of living, in native terms, was high, due to the cost of head porterage of basic commodities such as salt and paraffin. Potentially, however, the area of some eighty miles by forty miles was a very wealthy province which could support a far greater population and produce much-needed cash crops as well as the protein so badly required in other parts of Nigeria.

After the hurried fortnight's reconnaissance, and discussions with the Native Authority at Gembu and the District Officer, I returned to Kaduna with a preliminary outline plan involving a great deal of plant and not much labour. As it turned out, this was entirely the wrong solution. However, the beauty of such an off-the-cuff scheme is that it can be modified as one goes along.

The project, like Topsy, just grew without ever really being set out as official policy. The main help and instigation came from John Smith. Planning was an oscillation between what I should have liked and what I could get permission for. The road was to follow the line proposed by the consultants as far as possible. In the way of things air photos, made available *after* the project, would have indicated major modifications had the information arrived earlier. It had to be completed by a specific date, governed both by the coming of the rains and some external factors, and very little time was left for detailed planning before moving into the area. From

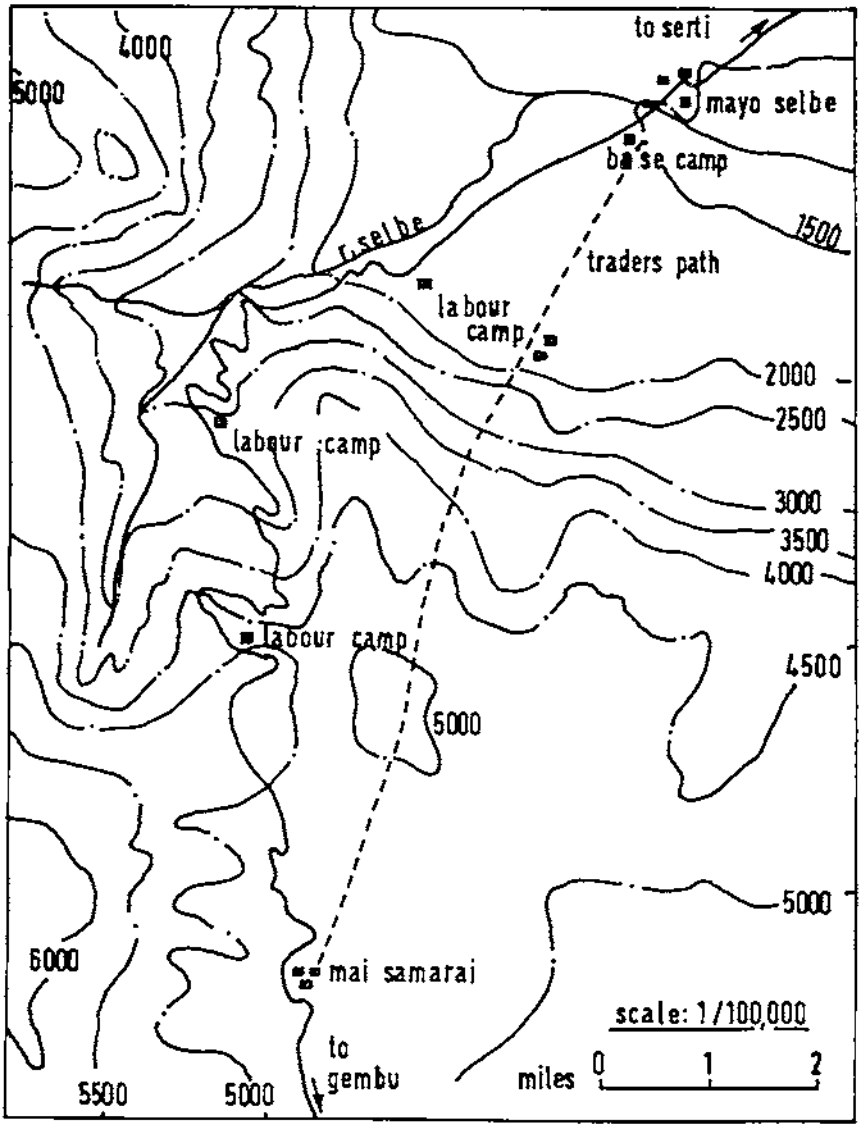
the point of view of the Military, it was a project of minor military value, and only a minimum of stores and men could be spared. In the end I took with me a total of thirty soldiers, including two sergeants, one of them a plant expert, several corporals, drivers, medical orderlies and signallers. As no administrative staff could be spared, my wife took on the clerical work. The financing was to be direct from the Premier's office, and I was allocated about £85,000 for the project. The civil authorities were considerably taken aback when we handed over some £40,000 of this, unspent, when we left—a circumstance which did not, we were given to understand, arise very often! The purse strings were held loosely by the District Officer at Gembu, Mallam Adamu Ciroma, whom we already knew. Bills were passed through him, and it was fortunate that we were dealing with such a helpful and co-operative person, since it took three days for our runner to reach him with bills, and another three days for the runner to return with the signed cheques! Had he been prone to make difficulties, the contractors would never have got paid. Accounting was governed by strict and, to the unitiated, complicated rules current in Government offices, and the difficulties of producing receipts from small stallholders in remote villages, or even from single traders met along the way, produced headaches unthought of in the normal course of construction work.

Agreement on financing, personnel, military stores and plant took some time to reach, and as the dry season was already started I had to do more pre-emptive buying than was good for my nerves. At one stage there were about £6,000 worth of stores on order, with almost no authority to back it. If this gamble had not been taken, there would have been no supplies with which to start work. The nearest large village to the roadhead was Serti, where the existing road ended. This lay some 250 miles south from Yola, the nearest town, which itself only boasted a few canteens, a small airhead, a bank and a resthouse. To pay the labourers each month meant the round trip of 500 miles to the bank for cash. To the west the nearest major town was Makurdi, a railhead through which most of our supplies passed. Between Makurdi and Serti are two large rivers, which could only be crossed by antiquated ferries, and weather often put the road out of action for days at a time, so each trip to the railhead could mean a fortnight's delay.

I moved up to the area in December with my family, which included two baby girls, the soldiers and military supplies, having arranged that what plant I could obtain would follow from Zaria as soon as possible. We established camp thirty miles beyond Serti, at the end of a bush track, at a small village called Mayo Selbe, where there was a one-room Government resthouse that I could take over as living quarters and office, and where there was plenty of flat land on which to set up the camp. We found a considerable number of labourers in the village, who had been drawn to the area by rumours of the project, hoping for work. In one way this made the job easier, as I was able to assemble a work force immediately, but the trouble was that they had been waiting some two months, with no money and far too little food, so that they were not up to a full days work through the first month until payday. This difficulty had to be solved by negotiation with an enterprising local trader, to whom the sole concession for food on credit was given, and who had a place at the pay office to collect debts at the end of the month. We had similar difficulties caused by weakness from hunger later on, during Ramadhan, when the heavy work and tropical heat took their toll of the Muslim labourers. I was able to get an urgent dispensation from the religious leader in Zaria to allow the men some leeway on the prohibitions and, backed by the fact that whilst no one was to be dismissed if they were absent from work during Ramadhan neither were they to be paid, the labour force soon reverted to its usual strength.

Supplies were mainly bought through traders who had heard of the work and came in droves to solicit business. The problem here was firstly to refuse the customary bribes without causing offence and then to differentiate between bribes and the "dash" which was merely a polite way of opening any conversation to do with business. We made a rough rule that a "dash" of up to six eggs, one hen or a few

mangoes could be accepted, but anything more declined, and that a return "dash", of similar value, had to be given by us. The other problem was that in their anxiety to gain the contracts the traders were apt to be optimistic about the amount it would cost to carry the cement, etc, over the unpredictable route from the railhead, and if they weren't watched they would end up bidding so low that their profit would prove negligible or even negative and they might cut their losses and sell the goods before they reached us. It was, however, difficult to explain why we often went for contractors who put in higher and more realistic bids, and I fear that there were often dark suspicions about my motives.



Mambilla Road escarpment section.

The number of labourers available fluctuated from 300 to 500 men. When we needed more recruiting parties had to be sent out over a wide area to remote villages. Some of the men we used had worked occasionally for the Native Authority on local roadworks. A few were specialists, masons, carpenters, etc. The majority, however, were migrant labourers from the small hill tribes, without even a rudimentary knowledge of hand tools, and with a disconcerting habit of working for a month and disappearing off home when they had earned enough to pay the year's tax. We had men from many different tribes, speaking some twenty-four dialects and languages. Most understood some Hausa, which was the lingua franca, and some had a little pidgeon English or French—one even spoke Danish! My sergeants, fortunately, both spoke three of Nigeria's main languages as well as English, and most of the soldiers spoke Hausa as a first or second language. I picked up enough Hausa of a sort for day-to-day use.

Sergeant Ayodele ran the stores, sergeant Etim looked after the construction and, when it arrived, the plant. He had to improvise most repairs himself, as it would have taken weeks to bring mechanics in to sort out breakdowns. Our communications with base were not always good. We had our own radio set, but it proved unreliable, and the only alternatives were the erratic postal services from Serti, which might take a fortnight or more to reach Kaduna, or a runner to Gembu, three days walk away, to ask the Police Post to send a message over their radio. This meant that more and more kit began to be improvised on the spot and new or replacement stores, spare parts, car tyres, etc, tracked down and bargained over in local markets instead of being indented for from the Army in Kaduna. It played havoc with the accounting, as much of the trading was done by barter, and it is difficult to explain the swop of a pregnant ewe for a landrover half-shaft in double entry-bookkeeping. However, it definitely speeded up the work, and proved much cheaper. The project could not have been completed in the time had we stuck to more orthodox methods.

The plant, when it arrived, had shrunk from my original grandiose requirements to the following: One D6, which ran well throughout, apart from an inordinate appetite for clutches; two traxcavators (a 933 which gave up the ghost fairly early on and probably still rusts in the bush, and a 955 which went fairly well, but which required constant rewelding of its bucket). There was also a grader, about which the least said the better, since it took months to arrive, having got stuck in every puddle on the 750-mile journey out, and thereafter acted like a prima donna. The plant operators, however, sent with their machines, were superb men, being amongst the best I have ever known anywhere. They were men of eccentric and noble character who would take the machines up impossible slopes and coax them to feats for which their makers certainly never intended them. We acknowledged their superiority with wage packets which made them the aristocrats of the area, and pandered to their every whim, praising the Lord. We had also "acquired" three concrete mixers on the way. We found them sitting in a compound, guarded by an elderly gentleman who had apparently been on the job for two years without the machines ever having been used. We gave him a paper to indemnify him and to indicate where they were, and carried them off, returning them six months later to the same gentleman, still guarding his empty compound. The most useful piece of kit we had was the compressor, which would go almost anywhere. It used to fall over occasionally when negotiating very rough bush, but was light enough to be lifted up again on to four wheels. We really needed two compressors, as there was an immense amount of work for the one to do, and the road would have been impossible without it. Local labour was trained in the use of the drills, and altogether some two tons of explosives were used. Probably most of the furniture on the Mambilla Plateau still has "ICI Nobel" printed on it! Explosives could only be obtained from Jos, 600 miles away, and we were often nearly out of supplies before the next lot got through.

However, the bulk of the road was cut without plant, using manual labour working to the beat of drummers. Normally they worked several gangs split into two groups —pickmen and shovellers—working alternately and moving vast quantities of earth.

Except on the flattest crossfalls, manpower proved superior and cheaper than plant. We perhaps ignore human labour too much, and to see hundreds of tons of material a day being moved by shovel is a corrective to our mechanized orientated upbringing. I would willingly have swopped all my earthmoving plant for another 200 men.

Petrol and diesel were purchased on Army chits and were in theory to be delivered by a contractor in 44-gallon drums, but when these didn't arrive we had to resort to the nearest local filling station, seventy miles away, where we were highly unpopular as we would run the pumps dry whenever we descended on them, leaving surrounding vehicle-owners bereft until the next tanker delivery.

Labour was organized into gangs of about fifteen men each, under a headman who was responsible for their attendance and discipline. The six junior NCO's with me each looked after a group of gangs, directing work and operating through a civilian overseer. There were a number of timekeepers and a head timekeeper who worked out the paysheets with my wife each month. These were complicated by the large amounts of overtime which were worked, and the two days before pay-day each month were very hectic. The pay had to be made in small coin, and although we had taken a small office safe with us, it generally meant that for the few days between the visit to the bank and pay-day I was sleeping with up to £4,000 under the bed in sacks of coins too bulky for the safe. We learned after the first couple of pay-days to make the pay-out always on a Saturday, since much of the money went on palm wine and celebrations, and it took at least one clear day to recover from pay-nights and for the labourers to be fit to face work again on the Monday!

In general labour relations were very good considering the inexperience of the men and the many tribes from which they were drawn. There were two minor strikes, one owing to a breakdown of communication when a misunderstanding blew up over pay for a religious holiday (having Christians, Muslims and various Pagan labourers among the workforce there was a stream of religious holidays to be observed), and the second over who should be entitled to be carried up to the work-face on the two lorries. A third almost blew up when a dozer operator practically drove over the side of a cliff, abandoned his sinking craft and ran down the hill complaining that there was a juju on the road! There was certainly a curse on him —we had to build a second segment of road below the dozer to recover it, on a 50° side slope! Looking back, it would have been more economical to have ditched it.

It only took ten days to set up camp—the soldiers were sited at the junction of the road line and the traders' footpath. Great care was taken with "bull"—white stones marked out the lines and a large painted board showed our progress. This went down very well with the local villagers, who treated the soldiers with considerable deference. The medical orderlies established a clinic for workers who suffered all the usual tropical diseases caused by lack of amenities and hygiene as well as from bilharzia and endemic goitre. The clinic was originally set at 8–9 am, but when it was found to be suspiciously popular with labourers who appeared perfectly healthy the time was put back to 5 pm, outside work hours. As a result only the really sick came. Throughout the project, and despite the very precipitous slopes worked, we did not have one really serious accident, and only one that needed evacuation to a hospital at Takum 250 miles away. All the same, it was a great comfort to know that the American Mission of a young couple, living at Serti, could in an emergency summon a light plane to airlift out any casualties. They were unfailingly helpful and always ready to assist in any way they could. Their main hospital, at Takum, supplied us with medicaments when we ran out and had no time to await fresh supplies from Kaduna, and gave advice when cases were beyond the rather sketchy bounds of our two orderlies. The orderlies, in fact, were extremely efficient and were soon being referred to as "Doctor" by the villagers. In time they began dealing with simple cases not only among our men but among the families of villagers for miles round. It came rather expensive in medicines, but was excellent for public relations and fulfilled a real need.

The first two or three miles of road were on flat plain and easily dealt with. Some

cutting out had already been started by the Native Authority and merely needed widening and draining, but thereafter the main body of the road was to rise very steeply for more than nine miles, an ascent of roughly 4,000 ft through fairly dense bush undergrowth, until the top of the plateau, where there were a further few miles of undulating, easy grassland. The bulk of the ascent was on steeply sloping ground, covered at that time with high elephant grass. The first major problem was a 500-yd stretch of road across a 45–50° side slope above a 300 ft drop. This was probably the most difficult stretch of the road, and it came inconveniently right at the beginning, with virtually untried labour. It required retaining walls of up to 25 ft height, built out of rough stone brought on porters' heads from a mile and more away. The skills of building the walls had to be taught and close supervision was required initially. Stone supply was a problem as the drills had not arrived to start with, and suitable stone was some distance away. The men could only carry at most 200 lb of stone each an hour—a slow rate of production, but this amounts to ½ ton a day per man, and to watch this ant-like building create 300 ft of retaining wall a week gives a real respect for human labour. The walls were capped with stone set in concrete slurry to a depth of 2 ft, to avoid wheel damage, and the road behind them cut to an average width at this section of 15 ft—adequate for a single-way road.

The progress here seemed agonizingly slow and was punctuated by crises—one whole section of wall had to be rebuilt when faulty workmanship showed up—but there was no way of outflanking this section and time seemed to be running out with ten miles still to go. Later on it was sometimes possible to leapfrog plant and labour and ultimately to set up two labour villages high up in the mountain, working downwards to join the gangs from the base village, but there were always limitations, since the only vehicle access was up the road already built. Incidentally, the beauty of working in Africa in the dry season was that a whole "village" could be built over a week-end—each man taking about a day to make himself a hut from local grasses and canes and co-operating on a few communal huts.

BRIDGE AND CULVERTS

Owing to the need to keep vehicle access as far as possible forward, we had to put in culverts very fast, since they could not be detoured. The rainfall during the wet season was extremely heavy in this area, and whilst we were there up to 3 in would fall in an hour, and it took very little time to churn the surface up unless there was extremely good drainage. This heavy rain would alternate with blazing sun which baked hard any damage done whilst the surface was wet. There were, towards the end of our work there, times when it was completely impossible to continue work owing to the rainfall, and it became necessary, as on many other Nigerian roads, to put up a barrier to prevent vehicles from using the road during really bad weather until the surface had dried out. Culverting was ARMCO, from 2 ft to 6 ft in diameter. The advantages were that the sections were head portable and the foundations did not have to be the quality required by concrete culverts due to the inherent flexibility of ARMCO; a truckload made a large number of culverts, and a complete culvert could be preassembled and rolled in. The normal 2 ft and 3 ft culverts were built in echelon by one gang digging, one gang assembling and one gang backfilling, with a few masons building the wingwalls—total cost about £2 per foot run of culvert!

The large culverts were minor projects in themselves and required detailed planning. Most of the work in these had to be done at week-ends to keep access forward open. One particular one on a hairpin bend incorporated a 50-ft stepladder cascade, to overcome a complex erosion problem. Pre-planning a sequence of culverts was difficult at times. For instance, a rising zigzag of hairpins might involve a complex culvert system from small ones at the top feeding into a large one at the bottom, with increasing drainage-channel sizes, junctions, etc, but on the ground, before building, the head-high elephant grass and thorn gave no idea of the actual topography beneath. We replanted the roadsides with elephant grass as soon as possible, however, to help check erosion.

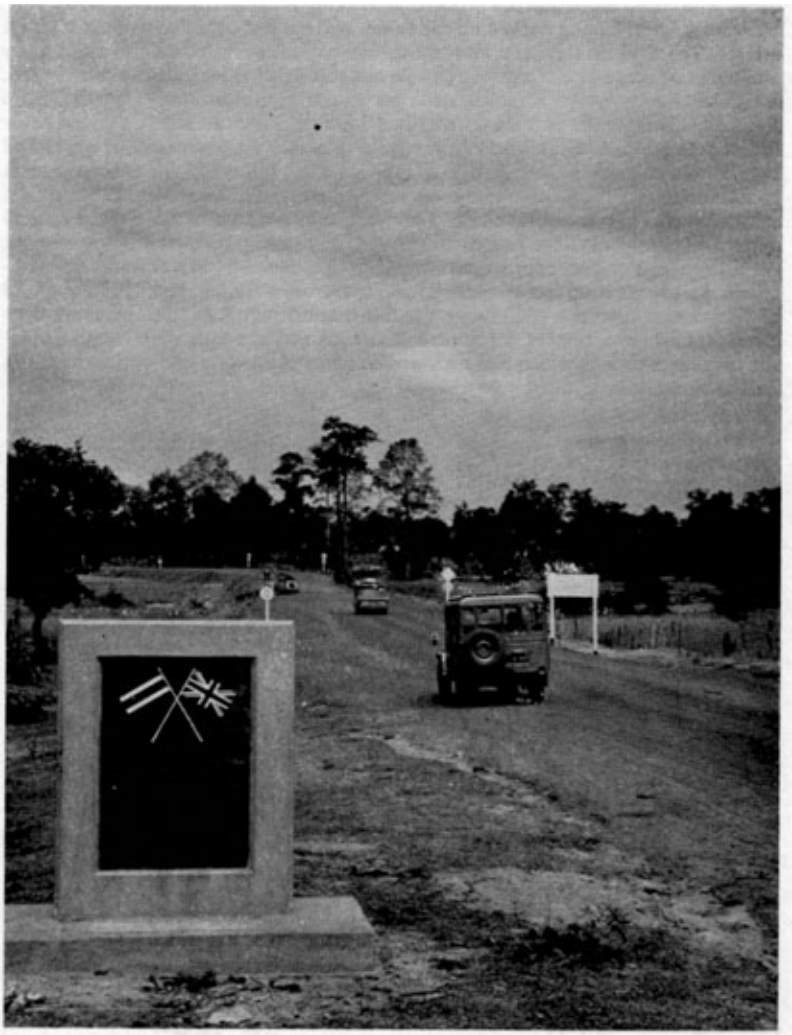


Fig 1. Start point of the POST CROWN Road, looking north from Loeng Nok Tha. The plaque, which is duplicated at the far end, bears the following inscription in Thai and English: "Road from Loeng Nok Tha to Ban Nong Phok built by the British Army and the Royal Thai Army Engineers, with the co-operation of the Thai people under the auspices of the National Security Command, 1967–1968."

Large culvert with anti-erosion steps.

One major bridge was involved on the plain section, over the Selbe River. This had to be designed for minimum quantities, as will be seen later. The river, though a dry-season trickle is a torrent 150 ft wide in the rains, and frequently floods. An initial design factor was what height to build the bridge. Oldest inhabitants were consulted, flood damage inspected, and the conclusion reached that to build a bridge above all possible floods would be far too costly in view of the earthworks involved. Some flooding had to be accepted, and a streamline cross-section was therefore essential if debris was not to accumulate and create a dam. Therefore, for instance, handrails were omitted. The detail is unimportant, though the designing of a RC bridge on the back of an envelope in the bush was a pretty good test of my structures knowledge! Redesign, too, as the wrong-size reinforcing bars turned up! We were fortunate on a trip in to Serti to discover in bush at the side of the road some Larssen sheet piles, which had once been used as land rover tracks across gullies and from this evolved the idea of a V-beam bridge using the Larssen piles as main tension reinforcement. To reduce weight the bridge was continuous over its four spans, a total length of 140 ft. The design was to HA standards—an overdesign in view of the probable traffic, but the Ministry of Works insisted.

Some points of interest cropped up. The shuttering had to be of hardwood—which was fortunately plentiful—to avoid termite damage and was very simple, due to the V shape. It was used twice, each half bridge being poured in one day—80 tons each half. After the shuttering was struck it made excellent coffee-tables and book-cases! Humidity at this time of year was practically zero and curing therefore a problem. The shuttering had impermeable polythene sheeting laid on it, which was very effective. On stripping seven days later, the concrete was still damp, and the

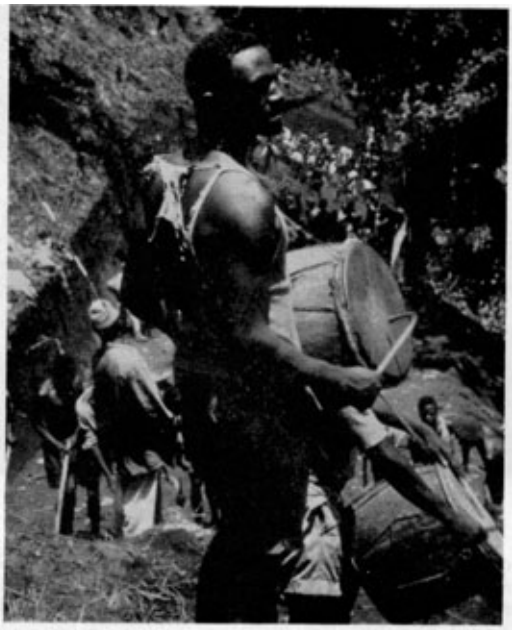
Selbe river bridge nearing completion.

finish, owing to the sheeting, was like marble. The upper surface was heaped with sand, and two small boys were paid 6*d* each a day to slosh buckets of water on to it.

Concrete pour days were great occasions. The 10/7 mixers "borrowed" from the PWD yard poured simultaneously on to the same platform and headpans were filled continuously. About fifty men lined each side of the bridge and full headpans of concrete were passed down one side of the bridge, spread and passed back empty along another row of men on the other side. We brought in drummers when the heat of the day caused work to slow up and this gave everyone new life. The men stamped to the rhythm of the drums to such an extent that the concrete was practically previbrated. The whole village turned out to help, work songs were composed and sung with enthusiasm and the whole thing turned into a great celebration, the local village headman even sending down calabashes of palm wine at the end to keep the party going with libations to various gods and the engineer. After seeing what the presence of drummers did in the way of boosting production on the bridge, we took two permanently on the pay-roll with excellent results, moving them to wherever the work was hardest.

The concrete was made up of aggregates won from the local river about a mile from the bridge site. I did some test gradings and made up samples of coarse aggregate which fitted the BSS curves, and showed these to the foremen. The labourers then panned from the river by hand, and the gravel checked by eye by the foreman. It sounds a slow method, but a man earning 6*s* a day could produce ¾ ton of graded gravel, far cheaper than the usual method of the region, which was rock crushing. Checks showed the gradings to be very consistent. Sand was also won by hand, but the overall grading lacked some fines, and these were produced by sieving won sand through nylon mosquito netting, conveniently about BS36 sieve. The resultant mixture of gravel, coarse sand and fine sand graded perfectly within the BSS envelope.

A contractor had at one point offered to build the bridge for us on sub contract, for a price of £10,000, and with the shortage of time I had been tempted, but decided to go ahead on our own. At the end of the work, when the bridgework was costed, it came to a mere £1,300!



Inspiration.

I had planned a second bridge further up the road, but time was against us, so the other stream crossings too big to be culverted were crossed by Irish bridges. In these I had groups of 2 or 3-ft culverts in the base to take the dry season flow, while accepting flash floods crossing the drifts. This was reasonable, since these streams during the rainy season rose and fell sharply and to cope with the maximum flow would have been uneconomic. Even these Irish bridges took quite a lot of building, since they absorbed large quantities of stone and labour, which were not always immediately available.

ROCKWORK

The ground was mainly the micaceous clay residues of weathered granites. Embedded in this were large granite boulders surrounded by onion-like layers of weathering. Elsewhere were large cliffs. We needed a lot of drilling for this, and I had a Holman Tractair compressor which could power one rock drill. The drill was a standard hammer, but I would have been happier with an airleg on it, as prolonged working on horizontal drilling was exhausting. The standard military cruciform drill bits were tried at first, but they only managed 6–10 slow inches before expiring and proceeding to their secondary use as crowbars. I then managed to get hold of some Sandvik Cormorant drill steels in 2 ft, 4 ft, 6 ft and 8 ft lengths. These were excellent and gave up to 200 ft life before replacement. Had I had a regrinder with me, this could have been extended even further.

Explosives were a problem. Eighty per cent blasting gelatine was available, but only in 4-oz cartridges for pop-shooting. Commercial practice in Nigeria is to use 4-in cartridges. Really 1-in cartridges were required, and some ingenuity was needed

Typical road section.

to make a couple of 4-oz pellets fit alongside each other in a drill hole. All blasting was done with detonating cord and safety fuse. No delay detonators were available and therefore good blasting patterns were difficult to achieve. At times, too, we ran short of safety fuse, and Sergeant Etim and I, the only people to handle explosives, became experts at finding cover close to the explosion and at moving very fast indeed —this was pretty dangerous, as the granite flew large distances due to the residual tensile stresses in the rock.

