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Editorial

THE FUTURE OF THE INSTITUTION

THE role that the Institution should play in the life of the Corps is a subject in which bursts of interest have from time to time been shown. Over the past years, however, nothing much has appeared to change, but change just for the sake of change is unwise and it would be fair to conclude that the Corps has been satisfied with the services rendered by its Institution. Nevertheless consideration should be given to the question: "Where have we got to now?"

According to its Charter the objects of the Institution are "The general advancement of Military Science and more particularly for promoting the acquisition of historical and scientific knowledge in relation to Engineering as applied to military purposes". In addition the Institution is responsible for the custody and maintenance of the RE Museum and Library and Corps Memorials, the administration of certain Trust Funds and the fostering and furthering of all such objects as have a bearing on the professional and domestic activities of the Corps of Royal Engineers.

Some ten years ago the Council proposed a reorganization of the membership structure of the Institution, from Student membership for newly commissioned officers to Corporate membership obtainable after certain academic and professional qualifications and experience had been gained. It was hoped that the engineering profession would recognize the status of corporate membership of our Institution as a valid professional qualification and that the proposal would act as an incentive to members to increase their competence as military engineers and assist regular RE officers, who had gained corporate membership of the Institution, when seeking employment on retirement. A detailed description of the proposals was published in the *Journal* and the views of serving officers were sought through Chief Engineers. The major professional Institutions were also approached for their reactions to the scheme. Although it appeared, from views expressed, that a small majority of serving officers were in favour of the scheme others thought it divisive and indeed several Sapper officers, who had reached the highest ranks in the Army, would, under the terms of the proposal, have failed to obtain corporate membership of the Institution. The Council felt that so radical a change should not be made unless there was overwhelming support from within the Corps. Furthermore, and an even more cogent reason why the proposal was dropped, the professional Institutions were not prepared to reciprocate, they being at that time concerned with the birth of the Council of Engineering Institutions, and thus the whole object of the scheme was not to be achieved by the method proposed.

In this latter connexion it is worth remembering that a civilian professional Institution has three main tasks, namely to further the advancement of knowledge among its members, to regulate codes of practice and professional behaviour and, as an examining and qualifying body, to control promotion between grades of membership. Under the terms of its Royal Charter our Institution is charged, as are other Learned Societies, only with the advancement of a particular science and the promotion among its members of the acquisition of knowledge in relation to it. Codes of practice, professional behaviour and promotions are not the concern of Learned Societies.

In dropping the proposal to turn our Institution into a fully fledged professional Institution the Council reaffirmed its intention not to abandon its efforts to make the Institution more attractive to RE officers of the active and reserve armies and to enhance its reputation as a leading Learned Society in the field of military engineering, a position it has unquestionably built up over the years. At the same time regular serving RE officers were encouraged to qualify in their own right for membership of civilian professional Institutions and by their influence in them enhance the reputation of the Corps and the Institution and let the engineering profession

know the quality of Sapper officers and prove their value in the civilian world during their time in the Army and after retirement.

The *Journal* has always been the principal medium for the dissemination of historical and professional knowledge essential to the military engineer. Its value depends entirely on contributions submitted and surely, at this moment, there must be in the Corps a vast amount of professional knowledge and experience that should be disseminated through the pages of the *Journal* for the benefit of all Members of the Institution. At times, as in this issue of the *Journal*, articles on specialized subjects are published written by authors who are not serving RE officers and periodically the Correspondence section becomes quite lively.

The *Journal* has a world wide circulation outside the Corps and its quality and worth does much to enhance the status of the Institution and the Royal Engineers. The maintenance of the high standing of the *Journal* is related directly to the measure of excellence of articles submitted by Royal Engineer officers. The continuing status of the Institution thus rests largely in their hands.

It has been the practice to hold joint meetings with the major professional Institutions at their London headquarters and such meetings have been held over the past years with the Institutions of Civil, Mechanical, Electrical and Structural Engineers, the Institute of Transport and the Royal Institute of Chartered Surveyors. These meetings have helped preserve our close liaison with these professional bodies and have done as much for the standing of the Institution within the Corps as it is hoped that they have done outside it.

The Council has recently been considering ways of widening still further the scope of Institution activities to include branches at suitable centres throughout the country to organize meetings and discussions. A Committee has been set up on instructions from the Engineer in Chief, with the Commandant RSME as chairman, to prepare an over-all programme, to co-ordinate subject matter for the meetings and to organize publication and publicity. Such meetings will normally be sponsored by a Regular Headquarters. They would be particularly valuable if they could attract support from the T & AVR, retired RE officers and other technical corps of the Army. Some might be held with the local branches of the professional Institutions. A pilot meeting was held at Chatham (see the June 1971 issue of the *Journal*). Another is planned for 14 December 1971 with the Kent Branch of the Institution of Civil Engineers, and it is hoped to hold branch meetings in Edinburgh, Newcastle, Birmingham and Cambridge during 1972.

The dividing line between the professional activities of the Institution and the training responsibilities of the Engineer-in-Chief is a narrow one, and this is a problem that has to be faced. However, there is every reason to hope that the holding of branch meetings at different centres, catering for different interests and disseminating different experiences, will not only provide a very worthwhile forum for discussion but also bring together a wide variety of individuals outside the Corps which only an organization, such as the Institution, is in a position to do.