At one particular site Sergeant Etim and I were letting off a series of shots on Sunday, in order not to delay work. Fuses were very short and we were using a near-by half-completed 5 ft culvert for shelter. We had done a fast sprint for cover and were squatting in the culvert with a couple of labourers when a boulder weighing about 50 lbs did a neat in-off the rock face, came whistling straight down the culvert, passed across my knees and those of the labourers to catch Sergeant Etim amidships. He disappeared from sight out of the end of the culvert, clutching it to his bosom. Apart from bruises he was none the worse, but it was bad for the nerves! Labourers tended to become a bit blase about bangs and our 700 yds safety distance crept in as no one got hit, until one particular rock-face went up. The Cat driver, about 300 yds from the site, had declined to move from his cab and the Cat was surrounded by labourers. An enormous boulder soared gracefully into the air and hit the D6 clean on the blade, leaving quite a dent, while half the labour force moved off like a pack of Olympic athletes downblast!

One factor for which we had not reckoned was the stream of visitors. We had innocently supposed that, being so remote, we would never see an outsider from one month's end to another. We had taken three months' supplies of food and liquor for my family and basic food for the soldiers, but had hardly been there a couple of weeks before the first visitors arrived. From then on there was a steady stream of local dignitaries, missionaries (one particularly charming Irish pair had such a capacity for whisky that they saw us through our three months' supply in three memorable evenings), Ordnance Survey from England, police chiefs on annual rounds, an MP, several Peace Corps teachers on "safari" and occasionally senior

Army officers to check that we were still there. As I had only a one-room hut, and my wife only a single primus to cook on, we had hurriedly to improvise a guest tent, camp beds, and buy local tin plates from which to feed our visitors. The three months' supplies vanished in less than five weeks and thereafter food supplies were wildly fluctuating. If the soldiers killed a cow which they bought by pooling their ration allowances, we would eat meat, and particularly the liver, which they always gave us, until we were glutted, but at other times we all went meatless for days or weeks at a time, save for what the soldiers or local hunters could kill in the bush. Monkey doesn't taste too bad, but some other animals were doubtful, to say the least. Fish was sometimes available, and chickens, but eggs were not generally eaten in the area and we were only ever offered ones which were obviously not going to hatch, by which time they were inedible and highly odorous. Maize and plantains were grown locally and avocado pears and pineapples could sometimes be brought back from more distant markets, but green vegetables or potatoes were unobtainable and visitors were sometimes regaled with very odd meals. One memorable evening we entertained a Hindu engineer who could not eat beef, a Muslim DO who could not touch pork and an Irish missionary who should not have eaten any meat since it was Friday. In desperation we slung a dynamite charge in the river and were thus able to eat fish, as did the entire population of the village that night!

Towards the end of the works there was a sudden uprush of visitors, since it had been learned that the Prime Minister of the Northern Region was coming in person to open the road, We were given an arbitrary date for the opening, which bore no relation to the progress we had made, or were likely to make, since the rainy season had now started. There was still a considerable amount to do, including a very recalcitrant piece of rock to be blasted some three miles from the top. The top stretch was already clear, having been worked from the top camp, but unless we could clear the cliff the Prime Minister and his entire entourage would have to walk the last few miles, which would have been a Poor Show. We worked every hour of daylight seven days a week, stepped the labour force to 700 by desperate recruiting, and Sergeant Etim and I began doing the blasting after dark to try to finish in time. We were hampered by the stream of minor officials wanting to drive up the road to prepare the top village for the stay of the Prime Minister. It was only an ordinary small bush village, so that somehow all the amenities of civilization, such as lavatories and bath-tubs, bedlinen and cooking utensils, chairs and tables, had to be taken up in advance and carried those last few miles. The rains had already broken and the surface of the road, only intended for dry-season use, was being ruined by the stream of landrovers. TV and radio cars added to the traffic and a positive army of police, native authority officials, etc, constantly moved back and forth whilst the work went desperately on to clear the last stretch. One TV van parked too near a rock blast ended up 40 ft below in a gully, fortunately minus its driver. Came opening day minus two and, with the last 100 yards of cliff still to blast, the compressor broke down. Panic! contemplation of a ruined career! Every mechanic in sight was ordered to doctor the machine. The local witchdoctor, who had been very helpful about making magic to ensure a good dry day for the opening ceremony (it worked, too, the first and only rainless day in three weeks), offered a few rites to assist, and with twenty-four hours to go the compressor resumed work and the last blasts were made.

On the day the Prime Minister arrived at Serti for his overnight stop before the opening ceremony I drove my landrover up from bottom to top of the road for the first time. As we neared the top village the headsmen and overseers jumped on the back, the two drummers perched on the wings and we drove into Mai Samari through double lines of cheering villagers, followed by the entire labour force with enough breath to both run and yell. A celebratory impromptu party started up with soldiers, plant operators and labourers all downing such vast quantities of palm wine that by the time the official opening arrived next day they were in a somewhat hungover and subdued mood. The Prime Minister went up with a procession of forty land rovers. The police were terrified that someone would drive over the edge, since the narrow

road was slippery from the rains and many of the drivers were totally unused to the hair-raising bends and 1 in 4 gradients. Fortunately no one did and everything went off very well, complete with dozens of galloping Fulani horsemen in full ceremonial dress, who raced alongside the procession, making a wonderful show.

A week later, having packed up the camp, we left, just over five months after we arrived. The work on the last plains section was handed over to the Native Authority and we have heard since that the road is now through to Gembu, and the plateau, which had hardly known a vehicle, now has traders' lorries regularly travelling from the plains. One of the first things that had been done was to send up a land rover full of pennies (fact: a landrover can only carry £100 worth of pennies), which had begun in a small way, a drop in the cost of living, since hitherto 1*s* had been the most usual coin in use. Now the whole economy of the area has been altered, which is a somewhat sobering thought and one I had not seriously considered. Even the social pattern of the small tribes had been changed, and during the five months of work the little village of Mayo Selbe had swelled until it covered twice the area and contained three times the population it had before the work started. From my own point of view it had been a wonderful few months, and I was grateful for having been given the chance of running, albeit on a shoestring and in a somewhat Heath Robinson fashion, a project which had provided so many challenges and opportunities as well as so much enjoyment.

I make no apologies for the formidable length of this composite effort. Firstly I believe that a successful project which has personally involved a thousand members of the Corps deserves good coverage; and secondly this is in effect five separate articles—six counting my own conclusion—written in differing styles by different authors. However, for those readers who lack either the time or the inclination to accompany us right through, I suggest that a brief reference to the list of contents will provide a reasonable choice.

The story is begun by Freddie Rose, who sets the initial scene and describes the first eight months of the project and the preceding four months of planning. As the first full member of POST CROWN Force, indeed its only member for several weeks of very hard work, there is no one better qualified for this task.

PART I

by

Major C. F. ROSE, MBE, RE

Project Officer POST CROWN Force,

September **1966** – *September* **1967**

NORTH-EAST THAILAND

TOPOGRAPHY

THE whole of North-East Thailand, sometimes known as the Korat Plateau, is a large shallow basin encircled by hills. It is a sandstone region, with alluvial deposits in the valleys, and the general dip is towards the south-east and the Mekong River, which forms the eastern boundary of the area. Most of the terrain is flat, although low sandstone hills, densely forested, are found in most areas. The soil is poor, and the landscape is made up of three main types of vegetation; low, cultivated areas, of which about 90 per cent is rice padi; scrub and light forest; and thicker forest on the higher ground and the hills.

CLIMATE

The hills enclosing the region largely cut it off from the cooling south-east winds, and for much of the year the land is scorched and dusty. The rainy season occurs from May to October, but although the annual rainfall is fairly constant at about 58 in, the monsoon may be early or late and it is quite possible for some of these months to be completely dry. In 1967 a total of 64 in was recorded, of which—to the dismay of 11 Squadron—over one-third fell during the month of September. However, the padi is invariably covered with water by August, and even before this wheeled or tracked movement in low areas becomes impossible. From October to February there is a relatively cool, dry season with winds from the north-east. The harvest is gathered in November and thereafter the padi dries out. From March until May the north-east winds diminish and the days are hot and still, with shade temperatures of up to 110°F. Dust becomes a major problem.

THE PEOPLE

Ethnically, the people of North-East Thailand are more Laotion than Thai. The local dialects are far removed from the classical Thai spoken in Bangkok. There is a tradition of independence, and it is only relatively recently that improved communications and outside pressures have caused the Central Government to speed up development of the area. The people are basically cheerful, fatalistic and content, and exhibit the common sense and shrewdness so typical of the South-East Asian peasant. Buddhism is almost universal, although with some fascinating variations, and petty crime is virtually unknown. Banditry is traditional, however, and is accepted in the remoter regions as a fact of life.

Operation Post Crown

(ROAD CONSTRUCTION IN THAILAND)

LIEUT-COLONEL P. F. AYLWIN-FOSTER, RE, MA, MICE, AMBIM
MAJOR C. F. ROSE, MBE, RE
MAJOR P. WOOLCOTT, RE, MA, MICE
MAJOR C. J. ROUGIER, RE, MA
MAJOR P. R. T. DRISCOLL, RE, BSc
MAJOR G. E. C. WOOLLATT, RE, MICE, AMIPlantE

CONTENTS

INTRODUCTION

Lieut-Colonel P. F. AYLWIN-FOSTER, RE, MA. MICE. AMBIM
CRE (Ops) FARELF/CRE 17 Division
January **1967** – *November* **1968**

THIS is the story of forty kilometres of six-metre wide road, constructed by the Corps in a remote corner of South-East Asia in 1967–8.

From 1963 until the end of 1966 a composite force of some 450 men, comprising basically a field squadron with supporting services, worked near Loeng Nok Tha in North-East Thailand on the construction of a 5,000-ft MRT airfield. That was Operation CROWN.

When that project was nearing completion the proposal was made, largely at the instigation of the Chief Engineer FARELF, that a part of the force should remain

for a period to undertake other urgently needed engineer work in the area. From the Corps' point of view here was a ready-made opportunity to gain some more first-class training in construction engineering. The base was already established, a well-appointed construction camp existed and much of the necessary plant and equipment was already on site. Added to this it would have been hard to find in South-East Asia a better place in which to promote military aid to the civil community or one in which this would give greater benefit both economically and politically. From the Thai point of view we were offering to work in a particularly suitable area. Loeng Nok Tha District is only 100 miles from North Vietnam, and since early 1965 had been a prime target for Communist activity. In view of the poverty and the very low standard of living of its inhabitants, and their lack of proper administration, this was not really surprising. The Bangkok Press reported that a steady stream of young Thais, a hundred or more at a time, were being taken across the Mekong River and through Laos to a training camp near Hanoi, where they were given several months' indoctrination in political and military insurgency. They were then returning to organize cadres in their villages or to join guerrilla groups in the surrounding jungles. During the first four months of 1966 they killed seven out of the thirty eight policemen in Loeng Nok Tha District, as well as a number of other officials, headmen, teachers and so-called informers. In an interview with a Bangkok newspaper in 1967 the Governor of Ubon Province was quoted as saying that in 1965 the Communists had regarded Loeng Nok Tha and the three neighbouring districts as liberated areas, and that local government officials would not dare to venture more than two kilometres from their district headquarters.[1]

It was against this background that after much negotiation a firm offer of engineer assistance was made to the Thai Government and was eagerly accepted. It was agreed that a part of our force would remain for a period of one year after the completion of CROWN airfield, would continue to be based on CROWN Camp and would undertake road construction in the Loeng Nok Tha district. The project would be financed partly by the British Foreign Office and partly by the Thai Government. Thus was born Operation POST CROWN.

This five-part article sets out to tell the story of the project and to underline some of the lessons learned, or—as is so often the case—relearned. The five parts have been written independently by five Sapper officers, each of whom played a prominent part in the operation, and each of whom—as any Sapper should—has very definite ideas of his own. There was no magic in the decision to have five authors. It seemed to me, sitting in Duke of Plaza Toro style in Singapore, charged amongst other things with the task of producing in due course an account of POST CROWN for the *RE Journal*, that I could hardly do better than make some of the senior members of the "Site Staff" contribute to the final report. As there has yet to be a construction project, either civil or military, without subsequent controversy on some of the systems employed or the decisions taken—which, of course, is no bad thing—there must clearly be no party line and plenty of scope for opinion. The logical requirement therefore was a contribution from at least two of the technical staff, at least two of the management staff and at least one of the supporting staff at the main base in Singapore. Hence the chosen five, who were respectively the two successive Project Officers, Majors Freddie Rose and Pat Woolcott; two of the four successive Force Commanders, Majors Jeremy Rougier and Terry Driscoll; and finally my own Project Officer in Singapore, Major Geoff Woollatt. Each was invited to write about his own aspects of the project without reference to his fellow authors. In the unlikely event of it not becoming readily apparent to the reader I can assure him that these are five completely independent and unvetted views. The only stipulation I made was that they should avoid technical detail. For any reader who regrets this there is in the RSME Library a full and excellent Technical Report on the project by Pat Woolcott, which I would strongly commend to anyone faced with a similar project in the future.

[1] "A Constructive Use of Soldiers Overseas", Major-General R. L. Clutterbuck, OBE, *RUSI Journal*, November 1968.

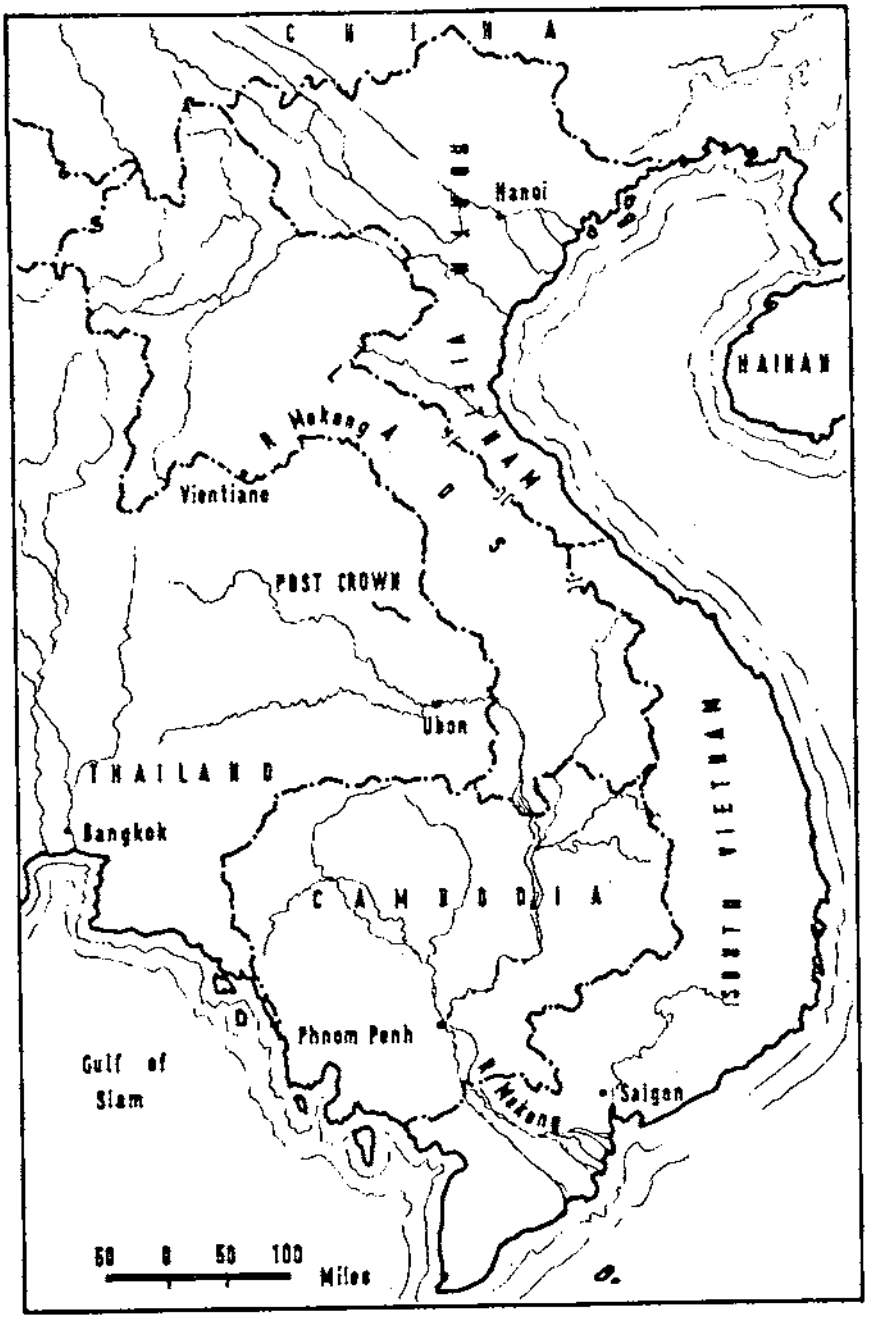


Figure 2. INDO-CHINA and THAILAND

ECONOMY

The region is sparsely populated, with an average of well below 100 to the square mile, and it has not shared in Thailand's phenomenal population growth in recent years. The rice-production cycle dominates the life of the vast majority and this staple crop supports a simple but guaranteed economy. There is no mineral wealth, although oil prospecting is currently in progress. Timber, jute and very limited vegetable and fruit production are the only variations to the rice economy. No one goes hungry, but protein is normally deficient, as there is virtually no game, and the villager depends on fish, lizards and insects for most of his "meat". Red ants, eaten live, are a popular delicacy.

POLITICS

Apart from occasional moves towards closer ties with the Laotions across the Mekong, and away from the central Bangkok Government, the area has been politically quiescent for decades past. Postwar movements in South-East Asia have, however, made the area sensitive, and over the past few years all the signs of an embryonic emergency have become apparent. Communist propaganda has been directed at the population, and armed bands have appeared, building up the classical pattern of subversion and intimidation at village level. Local officials and teachers have been the main target, and in 1965 eight to ten assassinations a month were occurring in Loeng Nok Tha District. The Provincial Government considered this particular district to all intents "lost" to the Communists.

During the past few years the Central Government has initiated a large-scale development programme for the region, together with measures to combat the subversion, but lack of adequate communications has made their task an uphill one. Road construction has therefore been given first priority, and many special agencies, such as the Accelerated Rural Development teams, have been set up. As soon as remote areas, normally cut off completely during the wet season, are brought into contact with District centres, then such important benefits as education, medical services and better policing can follow. This policy is now producing real results, and at the moment the Government shows every sign of winning this particular battle.

THE ROAD PROJECT—PLANNING

It was with this background that ideas began to germinate, in mid-1966, on the possibility of a force remaining in North-East Thailand after the completion of CROWN airfield, to contribute to the development programme. Road construction was the obvious avenue to explore, since the base for this existed in the form of CROWN Camp, together with part at least of the required plant and much of the "know-how" and the essential local knowledge.

Tentative approaches were made to the Thais, and these were received with enthusiasm. The Foreign Office also agreed to meet, in part, the additional costs involved in keeping a military force in Thailand beyond the end of the project.

In early September 1966 I, as OC of 522 Specialist Team (Construction) and Project Officer designate of POST CROWN Force, was briefed by the Chief Engineer FARELF to move to CROWN, to examine various possible road-development tasks in Loeng Nok Tha District, and to start the collection of planning data on local road and bridge standards, drainage problems, civil labour, resources, etc. I visited other road projects, including the recently completed Australian project from Khon Kaen to Maha Sarakan, and the New Zealand/Thai road planned to connect Maha Sarakan and Buriram.[2]

By mid-October it was reasonably certain that a project would be approved, and some of the parameters were becoming clear. The financial contribution by the Thais would be limited to about three million Baht (£61,000), spread over one year, and it was clear that anything less than about 30 km of completed road by the end of the year

[2] "Thai-New Zealand Feeder Road Project", Lieut-Colonel K. C. Fenton, *RE Journal*, June 1966.

would be unacceptable both from the Thai and the British viewpoints. At the same time, it was not clear what type of road would be required, nor its location, nor the size of force (and its plant) which would be approved. Planning therefore had to assume a probable form of road construction, based on the Thai "feeder road" specification, an average number of bridges and culverts, and an "ideal" labour and plant force. With these fixed, a Critical Path analysis was made of two forms of road construction; through typical light forest/scrub country, and across padi. Dry-season conditions for construction were assumed. This analysis produced a rate of progress of about 2·35 km per month for the "forest" condition, and about 2·20 km for the padi with its requirement for minimum flood embankments. In the event these rates were generally exceeded; the progress over the project as a whole (including the monsoon season) works out at approximately 2·51 km/month.

The Force organization also required thought at this time. It was unlikely that the CRE of CROWN, with his staff, would remain after the completion of the airfield, but the project was to be similarly based on a field squadron, supported by much the same services as had been required for CROWN. Eventually it was decided that the OC of the Field Squadron should be the Force Commander, under the command of CRE(Ops)FARELF based in Singapore. Planning, design and technical supervision would be carried out by a Project Officer, assisted by a small team of surveyors, draughtsmen and CLOs drawn from 522 Specialist Team (Construction). The Project Officer, although part of the Force, would also report direct to CRE(Ops) FARELF. In practice, this "Consultant-Resident Engineer-Contractor" relationship will usually depend a good deal on the personalities involved. Let it merely be said that throughout the whole project the harmony of the entire team was one of the most rewarding aspects, and that the system worked extremely well. The Project Staff produced the outline schedule of work, the drawings and the specification, pegged out the centre-line of the alignment and established the grade profile. They were also responsible for the provision of construction stores. All subsequent work was the responsibility of the Field Squadron. Great care was taken to ensure that no executive orders were given to troops of the Squadron by the Project Staff. If work was not up to specification, this was reported to the Project Officer, who took the matter up with the OC Field Squadron or the Squadron Construction Officer. The system also allowed a good deal of scope for the Troop Commander; the method of carrying out the work and such matters as the design of ditch falls to suit the culverts were his responsibility. Access roads linking villages with the main road were also, invariably, left to the Squadron to design.

It was also clear at this stage that a similar organization for logistic backing to that developed for CROWN would be required. In the event the system worked well, thanks largely to the constant watching of our interests by the staff of CRE(Ops) FARELF. A continual though minor irritation, was the seventy-five mile journey by road to Ubon. In spite of pressure, neither the Thai Air Force nor the RAF were prepared to activate CROWN airfield, and throughout the project the weekly maintenance aircraft continued to fly in to the USAF base at Ubon. Small wonder that road-weary sappers were heard to describe the airfield as the largest unused parking lot in South-East Asia!

FALSE START

On 20 October 1966, agreement having been reached on the retention of a force at CROWN for one year from 1 January 1967, the Thais produced their requirement. This was a road from the new District Headquarters at Sam Yeak eastwards towards the Mekong to a village called Kham Duai. The route led through heavily forested country and there were few villages in the area. It was clearly a primarily military road, as it would cut a route between two hill areas which were known to harbour dissident gangs. Economic value would be low.

However, the Thais appeared adamant that this was their first priority in the area, so reconnaissance and planning started accordingly. This was aided at this stage by

the arrival at CROWN of Lieut-Colonel N. F. Hughes, ERD, TD, FGS, of the Department of Geology, Cambridge University, an officer of the Reserve Army pool of geologists. He was conducting a survey of the geology and gave valuable assistance in the location of the first sections of the road and the search for sources of laterite.

A meeting was held in Bangkok in mid-November to agree final details for the project, and it was at this late stage that the Governor of Ubon Province came out strongly against the proposed road. He pleaded, in our view with every justification, that the Kham Duai road would not contribute to the long-term development of the region, and that, even if it contributed immediately to the anti-guerrilla campaign, he would not thereafter be able to maintain it. The debate continued for several days and in the end the Governor got his way; we would switch to a completely new route, north-westwards from Loeng Nok Tha to the Provincial boundary at Khok Klang. We were delighted. Here was a really worthwhile route which would reach out to a chain of villages and populated areas, and which, as the map showed, would be a logical contribution to the long-term road network of the Province. It was clear that the road would eventually link with the one under construction by the Thais eastward from Waeng in Roi Et Province. (See Fig 3.) At the same time, the prospects were somewhat daunting. It was now late November, and construction was due to start on 1 January. However, some reconnaissance had already been done of the area now proposed, we had good photographic cover, and the Provincial Governor's office in Ubon made available to us various surveys which they had carried out.

THE LOENG NOK THA ROAD—PREPARATION

For the next few weeks the surveyors, soil mechanics, draughtsmen and other members of the planning staff had to compress several months' normal experience into days. The Thai surveys were replotted at a scale of 1:1,000; tacheometric survey filled in the gaps, and a tentative alignment was selected for the first 12 km. At the same time, a meeting in Ubon confirmed the general line of the road, established the principle that the road should pass close to—but not through—villages along the route, and agreed the methods of supply of construction materials.

Meetings were also held in Bangkok to agree the financial arrangements and planning criteria for the project. The finance was straightforward. We would forward stores lists for construction material to a Thai Army procurement office in Ubon, who would arrange supply. After agreement on delivery, quality, etc, we would jointly sign the invoices, which would then go to Bangkok for payment. Local labour was to be paid directly by us, and claims made on Bangkok. The third Thai contribution—rail transport charges and port handling dues—were to be dealt with in Bangkok by a succession of RCT Movement Control Liaison Officers. The latter gave sterling support to our projects throughout the whole of Operations CROWN and POST CROWN.

Based on the Thai classification of the new road, a Specification for the project was issued (see Annex A). This, with minor amendments, served as the basis for the whole project. The amendments required in the light of experience, and the degree to which the Specification standards were achieved, are discussed in detail in the full Technical Report on POST CROWN.[3]: Annexes in that report show typical construction details for the road, culverts and bridges. They are mostly self-explanatory, although the standard cross-section may excite comment. The width of both the formation and the cleared area was dictated by the need to keep side slopes at a low angle (observation of other roads in the region had shown the critical nature of embankment slopes in the development of erosion), to provide generous ditches for containment of flood water, and to provide compactible fill material for the centre of the formation at minimum haul distances. (See Fig 4).

The plan for the initial phase of work had to take three main factors into account. First, although the concreting of CROWN airfield was complete, the inevitable "tidying-up" jobs would take some of the Squadron effort for another six weeks or

[3] "POST CROWN Road Project", by Major P. Woolcott, RE.

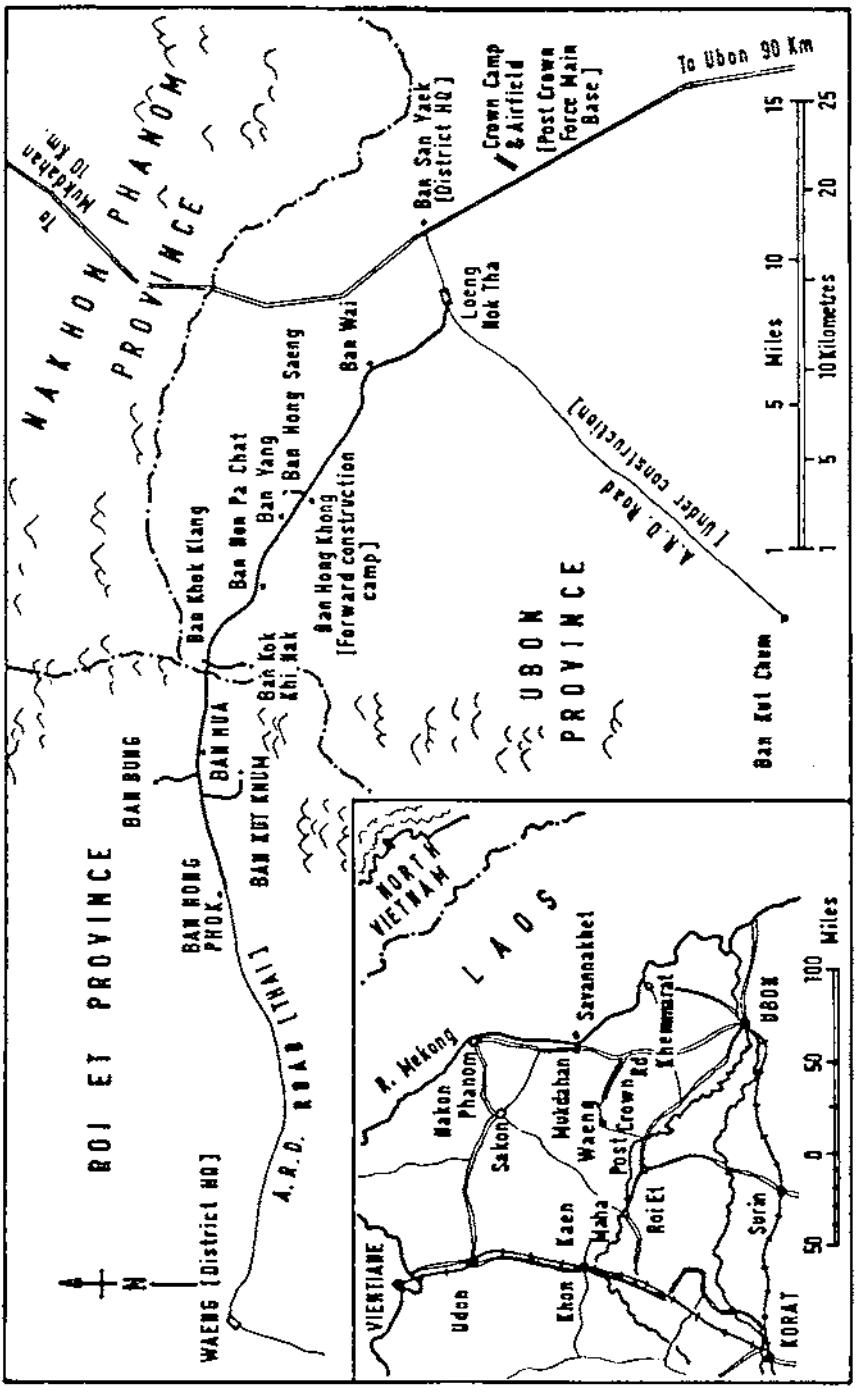


Figure 3 POST CROWN ROAD

so. Second, adjustments to the plant holdings at CROWN were still under way. Plant not required for the road project was being backloaded to Singapore, and additional earthmoving and compaction plant was on its way up, but would not be complete at CROWN until mid-February. Third the monsoon was due any time after the beginning of May.

With these factors in mind, the outline plan envisaged a start as soon as possible at the beginning of the alignment at Loeng Nok Tha—and a concentration there of the bulk of the earthmoving plant then available. At the same time, a start would be made on the construction of a Troop Camp at Ban Hong Khong, some 12 km from the start of the route. From this advance camp a second construction team would start to operate as soon as manpower and plant became available. At first, they would work back along the alignment, but as work progressed and the monsoon approached they would be poised to reverse direction and push the road from the area of Hong Khong across the padi and on to the start of a long section of higher ground.

JANUARY TO MAY 1967—34 FIELD SQUADRON

On Saturday, 31 December 1966, a D8H started the first clearance along the centre-line from Loeng Nok Tha. The move of the plant from CROWN Camp to a temporary park, made available to us by the local Thai Rural Development team, had not been without incident. Some of the timber bridges on the "main road" (classified according to ME, Vol 3, as Class 12) took a D8H on a 30-ton trailer fairly happily; others were thought just a little unsafe and diversions were made, one involving damming a substantial stream to form a causeway.

Meanwhile the argument in Thai circles as to which road they wanted us to build was not entirely resolved. We knew that on 6 January General Kriangsak (Deputy Chief of Staff of the Thai National Security Command) was coming to CROWN with the Governor of Ubon and the British Ambassador for the formal hand over of the airfield to the Thai Government. The last thing we wanted was a change of mind just when we were getting under way, so we made sure that our D8s had extended the 40-m clearance through several kilometres of jungle during that first week. This looked very impressive from the VIP helicopter. The General and the Governor flew along it and landed at the first village, where they were greeted with great enthusiasm by the villagers, who could see what was happening. This marked the end of any doubt as to which road we were going to build.

At the same time, the first tents appeared at Hong Khong Camp; improvements were started to the fair-weather track linking Hong Khong to the start of the road; and setting-out began for the first bridges.

Altogether fourteen bridges would be constructed on the road, and the first five, built between January and May, were typical. All were Class 24, one way and either piled or of "buried trestle" design. The buried trestle type is a very popular form in Thailand, and has the merit of producing some of the advantages of a piled pier without the use of piling equipment. Expediency dictated the use of this form on Bridges 3 and 4, as only one set of piling kit for the RB19s was available at the start of the project.

Culverts were also a problem at this stage. Economic factors had led the Thais to exclude ARMCO or similar culverting and to require concrete. The nearest source of supply was Ubon, and Thai experience had shown a 25 per cent breakage rate of concrete pipes over the road journey from Ubon to Loeng Nok Tha. By mid-January a solution had not been found, and the Project Officer, having discovered that Ubon contractors might be willing to set up a culvert "factory" at Loeng Nok Tha if guaranteed enough work, went to Bangkok to try to arrange this. The sequel illustrates well the charm of working with the Thais. Ten minutes' explanation of the problem to General Kriangsak brought an offer to supply a Thai Army detachment, complete with steel culvert forms and other equipment. This team, under a most efficient and delightful Thai staff-sergeant, arrived just over two weeks later, set up a well-organized production line in a corner of CROWN Camp, and by the end of the

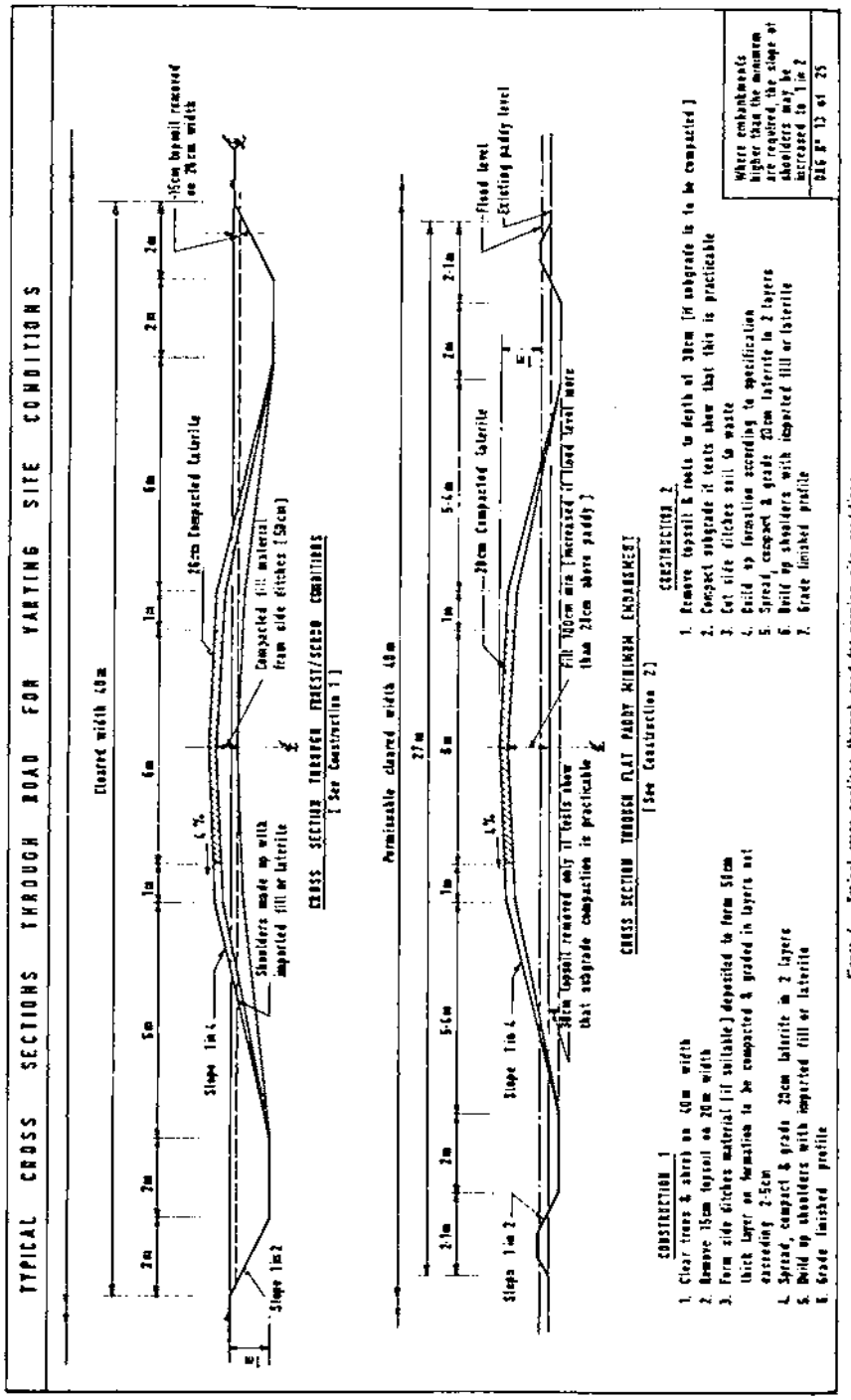


Figure 4. Typical cross sections through road for varying site conditions

project had made 1,766 concrete pipes 1 m long and varying in size from 40 cm internal diameter to 100 cm. All were excellent quality, breakages were negligible, and production, although always critical over the first few months, enabled 34 Field Squadron to complete all their culverts on schedule.

The earthwork on this first phase of the project presented no major problems. More it was a question of organization within the Squadron to produce maximum output with the available plant. Methods of working had also to be tried and compared. The soil was remarkably constant—a silt sand mixture, with clay and laterite entering the profile at varying depths. It was difficult to compact, but given close supervision and strict attention to moisture content, a quite acceptable strength was possible. Emphasis was placed from the beginning on continuous compaction testing, and to this end a number of non-CLO tradesmen were taught to carry out such tests. This greatly assisted the Troop officers in verifying the standard of work done and in anticipating possible bad patches.

Methods of plant working and performance statistics are fully covered in the Technical Report, but in the main the problems, and their solution, were the normal ones. D8H tractors with 12 cu yd scrapers were used for the main earthmoving, and on many sections it was possible for these to cut the side-ditches and deposit the resulting fill over the centre of the formation; this was then graded and compacted to form the finished profile. The two old 12 cu yd Euclid motorized scrapers also gave most valuable service in the early stages of the project. With the light soil and adequate back-up by D8H tractors for push loading some remarkably high output figures were achieved. Although later on old age and infirmity finally defeated both machines, it is true to say that without them 34 Squadron would not have achieved their target.

Water for compaction was a major problem, both from availability and from the inadequacy of the transport. Haul distances at the worst were up to 8 km, and numbers of improvised tankers consisting of two 400-gallon steel tanks on a 3-ton cargo dropside were used. Many varieties of pump were also obtained to fill these home-made bowsers.

The search for adequate quantities and quality of laterite was also a problem from the beginning—as it had been throughout Operation CROWN. Good laterite is very rare in North-East Thailand, although poor-quality is widespread. The seams were rarely more than about 2 ft thick, and winning laterite in such conditions was a skilled operation. A D8H was normally used to clear the top soil until the seam was exposed and then to push up stockpiles for loading by LWTs. Ten-ton Aveling Barford dump trucks transported the material to the road, where it was laid and compacted in two 10-cm thick layers. Normal practice was for the first layer to be put down as soon after completion of the formation as possible; the second layer followed several kilometres behind, after the first had weathered to some extent and had had the benefit of compaction by traffic.

Prospecting for laterite, looking for water sources and many other problems were eased in March with the arrival of two helicopters of the FARELF RE Air Troop. Their activities from then until the end of the project have already been described in the *RE Journal* of June 1968, but suffice it to say that their contribution to the planning and control of the project was incalculable.

Variety was also added at this time by numerous visitors to the project, ranging from Members of Parliament to Harry Secombe and Anita Harris.

As May approached, and with it the end of their nine months in the Far East, 34 Field Squadron redoubled their efforts to achieve completion of the first phase of the project. In the event the target of 12·5 km of completed earthwork, five bridges and twelve culverts was achieved, together with a further 3 km of pilot track, the concrete bases for Bridge 6 and a considerable amount of "hearts and minds" work ranging from wells to water-catchment systems on temple roofs. In all, the Squadron had set a standard for the project which would prove a challenge to those who

Fig 5. Bridge 1, built by 34 Field Squadron.

followed. The opening ceremony for the first, and in many ways most vital, 12 km of the road was performed by the Governor of Ubon on 29 April. The following day 34 Squadron handed over to 59 Field Squadron.

MAY TO JULY 1967—59 FIELD SQUADRON

The tasks set for 59 Squadron on their arrival assumed that a limited amount of earthwork would be possible, despite the monsoon, on the high ground south-west of Hong Saeng. First priority was to be given to culverting and the construction of minimum embankments over the various re-entrants which crossed the alignment. At the same time work would continue on Bridge 6, which was to include two relatively high piers constructed with 20-ton Christchurch bridging cribs, welded after erection.

A sharp reminder of the effects of the monsoon was given on 1 and 2 May, when sudden and violent storms swept the area. Several inches of rain fell in a few hours. Local rumours of an early monsoon seemed about to be substantiated, but luckily the rains passed and within hours the ground was again firm. Indeed, it was remarkable how in this early part of the wet season earthwork could restart so soon after torrential rain. The soil, without moisture for nearly eight months, seemed to be able to absorb the most violent rains. It was only as the season advanced that saturation was reached, first in the low areas where the first rice seedlings began to appear about June, then gradually higher, until by late August several days' drying-out became essential after any rainfall. To touch the formation before it was properly dried out inevitably did more harm than good. However, luck continued to run with the project, and such rain as fell in June and the early part of July was spaced. 59 Squadron forged ahead, the drop in production inevitable during the changeover of Squadrons being quickly made up. First the low spots were "bridged" with minimum embankments as the culverts went in, and then bound by bound the road went over these dips.

Fig 6. Bridge 6, built by 59 Field Squadron. (Note: The track leading away top right of the picture is typical of the only "roads" in the area before POST CROWN was started).

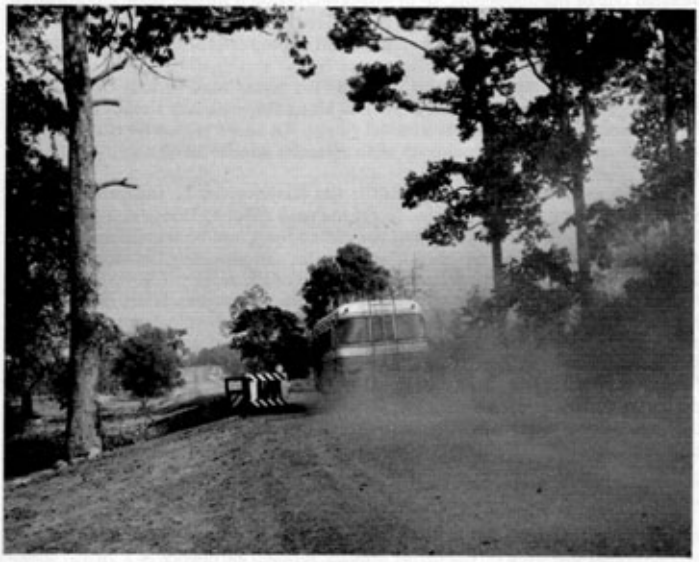


Fig 7. Bridge 6 in use.

Operation Post Crown 6 & 7

Ahead of all expectation the road was through to Bridge 6, which was itself finished in time to meet the formation. But now another target had been set—to continue over the wide valley beyond Bridge 6 and gain the next section of high ground leading to Non Pa Chat. This was an exciting prospect, made possible by the unexpectedly small interference with earthwork in the early weeks of the monsoon, and the splendid maintenance of momentum by 59 Squadron and the "old hands"—the plant operators of 54 Support Squadron. By now only one faithful old Euclid motorized scraper spearheaded the work, black smoke pouring from its exhaust, but once again a causeway appeared over the padi, guaranteeing access to the high ground. Now the way was open to Non Pa Chat and the site of Bridge 7, and construction of this, together with the numerous culverts between Bridges 6 and 7, was added to the Squadron's programme. The pilot track reached Non Pa Chat on 9 June.

The kilometre leading to Bridge 7 gave unexpected trouble. Outcrops of sandstone crossed the alignment and unexpected pockets of soft saturated ground appeared. These were on the line of small watercourses and were the sites of old ponds formed by damming the stream. The dams had long since disappeared, but the marshy ground remained. At this time, too, it became impossible to work plant off the formation, so ditch lines had to be left or hand formed, and the side slopes of embankments remained ungraded.

Concrete foundation pads for the double trestle bent timber piers of Bridge 7 were necessary, as sandstone formed the bed of the stream. These were in, and work well advanced, when the river began to rise at an alarming rate. A quick look from the helicopter soon solved the mystery. A kilometre downstream of the bridge site there was a dam, the level of which had always been carefully fixed by the villagers to permit use of a ford on the old track leading to the village. With the new road and bridge making the ford redundant, the whole village was out raising the dam to give a bigger and better lake. Some hasty levels proved that the new river level would threaten one of the abutments, so in mid-construction a further span was added to the design—somewhat to the dismay of the Troop Officer building the bridge, who now had to work round the clock to ensure that a completed bridge would be handed over to 11 Squadron.

Another task completed at this time was the access road to Ban Hong Saeng. This village, the largest and most important along the road, was already earmarked for development by the Thais as a model village. An added reason for early completion of the access was the opening up of an extensive laterite pit on a spur beyond the village.

So July came to an end, and with it the handover to 11 Independent Field Squadron. From a provisional plan to get the road as far as Bridge 6, 59 Squadron had achieved an additional 2·5 km of completed road, and built another important bridge, as well as continuing the civic action tasks and providing the access to Hong Saeng. The pilot track now stretched to the foot of the ridge which would take the road over to Ban Khok Klang—the target for the end of the year. It was obvious that, even with substantial delays from now until the end of the monsoon, it would be possible to reach Khok Klang before December, and attention thus focussed on how far it might get by the end of the year. If it could be pushed well westwards towards Nong Phok, and if the Thais, having reached Nong Phok from the west, could be persuaded to continue towards a junction, then the prospects for completion of the through route seemed really hopeful, even if it meant the Force remaining for some time into 1968.

AUGUST TO SEPTEMBER 1967—11 INDEPENDENT FIELD SQUADRON

The arrival of 11 Squadron coincided with the culmination of the effects of the monsoon. A week or two of splendid progress beyond Non Pa Chat and then rain and saturated soil, even on the higher ground, brought earthwork to a virtual standstill. Any opportunity of work on the formation was seized, but it was a frustrating

time. The Squadron had arrived, full of enthusiasm and drive, and determined to equal or better the impressive progress achieved by their predecessors. Now the days were slipping by, without very much visible result.

However, progress was being made. Culverts were going in, the sappers sometimes working up to their waists in floodwater; the pilot track and clearance had advanced almost to within sight of Khok Klang; and extensive rock blasting was in progress on the Khok Klang ridge. This ridge presented one of the most difficult sections of the route. The forest was thick, with areas of dense, tangled, secondary growth, and the line of the escarpment was marked with rock. Survey and centre-line clearance were so difficult in places that short sections of the alignment were set out entirely from the air. The Project Officer communicated by radio from the helicopter with a ground party, which was equipped with long bamboo poles painted in bright colours. These were set in by eye from the helicopter, and were placed close enough on the ground for a D8H operator to see them one after the other, as he cut the pilot track. Very large trees also became a problem for the first time—but not the last—and these were tackled with explosives.

Throughout this trying period it was always heartening to receive our monthly visit from the CRE. We also welcomed the periodic visits of the Chief Engineer, who had launched and sustained the project from its inception and whose visits were invariably characterized by midnight oil and inspiration in full measure.

Mid-September brought another visitor, the C-in-C FARELF, General Sir Michael Carver. His tour of the project coincided with the height of the monsoon floods, with all the bridges and culverts flowing full and the road appearing as a causeway across a lake for much of its length. This also seemed an appropriate time for the first Project Officer to leave, so the story is taken up by my successor.

Fig 8. The completed road at the twenty-second kilometre, known by the Force as "the escarpment". It was along this stretch that 11 Independent Field Squadron did considerable blasting of rock and trees, using Prilled Ammonium Nitrate. (See "Use of Prilled Ammonium Nitrate as an Explosive", by 2nd Lieutenant I. J. K. McLean, *RE Journal*, September 1968.)

PART II

Major P. WOOLCOTT, RE, MA, MICE
Project Officer POST CROWN Force
September 1967—*May* 1969

INTRODUCTION

I TOOK over from Freddie Rose in September 1967, and here take up the Project Officer's story of POST CROWN from that date. I have not attempted to give an account of the speed of construction or the techniques employed for the latter part of the project, except where these differ from those already described.

The problems of road-building are intimately connected with keeping the plant working. I have therefore thought it appropriate to discuss here some of the machines we employed and their maintenance and repair.

Most engineering projects require a guiding specification. The specification produced for POST CROWN, although good on the whole, did contain some peculiarities which I believe merit discussion. I have therefore made some comments on these, but have relegated them to Annex B in order to avoid breaking the continuity of the narrative.

PROGRESS

The original target for 1967 had been 25 km of road. By midsummer the work was some 5 km ahead of schedule, and it had become clear that if the project could be extended for four months into 1968 we should be able to achieve the appreciably greater and much more attractive target of linking up with another road being built by the Thais, thereby opening up an important new lateral highway right across Thailand. After considerable high-level discussion in London an extension was finally agreed; but it was also made abundantly clear that even if we did not complete the link-up in time no further extension beyond 30 April 1968 would be contemplated. We therefore had an exciting new target in both distance and time. Another field squadron from the UK was asked for, to take on the additional four months' work, but this request had to be refused, largely because any suggestion of "counter-flow" against the stream of the general withdrawal from the Far East was politically unacceptable. So it was decided that 11 Squadron would be relieved in their turn by a composite force, made up of 54 Support Squadron reinforced by troops from two other field squadrons in the theatre.

11 Squadron in their time probably had to cope with the greatest extremes of rainfall and terrain. Rain impeded progress in August; in September it stopped the earthmoving completely; in October and November the rains slackened and by December the ground had become so dry that compaction was hindered by lack of water. The terrain varied from rock outcrops to soft padi, and from thin scrub to heavy forest in which the larger trees could not be pushed down by dozers and had to be felled with explosives.

54 Squadron, with their detachments of other units under command, took over in mid-January 1968 with the main earthworks at km 29. Their target was Ban Nong Phok (km 40) which the main earthworks reached on 15 March, leaving several access tracks, some laterite surfacing, culvert headwalls and road signs to be completed by 18 April, the appointed day of the opening ceremony. The final target was achieved by a combination of good organization, dry weather, sufficient working numbers and reasonable machine availability. For the last few weeks 54 Squadron were helped by a very small Royal Thai Army Engineer Detachment. This varied in strength, but averaged in machines one size II dozer, four dump trucks and one water bowser. These machines were operated by Thai soldiers who were under the supervision of a Thai master-sergeant, in turn under the direction of POST CROWN Force.

SURVEY AND RECONNAISSANCE

The system of establishing the road line has already been covered in Part I, and the use of helicopters in this role and other POST CROWN tasks was covered in the article by Captain D. E. Durham, RE, in the June 1968 *RE Journal*. My intention here is only to reinforce some of the comments already made.

Had the helicopters been available for the initial recces of the road line, the maximum possible planning benefit would have been achieved. The area of the road was subject to some minor terrorist activity and, at least early in the project, no publicity of the involvement of British troops in skirmishes with terrorists, possibly Communist, would have been welcomed. For this reason recce and survey parties were not allowed to remain out at night. When the helicopters were available parties could be repositioned next morning with the minimum of delay.

For various unavoidable reasons, the forward survey establishing the road centre-line in August/September 1967 was only 1–2 km ahead of the main earthworks. This was not good for Squadron planning, nor for calm decisions by the surveyors. Neither was it good for villagers, who were hardly told where the road was to pass near their village or through their padi before it was there. The ability to keep the forward survey at least 5 km ahead of construction would have paid dividends in Squadron planning and local relationships.

RESOURCES

By the end of the project the small Resources detachment had handled about 700 tons of timber and 1,400 tons of concrete materials. The timber was generally not seasoned and provided constant headaches on delivery times and quality. Although the Thai Army Resources Unit at Ubon was responsible for the supply of timber to POST CROWN demands, much direct liaison with sawmills had to be undertaken by our own Resources detachment.

About 5 per cent of all timber delivered had to be rejected as unsuitable. It was not always possible to inspect at sawmills before delivery, as the distance of these varied up to 200 miles. Nor was it possible to check at the time of unloading, as this often happened at night and in the most unlikely places. Many varieties of timber exist in North-East Thailand, and some of them have a life of only two or three years. In retrospect it would have been advisable to obtain the services of a local timber expert to check the quality of all the main structural timbers.

A total of 1,766 reinforced-concrete culvert pipes, varying in size up to 100 cm in diameter, were constructed in the Resources area under the control of a Thai staff-sergeant, and what could have been a constant problem of manufacture went remarkably smoothly. The transport of these heavy culvert pipes and their installation, especially in the wet season, were problems which would have been eased by the use of ARMCO steel culverting. However, these would have been more expensive and would have had to be imported into Thailand and the Thai Government was, of course, trying to minimize the cost of imports. At the start of any similar project in the future it might be sensible to allocate sufficient funds for about 10 per cent of the culverts to be of the ARMCO type. These could then be used while the first concrete pipes are being manufactured, and also for some of the wetter sites.