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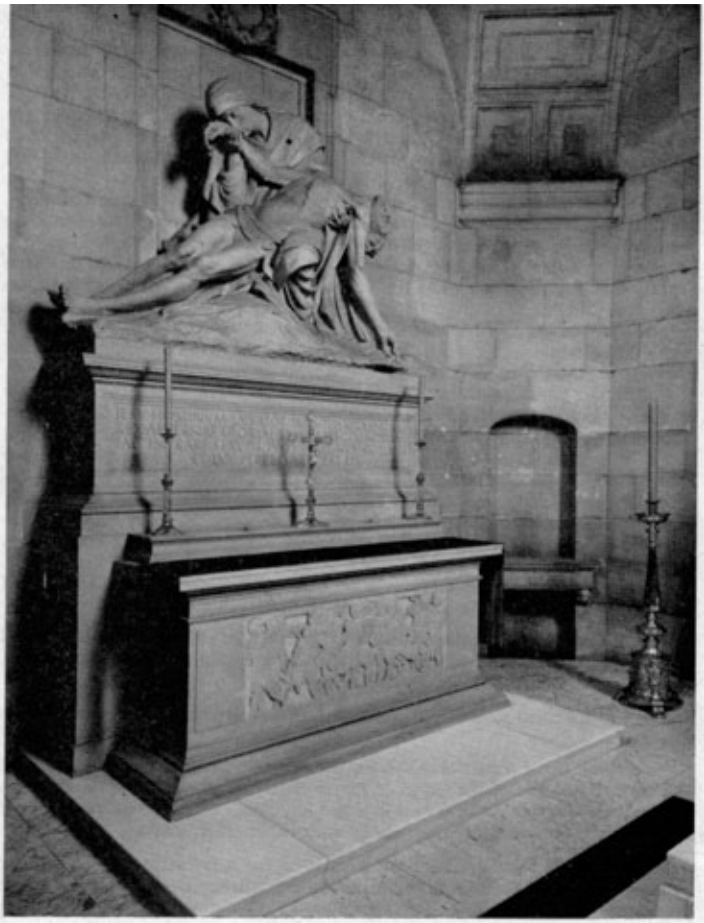

George, Soldier of Christ. The Rolls of Honour are housed in a recess in the North wall of the Chapel protected by a wrought iron screen. The 1914–18 RE Roll of Honour contains over 18,500 names and the 1939–45 Roll over 11,000. The Chapel is therefore a perpetual Memorial to some 30,000 Royal Engineers who gave their lives for their country, and many thousand Commonwealth Engineers who sacrificed theirs.

May they all rest in peace: "At the going down of the sun and in the morning we will remember them".

We Will Remember Them

A SUPPLEMENTARY Roll of Honour containing the names of Royal Engineers of all ranks who lost their lives on operations since the Second World War, was dedicated at St Paul's Cathedral on 5 October 1971 and laid up as a perpetual memorial in the Chapel of All Souls (Kitchener Chapel). It now rests with the other Rolls of Honour containing the many thousand names of those Officers and Men of the Royal Engineers, the Engineer Corps of the Dominions and of the Sappers and Miners of the Indian Army who gave their lives in the First World War 1914–18 and the Rolls of Honour for the Second World War 1939–45.

The Service of Dedication and Laying-Up was held in the Crypt of the Cathedral. The Service was conducted by the Archdeacon of London, Canon in Residence the Venerable Sam Woodhouse; the prayers were taken by the Reverend John Llewellyn, Succentor at St Paul's and the Reverend D. I. R. Thomas, Senior Chaplain to the Forces, Chatham Garrison, read the Lesson. The Venerable Woodhouse was an Army Chaplain during the Second World War and his last service appointment was at the School of Military Engineering when it was at Ripon. The Cathedral Choir sang the hymns and anthems and the vaulted Crypt rang to the sound of their manly voices.

The Service was attended by General Sir Charles Jones, Chief Royal Engineer and Lady Jones, General Sir Frank Simpson, Chief Royal Engineer 1961–7, Major-General J. K. Shepheard, Representative Colonel Commandant RE, Major-General F. G. Caldwell, Engineer-in-Chief, Major-General Sir Gerald Duke, President of the Institution of Royal Engineers, Major-Generals C. W. Woods and Ll. Wansbrough-Jones, the present and immediate past Chairmen of the Royal Engineers Association, a large number of serving and retired Royal Engineers and several relatives of those whose names are inscribed on the Roll of Honour. Royal Engineer Warrant Officers and Senior NCO's acted as ushers.

During the course of the Service the Chief Royal Engineer unveiled the Roll of Honour and Archdeacon Woodhouse pronounced the following Dedication:

"In the faith of Jesus Christ we dedicate this Roll of Honour to the Glory of God and in memory of those whose names are written therein: In the name of the Father, and of the Son, and of the Holy Ghost. Amen."