REPAIR AND MAINTENANCE OF PLANT

Availability of plant is clearly the main factor in the ability to build roads quickly. The POST CROWN Force organization for repairs, servicing and spares supply is discussed in some detail in Parts III and IV of this article. The records which the Force were required to keep were sensible but not really in sufficient detail to indicate specific reasons for some of the lack of plant availability. On average, machines were required to work at least fifty hours per week and some up to eighty hours per week. Allowing for three weeks in September 1967 during which 23 in of rain fell and no

earthmoving machine operated at all, the average weekly hours worked per machine were typically:

Graders	20 hours
Michegan 75	18 hours
Fordson tractors	25 hours
Tractors D4C	25 hours
Tractors D4D	34 hours
Tractors D8H	31 hours

These figures must be interpreted with great care, since they sometimes include machines at CROWN Camp awaiting return to Singapore. However, they do indicate a plant availability of only about 50 per cent. On some of the worst days availability dropped to as low as one out of nine D8 tractors and one out of six motor graders. Old and worn-out machines, lack of spares, the distance from base workshops and occasionally bad operating techniques all had a share in these figures.

Well-supervised servicing and regular inspections are two elements of plant management which are within RE control, and yet the peculiar situation invariably arises that the more work there is to be done, and therefore the greater the need for regular inspections, the less do the latter take place. When a machine is in its base doing next to nothing inspections and documentation are well performed; when the machine is being worked hard on site both these matters receive less attention, when they should, of course, have more! It is pointless trying to apportion blame for this state of affairs. Some progress has been made by the creation of the Plant Quartermaster, whose experience should encompass the long-term necessity for servicing, inspections and documentation. More help to the Plant Quartermaster's arm would be a central directive about the plant statistics to be kept. Such central control might divert some of the attention away from the immediate site requirements of uninterrupted progress towards the longer-term viewpoint.

The sphere of the Plant Quartermaster will often overlap that of the Troop Commander allotted a task. The precise division of responsibilities will often be vague, and be viewed differently by different commanders. In the case of POST CROWN there were four successive Squadron Commanders to one Plant Officer and it says a lot for the good sense of those concerned that major conflicts did not occur. However, this is not to say that on jobs such as POST CROWN the relationship between Troop Commander/Site Officer and the Plant Officer should not be given careful attention. Whatever the other duties of the Plant Officer, he will certainly be responsible for plant documentation and for holding some spares. For these jobs he tends to be given lame or recalcitrant plant operators. If he is also required to keep a few more statistics, he will need better-quality help.

COMMENTS ON INDIVIDUAL MACHINES

Many nations are now building roads in Thailand. Within about 200 miles of POST CROWN Force, Australians, Chinese Nationalists, Japanese, Italians, New Zealanders and not least Americans, were all engaged in pushing roads into the comparatively undeveloped north-eastern provinces. Most of these were well-equipped organizations, whose plant and vehicles were often better than those at POST CROWN. Apart from their machines being new, which is a matter getting some airing within the Corps at present, a number of other points of comparison are noteworthy.

For compaction, self-propelled wobbly-wheel rollers were evident on all other projects. Although towed wobbly-wheel rollers can be used, they are not so manoeuvrable as the self-propelled type. This applies particularly on a 6-metre formation width like POST CROWN, where rollers were often slipping off embankments and damaging both their tyres and the towing tractors. Vibratory rollers were also in evidence elsewhere for compaction of the less-cohesive soils.

POST CROWN had frequent trouble with lack of water trucks bringing water for compaction. Very few improvised water trucks were to be seen on other projects.

Perhaps a good compromise would have been a base workshops conversion of a standard 3-ton vehicle rather than our local system of placing a domestic water tank on the back of a 3-ton load carrier.

The Aveling Barford 10-ton dump trucks available to the Force had a very low availability record, possibly through use over long hauls at high speed, for which they were not designed. More applicable to the POST CROWN project would have been 7-ton standard civilian tippers, capable of 30–40 mph without the disturbing vertical oscillations of the Aveling Barford dump trucks.

Fairly obviously there is no need for such an exquisite crane as the Coles bridging crane on earth roads and timber bridges. Although we have to put up with standard machines, and indeed sometimes ought to train with them, keeping them serviceable in remote areas can take up a disproportionate amount of repair time.

COMMUNITY RELATIONS

Although the specific aim of POST CROWN Force was to build a road, it was realized right from the start that the road-building was only one part of the process of development of the North-East Provinces of Thailand. To have rebuilt a road and incurred the distrust of the local people would have been failure. Good relations with all the local populace, ranging from the Provincial Governors down to Village Headmen and the villagers themselves were always in mind. The ready smile and wave to passing British vehicles were always a good indication of the pleasant feelings towards the British soldiers.

In many ways the villagers were brought to realize that the "Farangs" (foreigners) were out to help, and were trying to smooth the transition from remote isolation to good communications. Inevitably some hardships were caused by the alignment of the road. Wherever possible those who appeared to have been severely affected had some forest cleared for them or were given some paid work with the Force. Compensation for accidents, and in one case for oil pollution of a padi field, were speedily dealt with. This sort of administration at a low level gave a good background to a reputation for fair dealing. School furniture was produced; concrete well liners were made and distributed; small water tanks were set up for storing water from temple roofs; tools were obtained for tradesmen. All these things were done officially. Many others were done unofficially.

Carefully tended and watered gardens and vegetable plots, oases of green in the parched surrounding soil, sometimes had to disappear under the thrust of the earth-moving machines. But although such destruction was inevitable, "Never"—as one District Officer enthusiastically remarked—"did we imagine that you would think so carefully of the problems of the people as to give them seeds to help them start again!"

No mention of Community Relations would be complete without credit being given to the successive Force Medical Officers and their staffs. The sick parades in Camp and the clinics in villages probably did as much as anything else to maintain good relations.

Although it would have been possible to have claimed complete credit for the British in these various minor aid schemes, as much as possible was channelled through the local government organizations. On one occasion a party of Village Headmen and Elders were taken to the Government Fishery and Agricultural Centres at Ubon to see what their own Thai Government was doing for them.

It is possible that too long a stay of the Force in the area would have usurped the local government power and kudos. Although other agencies are remaining four or five years in North-East Thailand, they are probably more welcome for the long term, as they include training facilities for the Thais at various levels on their projects. POST CROWN was essentially a military project with a limited short-term objective.

DEVELOPMENT OF HONG SAENG VILLAGE

Hong Saeng village, at the fifteenth kilometre along our road, has about 2,500 inhabitants, and the fertile valley in which it lies provides a source of livelihood for

about another 5,000. Once the POST CROWN road had given good all-weather access to this community, the rapid development of the village was seen to be a possibility.

POST CROWN Force was required to draw up a plan for the electrical supply, the water supply and the internal village roadworks, and to develop a deep well for the water supply. Two Clerks of Works, one Construction and one Electrical, drew up the master plans for this development, and a small well-drilling team under a BI staff-sergeant drilled for water.

Within three months, under the direction of a Thai Mobile Development Team, the village of Hong Saeng had a 30 kVA electricity supply, 1,000 gallons per hour of good water, a reasonable internal street system—which because of complete lack of planning in the past meant inevitably that several houses had to be demolished and rebuilt elsewhere—a health centre and a village hall. Although the actual implementation of this startling change to Hong Saeng was mainly due to the Thai Mobile Development Team, the impetus was unquestionably given by the construction of the POST CROWN road.

FINANCE

The division of the costs of POST CROWN between the British Ministry of Defence, the British Foreign Office and the Royal Thai Government produced not a few accountancy problems on what to charge to which budget. However, all expenditure was finally within the estimates.

Some apprehension existed at one stage that the Thai budget would be exceeded. Although the expenditure on civilian labour and materials was higher than estimated, that on transport within Thailand was well below the estimate. As the Force was not constrained to the individual sub-heads of the Thai budget, we were able to adjust so that overall no overexpenditure occurred.

It is not possible to compare the complete costs of Royal Engineer road building in Thailand with that of other agencies doing similar work there. It is, however, possible to say that the Thais would have been charged about £8,000 per kilometre by a civilian contractor, whereas their actual bill, mainly for materials, came to only about £1,770 per kilometre. Moreover, the Thai Government was involved in virtually no overseas expenditure.

Simultaneously it may be said that for less than £0·25 million, the British Foreign Office acquired a lot of kudos, and the members of POST CROWN Force gained a lot of good training and experience.

CONCLUSIONS

Probably no new lessons were learnt at POST CROWN, although plenty were relearnt.

These few notes may seem to some a recital of problems and difficulties often met before. No apology is offered for this, since POST CROWN, like most jobs, can withstand improvement, and any appraisal should bring with it discussion, improvement and increased ability.

True it is to say that we should always be preparing for war. Sometimes we may be able to fulfil that aim by helping to curtail the dissatisfaction which is the usual forerunner of the shooting. Insurgency is active in North-East Thailand; maybe in some small way POST CROWN Force has helped to contain it.

Although more time on a complete survey and reconnaissance of the road would have helped to smooth progress, it is probably correct that as military engineers we should always be expecting to meet some snags, make some improvisations and develop some haste. This is not to say that we should do no planning, but rather that because of our training and organization the Corps should be able to take on tasks which other agencies might shun.

What tasks should we take on and what planning is needed for them? POST CROWN seems to have been the kind and size of job which suited admirably.

PART III

by

Major C. J. ROUGIER, RE, MA

OC 11 *Independent Field Squadron*

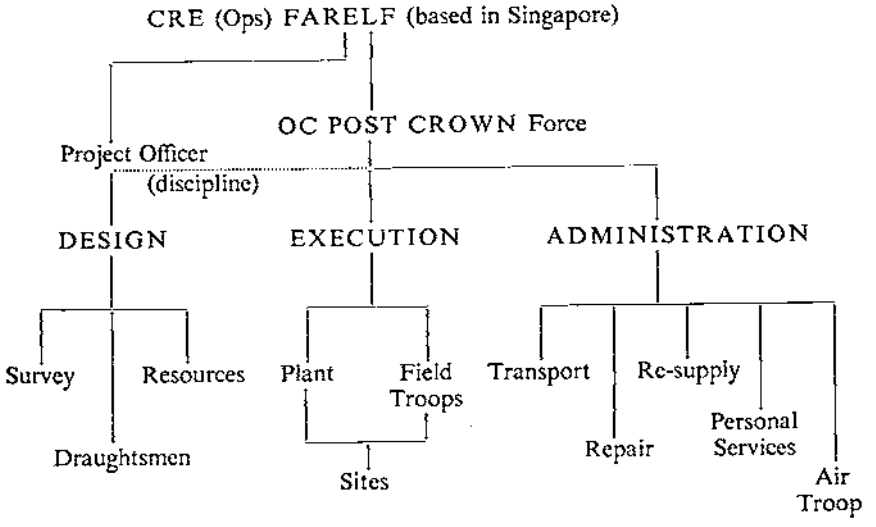
and OC POST CROWN Force—September 1967 *to January* 1968

INTRODUCTION

11 INDEPENDENT Field Squadron relieved 59 Field Squadron on the project in August 1967, and at the same time I took over command of POST CROWN Force. My brief from the CRE for this article was to concern myself entirely with the command and management aspects of the operation and to keep clear of technical detail.

ORGANISATION

The Force, of total strength some 300 all ranks plus about 200 local labourers, consisted of one field squadron and a large "increment". The latter included elements of a support squadron and a specialist team, a REME Workshop and various other detachments such as postal and signals. The Force was broadly divided into three groups:



A small design team controlled by the Project Officer was responsible for producing all the drawings of the road, setting out the centre-line on the ground, obtaining materials and checking that the specifications were being met.

The execution of the Project Officer's design fell to the Works Officer (who also happened to be second-in-command of the Squadron) and the Plant Officer, who between them ran the day-to-day work on the road. This was normally in three distinct divisions, namely bridges and culverts, formation (where most of the plant was employed) and surfacing. The number of site officers varied, but it quickly became apparent that, firstly, neither the Works Officer nor the Plant Officer should get involved in one site only, and secondly, the allocation of responsibilities should be on a strictly geographical basis.

The administration consisted of a workshop under a REME major, and the MT and the normal services under an Administrative Officer, also a major. There had at one time also been a Force Quartermaster, yet another major, but there proved to be

insufficient administrative work to keep two officers fully occupied, so the Administrative and Quartermaster jobs were combined. All these departments were located at the old CROWN Camp some thirty miles from the roadhead, and many of the later administrative problems were due to this excessive distance.

Because the road project developed from the CROWN Airfield administrative base and because the work was at first planned to last for only one year, any gain in closing CROWN Camp and moving the support nearer to the scene of operations would have been greatly outweighed by the extra work that this would have involved. However, as work progressed and the project was extended, the intermediate camp at Hong Khong was made more permanent, and efforts were made to move essential services out there. Even this camp, at the end of the work, was 27 km away from the roadhead. The location of the workshops and the culvert factory at CROWN Camp were—in retrospect—mistakes, because the distance that plant had to be moved if it was to be repaired in the workshops meant that there was a tendency to carry out major repairs on site without proper facilities. The fact that CROWN Camp and the road were linked by four bridges, officially classified as anything between 0 and 8, also discouraged the proper backloading of plant for repair. The move of the culvert pipes to site put an almost intolerable strain on the MT.

On such a project as this, when there are no nearby units and the operation is mounted from several thousand miles away, there must, of course, be a small semi-permanent camp; but this should not contain more elements than are necessary for "rear-link" activities such as accounting and documentation, backloading and resupply. The forward camp should contain all the administration that is directly supporting the work, and under no circumstances should this camp be made permanent. A large amount of tentage will be required for the workshop and for the RAOC stores section, but this must not be allowed to become an overriding factor. As the British Army withdraws to Europe, sappers will—it is hoped—continue to undertake projects in countries overseas. The problem of an administrative base for any such project will increase, and it is worth suggesting a split of responsibility between the two organizations.

(*a*) *The Semi-permanent Camp*

This should be of CGI or Twynham hutting, located near a road, rail or airhead and be able to administer a number of projects. It must deal with all the work concerning resupply of spares, equipment, food and POL and backloading; it must run the communications network and the hospital; and it must deal with all matters not directly related to the work—such as soldiers personal administration and the inevitable swarm of visitors! This camp should be commanded by the Administrative Officer.

(*b*) *The Mobile Camp*

This should be entirely tented and the tendency to make smart officers' messes avoided at all costs. If the project is a road, then it should move frequently and should never be more than, say, five miles from the works site. The Officer Commanding the project should live here, as should the design staff who are working ahead of the plant. Apart from containing the "executive" department (the plant operators, bridge-builders, etc), *all* of the workshops and stores back-up must be located here, except for a small LAD to look after the semi-permanent camp. Only by so locating the workshops can the REME effectively carry out their tasks, and they must be equipped so that they are able to make frequent moves. Likewise, the Resources organization must be at this camp and must plan its dumping programme so that stores are not left on the ground too far back.

In POST CROWN there was a marked split between the two camps. A cynic once remarked that the Regimental Police guarded the power station that produced electricity for the kitchen so that the RP staff might be fed! Too much of the manpower was self-generating in this way. In general, morale was immensely high, but undoub-

tedly there were some soldiers in CROWN Camp who found it difficult to identify themselves with the project, and this was because we probably based too much of the Force on this camp.

COMMAND AND LIAISON

The whole project was commanded by the resident squadron's OC who, since his squadron had been swallowed up in each of the three departments, found no conflict between his two commitments.

There has been a certain amount of discussion over whether the Force should have been commanded by a lieutenant-colonel, since there were three majors at the head of various departments, in addition to the OC of the Squadron. The argument for such a course is based on a misconception. This is that the Force and project equated to a civil construction job. There the interests of the consultant engineer are to see that his client gets best value for money by ensuring that the standards he has laid down are adhered to. These are in direct conflict with those of the contractor, who hopes to make as much money as possible by getting away with as low a specification as he can. This is not to decry the standards of civilian engineering, but nevertheless the contractor's motive is profit. In a military project this dichotomy is absent. The aim may be speed of completion at all costs or—at the other extreme—perfection; but whatever it is, those involved in the task will always have exactly the same aims in their respective departments and the conflict will not exist.

The other problem is that if the Force is commanded by a CRE there is no satisfactory job for the OC. No matter where he is put in a major's slot in the organization he will only command a fraction of his Squadron. No OC could contemplate such a situation! The decision to make the Squadron Commander the OC of the Force was therefore without a doubt soundly based.

In practice everyone at POST CROWN was building the same road and worked together. There was never a case where a conflict of views had to be put to the CRE to resolve, and this says much for the loyalty and flexibility of those in the Force. The CRE was based in Singapore where he was really needed, commanding four projects around the Far East, arguing our case at Far East Headquarters and assuring for us the support without which we would have been helpless. In any case, his other hat of CRE 17 Division precluded him from being based anywhere else.

The organization shows "command" lines, but in fact at every level there was continual liaison so that any minor differences could never develop through misunderstanding. In practice the chain was fairly flexible. We took great care, however, to feed in executive orders at the top, as there are few things more frustrating to a sapper than to receive a series of orders from different people telling him to do different things.

CONTINUITY

It is neither practical nor desirable to keep one squadron on a project of this size throughout its duration, so consideration must be given to the most suitable length of stay and to continuity of work. In order to spread the value of projects through the Corps, squadrons should change over as often as is commensurate with efficiency. We stayed for six months of which roughly two were during the rainy season, giving us about four months' effective work. When we came to leave everyone was sorry to go. One is probably not really effective until two months have elapsed, and after six months one starts to become stale; so the optimum period is probably about six months.

POST CROWN had a sufficiently large permanent cadre for continuity not to be lost, but some of these people stayed too long. No one should be on an unaccompanied tour of longer than nine months.

We used the handover period to carry out a major servicing and inspection programme on the plant. Although this is the last thing that an OC, striving to meet a target, wants to do at this stage, there is no doubt that the dividends to the succeeding squadron far outweigh the time lost by the outgoing one.

PLANT

Another vital lesson learnt was in the organization and control of the plant. The importance of plant management was probably underestimated by us, but it soon became apparent that on a simple job like a road such sophisticated control techniques as Critical Path Analysis were almost worthless compared with the importance of keeping the fleet serviceable. In fact, CPA in its formal sense was never used, since it is obvious that in the middle of an earthmoving project the largest earthmovers are "critical" and so must never be held up by any other activity. Thus we all became "Scraper-watchers", since if two scrapers out of the four were stationery then the entire project was proceeding at half speed. It was interesting to note that the Americans backing the Accelerated Rural Development teams gave free rein to the Thais in their road design and operation of plant, but servicing and repair they controlled most carefully themselves.

The weakness of the split in responsibility for repair between RE and REME, which is now being remedied, was soon exposed, as the Plant Officer had a triple responsibility for advising on the use of plant, carrying out its servicing and its first-line repairs. Because of the length of the line of communication, some of the so-called first-line repairs carried out during several weary days and nights by the roadside were, in fact, lengthy base workshops jobs; but to have backloaded each machine on every such occasion would have brought the work rapidly to a halt. The Plant Officer thus got deeply involved in repair at the expense of his other two functions, which in the short term are less important, but which if neglected will eventually cause total dislocation. The need to repair broken-down equipment is a distraction from the job in hand.

Another weakness exposed was the difficulty in implementing the formal establishment for fitters and supervisors for the project. For several months we had no Fitter Sergeant at all, and when he returned the Military Plant Foreman was taken away. This resulted in men being forced to do jobs for which they lacked the necessary experience, and the mistakes which they made through no fault of their own cost us valuable time. As in all trades, one really experienced sergeant or warrant officer is worth a dozen Class III men.

The lessons learnt in this field were probably the most important ones in the project and so it is worth spelling them out:

(*a*) REME must provide a generous scale of Forward Repair Teams and be responsible for all repairs, whether on site or back in workshops.

(*b*) The RE responsibility should be for servicing, documentation and operation; and on a project an officer should be allocated solely for this job. There is no short cut to the routine servicing and inspections of plant.

(*c*) Each site (defined as an area one man can observe from one spot) must have a fitter sergeant and an operator sergeant, and any work on a machine must be supervised by them.

(*d*) A scale of repair resources must be calculated for a given size and age of fleet and conditions of work, and must be provided for a project as surely as a squadron is provided with, for example, an SQMS. It must not be an *ad hoc* arrangement.

SPARES

The peculiar problem in road construction is that the scene of operations is continually moving away from its backing. We began to find that machines were off the road for long periods of time waiting for a spare part to arrive. On closer analysis it was usually found that either the fitter had identified the part incorrectly, or else had decided personally to drive up to sixty miles so that he could go shopping himself in the stores section of CROWN Camp.

A system of indenting was introduced that had a fancy code name and gave the helicopters a less restful existence than previously, but its essence, as with plant repair, was the introduction of the professionals. An RAOC sergeant was positioned in a home-made bin wagon on the works site, armed with the spare parts book for

all the machines on site. In consultation with the fitter he identified the part, filled in a special demand for himself and sent it over the radio to the stores section. The part was then despatched by the MTO by the fastest means available, and frequently this was a helicopter, although a Sioux is not much faster than a determined landrover driver.

Here again the important part of the system was the use of an experienced and trained senior NCO who eliminated the inevitable mistakes and thereby saved valuable time.

CONCLUSIONS

The value of spending nearly six months on a detached project in an undeveloped area of the world was inestimable. Apart from the obvious advantages of doing a job with a permanent and useful end product, perhaps the most profitable aspect of the work was the singularity of aim. There was never a question of deciding the priorities between the soccer team and the administrative inspection: if something contributed to the road, then it took place; if it did not, it was forgotten. This was a most refreshing feeling.

I believe we learned several important lessons. In the field of organization and control there was a lesson in assessing the right level at which a job should be pitched. On the one hand we learnt the requirement for experienced senior NCO fitters and operators; on the other, the fact that the command of such a project at Squadron level was an enlightened and correct decision. Secondly we learnt the paramount importance of organizing the administrative backing to be in the correct place. Unwieldy organizations such as a REME Workshops and RAOC Stores Section must be properly equipped, and must be prepared to make frequent moves.

Lastly we learnt that the plant organization must always be examined most carefully. In the end we achieved excellent servicability, thanks to some first-class co-operation with the REME, but the intervening period was too fraught for comfort. If details of the responsibilities of individuals are written down, together with realistic scales of men and spares, I believe the next project will maintain a more practicable rate of progress.

Fig 9. Bridge No 9, built by 11 Independent Field Squadron.

PART IV

by

Major P. R. T. Driscoll, RE BSc.

OC 54 *(FARELF) Support Squadron*

and OC POST CROWN Force—January to April 1968

INTRODUCTION

In mid-January 1968 I relieved Jeremy Rougier as the Force Commander. In this part of the report I shall deal with the final stages of the operation, namely the completion of the road and the withdrawal of the Force to Singapore. These tasks were given to 54 (FARELF) Support Squadron, with detachments from other units in support. The strength and composition of the Force for this period were as follows:

54 (FARELF) Support Squadron	140	
11 Independent Field Squadron	5	
51 Field Squadron (Airfields)	43	(until 17 March 1968)
59 Field Squadron	53	
522 STRE (Construction)	7	
RE Air Troop (FARELF)	11	
POST CROWN Force Increment	64	
Total	323	

These figures varied from time to time, but the over-all strength of the Force was fairly constant until the departure of the 51 Squadron detachment for the United Kingdom in mid-March. We kept the organization and control structure we inherited from our predecessors, making only a few changes. I shall not therefore describe the organization as a whole, as this has already been done, but describe the changes we instituted, as these had a direct bearing on the actual work on the road.

I have no intention of trying to lay down any hard and fast rules for road-building in underdeveloped countries. The experience of POST CROWN showed quite clearly that every squadron had its own approach to the problem and that each enjoyed success. I think it is also true to say that many problems we encountered were peculiar to POST CROWN and need not necessarily be expected on similar operations elsewhere. Every operation will have its own problems and they will almost certainly be different to anything experienced before. The story of POST CROWN should be read in that context.

THE TASK

The task given to my Squadron was slightly different from that given to any of our predecessors. It is as well therefore to state what my aim was and what bearing it had on our subsequent approach to the problem. The aim given me by the CRE was:

"To complete the road to Ban Nong Phok and link up with the Thai ARD road, if possible by 31 March 1968, but in any case before the final handover ceremonies due to take place in mid-April."

At first sight this aim seems clear enough, but it was not quite so easy to interpret. We hoped to take over from 11 Squadron at the 29-km chainage point (we actually took over at 29·7 km), which would leave 10·4 km to Ban Nong Phok. The Thais had agreed to continue building their road eastwards beyond Ban Nong Phok, their planned terminal, in order to meet us at about the 35-km point. Their road was being built under the Accelerated Rural Development scheme (ARD). Unfortunately there was no guarantee that work on their road would progress quickly enough, and there was a strong possibility that we would be required to go right through to the end. In the best case this would mean that we would have some 6 km of road to build in

three months, and in the worst case—if the Thai road made no progress—about 10 km. I say "worst" and "best", but we in the Squadron really wanted to build 10 km of road and hoped the Thais would not make any progress.

This affected our planning in that we had to be prepared for the worst case. To do this and leave time at the end for repairs and maintenance to the road, backloading, and preparations for the handover ceremonies, meant we would have to build at the rate of 4½ km a month. The measure of this target can be gauged by the fact that this speed would be more than twice the average produced until then, and one and a half times the record for any one month.

Planning started in the Squadron three months before we went to Thailand. Target dates were decided for various parts of the road and for the bridges—we knew we had to build two bridges, but there was a strong possibility that we would have to build a third. We also considered the possibility of having two formation teams working some 4 km apart, and also the possibility of using shift work. We prepared plans for both these contingencies, but left the final decisions until we got there. Quite clearly we were going to have to work seven days a week.

To implement any of these plans meant a requirement for more plant operators, drivers, fitters and combat engineers. These were provided without too much trouble from other squadrons, and all my requests were met. Every member of the Force was briefed by myself and for the last six weeks before we moved north I regularly harangued them once a week. When we eventually got there nobody had any doubts as to what our task was!

In the first month we built at the rate planned and achieved our 4½ km. This was as well, because before the month was up we were told that we would be going through to the end, and would build the third bridge. The Thais were to help us with forward clearance, and were also to provide what plant they had to work under our direction. We eventually completed the formation (9·7 km) in eight and a half weeks on 15 March, and all first -and second-layer surfacing (18 km) by 31 March. By 15 April we had also completely regraded the road, repaired certain bridges, and erected all the traffic signs throughout the 40 km.

ORGANIZATION

Within the first week it became apparent that we could not work two formation teams. There was not sufficient plant and much that was available was not serviceable. 11 Squadron had taken all plant off the road for two weeks for repairs and maintenance prior to our arrival. This meant we had a very good start with the equipment which was on the road in good condition. There was still, however, a substantial "graveyard" of plant awaiting spares, some of it for over six months.

We soon settled into an organization that saw us through to completion of the formation and to the departure of the 51 Squadron detachment. We worked a shift system at this time, organized as follows:

Formation Team 'A'	0600–1200 hrs	(*a*) Reveille at 0430 hrs. (*b*) Afternoon shift the following day and then revert to original timings.
Formation Team 'B'	1200–1800 hrs	Morning shift the following day and then revert to original timings.
Surfacing Team	0700–1700 hrs	One shift.
Fitters	0700–1700 hrs	One shift.