Taking the dedicated Roll the Chief Royal Engineer handed it to the Archdeacon saying:

"Venerable Sir: I request that this Roll of Honour, containing the names of 362 Officers and Soldiers of the Corps of Royal Engineers who lost their lives whilst engaged on operations between June 1945 and July 1969, may be accepted and housed in All Souls' Chapel in everlasting remembrance of their sacrifice."

Accepting the Roll the Archdeacon placed it on the Altar and a Royal Engineer Trumpeter sounded the Last Post and, after a brief silence, the Reveille. When the Service was over the Roll of Honour was displayed for those who wished to see it before it was finally laid up in the Chapel of All Souls.

The Chapel of All Souls was presented to St Paul's Cathedral by the Kitchener Memorial Committee as a permanent memorial to Field-Marshal Lord Kitchener who lost his life in the sinking of HMS *Hampshire* in June 1916. The dominant motif of the Chapel is the spirit of sacrifice which characterized the great soldier whose memory it enshrines and which inspired the volunteer Armies which rose at his call. The utmost importance is therefore given to the Pietá, representing the Sacrifice of the Death of Christ, above the altar which was given by the Corps of Royal Engineers in memory of the Field-Marshal and all their other comrades of all ranks who fell in the 1914–18 War. The Chapel also contains a recumbent figure of Lord Kitchener flanked by the Warrior Saints Michael, the Standard Bearer, and

Memorials to the Indian Army

COLONEL H. E. M. COTTON, OBE

MONUMENTS to individual Regiments and campaigns of the old Indian Army have been set up in various places, but never until this year has any tribute been paid to the memory of the Indian Army as a whole—that great Army recently referred to in *The Times* as "the strongest strut of the Imperial Crown"—which has contributed so greatly to bringing peace and prosperity to a large part of South East Asia, and whose soldiers have fought alongside their comrades of the British Army in so many campaigns.

This year however due tribute has at last been paid. Through initiatives emanating from different but complementary sources, two magnificent Memorials to the old Indian Army have been unveiled during the month of June 1971, one at the Royal Military Academy Sandhurst, and the other in St Paul's Cathedral.

Ever since 1858, when the British Crown took over the Government of India from the East India Company, the Corps of Royal Engineers has had a special link with the Indian Army. In that year the Engineer Officers of the three Presidency Armies of Madras, Bengal and Bombay were incorporated into the Corps of Royal Engineers. Since that date the Corps has provided Royal Engineer Officers and also a cadre of RE NCOs for the three Corps of Sappers and Miners and the Military Engineer Services as well as for the Survey of India, the Public Works Department, the Indian Railways and the Indian Mint, and these RE Officers and NCOs have had the special position of being both British Service and also corporate members of the Indian Army. Many Royal Engineers have thus passed the greater part of their service in India, and some have attained to the highest positions on the Indian Establishment. The distinguished services they have rendered to India, over a wide range of engineer activities, both military and civilian, have been acclaimed by all, and not least by the people of the Indian Sub-Continent. These services have been extremely well documented in Colonel E. C. W. Sandes' books *The Indian Sappers and Miners*, *The Military Engineer in India* and *The Indian Engineers 1939–47*. The unveiling of these memorials to the Indian Army in which so many Royal Engineers have been proud to serve has therefore a special and historic significance for the Corps. The following account of the unveiling of these memorials, together with the events that led up to them, has been written so that Royal Engineers may know of the dignified ceremonial which has marked the closing of this great chapter in the History of the Corps.

MEMORIAL WINDOWS TO THE INDIAN ARMY AT SANDHURST

On Sunday 20 June 1971, three Memorial Windows were unveiled in the Indian Army Memorial Room at the Royal Military Academy, Sandhurst. This Room forms part of the Museum of the RMA Sandhurst which itself harks back to the earliest days of the Royal Military Academy Woolwich and the Royal Military College Sandhurst, which were founded by Royal Warrant in 1741 and 1801 respectively, and both of which had always been repositories of relics and trophies of great military and historical interest. In January 1947 when the "Shop" and Sandhurst were combined into the RMA Sandhurst, all these were collected together at Sandhurst. In 1949 the Sandhurst Museum became the National Army Museum whose character would be to preserve objects of interest to the Army which did not fall within the scope of existing Regimental Museums, e.g. items connected with the Indian Army, British Cavalry and the old Irish Regiments. The nucleus of an Indian Army collection already existed and as a result of appeals since made, a collection has been brought together which in its scope and interest is unrivalled. More recently it has been decided to house the National Army Museum in a new building now under construction in Chelsea. The Indian Army Museum however is to remain

at Sandhurst where it will be centred on the Indian Army Memorial Room, extending through the passages of the Old Building to the Hastings Room and the Blenheim basement.

The unveiling of the Memorial Windows was preceded by the Sunday Morning Parade of the Royal Military Academy at which the salute was taken by Field Marshal Sir Claude Auchinleck, the last Commander-in-Chief in India, who returned from his retirement at Marrakesh for the occasion. He was accompanied by the Commandant RMA and attended by two Gurkha Orderly Officers. The parade was watched by a large assembly of Officers, Wives and Widows of the old Indian Army, among whom were representatives of all three Corps of Sappers and Miners. Also present were representatives of India, Pakistan and Nepal and many distinguished guests. The Gurkha Pipe Band, which was visiting the UK and giving brilliant performances at the Royal Tournament and elsewhere, also took part in the Parade.

The Parade was followed by Morning Service in the Academy Chapel, which was taken by the Venerable Basil Stratton, Archdeacon of Stafford, who served for many years on the Indian Ecclesiastical Establishment and became Officiating Chaplain General in Delhi and Simla. His sermon was on the theme of Obedience as exemplified by the Gospel story of the Roman Centurion in a foreign land who had under him soldiers who obeyed him. He said that the Indian Soldier whom we were honouring today understood obedience. It was this that made him the fine soldier he was, and which underlaid the deep love and lasting respect between the Officers and Men of the Indian Army.

After the service the assembly moved to the Indian Army Memorial Room for the unveiling ceremony. General Sir Frank Messervy in a speech introducing the Field-Marshal explained that the idea of this Memorial took shape at a meeting in 1969 between Field Marshal Sir Gerald Templer, Lieut-General Sir Reginald Savory and himself. General Savory had taken it upon himself to raise the necessary funds and bring the idea to fruition. Each window had cost £2,000. The principal donors had been British Petroleum, The National and Grindlay's Bank, The Hong Kong and Shanghai Banking Corporation, and Lloyds Bank who had all contributed as a mark of their gratitude to the old Indian Army for the security it had provided to their operations in the Far East. He then asked Field-Marshal Sir Claude Auchinleck to unveil these windows. In a stirring address in which he showed he had not lost any of his incisive soldierly rhetoric, the "Auk" said that the windows were a memorial to the Indian Soldier. He added "The old Indian Army under the British Raj was one of the most extraordinary armies that ever existed. The men that served us so faithfully for 200 years came from all over India and were as different from each other as a Highlander from an Italian. Nevertheless under their regimental officers that army was as well disciplined and well trained as any I have seen. The men were all volunteers. There was never any hint of conscription. To us British Officers, who had the honour of training and leading these men, it became our life's work. Son followed father and nephew followed uncle into the ranks of the army, and when we visited the villages from which our regiments were drawn, we were received not as Officers but as friends, almost as relations. Without these men one wonders whether Britain would have achieved an Empire. The British are a forgetful people but these men deserve to be remembered."

The three stained glass windows were then unveiled in succession. Two are on the east side of the room, and the third is on the west side which already has one stained glass window commemorating 150 years of service by the 2nd King Edward VII's Own Goorkhas which was unveiled by HRH Princess Alexandra in 1967. Each window is 13 ft 3 in high and 7 ft 8 in wide and is divided into six separate lights or panels. They have been designed by Mr Ronald E. Page, working in conjunction with Mr David G. Maile, in the studios of G. Maile and Son, The Borough, Canterbury. The three Memorial Windows illustrate the achievements of the Indian Army during the period 1914 to 1946. They are dramatic in design as well as vivid in colour. The first illustrates the period of the First World War 1914–18; the second

the period between the wars 1919–39, and the third the period of the Second World War 1939–45. The design of each window will now be described.

The Period 1914–1918

The first window unveiled portrays the deeds of the Indian Soldier in the First World War. The lower central panel depicts an Indian soldier in action in France and Flanders. In the foreground is a wheel sunk to the axle in mud, with trenches, barbed wire entanglements and shell-blasted trees in the background. The border of the panel has a motif of barbed wire inter-twined with Flanders poppies. The central panel at the top depicts Gurkhas storming the Sari Bair ridge at Gallipoli. In the lower side panels are, respectively, a mounted Lancer in Palestine, and an Infantryman in Mesopotamia. Subsidiary operations in Egypt, East Africa, Aden, Trans-Caspia, and the North West Frontier are also included. The coats-of-arms of the two Commanders-in-Chief for the period, Generals Beauchamp Duff and Monro, appear in the top corner panels.

The Period 1919–1939

This window portrays the activities of the Indian Soldier between the two World Wars. The lower central panel illustrates action in the third Afghan War. The small panel beneath it depicts typical fortified villages with their watch-towers in Waziristan. The upper central panel shows Indian Mountain Artillery in action in Waziristan in 1919–20 and 1937–8. The figures in the two side panels commemorate service in the Shanghai Defence Force in 1927, and in Kurdistan in 1923. The Arab Rebellion in Iraq of 1919–30 and operations on the North West Frontier are also included. The design in completed by the coats of arms of the four Commanders-in-Chief, Field-Marshals Rawlinson, Birdwood and Chetwode and General Cassels.

The Period 1939–1945

This window portrays the deeds of the Indian Soldier in the Second World War. The central lower panel shows an Infantryman in Burma supported by a Sherman tank and supplied from the air by Dakota 'planes escorted by fighters—an important feature of the Burma campaign. The border surrounding the panel has a bamboo motif. The panel at the top shows an attack supported by Matilda tanks at Sidi Barrani in North Africa. One lower side-panel depicts the fighting in Eritrea with a representation of Mount Sanchil at Keren; and the other the operations in Italy with a portrayal of the Monastery of Monte Cassino. Syria, Iraq, Malaya, and Hong Kong are also included. The badge of the 14th Army, as well as the Corps and Divisional signs together form a colourful feature of the window. The design is completed by the coats of arms of the two Commanders-in-Chief, those of Field Marshals Wavell and Auchinleck.