Work went on for seven days a week with one day completely reserved for servicing. The operators had the most unpleasant task because of the extremely hot and dusty conditions. Because of this they worked shorter hours than the rest of the formation team, and the shift system we employed did allow them twenty-four hours off every other day. The operators also assisted the fitters with repairs and maintenance on servicing day.

SITING OF CAMPS

A disadvantage of the layout at POST CROWN was that most of the Force were based at CROWN Camp. This was 11 km from the start of the road, so when we took over the roadhead was 40 km away. It should have been an advantage having CROWN Camp located at an airfield, but the Royal Air Force were not permitted to use it for scheduled flights, as it was not activated with radio and fire-fighting facilities. Consequently we regularly had to send a convoy to Ubon, some seventy-five miles away, to meet the weekly maintenance aircraft and bring up our supplies.

Because CROWN Camp was so far from the road, an intermediate camp had been built half-way along the road at Hong Khong to house the formation teams and fitters. This was an unfortunate but unavoidable arrangement. It inevitably led to a split in the Force, and unless one was very careful it resulted in the people at Hong Khong feeling that those in CROWN were contributing nothing, and those at CROWN developing a detached view of the road. This was overcome to a certain extent by organizing visits to the road and publishing regular weekly sitreps. These sitreps attempted to tell the Force what everyone was doing and mentioned individuals by name. It was not the complete answer, however, and it would have been much better if the base camp had been on the road.

Hong Khong Camp was not ideally placed either. It would have been better nearer the roadhead. The only way this could have been achieved would have been to make it mobile. My Administrative Officer carried out a feasibility study on this before we got there. It would have been possible, he decided, to organize a forward camp that was capable of moving forward, say once a month, with not more than two days spent in striking and re-erecting. Unfortunately it would have taken at least a week to organize initially, and we could not afford that amount of time.

RE/REME WORKSHOP

We worked a seven-day week; utilized all the hours of daylight; had a very strong team of operators; and had a target. But the one factor, more than any other, that enabled us to build the road so quickly was the high rate of plant serviceability we achieved. The entire credit for this must go to the combined RE/REME fitters who worked together in the base workshops and on the road.

The organization used for most of the operation had separated the Royal Engineer and REME fitters. It had had them working under their own officers and NCOs, and had a base workshop at CROWN Camp, largely doing second-line work. Another second-line workshop was located at Hong Khong, and a forward fitters team worked with the formation team doing first-line repairs.

We replaced this with a very strong forward repair team undertaking first- and second-line work, and a workshop at CROWN camp which fulfilled what would normally be regarded as a base workshops role. The Hong Khong workshops were closed. The forward fitters were entirely Royal Engineers, but were commanded by a REME staff-sergeant. They were responsible for the maintenance and first-line repair of the plant, but also undertook such tasks as engine changes for all plant, repairs to track assemblies, axle changes, and complete clutch and brake overhauls. No second-line jobs went back to CROWN workshops. The forward fitters team followed the roadhead very closely and moved their location about once a week.

The work undertaken in the CROWN workshops was primarily concerned with rebuilding plant that had been off the road for up to nine months. The workshops team succeeded in doing this to a remarkable degree, in one case repairing a D8H tractor for which they manufactured over 400 components themselves. This was another case of the success of a combined RE/REME organization, with Sapper welders, blacksmiths, fitters and machinists working alongside REME tradesmen.

In overall technical command of all fitters was the commander of the REME workshop, but the NCO in charge of the forward fitters was also directly answerable

to me for the serviceability of all plant on the road. This command structure worked well and obviously suited the conditions at POST CROWN. Although we were forced by the distance from CROWN workshops to do all our second-line repairs well forward, it is a system I would go for again and again in similar circumstances. The results showed that we had the talent capable of taking on such a task, and the best measure of their achievement is the fact that we had more plant on the road at the end of the operation than when we took over. This was in spite of doubling the average working hours of each machine.

STORES ORGANIZATION

We inherited from our predecessors an extremely efficient system of getting spares forward very quickly. It went under the name of "Superspeed" and we employed it to the end. We also built up the holdings of fast-moving spares well forward and had an RAOC storeman with a mobile store as part of the forward fitters team. We were also kept well supplied with spares from Singapore, and were allowed to purchase vital spares in Bangkok if they could not be got to us within forty-eight hours from Singapore.

PLANT

Some of the plant we found to be completely unsatisfactory for the job we wanted it to do. The wobbly-wheeled rollers shed their tyres too quickly, and were very difficult to manoeuvre on embankments, as they needed a large turning circle. The other unsatisfactory pieces of equipment were the Aveling Barford 10-ton dump trucks. These were clearly designed for short hauls, but at times we required them to make fifteen-mile round trips. They took a very heavy toll of the road, and in turn suffered badly from the hammering they received when driven over parts of the road that were corrugated.

Spares for most of the plant we used were available somewhere; either in Singapore or Bangkok. The spares for the Aveling Barford dump trucks were difficult to obtain, however, and much of what we needed had to be manufactured in our own workshops. This included complete leaf-spring assemblies, brake pipes, seals and wheel studs and nuts.

ROAD MAINTENANCE

When we took over in January the project had been going for one year, and nearly 30 km of road was in operation. In that time most of the road had not been regraded at all. A Road Research Laboratory leaflet in our possession suggested that a laterite road with more than 250 movements a day should be regraded once a week if it is to be kept in good condition. On parts of our POST CROWN road, with considerable military and civilian traffic, we were getting nearly 500 movements a day. The condition of parts of the road was therefore poor, as one would expect.

The reason that road maintenance had not been carried out was simply the lack of plant. There were insufficient graders, rollers and water bowsers to form a maintenance team.

The condition of the road was a source of some concern. It was rough going for all the "B" vehicles and dumpers, and there was little we could do about it while we had to push forward so quickly. It meant that when the target was reached we would have to go back over the whole length, repairing and regrading. This proved to be an enormous task, and we only finished it three days before the final ceremonies.

BACKLOADING

In addition to building the road we were also faced with the task of closing down the project and backloading as much of the equipment as we could to Singapore. Fortunately our Quartermaster had done a similar task in Borneo, although he considered the POST CROWN task was more difficult.

He had to start his backloading programme six weeks before we left, but at that stage we were still building. His problem became one of continually foraging and extracting plant from the road as and when he could, preparing it and then getting it to the docks in Bangkok. He succeeded, but only as the novelists say "in the nick of time", which was, of course, exactly what we wanted. He and I were the last to leave Thailand—appropriately in a Malaysian Singapore Airlines 21st Anniversary flight, which was champagne all the way!

RELATIONS BETWEEN THE FORCE COMMANDER AND PROJECT OFFICER

When two men of the same rank and similar seniority fill these two posts everyone expects there to be some upset or friction at some stage. They are sometimes right, there is! But the stage in life we had reached usually allowed us to achieve a happy compromise, and there was never a problem so difficult that could not be solved amicably.

What I did find difficult when I took over was the discovery that some fragmentation had occurred in responsibilities. The Project Officer, in addition to his normal duties, had been given the responsibility of controlling the Thai contribution to the budget and, with it, the control and recruitment of local Thai labour. This situation had obviously arisen at some stage in the past because presumably there had been a real need for it. I found it difficult and unwieldy and was not happy with the system. I wanted one man only to whom I could go on money matters, i.e. the Paymaster, and I wanted to recruit my own labour.

Throughout the operation, however, my officers and I were clear beyond doubt that we could not possibly have functioned without our Project Officer, and we were very grateful for all the help he gave. I hope he felt the same way about us!

Fig 10. Bridge 12, built by 54 Support Squadron.

CONCLUSIONS

We had a very special and interesting task. We all worked hard, but were agreed that it was the experience of a lifetime. I cannot believe that I will ever get quite such a job again, but I hope sincerely that many generations of younger sappers will. Although we were civil engineers building a road to aid the civil community, we treated it like a military operation. I left my own sappers in no doubt that whatever good the road did, as far as we were concerned we were training for war.

With such a task in such a country, you live, eat and sleep the road. I remember one day asking my Works Officer, Philip Biscombe, what day it was. He replied, "Monday, sir. You know; the day after servicing day!" That reply sums up POST CROWN for me.

PART V

Major G. E. C. WOOLLATT, RE, MICE, AMIPlantE,

Project Officer, CRE(Ops)FARELF

January **1967**—*November* **1968**

POST CROWN VIEWED FROM THE REAR

At first sight the support of a force of 325 men engaged on a large road-construction task in a remote area some 1,200 miles from its main base for a fifteen-month period appears to be a major undertaking. When the situation is further complicated by the lack of any effective road or rail link, the site is 300 miles from a port, and the country is incapable of feeding the force, the problem seems considerably greater.

It is therefore much to the credit of the Theatre Base in Singapore that POST CROWN Force was most efficiently supported throughout its existence, and without undue delays. It is only fair, however, to point out that after supporting a far larger force in somewhat similar circumstances during confrontation in Borneo, concurrently, moreover, with Operation CROWN, POST CROWN represented a fairly minor commitment. No special arrangements were required and no special cells were set up. The Force was treated as a normal routine air-supported unit, which, of course, it was.

The preceding Parts of this article have explained why the resident Squadron Commander was appointed OC POST CROWN Force, responsible to a CRE based in Singapore. The CRE—CRE(Ops)FARELF/CRE 17 Division—had a very small headquarters, total strength nine all ranks. His staff was led by a 2IC whose functions were the normal tasks of the second in command to a Regimental Commander, but were complicated in this instance by the fact that his units were very widely spread, from Brunei to Thailand. The particular unit which is the subject of this account was over 1,200 miles away. The third officer in the CRE's headquarters concerned with POST CROWN was his own Project Officer, myself. My job was to provide the technical support for all projects under his command, and in the specific case of POST CROWN to act as liaison officer for the Force.

Although throughout its duration Operation POST CROWN formed easily the bulk of my daily work, little of this was technical. With the succession of highly competent Project Officers resident in Thailand it was not really necessary for any technical work to be done in Singapore. I wonder therefore, in retrospect, if the duplication of Project Officer appointments both at POST CROWN and in the CRE's headquarters did not to some extent constitute the wasteful misemployment of one technically trained officer.

My POST CROWN duties in Singapore fell into three main categories—liaison, provision and movements. These were vital functions, and there is little doubt that if they had not been given continuous and very detailed attention the project would have slowed down considerably and probably ground to a halt. I think this was fully realized by the successive Commanders in Thailand whose not infrequent notes of appreciation were bright spots in a task which might otherwise have often seemed frustrating.

The most important task of the Project Officer at Theatre Base was to keep himself better informed than anyone else in Singapore on the requirements of the Force. This meant frequent visits and even more frequent signals, the latter sometimes up to fifteen exchanges in twenty-four hours. This, in retrospect, sounds most inefficient and probably indicates a failure of "communication" in its most general sense. It does, however, reflect the greatest credit on the tiny Royal Signals detachment at CROWN Camp which handled all our traffic most efficiently. Armed with all the information, the Project Officer could then set himself up as the oracle on POST CROWN matters, answering queries ranging from intergovernmental policy to why the RAOC Stores Section had demanded a gross of D8H track rollers to be at CROWN by yesterday! This situation, when fully developed, tied him to a telephone one hundred per cent of his time, waking and sleeping. It did, however, serve its purpose in keeping the Base staff off the backs of the Force. The telephone battles in Singapore waged long and furious, were often challenging and occasionally amusing.

Movements were a never-ending commitment. The Project Officer in Singapore tasked the RAF maintenance aircraft, usually one a week, which were charged against the project budget. He also spent much of his time chasing any other means of transport on which he could lay his hands free of charge. Training aircraft had their schedules "bent", VIP flights carried many Very Important (spare) Parts, and on one occasion a startled American civilian was accosted on the tarmac at Singapore Civil Airport, as he was about to board a flight for Bangkok, and a parcel was thrust into his hands with the laconic message "Please give this to the limey soldier who will meet you at the other end." SEATO exercises in Thailand were a godsend. They invariably meant aircraft all over the place, and a sharp increase in our signal traffic arranging for POST CROWN to round everything up at the other end.

Our own weekly maintenance flight was always oversubscribed and priorities had to be decided by the Project Officer, as advised by POST CROWN. The evening before take-off was invariably hectic, with the Force signalling down fresh instructions due to some plant emergency or other. The loading list was usually finalized at 1700 hours, re-finalized about 2200 hours and often altered and amended right up to the time of take-off. One of our better efforts was to activate the civilian staff of the Engineer Base Installation at 0200 hours one morning, to cannibalize the hemispherical bearings out of a wobbly-wheel roller, and load them on to an aircraft taking off at 0630 hours from an airfield twenty miles away. They made it—with the parts boxed, labelled and fully documented! On at least two occasions the aircraft had to be completely reloaded when last-minute amendments made a complete nonsense of the RAF's trim calculations. Apart from two infuriating occasions when the RAF loading party ignored the prepared loading list and selected items at random—with desperate results—surprisingly few mistakes were made. Our principal source of failure was demands for items which necessitated local purchase. Even Singapore shopkeepers are reluctant to do business at two o'clock in the morning.

In retrospect it was a most demanding fifteen months, with never a dull moment and more work than could really be done thoroughly in the time available. I enjoyed the rapid succession of problems that the job presented, but do not believe it was really necessary to have a professionally qualified engineer to do it. I am sure, for example, that either of the two excellent QMs we had on the project could have done it a great deal better.

CONCLUSION

by

Lieut-Colonel P. F. Aylwin-Foster, RE, MA, MICE, AMBIM

Each of the five authors has drawn his own conclusions and I want neither to repeat them nor to attempt to find a common thread. I would, however, like to underline the points made by Jeremy Rougier and Terry Driscoll on the deployment and use of their REME and RAOC support. I believe they got this absolutely right, and there is little doubt in my mind that this had a telling effect on the rate of construction and the general efficiency of their organization.

There is only one conclusion with which I disagree strongly enough to make comment, and that is the suggestion of my own Project Officer in Singapore that his job did not require a professionally qualified engineer. Geoff Woollatt does himself an injustice. With three other projects as well as POST CROWN going on in different parts of the Far East, and with his fifteen signals in twenty-four hours on POST CROWN alone, it was essential for these to be handled by an officer who really knew the technical background to what was needed. The idea that it is wrong to employ professional engineers as managers is nonsense. Indeed, it is perhaps one of the weaknesses of British industry that there are too few engineers in top management positions—largely through the fault of the engineers themselves, who feel that there is something wrong if they are not clutching a slide rule or wading through the mud. Geoff Woollatt did a first-class managerial job, and I am thankful that he was professionally qualified.

There is one important aspect of the project which has not yet been sufficiently stressed. This is cost-effectiveness. The total cost of the project to the British Foreign Office and the Thai Government was £281,000. The Foreign Office contribution to this was £211,000, which covered the "extra costs"—that is to say everything over and above what the Force would have cost if its constituent units had been deployed in their normal barracks. The Thai Government contribution of £70,000 covered the payment of local labour, the cost of all materials incorporated in the road, and the rail freight charges. Applying this total to the 40 km of POST CROWN road, and discounting the additional benefits such as the minor access roads, the wells and other by-products of the Force's community relations work, the cost works out at a little over £7,000 per kilometre. For obvious reasons it is not possible to compare this precisely with the cost of similar projects being undertaken by other agencies, but it is worth noting that the average tender figure published by consultants for feeder roads in Thailand was over £15,000 per kilometre. The real point here is that for the sum of £211,000 the British Foreign Office was able to hand over to the Thais about twice as much road as they would have got if the same sum had been used to finance a local contract in the normal way of aid to underdeveloped countries. To quote from Mr Hugh Hanning's article on the project, in the *Guardian* of 19 April 1968, . . . "this has been about as cost-effective a form of aid as you could get".

It would be not only invidious but also very difficult to compare the relative achievements of the four successive squadrons, since no two of them were faced with the same problems of terrain or the same conditions of weather. They all did a first-class job under trying conditions, in spite of continuous frustration with old and worn-out plant. The one really noticeable factor I found common to all of them on my frequent visits to the Force was the very high morale linked with enthusiasm for the task. I am left in no doubt whatever that a project of this type, which engenders—in Jeremy Rougier's words—a singularity of aim throughout every part of the unit, is of immense benefit to both the unit as a whole and to each individual tradesman. Time and again I spoke to sappers who assured me they would far sooner remain on that remote project, with its dust and discomfort, rough living and complete lack of normal recreational facilities, than return to normal duty in their base camps in Singapore or Malaya. They all felt they were doing a really worthwhile job and it

was impossible not to sense their pride of achievement. The married men, of course, were less keen to stay, but even they were quick to admit that from a work point of view they could ask for nothing better.

Several of the authors have referred directly or indirectly to the command problem, or more specifically to the Squadron Commander/Project Officer relationship in the absence of a resident CRE. All have stressed how smoothly it worked. This was one of the most satisfying aspects of the whole operation. There has been much discussion in the past about this relationship between the commanders of field squadrons and specialist teams. Not long ago a correspondent in this *Journal* described as "nonsense" a previous author's statement that "it is a fact of life that officers of equal rank responsible for parts of a single project are liable to quarrel". He went on to imply that officers in the Corps are normally above that sort of thing. Perhaps he put too strong an interpretation on the use of the word "quarrel", but in my view the statement, far from being nonsense, is a simple truism applicable to any profession. It is naive to suggest there is no problem, for if there was none the matter would not have given rise to so much discussion. Few can really doubt that it is any easier for two men of equal rank *and status* jointly to control a sizeable project without occasionally falling out than it is for one man to serve two masters and always please them both. The problem will always be there, but it is, of course, entirely a matter of personalities; and provided the individuals concerned can sort out their disagreements without disrupting the harmony of the force the problem will be happily solved. There were several disagreements on POST CROWN—it would be foolish to pretend otherwise—but there was never one which had to be referred to me for arbitration, nor, to the best of my knowledge, one which soured the harmony of the team. This is what really mattered, and I am sure that the command organization adopted for the operation was proved by experience to be right.

Although it would be wrong to try to compare the relative performances of squadrons, it would be unjust not to make brief mention of 54 Squadron's efforts in the last few weeks. They would be the first to admit that without the support they received from detachments of other squadrons they would not have accomplished their spectacular finishing run. None the less they deserve particular credit for achieving the final link-up at such an astonishingly fast rate of construction and for producing at the end such an impressive handover ceremony. It was really most fitting that this unit which had supported every other on the project, and indeed on CROWN previously, with strong teams of plant operators and fitters, should have drawn the task of making the home run and then achieved it with such great success. There must also be some moral in the fact that although 54 Squadron were in command this was really a composite unit, made up from several different squadrons, which worked so well together to beat all previous records. If nothing else, it is proof of the health and good sense of the Corps when faced with a challenging job to do.

The handover ceremony has been described in full detail elsewhere, so I will mention it only briefly.[4] It was attended by some 150 visitors, including the British Ambassador, the Chief of Staff of the Thai Armed Forces, and numerous senior British and Thai officers and officials. It comprised a joint British/Thai ceremonial parade, preceded by a short but fascinating religious ceremony and followed by the unveiling of a commemorative plaque and the usual cutting of a ribbon across the road. The religious ceremony took place behind the saluting dais in a festively decorated marquee, in which the assembled VIPs were seated before a row of nine saffron-clad Buddhist monks. After a number of prayers had been chanted for the new road and its future users, the principal guests filed past the monks in turn, to make an appropriate bow and be sprinkled with holy water. They were then all refreshed with coconut milk, served "in the coconut" by attractive Thai girls.

Considering the conditions in which it took place, the ceremonial parade which followed was a *tour de force* for which all the participating sappers deserve enormous

[4] "The Final Ceremonies on the completion of Operation POST CROWN", by Major P. R. T. Driscoll, RE *The Sapper*, September 1968.

Fig 11. The first section of road, looking north from Loeng Nok Tha, during the 1967 monsoon.

Fig 12. The far end, km 40. Air Chief Marshal Dawee Chullasapya and the British Ambassador driving back along POST CROWN Road after the opening ceremony at Ban Nong Phok.

Operation Post Crown 11 & 12

credit. Neither the actual form of parade not the drill were unusual, but in view of the heat and the fact that the "parade ground" was quite literally a field of dust, the performance as a whole was superb. On parade, from right to left, were a regular Thai Army band, a company of the Thai Army, a composite Sapper Squadron made up of troops from 11, 54 snd 59 Squadrons, and finally 54 Squadron's volunteer Corps of Drums. The Army Commander FARELF, who was amongst other VIPs on the saluting dais, subsequently described the Sapper effort in a letter to the CGS in the following terms:[5]

"The Squadron had trained up a Corps of Drums and Fifes, which (the previous evening) Beat Retreat in an exemplary manner, and was hard to tell from Regulars. They were drawn from members of the squadron; plant operators, storemen and the like, who had learned their instruments in their very limited spare time over the past four months. . . . At the parade on the next day the Drums and Fifes played again in support of a contingent of three troops, all very smart in No 3 dress. They showed up magnificently and were enterprising enough to march past Air Chief Marshal Dawee in line. The Thai officers had great difficulty in believing that these were the men who had been operating the plant and carrying out other duties on the road, and had not been flown in specially from Singapore for the occasion. It was clear from their bearing on parade how proud they all were of their achievement." Altogether it was quite a memorable occasion.

There is one more of the final celebrations which should be mentioned here because it involved a hitherto unreported silver presentation by the Corps. It was less spectacular, but in its own way highly entertaining. This was the Farewell Party to POST CROWN Force thrown by Lieut-General Kriangsak Chomanan in the roof garden of the Grand Hotel in Bangkok. General Kriangsak was the Deputy Chief of Staff of the Thai Security Command, and the principal senior Thai officer with whom we had dealt throughout both the CROWN and POST CROWN operations. Some thirty members of the Force, representatives of all ranks from all constituent units and detachments, were flown to Bangkok and back at Thai expense for an evening they will long remember. They were splendidly extertained to a magnificent meal by the General and his officers, and subsequently to rather more energetic activity on the dance floor by a more than equal number of Thai girls. It would be something of an understatement to say that informality was the keynote, but there had to be a few speeches and these included two formal presentations. After a touching tribute to the Corps' five years work in Thailand, General Kriangsak presented the Force with two full-scale model Thai crowns which are now in the RE Museum. On behalf of the Corps the CRE then presented him with a suitably inscribed silver cigarette box, purchased with a grant from the Corps Silver Fund augmented by individual contributions from several officers who had been most closely connected with him. He was a great friend to the Corps in Thailand and this unique momento from another army was as well deserved as it clearly was appreciated.

On 22 October 1968, six months after the Force had withdrawn, I paid one final visit to the road to make a post-monsoon inspection. The first 20 km had already been 'proved' in the 1967 monsoon, but the second 20 km had never been tested by wet conditions before the road was handed over. It was a rewarding trip. Despite an obvious but not altogether unexpected lack of maintenance, the whole alignment generally was in excellent condition, having clearly come through the recent monsoon with flying colours. Except for three or four short patches of potholes the entire route could be comfortably motored at 50–60 mph and was surprisingly little corrugated. With one exception the fourteen bridges and fifty-eight major culverts were also in first class-condition. The only fault which really gave me cause for concern was one span of a bridge in which several roadbearers on one side had cracked at mid-span. This had not gone unnoticed, because a small signboard was tied to the handrail above the point of failure, apparently (according to my Thai driver's

[5] E-in-C's Address to the Annual General Meeting of the Corps 1968, *RE Journal* September 1968.

interpretation) advising traffic to keep to the other side of the bridge. As the bridge was only one-way in the first place and as the warning sign could only be seen when it was too late to stop, this struck me as being a case of typical Oriental optimism! The cause of this failure can only have been poor timber or serious overloading, or a combination of both. Whichever it was, it justifies Pat Woolcott's comments (in Annex B) on the need for very careful testing of timber, and the dubious wisdom of continually driving heavily loaded construction vehicles over Class 24 bridges. At the end of my recce I voiced concern about this particular bridge to the District Officer, and suggested it be repaired with some urgency. He did not seem unduly worried. As traffic on the road has clearly increased considerably, one can only hope that something was or will be done before an accident happens. One other bridge and two of the culverts showed signs of erosion which needed attention, but apart from being unsightly these were all still structurally sound.

I set about that final inspection, which took me some five hours, with the deliberate intention of being as critical as possible and finding every fault I could. Leaving aside minor potholes and ruts due entirely to the complete lack of maintenance, I found not more than ten faults over 40 km of road; and only one of these—the damaged bridge—was at all serious. By any standards this was a pretty satisfactory result. As a general summary the whole road was in excellent condition despite another testing monsoon; and it remained a great credit to the project officers and squadron commanders who had planned and designed it and supervised its construction. Spreading the credit a little wider to include the men who did the physical work, one of the nicest aspects of this final trip was the reaction of the local Thais to my British Army uniform. Driving slowly along the road and making frequent stops, I was greeted time and again by a spontaneous smile, shout and wave from children and adults alike as they recognized the uniform not seen for six months. This unintentional but clear tribute to the men of POST CROWN Force, coupled with the visible proof of a fine laterite highway, sent me back to Singapore feeling rather proud of the British Army and my own Corps in particular.

What in practical terms has the construction of this road achieved? It has opened up the area to Government control and Government aid. Administrators, doctors, nurses, teachers can now reach many villages much more quickly than before, and the inhabitants themselves now have access in the other direction to market their produce more easily and at better prices. Something in the order of 16,000 people can now for the first time in their lives begin to enjoy the benefits of proper administration, security and trade; and the internal security situation in the district has shown a remarkable improvement. As a priest in one of the villages said to the British Ambassador—"we have come out of the jungle". Last, and from the Corps' point of view by no means least, about one thousand Sapper officers and men have had some first-class experience on a worthwhile construction project and have enjoyed it to the full.

ANNEX A

POST CROWN
CONSTRUCTION SPECIFICATION

Design Criteria

1. (*a*) *Carriageway*	20 cm compacted laterite, 6 m wide with 1 m shoulders
(*b*) *Maximum Gradient*	3·33 per cent (1 in 30)
(*c*) *Ruling Gradient*	2·50 per cent (1 in 40)
(*d*) *Minimum Curvature*	10° (574 feet radius)
(*e*) *Minimum Intervisibility Distance*	153 m (500 ft) at 1 m above road level
(*f*) *Maximum Single Wheel Load for Pavement Design*	10,000 lb (equates to CI 16 wh)
(*g*) *Military Load Class for Bridges*	CI 24 (wheeled)

Road Formation

2. As shown on Drawing 13 (Figure 4 this article) except:
(*a*) Width of side ditches shown (2 m) is a minimum. Actual width can be increased (outwards) to conform with plant used to form the ditches.
(*b*) The width of laterite carriageway (normally 6 m) is to be increased by 50 cm on curves sharper than 3°. In such cases the 1 m shoulder will be retained, making the overall width of formation 8·50 m.

3. *Superelevation*

(*a*) Superelevation will be provided as follows:

Degree of Curve	*Superelevation*
(1) Over 3°	5·5 per cent (1 in 18)
(2) 3° or less	4·0 per cent (1 in 25)

(*b*) The normal 4 per cent camber is to be decreased uniformly from a point 50 m before the tangent point of the curve. The road cross-section should be level 25 m before the tangent, and full superelevation provided at the tangent point.
(*c*) On the approaches to bridges the camber is to be run out uniformly over a distance of 20 m before the bridge so as to provide a level carriageway at the abutment.
(*d*) Camber and superelevation are to be formed during the initial earthwork before the laterite surface is applied.

Earthwork

4. (*a*) *Clearance*

(1) In forest and scrub conditions the clearance is to be 20 m each side of the centre-line.
(2) In areas of padi or light vegetation clearance is to extend to 15 m each side of the centre-line. Individual trees or bushes within this line may be left at the discretion of the officer in charge of construction, but these must not impinge on the area bounded by the outside edge of side ditches.
(3) Where the road is being constructed on a side hill slope clearance of vegetation and top-soil is to be to the lower side of the cleared area.

(*b*) *Subgrade*

(1) In forest/scrub areas, where the top-soil is removed and where the total height of fill is less than 1 m, the subgrade is to be compacted until the air voids ratio is reduced to 10 per cent or less. If the fill exceeds 1 m in height the subgrade compaction can be to 20 per cent.
(2) Across padi the top-soil is not to be removed, and compaction of the subgrade will not be attempted unless specially ordered by the Project Officer.
(*c*) *Embankments and Road Formation*
(1) Fill material is to be spread, brought to correct moisture content, and compacted in layers not exceeding 20 cm. This figure will be reduced if test results show that the required degree of compaction is not being achieved.
(2) The top 40 cm of any fill is to be compacted to 5 per cent air voids ratio or less. Between this level and the subgrade, compaction is to be to 10 per cent voids ratio or less.

(3) The laterite surfacing is to be laid and compacted in two layers, each 10 cm thick. Compaction is to be to a minimum of 5 per cent air voids ratio. Whenever possible the first layer of surfacing will be left to take road traffic for a minimum of one week before the second layer is applied. Moisture content for the laterite surfacing should be 1 or 2 per cent more than the optimum moisture content value established by laboratory tests.

Tests

5. (*a*) Tests for Optimum Moisture Content of the subgrade and of proposed fill material are to be carried out by CLOs (Construction Laboratory Operators) under the direction of the Project Officer. Results of such tests will be recorded and noted to the Squadron Works Officer.
(*b*) CLOs will be available as required to assist the Squadron Works Officer in selecting borrow areas and laterite pits. In these cases the CLO will test for moisture content and suitability and record the results of such tests.
(*c*) The Squadron Works Officer is to be responsible for carrying out regular testing of compaction to determine the Air Voids Ratio. This will be done by measurement of the Density and Moisture Content. A minimum of six such tests should be made daily when earthwork is being done. Records will be kept of all tests carried out.
(*d*) Tests to determine the CBR value of the subgrade and formation are to be carried out at intervals as directed by the Project Officer.

Culverts

6. (*a*) The profile drawings give information on the type, size and location of culverts, and quote a maximum invert level. This level may be lowered at the discretion of the Squadron Works Officer to conform with the level of drainage ditches. Crossfall of culverts is not specified and will be established on site by the officer in charge of construction. It will normally be in the order of 20 cm for the standard 18 m long culvert. In flat areas where culverts are provided to balance water levels across padi the pipes may be set level.
(*b*) Culverts are to be laid, haunched and the ends stone pitched as shown on Drawing 14 unless a special drawing is issued. Joints between the pipes are to be sealed with a sand-cement mix. The joints will be thoroughly wetted before the grout is applied, and will be cured by the application of wet sacking for a period of twentyfour hours after jointing.

Drainage

7. Dimensions of side ditches are shown on Drawing 13. Levels for ditches are not shown on the grade profile drawings. Such levels are to be determined by the officer in charge of construction, who will ensure that sufficient fall is provided to prevent water standing in the side ditches. A minimum fall of 1 in 150 should be provided whenever possible. Falls steeper than 1 in 20 are not to be used.

Bridges

8. (*a*) No variation is to be made to the line, level or construction details shown on the drawings without the prior concurrence of the Project Officer.
(*b*) Where the piers and/or abutments are piled the piles will be driven to the full penetration shown on the drawings, irrespective of the calculated final set, unless the piles are being damaged by hard driving. In such cases the Project Officer is to be advised. Records are to be kept of all pile driving, showing drop of hammer, number of blows and penetration. Final embedded length must be recorded for every pile.

ANNEX B

COMMENTS ON SPECIFICATION FOR THE POST CROWN ROAD

by Major P. Woolcott, RE

Construction Specification

The construction specification for POST CROWN was a sensible one, but did contain some matters worthy of discussion.

Although the requirement of the area was for Class 24 bridges, the passage of numerous loaded plant transporters during construction would probably have justified temporary strengthening. Occasional limited overstressing of timber structures is said to be allowable—but how much and how often? The construction of minor roads in developing countries by large earthmoving machines will often raise this problem.

The compaction of soil was specified by defining a maximum percentage of air voids. In general, soil needing "good" compaction was required to have a maximum of 5 per cent.

Most of the soil along the road line was silt/sand material, for which a requirement of 5 per cent was asking for soil densities greater than those obtained in the British Standard Compaction test at Optimum Moisture Content. The experience from POST CROWN is that to define compaction by the air voids system is dangerous unless tests have been done on all the soil to determine what air void percentage is reasonable. POST CROWN road was laterite-surfaced, and to require 5 per cent air voids was, in some respects, like asking for a degree of compaction similar to that under a motorway. Later investigation and experience showed that 15 per cent air voids for the prevalent silt/sand material indicated an acceptable degree of compaction under the laterite surfacing.

Most of the area crossed by the POST CROWN road was flat or slightly rolling country, for which the specification of a maximum slope of 1 in 30 never gave much trouble. However, in the area of the Ubon-Roi Et provincial border—known by the Force as the "escarpment"—it is possible that a relaxation of the maximum slope requirement would have allowed a different alignment with less earthworks. The determination of a maximum slope will generally depend on a number of factors—the traffic expected to use the road, the type of surface, and in areas of heavy rains the probability of erosion of both the surface and the side ditches.

The clearance of scrub and trees to a width of 40 m, in the middle of which was placed a 6-m carriageway, was often queried by visitors. Neither the rapidity of encroachment of the surrounding jungle nor the shading of the road surface by the tree canopy were such important factors in clearance width as they were in Malaya and Borneo, the soil of North-East Thailand being not so fertile and the canopy nothing like so dense. However, a number of factors made this seemingly wide clearance sensible. The easily eroded silt/sand material limited the side slopes of the construction; the general flatness of the area and the heavy monsoon rains suggested ditches of large cross-section to contain floods and allow evaporation; and the acquisition of land and the method of side-ditch-to-crown construction were easy.

Bridge Design and Construction

The basic design of the timber bridges followed the principles of ME, Vol 3, Pt 1, but as in all engineering works a number of local problems arose and had to be solved. The major difficulties and peculiarities are worth discussion.

The timber used in construction varied from well-seasoned and defect-free to unseasoned and delivered to site within a week of being cut from a forest. The assumption that the early supplies of timber were of Group 1 quality was subsequently verified by its performance in the first few bridges. Later, however, unseasoned timber often did not stand up to use as roadbearers, and sometimes cracks developed even in unstressed members. The cracking probably had no single cause, but was due to a combination of overloading by construction vehicles, lack of seasoning and lack of distribution of the load between roadbearers by the 2-in decking used on some bridges. The 2-in decking was strong enough in bending to span the gap between roadbearers, but probably not stiff enough to transmit the load to the number of roadbearers presumed by the design. On later bridges the spans were reduced from 6 to 5 m, and the decking increased to 3 in.

Where soil is granular and end-dam revetments are likely to be covered in floods, it is good practice to lap the butting end-dam planks with cover strips to prevent erosion.

For safety reasons, clear and prominent bridge markings are essential to indicate one-way timber bridges on a two-way road.

Some other points on bridge design, more opinion than fact, are worth mentioning, The varieties of timber sizes and bolt diameters should be kept to a minimum in timber bridging, as neither the allowable stresses nor the imposed loads are known with any real accuracy. Wearing surfaces on timber bridges require replacing about twice per year, so attention to them in design and construction is repaid by less need for maintenance. The Thai practice is to use a longitudinal wearing surface, covering only the two 1-m wide wheel tracks. POST CROWN Force tried a number of types, including diagonal, herringbone and longitudinal, but all covering the whole bridge surface. Because of rapid wear and frequent breakage I believe that the Thai system is to be recommended. The wearing surface of a timber bridge is subjected to considerable flexing, in sympathy with the flexing of the roadbearers. Nails will not restrain the loosening of the wearing surface and it is better to use spikes or bolts. Some authorities even use a metal band wrapped around the planks.

The local Thais proved quite efficient at the rough carpentry for timber bridges. The best employment of British sapper carpenters in these conditions is probably in a supervisory and plan interpretation role.

Most of the bridging teams concerned with piling started with considerable apprehension

as to how they would be able to guide their piles in straight. In conditions such as those at POST CROWN, and using a 19RB pile-driving rig, all that is really necessary is to dig a hole 2 ft deep in the correct position and carefully level the 19RB base machine on firm ground or timbers.

Most of the connecting ironwork and special bolts for the bridges were fabricated in the REME workshops in CROWN Camp. Sometimes this was a considerable load which might have been better undertaken by an RE 10-ton machinery lorry, actually at the bridge site.

A large number of bolt-holes required drilling and a large amount of timber required cutting to length at every bridge. I consider that nothing less than a 300 cfm compressor is really acceptable for this task.

Earthworks

There was no sidehill cut on the road and, except for embankments, once the top-soil had been removed the formation was mostly constructed by excavating material from the ditch lines and placing it on the crown. Tractor-drawn scrapers were good machines for this technique when the ditch material was of acceptable quality for construction. The latter part of the project saw the final breakdown of the two motorized scrapers, and thereafter all earthworks had to be done by the tractor-drawn machines. These have a maximum one-way haul distance of about 300 metres, which sometimes—because of the deadline date—meant using material with insufficient cohesive qualities. The number of dump trucks available was only barely sufficient to haul laterite surfacing, and there were never any spare for the main earthworks.

There is no doubt that the prevalent silt/sand material helped the turn-round time of scrapers, but it did simultaneously cause problems in the compaction.

Little restriction was placed on the siting of borrow areas. The local rice-growing was confined to the low-lying padi fields, where, except in the driest season, it would not have been reasonable to establish a borrow pit. On the slightly higher ground, however, where the local farmers only infrequently planted jute and cotton, they had no objection to the opening up of pits. Some of these were later used by the Thais as fish ponds or as additional rice patches. The ability to establish borrow pits almost anywhere meant that in the design process the balancing of cut and fill was only a minor factor. Such balancing of cut and fill over distances of more than about 300 metres would in any case have been impossible after the motorized scrapers became unserviceable.

At one time it was thought that the compaction being given to the road would have reduced the formation of transverse corrugations on the final surface. This theory was not borne out by experience. One must remember that a laterite-surfaced road is a relatively cheap product in which an attempt is being made to get an acceptable compromise between those properties good for the dry season and those for the wet. To prevent corrugations in the dry season, a high clay content in the surfacing material is desirable; whereas in the rainy season a high granular context is required. The best balance of clay and granular materials will inevitably mean that some corrugations will appear. At one stage the corrugations on the POST CROWN road were very disturbing to travellers in vehicles, and positively damaging to the vehicles themselves. In retrospect it can be said that there were not enough graders and compactive equipment to both build the new road and maintain the old. When towards the end of the project the target was to achieve the link-up at Non Phok, an aim entirely dependent upon the availability of plant, the diversion of machines to road maintenance would not have benefited the project as a whole, although it might have cut down the "B" vehicle repair problem.

Although a laterite-surfaced road would not normally require much compaction control of the quantitative kind, the rotation of units on to the task at four to six months intervals from entirely different work brings its special problems. Control is considerably eased if some quantitative measure of compaction can be passed on from squadron to squadron.

The availability of laterite for surfacing was a constant problem. In the later stages haul distances up to 20 km one way were often used. The ability to predict the existence of good laterite in North-East Thailand would be very rewarding. Examination of aerial photographs and the foliage of trees and extrapolation along contours from known deposits were tried, but were never really reliable. Actual observation of the deposit either in a well or river bank, or along the side of an eroded area, were the most effective methods. Information from the locals was a help which had to be accepted with caution, lest the aim of the villagers was more for a track into their village than for the production of good laterite. Bearing in mind the importance of this material and the fact that the largest deposit along the alignment was found by chance after the main earthworks had passed it, I am sure in retrospect that not enough emphasis was put into searching for laterite.

ANNEX C

RE UNITS WHICH TOOK PART IN OPERATION POST CROWN

CRE(Operations)FARELF/HQRE 17 Division

11 Independent Field Squadron, RE

34 Field Squadron, RE

51 Field Squadron (Airfields), RE

54 (FARELF) Support Squadron, RE

59 Field Squadron, RE

84 Survey Squadron, RE

522 Specialist Team RE (Construction)

RE Air Troop (FARELF)

302 Postal and Courier Communications Unit, RE

There were also several RE individuals included on the establishment of the POST CROWN Force Increment.

Correspondence

Lieut-Colonel P. F. White, OBE, RE (rtd),
The Paper Mill,
Hawkhurst, Kent.
21 July 1969

THE GREAT ABBAI EXPEDITION

Sir,—The article in the March 1969 *Journal* on the Great Abbai Expedition interested me greatly, and proved how indebted I am to the late Signor Mussolini for being able to write this letter to you.

During the winter of 1926/7 I was introduced by Sir James Wordie, with whom I had been to Greenland (*REJ* September 1928), to a Mr Reay, who, with his wife, had lived for some years in Abyssinia. He asked me to join an expedition which he was organizing to navigate the Blue Nile from Lake Tana to Khartoum.

The party was to consist of Mr and Mrs Reay in one boat and myself, as surveyor, with a Mr Grabham in the other. Grabham, who died recently ,was an irrigation officer in the Sudan and so was very interested in the upper reaches of the Blue Nile. I do not know anything of the subsequent history of the Reays.

Shorts of Rochester had designed two boats for us. Each was to be built in four sections, two decked-in end sections and two open middle sections. These were to have been transported by sea and rail to Addis Ababa and thence on donkey or mule to the source of the river, where they would have been assembled. We had the blessing of the Emporer on our enterprise.

I was granted six months—or more—leave by the War Office in spite of a stern warning by Brigadier Winterbotham, then Director of Ordnance Surveys. I was all ready in 1929 to set off whenever Reay should summon me. However, to my great disappointment at the time, the Italians entered Abyssinia and forbade our trip.

A few years ago, just before his death, I met Colonel R. E. Cheesman, who explained, without mincing his words, what a lucky chap I was! Having read Major Blashford-Snell's article, I realize how right he was.

I offer my congratulations to the successful Expedition.—Yours faithfully, P. F. White.

Brigadier T. W. R. Haycraft,
Belstone Barton,
Nr. Okehampton,
Devon.
22 June 1969.

CIVIL EMPLOYMENT OF SAPPER UNITS

Sir,—With reference Professor Donald Portway's letter, published in the June *Journal*, it may be of interest to know that, when I was commanding the 7th (Field) Company RE at Colchester in 1930–3, we undertook on behalf of the Ministry of Works, the rebuilding of an East Coast sea wall demolished in a gale.

We submitted our proposals to the Ministry for approval and the Ministry supplied cement, reinforcement, etc, and hired machines for us. It was an interesting and worthwhile task into which the Company entered with enthusiasm. Civil engineering jobs like these are very suitable for Sappers who can live under canvas instead of being paid an allowance for living away; they work much longer hours than civilians, and they thoroughly enjoy themselves.—Yours faithfully, T. W. R. Haycraft.

Major-General C H Foulkes CB CMG,DSO.

Memoirs

MAJOR-GENERAL C. H. FOULKES, CB, CMG, DSO

Chevalier of the French Legion of Honour, French Croix de Guerre, with Palm, Commander of the Order of the Crown of Belgium, Belgian Croix de Guerre, with Palm, Commander of the Order of the Crown of Italy, American Distinguished Service Medal, ADC to King George V

Colonel Commandant RE, retired

MAJOR-GENERAL C. H. FOULKES, doyen of the Colonels Commandant RE and father of a Colonel Commandant, died peacefully on 6 May 1969 in his ninety-fifth year.

Charles Howard Foulkes, born at Bangalore on 1 February 1875, was the last survivor of the seven sons and one daughter of the Rev Thomas Foulkes. All seven sons served the Empire as soldiers or administrators, or both, and five of them lie buried overseas. Charles was the fifth son. Their father was a senior Chaplain in the Madras Government Service and a distinguished Tamil and Sanskrit scholar. He was for eight years Chaplain of St John's, Bangalore, where he became so great an admirer of the Commandant of the Madras Sappers and Miners, Colonel (later General Sir Harry) Prendergast, VC, that he set his heart on one of his sons becoming a Sapper officer.

Charles Foulkes left India at the tender age of seven, with his father and an elder brother, to spend two years with the Rev Samuel Pettigrew, Rector of Puddlestone, near Leominster in Herefordshire, there to prepare for entry into The Lord Weymouth's School, Warminster. He was at Warminster for five years with four of his brothers, and from his first arrival in England he saw little more of his parents. From Warminster he went for two years to Bedford Modern School, which then had an Army Class, and thence passed into the "Shop" at the age of seventeen.

He was gazetted and commissioned into the Royal Engineers in 1894, when the pay of a 2nd-lieutenant was five shillings and sevenpence a day. His subsequent career provides an example of the versatility for which members of his Corps are renowned.

His foreign service included duty in Sierra Leone (twice), the Gambia, the Gold Coast, South Africa and the West Indies (all in the period 1897–1902), Nigeria (1902–4), Ceylon (1909–12), France and Belgium (1914–18) and India (1919).

When only 22 years old he held the impressive title of "CRE, West Coast of Africa", at a time when the "Scramble for Africa" was reaching its climax. There he built coast defences and accommodation in Sierra Leone, drew up the first defence plan for the Gold Coast and inspected buildings in the Gambia. He also took part in the "Hut Tax Expedition" of 1898–9, for which he was awarded the West African Medal with clasp. He became acquainted with famous men including the great administrator and Empire builder, Sir Harry Jackson, and the discoverer, a little later, of the life-cycle of the malaria parasite—Colonel Sir Ronald Ross. But West Africa was still "The White Man's Grave" and on more than one occasion all four of Foulkes's British subordinates were down with fever at one time and he himself was carried on board ship with severe malaria and invalided home at the end of both Sierra Leone tours.

In 1899 he contrived, when on leave between tours in Sierra Leone, to take part in the South African War by devising bicycle-mounted photo-reconnaissance equipment and convincing the Adjutant-General, Sir Evelyn Wood, of its military value. The Photo Reconnaissance Section RE, shown on the South African War Memorial Arch at Chatham as part of the Sapper Order of Battle for that Campaign, consisted of only himself and a Corporal Ford. They were, however, actively employed and frequently came under fire when photographing Boer positions.

Good use was made of their pioneer work, but the shortage of Sapper officers soon led to Foulkes's absorption into the mounted 1st Field Troop RE commanded by Major, later Lieut-General, Sir Aylmer Hunter-Weston, which operated with the Cavalry, where he was given command of the 1st Field Section. A lifelong friend and admirer, Lieutenant, later Lieut-General Sir Ronald Charles, and Chief Royal Engineer from 1940 to 1946, commanded the 3rd Section.

Brigadier-General Broadwood, commanding one of the Cavalry Brigades in South Africa, invited Foulkes to be his Staff Captain Intelligence, in addition to his photographic and other RE duties, and he was happily engaged in the first pursuit of De Wet in August 1900 when peremptory orders from the War Office recalled him to Sierra Leone, where he was long overdue. During the ten months spent in South Africa he had taken part in operations with French's Cavalry Division from Colesberg to Pretoria, seen many of the most famous British commanders of the day in action and come to his own conclusions about the conduct of the war. He was awarded the South African Medal with six clasps.

In 1902, when on leave from Sierra Leone and expecting a posting to India, he took advantage, on War Office instructions, of the series of great volcanic eruptions in the British island of St Vincent and in French Martinique, among the major natural disasters in recorded history, to join in the throng of tourists, scientists and newspapermen in order to make a military reconnaissance of the French island, which was thought to be of strategic importance as it lay on the route to the projected Panama Canal. For cover he was accredited to a London press agency and his specialist knowledge of photography, coast defence and intelligence duties stood him in such good stead that his delicate mission was entirely successful and free from any embarrassment with the French authorities. His vivid and acute descriptions of the eruptions of Mont Pelée and the effects of drastic changes in temperature and atmospheric pressure caused by these eruptions were strongly suggestive of modern accounts of nuclear explosions.

Six weeks after his return from Martinique Foulkes was invited by Lieut-Colonel G. S. McD. Elliott, RE, to join him as a member of the Commission appointed to delimit the thousand-mile boundary of Northern Nigeria with French Sahara between the River Niger and Lake Chad, in hostile and largely unexplored country. The Commission left Liverpool in October 1902. That part of the world had not then been triangulated; there was no telegraph line and there was, of course, no wireless in those days. The seven half-chronometers, which had been so carefully selected and tested, proved useless under field conditions and longitude had therefore to be computed from the occultation of stars by the moon. Lieutenants Foulkes and G. R. Frith, both of whom held the temporary rank of captain, were the astronomers of the party. That undertaking of nearly seventy years ago, entailing as it did travel by canoe and country pony, the use of steel tapes for the measurement of bases, logging distances by single-wheel "perambulator", carrying chronometers by porter and taking occultations, could hardly have been in more marked contrast to modern methods of air survey, movement by helicopter, measurement of distances by tellurometer and of longitude by radio signal, and the fixing of points on the earth's surface by use of satellites.

It was while he was taking astronomical observations at the village of Illela, ninety-five miles north of Sokoto, that Foulkes received news from the friendly Hausa Seriki of Tchara of the capture of Kano by the British Expedition from the south and the flight of its Emir Aliyu towards his Fulani brethren in Katsena, and that a decisive battle with the Fulani Sultan of Sokoto was expected at any moment. Foulkes thought that by acting at once he might be able to intercept the fugitive Emir of Kano on the road and take him prisoner before he did any more harm. He therefore rode off without delay with five African soldiers and his personal servant Farna, an intrepid Susu whom he had brought with him from Sierra Leone. He had already sent a fast messenger to the Chief of Gober, holding him responsible to the High Commissioner Sir Frederick, later Lord, Lugard for delaying the Emir till his

arrival. The party then rode post haste the 175 miles of desert tracks from Illela to Gober on country ponies in three days and two nights. Only Musa, a Yoruba corporal, his servant Farna and a Tchara guide were able to keep up with him. Omuru, the Chief of Gober, proved anything but cordial or frank. However, doubting the outcome of the forthcoming battle, he reluctantly handed Aliyu over to Foulkes, who brought him back to Illela and placed him at Lugard's disposal. The High Commissioner, after the victory at Sokoto, congratulated Foulkes in a personal letter on "his wonderful feat and the securing of Aliyu", although he appeared later to have been deceived by Omuru into believing that he had intended all along to hand Aliyu over to the British. The reactions of Lieut-Colonel Elliott, head of the British Boundary Commission, were, however, the converse. He refused to forward Foulkes's report to Lugard and threatened to send him home in disgrace for his reckless action. This strange behaviour was explained (in Foulkes's opinion) by the fact that Elliott himself had just been censured by Lugard for intruding, with his French counterpart Commandant Moll, as his guest, into the Battle of Sokoto, and that Elliott was not at the time in good health. But it was a grave set-back for Foulkes. Some months later he again went down with such a severe attack of malaria that he had to be invalided, for the third time, out of West Africa. He was, however, awarded the Northern Nigeria Medal 1902.

Lieut-General Sir Ronald Charles wrote of Foulkes's early service that it was "only a prelude and pointer to the later stages of his career as a soldier engineer throughout which his characteristics of originality, initiative and determination found full scope for their exercise".

His work in Northern Nigeria was followed in 1904 by a five-year posting to Edinburgh in charge of the Ordnance Survey of Scotland. It was a happy appointment, since it coincided with his marriage, though in later life he regretted not having left Survey and tried to enter the Staff College. That posting was followed in 1909 by the command of the 31st (Fortress) Company in Ceylon, in those days a sportsman's paradise.

After his return from Ceylon he was posted in 1913 to the RE Depot at Chatham to command "L" Company which, among other things, administered the RE Band, in which he took an enthusiastic interest.

Just before the outbreak of the First World War in 1914 he was promoted Major after twenty years' service and six months later he was given command of the 11th (Field) Company when it was engaged in the first Battle of Ypres. In the Introduction to his book "*Gas!*" Foulkes described the work of the Field Company Sappers at the front, the conditions under which they worked, their heavy casualties and their superb morale. Despite his subsequent fame as the Commander of the Special Brigade RE, this period was probably the highlight of his service. He was awarded the DSO "for conspicuous gallantry in assisting to rescue a wounded man under heavy fire, and for valuable service rendered at Cuinchy in placing in a state of defence the position which was captured from the enemy on February 6th, 1915". He was also made a Chevalier of the French Legion of Honour and awarded the French Croix de Guerre with Palm for gallantry and was mentioned in despatches. Contemporaries have declared that he was an inspiration to all and he certainly appeared to bear a charmed life. Lord Cavan, commanding the Guards Brigade, who knew him well, wrote: "His personal bravery and untiring energy were proved nightly during the first Battle of Ypres in 1914".

Much has been written about Chemical Warfare and many eminent soldiers and scientists have had a part in its development. The story can be studied in Volume V of the *History of the Corps of Royal Engineers* and in Foulkes's book "*Gas!*" *The Story of the Special Brigade*. Chemical warfare started in France on 25 April 1915 when the Germans launched a surprise gas attack against French African troops in the Ypres salient, followed shortly afterwards by similar attacks against the British and Canadian fronts. The British Government reluctantly gave permission to Sir John French, the British Commander-in-Chief, to retaliate in kind and Major Foulkes was

appointed as Gas Advisor on the strength of his battle experience, with the brief that a retaliatory major gas attack was to be mounted quickly as part of a joint Anglo-French offensive. An entirely new type of warfare had thus to be developed *ab initio*. After hasty preliminary consultation with medical and scientific authorities, it was decided, on Foulkes's advice, to use chlorine gas, since it could readily be stored in liquid form. Special storage cylinders had to be designed, manufactured and transported, and methods devised to discharge a suitable form of gas cloud that would be operationally effective. Four Royal Engineer "Special Companies", so named to conceal their actual role, were raised in France for the offensive use of gas, containing in their ranks many brilliant scientists, chemists and University undergraduates, selected, commanded, trained and directed by Foulkes. The Companies were later expanded and incorporated into the Special Brigade RE, with a strength of 6,000 all ranks which contained, in addition, a field chemical laboratory and a meteorological unit. Foulkes was promoted Brigadier-General and given command of the Brigade.