As Field Marshal Sir Claude Auchinleck left the hall at the end of the unveiling ceremony, the RMA Trumpeters, in honour of his eighty-seventh birthday which was to be on the following day, sounded in his honour a newly composed and vibrant fanfare entitled "Auchinleck".

After the ceremony all present were able to examine more closely the newly unveiled windows as well as the other interesting exhibits in the Indian Army Memorial Room and outside. All were then the guests of the RMA at an excellent luncheon at which, presumably in their honour, a curry was served which was considerably hotter than any they had tasted in India! It was a nostalgic occasion at which many old friends had the pleasure of meeting again.

Memorial to the Indian Army in St Paul's Cathedral

This Memorial was unveiled by Her Majesty the Queen on Friday 25 June 1971. Before describing the ceremony, it is of interest to record the steps by which the Memorial came into being. The old Indian Army ceased to exist on 15 August 1947 when the two states of India and Pakistan achieved their independence within the

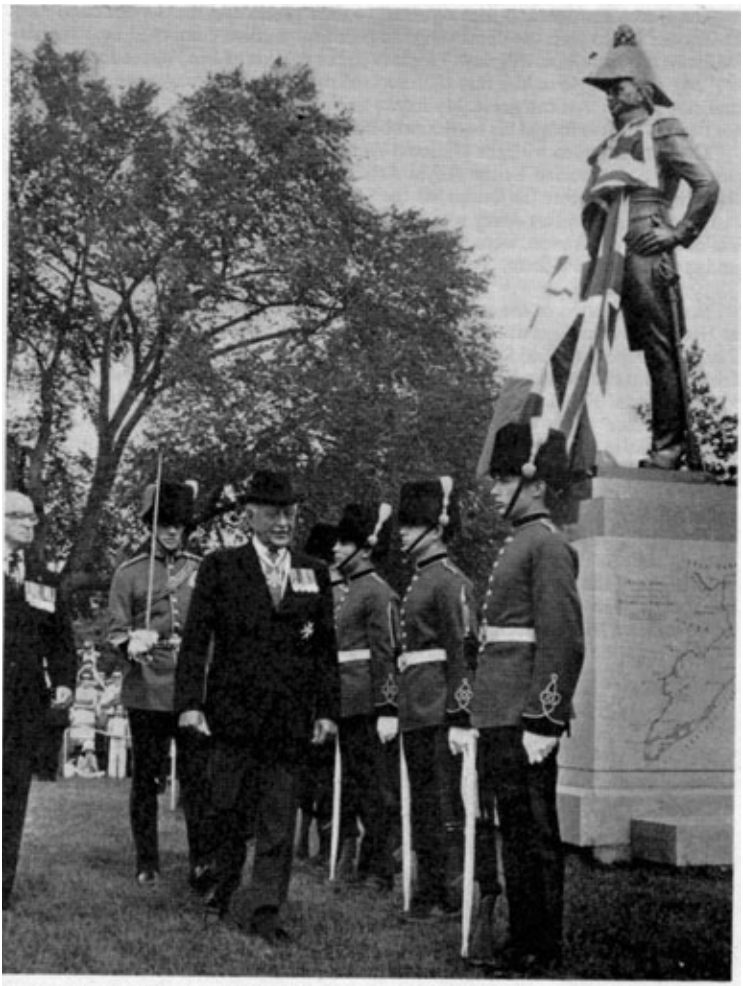

Plate 1. The Governor General with Brigadier-General J. L. Melville inspects the RE Guard of Honour commanded by Major P. O. M. Chitty RE.

Photo by The Canadian Press, Toronto

Canada's Tribute to Lieut-Colonel John By, RE

Commonwealth. Many British Officers continued to serve on for varying periods in one or other of the two new Dominion Armies. Under War Office regulations all BOs below the age of 40 were eligible for transfer to the British Army and many took advantage of this. All those over 40 were however retired on pension with compensation for loss of career. In the United Kingdom the ex-Officers of all Indian Army Regiments and Corps formed themselves into Regimental/Corps Associations and by annual reunions kept alive the spirit and comradeship of their old Indian units. They also maintained contacts with their old Regiments and Corps in India or Pakistan whose serving Officers were always warmly welcomed at their reunions and into their homes when they visited the United Kingdom for courses at Army Schools, duty at the High Commissions, or on private occasions.