The intended offensive was postponed for a variety of reasons and the first reprisal gas attack was launched on 25 September 1915 in the Loos sector. Altogether 5,500 cylinders, containing 150 tons of chlorine, were discharged from 400 emplacements established in the forward trenches on a twenty-four-mile front, together with 46,000 phosphorus smoke candles and bombs. Simulated gas discharges, using smoke, were mounted in other areas. The operation was a complete success. Subsequently, phosgene and other gases were used for cloud attacks and methods developed for the employment of gas shells, fired from guns and mortars, which made the use of gas less dependent on the prevailing wind. Electrically operated projectors, the Livens Projector, were also developed. Up to 400 of these could be fired simultaneously and 1,500 were used during the attack on Messines Ridge in 1917. Later in that year Foulkes was made Director of Gas Services, British Armies in France, and the following year he became, in addition, President of a Committee which covered both the offensive and defensive aspects of gas warfare.

It was largely due to his lucid thinking, determination, persuasiveness and magnetic powers of leadership that the initiative in chemical warfare was so quickly wrested from the Germans and they came to regret they had ever started it. At that time Corporal Adolf Hitler, lay in hospital temporarily blinded by gas, and who can say what influence that salutary experience may have had on the decision by the Führer of the German Reich not to resort to chemical warfare during the Second World War?

It may not be generally known that Foulkes personally tested the effects of every gas—most notably phosgene—taken into use, repeatedly in some cases, and that he declined promotion to major-general in 1918 in order to remain with his comrades of the Special Brigade RE.

There are very few people now living who knew him intimately in those days, and it is fortunate indeed that one of those should be that illustrious scientist and engineer, Brigadier-General Sir Harold Hartley, GCVO, CH, CBE, MC, FRS, an Honorary Member of the Institution of Royal Engineers. As Assistant Director to Foulkes in France he knew him intimately and has recently written ". . . I admired so much his imaginative approach and his shrewd judgement and decisions that made him such an effective leader of the Special Brigade. . . . It was a great compliment to CHF to be selected to develop our reply to the Germans' use of gas and the speed and effectiveness with which he delivered the answer shows his soldierly and imaginative grasp of the situation. He genuinely won Winston's confidence who gave him full support at the Ministry of Munitions and used to come and stay at our HQ to get the latest news. He picked a remarkable bunch of men as Company Commanders and he was quick to realize the potentiality of men like Livens and gave him a free hand to experiment. He once said to me: 'The worst of you scientists is that you don't know when to cut your losses', and I said, 'If you did, many discoveries would not have been made!' But of course he was right under the

pressure of war. His directives were models of clear expression and he imbued everyone with a sense of urgency. He had the gift of Decision."

For his work in Chemical Warfare he received brevets of Lieut-Colonel in 1917 and Colonel in 1919. He was created CMG in 1918, and in 1964 he became the senior surviving Companion of that Order. After the war, in 1919, he was a member of the Holland Committee which made recommendations as to the organization of Chemical Warfare, based on the expansion and development of Porton. He was offered the post of Commandant at Porton, but declined it. In 1962 the Institution of Royal Engineers decided to award from time to time a Gold Medal as a mark of rare honour for some major work connected with the advancement of historical, scientific or technical knowledge related to the activities of the Corps of Royal Engineers, and in 1964 Major-General Foulkes was presented with an Institution Gold Medal for his pioneer work in the development of chemical warfare.

In addition to other honours and awards, already cited, he was appointed Commander of the Order of the Crown of Belgium and Commander of the Order of the Crown of Italy, and was awarded the Belgian Croix de Guerre with Palm and the American Distinguished Service Medal, in recognition of his great services to all those Allied countries.

At the end of the First World War Foulkes was sent as a Brigadier-General to GHQ India for consultation on the future training of the Indian Army in chemical warfare. He saw active service in the Third Afghan War and against the Mahsuds in 1919. He was awarded the India General Service Medal with clasp Waziristan 1919–20.

After his return home in 1921 he was appointed CRE Fermoy during the "Troubles" in Ireland, a posting not very much to his taste. Soon, on the strength of his facility for writing, he was transferred to the General Staff and given charge of a propaganda department in Dublin which, however, for political reasons was scarcely allowed to function.

In 1922 he became CRE Northumbrian Area, first at Newcastle and later at Catterick Camp, where major reconstruction was beginning. At that time he was senior, by brevet in Army rank, to his own Chief Engineer in Northern Command. From there he was posted in 1924 to Salisbury as Deputy Chief Engineer Southern Command.

In 1926 he took up his last appointment, which he held for four years, as Chief Engineer Aldershot Command, a post which at that time carried the mobilization appointment of Engineer-in-Chief of the British Expeditionary Force.

In 1927 he was created CB and in 1928 he became ADC to King George V—an honour of which he was always more proud than any other.

Whilst Chief Engineer at Aldershot his forthright advocacy of mechanization did not always meet with the full approval of General Sir David Campbell, the General Officer Commanding in Chief, who, as a subaltern, had riden his own horse in the Grand National and, whilst GOC in C, could still show his prowess in the saddle by winning a Hunter Chase at one of the Tweesledown Military Meetings. It was characteristic of Foulkes to say, when invited to admire one of the General's fine new hunters, that he thought that a motor bicycle would be more useful.

When his tour as Chief Engineer at Aldershot was completed, although not being p.s.c, he had hoped and indeed expected to be made GOC in Malaya. However, at that time there was a World Recession and a General Staff policy of "No major war for ten years" and, on being promoted Major-General in August 1930 and placed on half-pay, he elected to retire.

He was a recipient of the Coronation Medal in 1937 and he was a Colonel Commandant RE from 1937 to 1945, being Representative Colonel Commandant in 1944.

Between the two world wars he became a private Air Raid Precautions adviser and consultant to more than 150 important factories, banks and business concerns in England and Scotland. He was also for thirty years on the Board of Directors of John Oakey and Sons Limited, a group of abrasives manufacturers.

Acutely disappointed at being over-age for active service in the Second World War, he was 64 years old in 1939, he served for a time on the Weapons Committee of the Chemical Warfare Board and was Second in Command of his local Home Guard Battalion throughout the war.

He published two books, "*Gas!*" *The Story of the Special Brigade* (Blackwoods, 1934), and "*Commonsense and ARP*" (Pearson, 1939). He also wrote an unpublished manuscript, copiously illustrated with his own excellent photographs, describing the first six years of his service, in Africa and the West Indies.

Among his other writings were the section on "Longitude by the Occultation of a Star" in the old *Text Book of Topographical and Geographical Surveying* and a dozen or so articles in *Blackwoods* and the *Wide World Magazine*, and the former *Windsor* and *Strand* magazines.

More recently, he contributed to the *RE Journal*:

September 1957, "The Photo-Reconnaissance Section, RE".

December 1959, "The Anglo-French Boundary Commission, Niger to Lake Chad".

June 1962, "Chemical Warfare now and in 1915", reprinted from an article commissioned from him at the age of 87 by the *Armed Forces Chemical Journal*, USA.

His Spartan—not to say harsh—upbringing, so far from breaking his spirit, taught him to stand on his own feet and develop his own particular individuality. He always retained happy memories of his headmaster at Warminster, the austere Dr Alcock, and his family of four boys and six girls with whom he spent most of his holidays. He received a firm grounding in Latin, Scripture, English grammar and arithmetic, all enforced by liberal use of the cane, which was even wielded by masters refereeing Rugby football. In consequence, he always retained a horror of false quantities, bad grammar, slang in writing, and mathematical inaccuracy, and became a very quick and meticulous arithmetician.

As a Young Officer at Chatham he did not shine on his courses, but his instructors rightly discerned an aptitude for Survey. Many of his personal qualities will already have been revealed by this account of his service, but there was more. At his Memorial Service on 10 June 1969, Canon E. A. Berrisford said in his eloquent address: "The many letters of condolence that came after the announcement of his death reveal the General's warm-heartedness, generosity of temperament and obvious gift of friendliness and kindliness. These qualities were exercised most naturally, indeed instinctively." Besides, he had a natural personal modesty which shunned the limelight: he had a very individual sense of fun and his powers of repartee lasted to within hours of his death.

From the time he was at the "Shop", though dependent for funds on the goodwill of "Uncle Cox", and never in his ninety-four years a wealthy man, he was constantly helping his less fortunate relatives and friends. Typical was the occasison when, on his secret and sudden departure for the West Indies, he left an equally impecunious young cousin a cheque for £1 "to be cashed only in case of dire necessity". Indeed he was consistently generous to his own family and gave much material aid to others of his relations whom he deemed to be less fortunate than himself, and it afforded him deep pleasure, at the age of 93, to be able to put a useful sum of money at the absolute disposal of the Chief Royal Engineer, as "a token of gratitude", he said, "for all the Corps has done for me".

Foulkes was not tall, but very powerful. At the "Shop", he would lift a fellow Gentleman Cadet, B. W. Mainprise, by the belt, with one hand from floor to shoulder and then press him slowly to arm's length above his head. He was as light as a cat on his feet. His eyesight was extremely sharp and remained good till a year or two before his death, and he had a wonderful capacity for predicting the motion of a ball. With this and his impetuous spirit, it is little wonder that all games and sports came naturally to him. At school his game was fives, but he had very tender hands. At the

"Shop" he played rackets, got his "Rep" for gymnastics, and ran in *all* the distances at the Sports. As a YO he represented the Corps at cricket, soccer, Rugby and billiards. He also rowed in all the regattas, fours, pairs and single sculls, winning the Open Sculls at Maidstone in 1895. The Corps had no eight in those days and did not go to Henley. He also played soccer regularly for the Casuals on Saturdays and was invited by the Gillingham professional club to sign on, though that was not allowed. In Scotland, much later, he did play for the First Division team, Heart of Midlothian, before taking up hockey, at the age of 30. Qualified to represent Wales, he was not allowed to play for Scotland until he had lived there for three years, but he then won eight "caps" and the Olympic competitor's medal for the Games of 1908. He captained the Scottish International Hockey side for the whole of the 1908/9 season; and played also for the Army. He was, much earlier, in the Corps Rugby side, captained by the English international P. Maud, which won the Kent Cup in 1896. In billiards he often played first string in the annual match against the Royal Artillery, and had many other successes at the game. Sir Ronald Charles has recorded that "at Chatham he built himself a 'spot' end of a billiard table so that he could employ his spare moments in his quarters in perfecting himself in the 'spot stroke' ". Always a perfectionist, it is sad to recall that the "spot" rules were later changed when certain professionals became too good at that feature of the game.

He became a successful weight-lifter at Sandow's School of Physical Culture, where he was a star pupil, while recovering from a bad attack of malaria. His photograph and that of his younger brother, illustrating the benefits to be obtained from the course, appeared in Sandow's book: *Strength and how to obtain it.*

He won many prizes, cups and medals for running, jumping, tennis, cycling and even speed skating and in certain light-hearted moments he laid (and won) some remarkable bets for long-distance walking. He might have become a first-class squash rackets player if he had started the game at 30 but he did not take up the game until he was 47, and at that age, playing against young men, he had to keep the rallies short and take undue risks. His big game shooting trophies included tiger and bison in south India and leopard, buffalo and black bear in Ceylon. In short, wherever he could compete, he "had a go" and never without success.

There were several aspects of his prowess at games and sport which were almost as remarkable as his actual success. First, his comparative lack of opportunity, because of overseas service and several almost fatal attacks of malaria. Indeed, he applied for service in West Africa, at the age of 22, when he saw the danger of becoming a Corps "gladiator". Next, he was never seriously coached, but played by the light of nature. As a batsman his joyous philosophy was: "Stop the straight ones and slog the rest," and woe betide the long-hop! He pained many a good bowler, and made a lot of runs. A contemporary once told the writer: "I remember Charles Foulkes winning the Open Tennis Singles at Chatham. It was a crime against the game." Sour grapes, perhaps, from a stylist. At 70 he was *still* discovering "a fine new way of sloshing the ball". Consequently he never knew, to his dying day, what his game, or distance, really was and there is no telling what he might have achieved had he concentrated on any one activity in his youth. Finally, he never went into training, and always ate and drank what he liked. A banquet at midday would not impair his hockey that afternoon. He continued to play on in his later years. At 55 he was still in first-class hockey for Aldershot Command and playing very well indeed. At 70 he had not ceased to be formidable at the net. He never had time to try golf, which he had reserved for his old age. He stood four-square at the age of 80, and continued to drive a car—forcefully and much to the consternation of his relations—till the eve of his ninetieth birthday.

Owing, perhaps, to having had no childhood home he took exceptional pleasure in domestic things. He was an ardent apple-grower, gardener, bee and poultry-keeper, and never liked to be without his cats and dogs. His tastes were very simple, but he appreciated good food and drink (with the emphasis on vintage port) and

enjoyed good music. He became a very skilled precision worker in rare woods, inlay and veneers and, had he asked to be remembered for one thing only, it might well have been that.

A very old Member of the RE Association observed quite recently: "In 1914 Major Foulkes was the idol of the Corps." By 1969, at the age of 94, he was its Grand Old Man. He continued to the last to take an active interest in its affairs. He was a Vice-President of the Eastbourne Branch of the REA, and remained in close touch with his old comrades of the Special Brigade and the brilliant scientists who had supported him.

Among the incidents which gave him particular pleasure and revived his spirits in his very old age were: the Sapper Fathers' and Sons' Guest Night at the RE Headquarters Mess at Chatham, on 16 April 1964, at which the Chief Royal Engineer, General Sir Frank Simpson, invited him to be President, while his eldest son was "Mr Vice"—a position not often filled by a Colonel Commandant RE—but it was a very special occasion (see *RE Journal* June 1964); the presentation of the Gold Medal of the Institution by the Chief Royal Engineer on 24 June 1964 for his pioneer work in developing chemical warfare in the First World War (see *RE Journal* December 1964); and the Reunion Dinner of the Special Brigade RE at Eastbourne on 25 September 1965, fiftieth anniversary of the Battle of Loos, which 134 brave old soldiers attended, when memories of past glory were revived—Brigadier-General Sir Harold Hartley was the Guest of Honour (see *RE Journal* December 1956). At the closing period of his life he experienced many touching acts of kindness from those in the Corps and their wives who understood what he was, and had been.

He married in 1904 Dorothea (Dodo), daughter of Herbert Oakey of Streatham and Eastbourne. She died in 1967 after sixty-two years of happy marriage. For many a year, after she had become almost completely crippled with arthritis, his twin aims in life remained to care for her and to defy physical infirmity. They had one daughter, who lost her life at the age of five in a carriage accident in Ceylon in 1910, and three sons, still living. For the last two years of his life he lived with his eldest son and was devotedly cared for by his daughter-in-law, Delphine. Just before midnight on 6 May 1969 he faded away: but never yielded.

The funeral service was conducted privately at Aldershot, his last military station, by the Rev G. I. M. Strong, Chaplain to the Training Brigade RE on 12 May 1969.

The Rev R. A. W. Hambly officiated at his Memorial Service in the Chapel of the Royal Hospital, Chelsea, on 10 June 1969 "to render thanks for his long, long service to his Country, his valour as a soldier and his brilliance as a military engineer; to recall to our minds his simplicity of life, his unfailing generosity, his merry humour, and his dignity to the last". Canon E. A. Berrisford, MC ,MA (Oxon), who commanded the 3rd Battalion of the Special Brigade in France, pronounced his Eulogy. Though Charles Foulkes had long outlived most of his contemporaries, "many accompanied him to the Riverside".

T.H.F.F

MAJOR-GENERAL F. V. B. WITTS, CB, CBE, DSO, MC, KStJ, DL

MAJOR-GENERAL WITTS, who served with distinction during the First World War in France and Mesopotamia, saw active service in Kurdistan, Iraq, Shanghai and Palestine between the two world wars and during the second was Deputy Chief of the General Staff of the British Expeditionary Force and later officiating General Officer Commanding-in-Chief Southern Army, India, died on 10 March 1969 in the Memorial Hospital, Cirencester, aged 80 years.

Frederick Vavasour Broome Witts was born on 30 January 1889, the youngest son of Canon Francis Edward Broome Witts of Upper Slaughter Manor, Gloucestershire. He was educated at Radley and when 16½ years old he passed top into the RMA, Woolwich, where he was awarded the King's Gold Medal and the Pollock Prize. He was commissioned into the Royal Engineers on 23 July 1907, the top of his batch.

On completing his Chatham training he joined the 5th Field Company at Aldershot and in 1912 he was posted to India. It was the start of twelve long years of continuous foreign service. His first appointment was Garrison Engineer Kohat and, after a year there, he joined the Headquarters of the 1st KGVO Bengal Sappers and Miners at Roorkee.

Shortly after the declaration of the First World War an Indian Expeditionary Force was sent to France which, on arrival, was rapidly deployed into action. Witts joined 4 Company Bengal Sappers and Miners after the Battle of Neuve Chapelle, where the company had suffered heavy officer casualties. He was with the unit during the Battle of Loos in September 1915. Indian troops were withdrawn from France in December of that year and transferred to Iraq, where, as Lieut-Colonel E. W. C. Sandes in his book *The Indian Sappers and Miners* wrote: "The Indian soldier knew that the struggle was connected intimately with the defence of his own native land and, as the sun grew stronger, his hopes rose higher and the sodden fields of France and Flanders receded into the dim distance until they became only a memory of mist, cold and hellish bombardment". On arrival at Basra in January 4 Company was engaged on road-construction work and on bridging the Euphrates at Nasiriya. In May 1916 Witts was selected to raise and command No 2 Mobile Bridging Train, Bengal Sappers and Miners. The train could provide initially 500 yds of medium floating bridge. The pontoons were carried on 200 modified AT carts and the superstructure on fifty-six GS wagons, pulled by 900 horses and mules; it occupied two miles of road space when on the move. Its potential was later increased. The train was designed for mobile work on the River Tigris against the Turkish flank and rear and was instrumental in opening up the advance to Baghdad.

One of its earliest bridging operations was unsuccessful despite the heroism and determination of the troops involved, and Witts received an immediate award for gallantry. A Special Order of the Day, issued by Lieut-General F. S. Maude, Commanding the Indian Expeditionary Force D, dated 9 January 1917, read:

In pursuance of the authority delegated to me by his Imperial Majesty, the King-Emperor, I make the following award for gallantry and distinguished service in the field:—

Awarded the Military Cross

Captain Frederick Vavasour Broome Witts, Royal Engineers.

For conspicuous gallantry and coolness on December 20th, 1916. Under heavy rifle and machine gun fire he made a personal reconnaissance of the river bank and subsequently led a party of his men carrying a pontoon across the open and down the bank. Although wounded himself, and in spite of casualties among his party, which made the task increasingly difficult, he succeeded, in full view of the enemy, in launching the pontoon.

Major-General FVB Witts CB CBE DSO MC KStJ DL

On another occasion General Maude sent Witts on a secret reconnaissance to take soundings in the Shatt Al Hai to discover whether it would be practical to use some motor lighters, recently arrived in the theatre from Gallipoli, as a means of dashing assault parties across the Hai Channel to outflank the Turkish defences south of Kut. Of this reconnaissance Witts wrote at the time: "Paddling about in a pontoon for two or three nights, with the Turks on one bank and our troops on the other, was no joke, although the river was 400 to 600 yards wide, and I was not sorry when I was in a position to report the scheme impracticable'.'

The most spectacular operation carried out by the bridging train was during the assault by III Corps across the Tigris at the Shumran Bend, to the west of Kut, on 23 February 1917. Witts had beforehand carried out a secret reconnaissance and selected a bridge site at the apex of the bend, where the river was 300 yards wide. Although the covering parties sent across the river to form a bridgehead had suffered desperate casualties and achieved little, Witts was ordered to go ahead with the construction of his bridge at 6.30 am. The shore transom was in position two hours later and by 4.30 pm the bridge was completed. In a congratulatory message to Witts, General Maude said that to bridge a great river in full flood in the face of the enemy in position was a feat of which the Sappers could be justly proud. For his efforts in this great river-crossing operation, which proved to be a major turning-point in the campaign, Witts was awarded the DSO.

No 2 Mobile Train subsequently carried out many lesser, but equally hazardous, bridging operations over the Tigris and Captain Witts remained as its commander up to the conclusion of the Mesopotamian Campaign, when on 30 October 1918, General Maude's army entered Mosul, 500 miles from the Persian Gulf, where the Turkish forces surrendered.

In addition to his award of the DSO and MC, Witts was made a brevet-major, three times mentioned in despatches and awarded the French Croix de Guerre.

The surrender of the Turkish forces at Mosul did not, however, mean the end of hostilities for Witts, who, as Brigade Major of the 51st Independent Infantry Brigade, was involved in operations in Kurdistan in 1919 and, as Brigade Major to Brigadier-General F. E. Conningham's Force, was engaged in quelling the Arab Rebellion in Iraq in 1920–1. For these operations he was mentioned in despatches three times and awarded the OBE and later created CBE.

In 1922 Captain and Brevet-Major F. V. B. Witts, CBE, DSO, MC, was selected to attend one of the early postwar courses at the Staff College, Quetta, and on graduating from there he was at long last posted home and took up an appointment in the Staff Duties Branch of the War Office.

Early in 1927 the situation in China, where there had been sporadic civil war since the fall of the Empire, gave cause for grave concern and an Indian Brigade, followed by two brigades from the UK, was sent to Shanghai to protect the International Settlement. The engineer tasks were to construct defensive positions, some equipped with searchlights and protected by wire, and rapidly to provide accommodation for some 17,000 British and Indian troops, together with offices, stores, armouries, workshops, bakeries and hospitals. Witts was sent as Staff Officer to the CRE, whose headquarters was augmented by four RE subalterns and four RE sergeants, and initially the only engineer troops were those of 10 Field Company QVO Madras Sappers and Miners. The services of the local Public Works Department were enlisted, Chinese contractors were employed and a Russian-speaking RE captain, now General Sir Nevil Brownjohn, lent by the Chief Engineer Hong Kong, raised a Works Company of White Russians headed by an exiled Russian Engineer officer of the Tsarist Army. Everyone worked for sixteen hours a day for weeks on end and eventually all the defences were constructed and manned and the entire force accommodated in huts fitted with fans. For good measure a theatre, amusement palace, Turkish baths, a riding school, a fire station, and a police station and gaol were also provided. The British hospital was installed in an existing new school and the Indian hospital in a Chinese piano factory.

No 56 Field Company arrived in Shanghai in 1928 and Witts took over command and brought the unit back to its permanent station in Bulford Camp the following year.

In 1930 he was made a brevet lieutenant-colonel and became an instructor at the Staff College, Camberley.

From 1932 to 1934 he was CRE 5 Division and Catterick Area and in 1935 he became GSO1 5 Division with the rank of colonel. In January 1936 the Division was sent to the Western Desert of Egypt at the time when Italian troops had invaded Abyssinia. The Division returned to Catterick in August, but was only to remain there for two weeks, since trouble was breaking out again in the Near East. The Mufti of Jerusalem, Haj Amin el Husseini, had organized a general strike throughout Palestine to paralyse the civil government in an endeavour to counter Jewish infiltration. At the same time Arab guerillas attacked Jewish settlements, disrupted all forms of communications and damaged the pipe-line to the Haifa refinery. To meet this situation, 5 Division was sent to Palestine from Catterick in September to be followed by 1 Division from Aldershot, and a corps headquarters was set up under Lieut-General Sir John Dill to direct operations. With the collapse of the general strike and the pacification of the country 5 Division returned to Catterick in 1937.

On promotion Witts was once again posted to India to become Brigadier General Staff, Western Command, and, after a year in that appointment, he was given command of 8 (Bareilly) Infantry Brigade.

Further promotion brought him back once again to the home establishment in 1939 to become the Commander of 45 (West Country) Division (TA) and in 1940 he was appointed Deputy Chief of the General Staff of the British Expeditionary Force. After the withdrawal of the BEF from France he was given command of the 59th (Staffordshire) Division, and in 1941 he returned once more to India, where he became Commander Bombay District, and during his tour in that appointment he was, in 1942, officiating General Officer Commanding-in-Chief Southern Army, India, with the rank of Lieut-General.

He was created CB in 1943 and retired on 23 September of that year.

Retirement did not bring to an end the full life that General Witts was accustomed to lead.

From 1944 to 1948 he was Lieut-Governor and Secretary of the Royal Hospital, Chelsea, and from 1948 to 1957 he was a Commissioner of the Hospital.

From 1944 to 1948 he was a Member of the Executive Council of the Red Cross and St John Joint War Organization, a Member of the Joint Committee of the Order of St John and the British Red Cross Society, the Assistant Director of Ambulance, Order of St John and a Member of the Chapter-General of the Most Venerable Order of the Hospital of St John of Jerusalem. He continued his connexion with that Order on returning to live in Gloucestershire and, in 1956, he was elevated from a Commander to a Knight of St John of Jersualem.

He was for some years Chairman of the South East Gloucestershire Group of the British Legion, and later Chairman of the Cirencester Branch. He was also a County Vice-President. He was Chairman of the Secondary School from 1952 to 1963, and a Governor of the Grammar School. He was a member of the Parochial Church Council for many years, and a sidesman of the parish church.

He was a member of the Gloucestershire County Council from 1951 to 1961 and was made a Deputy Lieutenant for the County in 1953. In 1958 he became Lord of the Manor and Patron of the living of Upper Slaughter.

He was a Fellow of the Royal Geographical Society and a contributor to the *RE Journal* and to the journals of the RUSI and other learned societies.

In 1929 he married Alice, eldest daughter of the late Arthur Wrigley, JP, of Wyck Hill, Gloucestershire. They had one son and three daughters.

The Funeral Service took place on Friday, 15 March, in the church at Upper Slaughter, the village where the Witts family has lived for two hundred years.

A Memorial Service was held on 11 April 1969 in the Chapel of the Royal Hospital, Chelsea. General Sir Frank Simpson, one of General Witt's previous Camberley students and recently Chief Royal Engineer, Governor of the Royal Hospital, read the lesson.

C.A.B. writes:

It is a privilege of old age to enjoy the recollection of happy associations and friendships established during one's lifetime and, with the passing of Freddie Witts, those of us who, like myself, have known him over a long period—in my own case more than fifty years—have that consolation which will always be with us as a cherished memory. His record of service portrays the wide range of his activities; but it was left to those who worked with him to appreciate the spirit which inspired all that he undertook and accomplished with modest but thorough efficiency. A true and fine example of "Service not Self".

LIEUT-COLONEL R. C. ORGILL, OBE

SOME officers of the Corps one never met, nor ever saw, throughout one's entire service, others were frequent companions to be encountered all over the world. For me Richard Orgill was very much one of the latter. Our friendship dated from very early in 1941 when a stocky, fair-haired little figure led the Malakotla State Sappers and Miners, plus their long string of mules, out of the frontier mountains to share barracks with us at Nowshera, and in the weeks that followed to chivvy me about the sun-baked hockey pitch like a little terrier, a description particularly suited to Richard, as his men did battle with our Madrassies.

Again in 1942 a green-clad Richard emerged from the jungles of Burma, with the Malakotla Sappers at his heels, to participate in a particularly lively month of training at the Eastern Army Bridging School on the Ganges, where I was instructing.