In 1957 it was decided to hold an annual Indian Army Reunion at Hurlingham in the month of June. A Committee was formed to organize this function and Field-Marshal Sir Claude Auchinleck became its first patron. In course of time it was realized that this Committee was required to deal with matters other than the annual reunion. In 1969 the Reunion Committee was therefore superseded by "The Association of British Officers of the Indian Army". Under its new Constitution one of the objects of the Association was "To create and maintain a worthy memorial to the units of the Indian Army in existence prior to 15 August 1947", and an Executive Committee was formed for this purpose. The President, General Sir Rob Lockhart began by approaching the Dean of St Paul's as to the possibility of placing the Memorial in the Cathedral. The proposal was very favourably received by the Dean and the Chairman, Colonel Roberts, was put into direct touch with the Cathedral Surveyor as to the siting and design of the Memorial. It transpired that the Cathedral Surveyor, Mr Bernard Feilden, had served with the Bengal Sappers and Miners during the war, and he immediately took the greatest interest in the project. With his advice the Committee recommended that the Memorial should take the form of a Tablet on a main pillar in the body of the Cathedral. This proposal was put to all Regimental Associations and agreed by an overwhelming majority. Mr Feilden then suggested the materials for the Tablet and the Committee prepared the design and inscription. These were approved by the Annual General Meeting of the Association in November 1969. The Dean and Chapter then accorded their formal approval to the siting and design of the Memorial. Details of the design and inscription finally achieved are as follows:

The Design

Tablet of grey marble 83 in high by 39 in wide with a black marble frame edged with gold.

Emblems in colour as follows:

Centrally at the top, the Imperial Crown of India (as worn by HM King George V, King Emperor, at the Delhi Durbar 1911).

Below the Crown, in line, the Royal Cyphers of the five sovereigns under whom the Indian Army served.

Below, central, the Victoria Cross (since Indian troops became eligible for the award in 1911, fifty-one VCs have been awarded to Officers and Other Ranks of the Indian Army. Of these eight were won by Viceroy's Commissioned Officers, and thirty by Native Other Ranks).

On either side, the Indian Orders of Knighthood, left—the Star of India, right—the Order of the Indian Empire.

Then the Inscription as below.

Below the Inscription, from left to right: The Order of British India (instituted in 1837 by the East India Company as an award for meritorious long service) the Indian Distinguished Service Medal (established during the reign of HM King Edward VII as an award for gallantry), the Indian Order of Merit (established by the East India Company in 1837 as an award for outstanding bravery). Only Native Officers and Other Ranks were eligible for these awards.

On the base line, centrally, the Arms of the Honourable East India Company.

The Inscription (in letters 1 in high in black marble, except for the words THE INDIAN ARMY which are in Indian Red)

1746–1947

THIS TABLET COMMEMORATES 201 YEARS OF FAITHFUL SERVICE GIVEN BY BRITISH, INDIAN AND GURKHA SOLDIERS WHO, AS COMRADES, SERVED IN

THE INDIAN ARMY

IN THE EMPLOY OF THE HONOURABLE EAST INDIA COMPANY AND AFTER 1858, UNDER THE CROWN.

THE INDIAN ARMY SERVED IN THE FORMER INDIAN EMPIRE AND OVERSEAS IN PEACE AND WAR. SINCE ITS FIRST OVERSEAS EXPEDITION IN 1762 ITS SOLDIERS TOOK PART IN 31 EXPEDITIONS AND FOUGHT IN 83 FRONTIER CAMPAIGNS.

DURING THE FIRST WORLD WAR THIS ARMY SENT MORE THAN ONE MILLION SOLDIERS OVERSEAS. IN THE SECOND WORLD WAR TWO MILLIONS WERE ON ACTIVE SERVICE. DURING THESE CONFLICTS THE INDIAN ARMY SERVED ALONGSIDE BRITISH AND ALLIED FORCES IN EUROPE, AFRICA AND ASIA.

IN THE TWO CENTURIES OF SERVICE HERE COMMEMORATED THIS WAS A VOLUNTEER ARMY.

Mr Feilden recommended as Sculptor Mr Skelton who was engaged on other work in the Cathedral. It was decided to aim at the unveiling to take place on the morning of the day of the Indian Army Reunion in June 1971. For this it would be necessary for Mr Skelton to start work by May 1970. But before he could do so it was necessary to obtain the approval of a number of authorities. Mr Skelton's detailed drawing of the Tablet was taken to Buckingham Palace where the Private Secretary accorded Her Majesty's approval to the inclusion of the Royal Cyphers, the Imperial Crown and the emblems and medals. It then had to go to the College of Heralds for Garter King of Arms to check that the details of the various Insignia were correct. Finally the approval of the Foreign and Commonwealth Office (as successor to the India Office) had to be obtained to the use of the East India Company's Coat of Arms. Only then was it possible for Mr Skelton to get on with his work. The Association also had to raise the necessary funds, originally estimated at £1,500. An Indian Army Memorial Fund was opened and a circular was sent through Indian Army Regimental/Corps Associations to all their members. Letters were also sent to a large number of firms connected with India. A special notice was included in the March 1970 *Supplement* to the *RE Journal*. In due course it was found that various fees had to be paid, and additional expenses met, which had not been anticipated. The target had to be raised to £3,500. In the event, and thanks to the generosity of all concerned, this target was achieved and passed.

It had always been hoped that Her Majesty the Queen would be pleased to unveil the Memorial, and a request to this effect had been made to the Private Secretary when the approval to the Cyphers had been sought. A reply was then received that HM's programme would not be considered till October 1970. In due course it was announced in the Court Circular that Her Majesty the Queen would unveil the Indian Army Memorial in St Paul's Cathedral on Friday 25 June 1971.