On my Supplementary Course he was ready and waiting at Chatham and, although I recall little of what he taught me at the then Construction School, I have vivid recollections of the first postwar race to Dinard when he skipped *Ilex* through a Channel gale, and Judy was practically the only member of the crew who did not succumb to *mal der mer*—I was laid out for "dead" in the sail locker. Later he and Judy set up home in an old MTB moored at Upnor and several of us spent much "recreational training" in puttying and painting.

When in 1949 I joined No 3 Long "Civils" Course Richard was just completing No 1, after which he became Chief Instructor and thereby my "master". Towards the end of my course he asked me to come to Chatham on his staff, but the lure of a return to "outpost soldiering" was strong within me, and at lunch in Victoria Street I declined the offer.

"Come down to Chatham and have lunch anyway," was his only comment.

At lunch we hardly seemed to discuss my prospective posting, but somehow I found that I had promised to join him—that was somehow typical of Richard. He also invited me to join his house-party for the forthcoming Summer Ball, and a jolly good party it was, even though, at the time, our host and hostess were away sailing somewhere in mid-Atlantic, again that was typical of Richard.

Working for him was indeed an experience, an exhausting experience, for he bubbled with enthusiasm and ideas; again and again the little shutter between our offices would slide open and, looking rather like the well-known "Chad", two eyes would peer over the sill (my next "master" had to bend down to peer through) and yet another new idea would be propounded. But one could never get cross with him, for any wrath one felt at having to cope with the machinations of his rather too nimble mind was quickly evaporated by that elfin grin.

His enthusiasm did, however, do a great deal for the Civil Engineering School, as it then was, and under his reign, and that of Hugh Cartwright-Taylor who followed him, the link between the Corps and the Institution of Civil Engineers became particularly strong.

Our paths were to cross again in the Middle East, later at my wedding, where he and Judy gave me the moral support of old friends, and finally at yet another Summer Ball when we stayed with the Orgills, and again it was typical that upon arriving back at Maidstone somewhat tired and jaded, with P and I opting for bed, Richard and Judy changed their "glad rags" for sailing rig, told us that the batman would produce breakfast when required and then departed for a week-end on the briny.

Boundless energy and enthusiasm in everything he did was probably Richard's chief characteristic, be it tramping frontier mountains, blowing up the towers of the Fakir of Ipi, trying out all his new ideas on his "long suffering"—and I use the term kindly—staff in school or regiment or in his greatest love—sailing. His other great characteristic was his likeableness; he could drive one nearly berserk with his schemes, but it was impossible to be angry with him.

The Richard Orgills are getting few and far between these days, and the world is a gloomier and more mundane place because of it.

G.H.

MAJOR (QS) S. PATTERSON, MSM

MAJOR SIDNEY PATTERSON, recently Chief Clerk of the Institution of Royal Engineers and a staunch supporter of the RE Surveyors of Works Club, died at his home on 16 May 1969, aged 66 years, over fifty of which were spent in the service of his Corps.

Born in Glasgow on 3 January 1903, the son of a Royal Engineer, he lost his mother in his early youth and was educated at the Queen Victoria School for the sons of Scottish Sailors and Soldiers, Dunblane, Scotland. Above his bed was the Sapper cap badge. Most other cap badges above the boys' beds in their dormitories were those of famous Scottish regiments, some of them now no more.

He enlisted into the Corps as a Boy for training as an instrument-maker on 17 January 1917 and on joining at Chatham, as became a true product of Dunblane, he wore the kilt.

He became a Sapper four years later on his eighteenth birthday and, after his recruits' training, he was selected for service with the Bengal Sappers and Miners, with which Corps he served for five years, returning to the home establishment in January 1927 with the rank of corporal.

After a tour of duty with the Boys' Company of the Training Battalion at Chatham, he qualified for a Military Foreman of Works Course which he completed with a Superior Grading in December 1929. He was posted first to CRE (Highlands) at Perth and then in 1935 to Malta, where he was employed on the modernization of the island's defence, soon to be stressed to the utmost by the combined German and Italian Air Forces. On promotion to QMS (CW) he returned home for duty with CRE London District, at that time engaged on the many works services necessitated by the great rearmament programme and the building of militia camps after Munich.

Soon after the outbreak of war in September 1939 he joined the headquarters of CRE (East) Advanced Air Striking Force, acting independently of the British Expeditionary Force, based on aerodromes taken over from the French in Champagne. During the evacuation of the BEF he was one of the few survivors of the RMS *Lancastria*, sunk by German planes at St Nazaire on 19 June 1940 with the loss of over 2,800 lives. For a short while he was employed with CRE Camps, II Corps, and on 4 August 1940, as a WOI (CW), he embarked at Glasgow for duty in the Middle East.

After a short time with CRE Alexandria he was posted as an Assistant Stores Officer to the Chief Engineer Western Desert Force, where his duties took him to Mersa Matruh, Sidi Barani, Sollum, Bardia and Tobruk during the fighting there. In January 1941 he returned to Cairo and was commissioned Lieutenant (QS). It was not long, however, before he was back again as a Stores Officer at Mersa Matruh. He was then posted to the headquarters of the Chief Engineer of the ill-fated force, hurriedly assembled, sent to Greece to try to stem the German advance. As no works organization could be set up, due to the desperate military situation, he was employed on RE Intelligence duties, and he was among the last away from Greece as part of the small Sapper party charged with the task of demolishing guns, equipment, vehicles and stores to prevent them falling intact into enemy hands. He joined the remnants of the Chief Engineer's staff in Crete and was soon in the thick of the fighting with German Airborne troops and, once again, he was among the last away from the island on HMS *Phoebe*, which took him to Alexandria.

After a time in hospital, suffering from dysentry, he joined 51 CRE (Docks) at Suez, at that time engaged in increasing the port's capacity and the construction of camps for troops in transit and for a local labour force. Fifteen months later he was posted to Palestine to 66 CRE (Works), where he was employed on the building of two hospitals, the repair of the Haifa-Latakia road and the construction of marshalling yards and oil depots for the Haifa-Tripoli diesel railway. He was repatriated to home in September 1943 suffering from facial trouble and X-ray burns.

After short stays at Exeter and Gravesend, he joined the Surveyor of Works Staff of East Kent District and was employed on the supervision of contract work on the construction of gun and searchlight sites, the provision of camps and the repair of bomb damage. In 1945 he joined the Works Staff at Woolwich before being posted as a Survey of Works on the staff of the Chief Engineer Works Rhine/Westphalia at Dusseldorf. He was awarded the Meritorious Service Medal in 1951.

On returning home he served as assistant to the Senior Quantity Surveyor at HQ Eastern Command and his last posting was on the QS staff at London District. He retired as a Major (QS) in 1955.

After retirement he became an instructor in the Quantity Surveyors' Wing of the Construction School at Chatham and he held that appointment until compelled to relinquish it by reason of age in 1965. He then became Chief Clerk to the Institution of Royal Engineers and continued cheerfully, methodically and unstintingly to give of his very best until failing health brought to an end his long, faithful, loyal and devoted service to the Royal Engineers in 1968. Unhappily his health deteriorated rapidly and, after several weeks in Preston Hall Hospital, he died at his home in Gillingham on 16 May 1969.

On 6 August 1936 he married Gwendoline Middleton. They had two sons. His widow and sons survive him and our deepest sympathies are extended to them.

J.L.

Book Reviews

THE ASPIRANT

BRIGADIER K. B. S. CRAWFORD, late Royal Engineers

(Printed in the Republic of Ireland by the Eagle Printing Co Ltd, South Mall, Cork, April 1968. 30*s* net from Brigadier K. B. S. Crawford, Redesdale, Broomleaf Corner, Farnham, Surrey)

The purpose of this unusual book is to help all those who are interested in the education of the young. None is more aware of the essentials of this problem than a soldier, since he knows that some never change, like the inculcation of virtue and honour, whereas others, such as up-to-date knowledge of the tactics of battle fighting, begin to alter from the first shot of a war.

There is, in fact, apt to be a "training gap" between theory and reality not only in the art of war, but *mutatis mutandis* in the art of life itself. Indeed, in periods of great technical and social change the hapless teacher may well find himself out of date and unimpressive to his pupils. If this is so, the spread of instant education throughout the world will lead inevitably to the spread of discontent amongst the young.

Moreover, the political trends of the day encourage whole multitudes of people to believe that all men are equal, which is a false and dangerous foundation for any human system. Although quite untrue, this inflexible theory of equality fosters all sorts of bogus activities, eg the banding together of men who devise new worlds of art where the difficult skills of old-style painters and sculptors are no longer necessary. We also hear of architects and engineers who care nothing for old-time factors of safety and erect tall buildings which fall down; so there is something dangerously bogus about such people also.

The discontent of the young is a natural phenomenon and the cause of it is always worth enquiry, for wise men speak not without reason of divine discontent. If, however, conceit comes into the picture, even slightly, an element of sham will be found once more to be close at hand. Usually also, young men and women of sound understanding do not immediately resort to violence to further their views. A propos of the youth disturbances at the present time, it would be of interest to know the exact cause of the famous mutiny at the RMA, Woolwich in the last century when Gentlemen Cadets lined up guns and fired loaves of bread at the Governor's house—Was it the impact of some new system for the recruitment of scientific officers, or had the "generation gap" become somewhat wider than usual?

However all this may be, we all remember that when we were young the world seemed at times to be a rough place and rather daunting to contemplate. In the *Aspirant* the author has put together an anthology of first causes which represent the conclusions of a lifetime. Since he started to collect them as a POW of the Turks, after Kut in 1916, and continued them as a prisoner of the Japanese in the Second World War. Like Bunyon, therefore, he had ample time for contemplation but in far grimmer surroundings. The book is thus worthy of attention from the young and old alike and the reader will dip into it eagerly to see whether his favourite words of wisdom find a place there. Many do, whilst some pop up unexpectedly from the columns of the daily press, which shows that good is to be found everywhere if you have the wit to recognize it. Neither La Rochefoycauld nor Voltaire receives a mention and Dr Johnson would note with fury that even after all these years he had not succeeded in killing off the "Letters of Lord Chesterfield to his Son". *Tot homines tot sententiae* and Lord Chesterfield had at least a son to write to, although gotten on the wrong side of the blanket. Seemingly great men are not always right in their sweeping generalizations from the particular. Why, for instance, should a man's character not change for the better after he is twenty? At any rate we can be sure that Brigadier Crawford has gained in wisdom from writing this pleasant and thoughtful book.

B.T.W.

WITH A MACHINE GUN TO CAMBRAI

GEORGE COPPARD

(Published by Her Majesty's Stationery Office. Price 6*s* net)

In the foreword of this book, Dr Noble Frankland, the Director of the Imperial War Museum, writes that Mr Coppard, hearing that the Museum was seeking to increase its collection of literary impressions of the two world wars, submitted a manuscript, described as a "plain soldier's tale", composed on the basis of diaries he had kept whilst serving on the Western Front during the 1914/18 War. The Imperial War Museum has published this tale for, in Dr Frankland's estimation, "it is the product of a viewpoint enriched by a power of spontaneity which gives it a unique place in the literature of the First World War". This is high praise indeed for an author who described himself as a "common private of the uneducated classes". Dr Frankland's opinion has been endorsed by the military historian Professor Michael Howard.

Coppard enlisted at Croydon into the Queen's Royal West Surrey Regiment, 2nd of Foot, on 27 August 1914, at the age of sixteen and a half, having given his age on attestation as nineteen. His battalion was one of the earliest members of Lord Kitchener's New Army of seventy divisions. During his initial training at Aldershot, his unit was inspected by Kitchener and Coppard noted a greyness about him contrasting markedly with the dynamic face on the famous poster which inspired over three million men voluntarily to give up all and join the Colours, an achievement without parallel in history. He was also picked, being a boy of robust physique, for guard duty at the Royal Pavilion when HM King George V, Queen Mary and the Prince of Wales visited the troops at Aldershot. The Royal Scots, 1st of Foot, mounted guard for the first week, and the Queen's, 2nd of Foot, for the next week of their stay. He records how the King, in the uniform of a Field Marshal and mounted on a black charger, smilingly acknowledged his salute as he left the Pavilion one morning and how the Queen visited the Guard Room, accompanied by two ladies in waiting, and spoke most graciously to everyone.

On 31 May 1915 the packet boat *Invicta* took Coppard's Brigade, the 37th Infantry Brigade of the 12th Division, to France. Within two weeks he was in the trenches near Armentières where he quickly learned that the front line infantry soldier was only concerned with a matter of a hundred yards each side of him.

Coppard then describes, from an infantry private's experience, the Battles of Loos, the Hohenzollern Redoubt and Givenchy before he was given home leave after eight continuous months of trench warfare. He wrote at the time "up in the front line anything approaching merriment was dead. Rude jokes, yes, but no merriment . . . We were starved of the joys and pleasures of life. The dreadful winter, coupled with the constant fear of death, and insufficient food, produced a yearning for England and home. I felt that if only I could get leave to see Blighty and know that it was really there, I would be able to stick it out". Grim thoughts for a boy not yet eighteen years old, and grimmer still in that his leave was only granted on compassionate grounds—his stepfather, a Sergeant in the East Surreys—having been killed in France a few days before. Although he did not know it at the time an uncle, on behalf of his widowed mother, applied for his discharge on the grounds that he was under age and his birth certificate was produced as documentary evidence. This however cut no ice: his Army age was that shown on his Attestation papers was the terse official answer.

On returning to France Coppard was transferred to the newly-formed Machine Gun Corps and, as a batman/body guard to his Company Commander, life became a little easier until this relative tranquility was swept aside by the horrors of the Battle of the Somme in 1916 in which the British losses, for the capture of a few square miles of territory, amounted to almost half a million officers and men.

Having survived that holocaust he was accidently shot in the foot during a revolver inspection and evacuated to hospital in England where, as a wounded Tommy, he "lapped up the attentions of the visitors like a young puppy". From hospital he was sent to a private Convalescent Home in Hereford where a Lady Butler "reigned like a Queen of Matrons, dressed in a scarlet silk habit of her own creation and looking like a female Cardinal". To his vast surprise he was given a Birthday Cake on his nineteenth birthday spent under the roof of that "very gracious person who more than fulfilled his preconceived notions as to what a titled lady should look like, and how she should behave."

From the Convalescent Home Coppard was sent to Grantham, the principle training camp of the Machine Gun Corps, and was soon drafted back to France where he was once again in the thick of things at Arras. "The sudden plunge back to the fighting area" he wrote

"brought back that wound up feeling under shell fire that was not easy to control, but the daily comradeship of his pals gave him strength. To most of them at that time it was not a matter of patriotism any longer—that had burned itself out long ago. What remained was a silent bonding together of men who knew there was no other way but to see things through. Deep down too there was an implacable hatred of the Huns for all the misery and death they had caused".

However there were lighter moments out of the line. Having won the sack race in the Unit Sports, Coppard went on to dead heat with a private in the Queens in the Brigade Sports and was put into strict training by his Unit for the 12th Division Sports attended by Sir Julian Byng, the new Commander of the 3rd Army. Present at the Sports were a number of soldier bookmakers, complete with grey bowlers and cigars conjured up by some miracle—all professional bookies in private life. Enormous sums of Machine Gun Corps money were staked on Coppard who, to the intense delight of his backers, hopped home an easy winner. Sir Julian presented him with his prize of ten francs and a silver medal and his officers and NCO's filled him with more beer than he could hold.

But these lighthearted interludes were few and far between. The agonizing struggle around Arras continued and Corporal—as he had become—Coppard and his Vickers machine gun team supported the advance of the tanks going into action for the first time in massed formation at the Battle of Cambrai. As the title of the book indicates, this was his last experience of active service. Severely wounded in the leg by a sniper's bullet, he was once again a Blighty case. Lying in hospital in England on his twentieth birthday Coppard received news that he had been awarded the Military Medal and received from the GOC 12th Division a Commendation for Brave Conduct in the Field.

Being down graded to medical category B he did not return to France and, a few days after his twenty first birthday, he was demobilized with a Corporal's gratuity of £28 and a quid for his Army great coat, which soldiers were then allowed either to keep or trade in, and a disability pension of 25*s* a week for six months, dropping to 9*s* a week for a year when the pension ceased altogether.

The youth had become a man but disabled and with only the capabilities of youth to meet the adult responsibilities of civvy street in a country haunted by the post-war spectre—Unemployment.

J.L.

Technical Notes

CIVIL ENGINEERING

Notes from *Civil Engineering and Public Works Review*, April 1969

River Leen Improvement Scheme, by F. M. Little, BSc Tech, FICE, MIMunE, AMIStructE, Nottingham City Engineer and Surveyor. This article gives an interesting account of flood protection work being carried out on a tributary of the River Trent within the Nottingham City boundary. In the past frequent floods have occured in the Leen valley, the last occasion of serious flooding being in 1960. As part of the scheme the Leen's confluence with the Trent has been moved upstream one and a quarter miles by the construction of a new diversion channel. This one and a half mile channel thus forms the lower part of the seven and a half mile scheme. Various forms of construction have been employed, such as box culverts, steel sheet pile and RC flumes and normal open channels. The £1.7 million scheme is due for completion in 1971.

Conversion Of A2 Track Coastal Line at Southport, by N. E. Tovey, CEng, FICE, MIMunE, MIStructE, MIHE, Borough Engineer of Southport County Borough Council. With the closure of over 7,000 miles of railway routes during recent years much railway land has been made available for development. Current official policy is that such land should be sold so as to provide the maximum financial benefit to the railways. A secondary consideration is the possibility of providing land for more roads. This latter course has been adopted at Southport, where a former branch line has been turned into a four and a half mile coastal road. The ash underbed for the railway sleepers provided an excellent base for the road. In fact, the only earthwork was the removal of some sand which the council was able to sell for foundry use. For a 24-foot carriageway the cost of the road was £30,000 per mile. An interesting sideline of the work was the experimental work on stabilizing the sand dunes in the area. Bituminous emulsion, synthetic rubber and sewage sludge were tried, but the best way found was to establish natural vegetation. The bare areas of dunes have been planted with brushwood and marram grass.

Improving Rice Irrigation In Kedah, Malaysia, by C. L. Clarke, MA, FICE, and E. M. Gosschalk, MA, FICE. This article gives details of the Muda Irrigation Project, which will allow double cropping of rice, where only one crop has been possible in the past, over an area of 400 square miles of coastal land. In the project a reservoir (800,000 acre feet) and a canal system are being created. The scheme is noteworthy because of the application of two important principles. The first one is that the rice fields themselves provide valuable water-storage capacity for rice growing. In effect, the rice fields are an additional reservoir. The other principle is that the total storage requirements can be reduced by minimizing water waste through effective control. The fields are given a consistent storage capacity and water levels are maintained by rainfall and other uncontrolled supplies. Only when the fields are nearly dry is the main reservoir supply drawn. By the close-control system the most efficient use is made of the water supplies. The control system is one that can be automated to any degree required.

Foulness. A short article gives the outline of the scheme proposed by the Thames Airport Group Ltd, a consortium of contractors and professional consultants. The emphasis is on the full development of the Foulness area rather than just the airport/deepwater port complex. In this way the scheme justifies the building of adequate road and rail links with London. A new town for 500,000 people on the River Crouch is envisaged and an industrial area to tie in with the port complex. The cost of the scheme, which includes a London terminal and the road and rail links, is estimated at £1,800 million. L.J.K.

Notes from *Civil Engineering and Public Works Review*, June 1969

The Strength Of Steel Beams With unreinforced Web Hole. In this article R. G. Redwood, PhD, CEng, gives details of his experimental work to confirm theoretical expressions derived for the values of moment and shear which, acting together at a section of a beam containing a rectangular hole in the web, will cause the beam to fail. He derives the theoretical expressions and his experimental results show a good agreement with them when the shear-to-moment ratio is low and is conservative when the ratio is high.

LIMEBANK SITE FOR BARCLAYS BANK. T. Henry, BSc(Eng), CEng, MICE, gives details of the structural scheme for the construction of the new Chief Foreign Branch of Barclay's Bank between Gracechurch Street and Fenchurch Street in Central London. It will be a twenty-three storey tower block on *in situ* bored concrete piled foundations.

SHEAR STRESS IN CONCRETE PAVEMENTS. The conventional design of concrete pavements is based on the modulus of rupture or flexural strength of concrete. Though it is generally known that the pressure of shear strength would modify the ultimate moment of resistance, practically no work has been reported to evaluate the order of shear stress developed in a concrete pavement under loading from vehicles. This article, by R. K. Ghosh, BE, CE, MACI, presents an analytical procedure for the calculation of shear stress under load for corner, edge and interior positions in highway and airfield pavements. R.C.G.

THE MILITARY ENGINEER

JANUARY—FEBRUARY 1969

Problems associated with an ice wharf in the Antarctic are discussed. The problems and solutions are interesting, but unlikely to be met by many British engineers.

Articles on mine clearance, and mines and booby traps in Vietnam show that problems, and methods of dealing with them, have changed little over twenty years.

A detailed article, with design charts, on airfield pavement design is of interest.

A very practical article on the problems of providing revetted bays for aircraft protection is worth noting if we should encounter the problem. The main aim is to avoid sympathetic detonation between armed aircraft—say 5,000–7,000 lb of explosive—rather than guarding against shrapnel damage, as was the case in the latter days in Aden and South Arabia.

MARCH—APRIL 1969

An investigation into the tidal implications of turning the Panama Canal into a sea, as opposed to a locked canal, produces some interesting facts. Although the differences in level between the Atlantic and Pacific Oceans is only 1 ft, the difference in tidal ranges mean that currents of up to five and a half knots may be encountered and 30% of all traffic would encounter four knot currents.

Methods of clearing fire support bases in Vietnam show that considerable reliance is placed on explosives. Shrapnel charges are used a lot for fox holes and bangalore torpedoes at 10 ft spacing between lines prove very effective against bamboo clumps.

An article on the increasingly popular use of brick bearing walls is of interest to the civil engineer. The construction of a Bailey suspension bridge of 240 ft span at the Australian SME and the 1,000 ft span Phu Cuong bridge in Vietnam illustrate contrasts in the bridge-builder's craft.

Forthcoming Events

12 September	Bomb Disposal Dinner Night and Reunion	RE HQ Mess
18–20 September	RESA Regatta (AGM, Fri. 19th)	Upnor
16 October	Civil Firms Guest Night	RE HQ Mess
30 October	RE/R Sigs Guest Night	Blandford
6 November	43 YO Batch Night	RE HQ Mess
9 November	Remembrance Sunday Parade	Brompton
20 November	Corps Guest Night	RE HQ Mess

SPORTS AND GAMES FIXTURES 1969/70

RE RUGBY UNION FOOTBALL CLUB

15 October	RE Corps, Rugby Cup Final	Chatham
29 October	RE *v.* RAOC	Deepcut
5 November	RE *v.* RMCS	Aldershot
12 November	RE *v.* R Sigs	Blandford
11 December	RE *v.* RA	Chatham
21 January	RE *v.* RCT	Aldershot
4 February	RE *v.* XL Club	Cambridge
25 February	RE *v.* REME	Chatham
11 March	RE *v.* RAMC	Mitchett
8 April	RE *v.* RMA Sandhurst	Sandhurst

KO in all games 1500 hrs.

RE HOCKEY CLUB

17 September	RE *v.* Staff College	Camberley
20 September	RE *v.* Guildford	Longmoor
28 September	RE *v.* Bournemouth Sixes	Bournemouth
4 October	RE *v.* Trojans	Southampton
11 October	RE *v.* Staines	Longmoor
18 October	RE *v.* Hawks	Away
19 October	RE *v.* Dorset	Longmoor
25 October	RE *v.* Beckenham	Chatham
1 November	RE *v.* R/Sigs	Away
5 November	RE *v.* Wiltshire	Shrivenham
8 November	RE *v.* Aldershot Services	Aldershot
12 November	RE *v.* Oxford University	Oxford
15 November	RE *v.* Mid Surrey	Chatham
22 November	RE *v.* Bournemouth	Bournemouth
29 November	RE *v.* Teddington	Longmoor
6 December	RE *v.* Infantry	Chatham
10 December	RE *v.* RMA	Sandhurst
13 December	RE *v.* Hampstead	Chatham
20 December	RE *v.* HAC	Chatham
10 January	RE *v.* Metropolitan Police	Away
21 January	RE *v.* US Portsmouth	Aldershot
24 January	RE *v.* Surbiton	Away
31 January	RE *v.* Polytechnic	Chatham
2 February	RE *v.* Cambridge University	Cambridge
4 February	RE *v.* London University	Away
14 February	RE *v.* Blackheath	Away
21 February	RE *v.* Cliftonville	Chatham
22 February	RE *v.* Maidenhead	Away

28 February	Final England Trial	Chatham
28 February	RE *v.* Cheam	Chatham
1 March	England *v.* Kent	Chatham
5 March	RE *v.* RA	Away
8 March	RE *v.* Villagers	Chatham
15 March	RE *v.* Chimps	Chatham
18 March	RE *v.* United Hospitals	Away
4 April	RE *v.* T & AVR	Chatham
18 April	RE *v.* Southgate	Chatham
25 April	RE *v.* Spencer	Chatham

QVO MADRAS S & M OFFICER'S ASSOCIATION

The Ladies' Tea Party will be held on Tuesday, 23 September (Assaye Day), at 4 pm at the Naval and Military Club, 94 Piccadilly, London, W1. The cost will be 15*s* per person. Cheques, payable to the Madras Sapper Officers' Association, should be sent to Colonel H. E. M. Cotton, 2 Grotes Place, Blackheath, London SE3.

ROYAL MONMOUTHSHIRE ROYAL ENGINEERS (MILITIA)

The Annual Dinner will be held in the Castle, Monmouth, on Friday, 26 September 1969, at 7.30 for 8 pm. Officers who have served in the Regiment and wish to dine should apply to the Secretary at the Castle before 18 September 1969.

NO 2 RAILWAY TRAINING CENTRE, RE, DERBY

The 23rd Annual Reunion Lunch will be held on Thursday, 9 October, at noon for 1 pm at the Rembrandt Hotel, Thurloe Place, London, SW7. Those wishing to attend contact Mrs Armstead, 27 Devonshire Avenue, Allestree, Derby.

KGVs OWN BENGAL S & M OFFICERS' ASSOCIATION

The 1969 Dinner will be held on Friday, 10 October 1969, at 8 pm at the Army and Navy Club, Pall Mall, London, SW1. The cost will be £2 5*s* excluding drinks Cheques, payable to the Association, should be sent to Major F. Collinge, 232 Parkside Avenue, Barnehurst, Bexleyheath, Kent, to arrive not later than 30 September 1969.

ROYAL ENGINEERS ASSOCIATION—ANNUAL DINNER 1969

The 1969 Annual Dinner will be held on Saturday, 11 October 1969, assembly 6.30 for 7 pm, at the London Scottish Regimental Centre, 59 Buckingham Gate, London SW1. Tickets at 30*s* may be obtained from the General Secretary, REA, HQ RSME, Chatham, Kent.