As previously stated the Dean and Chapter had agreed to the siting of the Memorial on a main pillar in the body of the Cathedral. It was finally decided to affix the Tablet to the north face of the second main pillar in the north aisle. This is next to the memorial to the Duke of Wellington (who commanded the British Indian Forces in the Mysore campaign of 1799 and in the second Mahratta War of 1803) and facing the Memorial to Field Marshal Lord Roberts, VC.

The Memorial Service was due to begin at 12 noon on 25 June 1971, by which time the body of the Cathedral as well as the east and west transepts were filled with over 2000 Officers, Soldiers, Wives, and Widows of the old Indian Army as well as Diplomatic and Military representatives of India, Pakistan and Nepal, representatives of the Cabinet and the Shadow Cabinet, Mr Jeremy Thorpe, the Defence Secretary, the Chief of the Defence Staff, the Chief of the General Staff, the Master Gunner, the Chief Royal Engineer and the Master of Signals. The Royal Engineers were represented by approximately ninety Officers, Wives and Widows from the three Corps of Sappers and Miners. These included three former Engineers-in-Chief in India and one former MGO in India.

The Memorial Leaflet

All those present found on their seats a leaflet with a photographic reproduction of the Memorial Tablet, and the following words:

"To-day we are unveiling a Memorial to an Army, the Indian Army, one which, during its 201 years of existence, was unique in the history of the world.

The Army was unique because, from its early beginning as parties of armed watchmen, to its crowning achievement during the Second World War, it was the largest volunteer Army in the world; it was multi-racial and of various creeds, being composed of the world's main races—Aryans, Mongolians and Dravidians; and the followers of four great religions—Hindus, Moslems, Sikhs and Christians. This amalgam of races and religions was held together by loyalty and pride of service, which continue today in the armies of India and Pakistan. This loyalty was further cemented by the brotherhood between the British Officers and their soldiers, which we properly commemorate here today.

The services of the Indian Army in war, as mentioned briefly on the Memorial, contributed greatly to bringing peace and prosperity to a large part of South-East Asia and, in addition, the Indian Army's service was as great in peace as in war. It was the initiator or the senior partner in all schemes of social welfare and of local government in the countryside. Its soldiers, on returning home, became the leaders in the village communities, directing and encouraging others in village hygiene, good husbandry and local self-government. Ex-soldiers predominated in the Village Councils and in the early attempts at self-rule in the countryside.

The Army itself was the pioneer of anti-malarial work within India; and its farms, dairies and remount depots were models of their kind. Excellent results in family welfare were obtained by the establishment of Unit Family Hospitals, supported and financed by the officers and men of the regiments, and at no cost to the general revenues.

But without in any way discounting any of the foregoing, the real virtue of the Indian Army must be that voluntarily, as so well commemorated on this Tablet, British India and Gurkha soldiers served as comrades."

The Memorial Service

On her arrival at the Cathedral the Queen was greeted at the foot of the steps by the Lord Mayor, and was then received at the West Door by the Dean and Chapter, the Bishop of London, Field-Marshal Sir Claude Auchinleck and General Sir Rob Lockhart. A fanfare was sounded by Trumpeters of the Royal Artillery. The Dean and Chapter with the Bishop of London then conducted Her Majesty to her seat under the Dome, and the service began. The Lesson, read by the Archdeacon of London was taken from the fifth Chapter of St Matthew: the Sermon on the Mount. During the hymn that followed the Queen, the Dean and Chapter, the Bishop of London and Field-Marshal Sir Claude Auchinleck moved to the Memorial. The Memorial was then unveiled by Her Majesty the Queen, after which it was dedicated by the Bishop of London in the following words:

"In the Faith of Jesus Christ we dedicate this Memorial to the Glory of God and to commemorate the two hundred and one years of service of the former Indian

Plate 2. Her Majesty the Queen saying goodbye to Field Marshal Sir Claude Auchinleck and General Sir Rob Lockhart before leaving St Paul's Cathedral.

Army, in the name of the Father and of the Son and of the Holy Spirit. Amen."

The Royal Artillery Trumpeters then sounded a fanfare and in this symbolic way the British Army expressed its tribute to its Comrades-in-Arms of the old Indian Army.

The Queen's procession then returned to their places and the Service continued. Before the final hymn the choir sang the beautiful anthem composed by Vaughan-Williams to words from Pilgrim's Progress on the passing of Mr Valiant-for-truth:

"My sword I give to him that shall succeed me in my pilgrimage, and my courage and skill to him that can get it. My marks and scars I carry with me, to be a witness for me, that I have fought his battles, who now will be my rewarder."

The Service ended with the National Anthem in which the Choir and Congregation were accompanied by the Royal Artillery Trumpeters from the gallery above the choir stalls. Before the Queen left the Cathedral, by her personal wish, representatives of the old Indian Army who had served on the Committee, together with Mr Feilden and Mr Skelton, were presented to Her Majesty and she shook hands with, and spoke to, each of them.

On the afternoon of the same day, the annual Indian Army Reunion took place at Hurlingham and was attended by over 800 officers and members of their families. *The Times* reported "Old Soldiers from Regiments like the Rajputana Rifles greeted friends from the Poona Horse and Sam Browne's Cavalry and told stories of the vanished days. The Band of the Royal Engineers played 'Merrie England' and 'The Student Prince' while Union Jacks and the gaudy flags of the old regiments made Whip-cracks in the breeze". The flag of the Royal Engineers was flying among the Indian Regimental flags. The playing of the RE Chatham Band was very much appreciated. Towards the end of the Reunion, Field-Marshal Sir Claude Auchinleck said that he wished to meet the RE Band. He shook hands with Captain Riding, Director of Music, and spoke to all the Bandsmen, congratulating them on their playing and thanking them for their participation. This expression of appreciation and thanks to the Royal Engineers from the last Commander-in-Chief of the Indian Army could also be considered to be of symbolic significance.

So ended a truly historic occasion. 201 years is a very long time. For the Indian Army it represents a span of glorious achievement.

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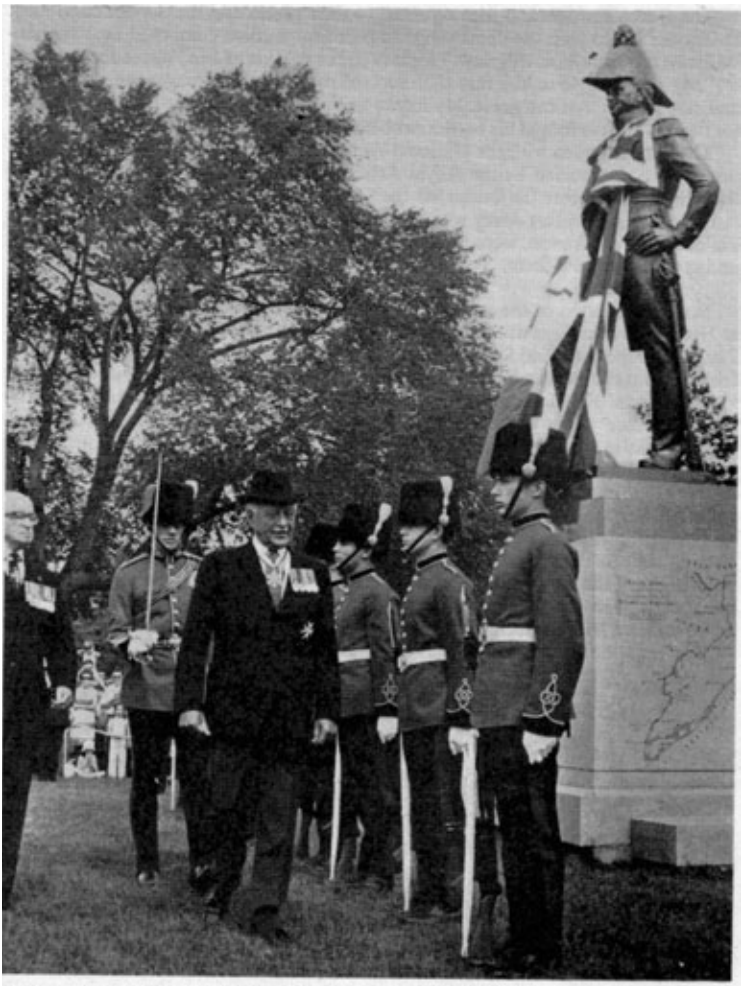

Plate 1. The Governor General with Brigadier-General J. L. Melville inspects the RE Guard of Honour commanded by Major P. O. M. Chitty RE.

Photo by The Canadian Press, Toronto

Canada's Tribute to Lieut-Colonel John By, RE

Canada's Tribute to Lieut-Colonel John By, Royal Engineers

LIEUT-COLONEL P. A. CAMP, RE

OUTSIDE of Canada today the name of Lieut-Colonel John By is scarcely known, even amongst those of his own Corps. Yet he was truly one of the great engineer officers of his time and founder of "By-Town", the township which was later to be renamed "Ottawa" and become Canada's capital city.

John By was born in 1781 and commissioned into the Corps in December 1799. He served in Canada from 1802 to 1811 where he was mainly engaged in improving the defences of Quebec and in the early planning of the Citadel there. In 1811 he joined Wellington to serve in the Peninsular War taking part in the first and second sieges of Badajos. He was wounded and invalided home. From 1812 to 1821 he was in charge of the works at the Royal Gunpowder Mills at Waltham Abbey, Faversham and Purfleet only to be placed later on the unemployed list due to redundancy in the Army after the Napoleonic Wars. However in 1826 he was recalled to take charge of the design and construction of the Rideau Canal System in Canada. It was one of the most challenging tasks ever given to an engineer, and the last and greatest work of British Military engineering to be carried out in North America.

The War of 1812 had highlighted the need for a line of communication between Montreal and Lake Ontario, secured from attack by bypassing that part of the St Lawrence River which runs along the American border. However it was not until 1825 that the decision was made to meet this need, by constructing a navigable waterway from the Ottawa River to Lake Ontario at Kingston, by then a major fortification and important shipyard. The route was to follow broadly along the course of the Rideau River from its junction with the Ottawa near to Hull, through the Rideau Lakes and thence along the course of the Cataraqui River.

By landed at Hull on 26 September 1826 and from there selected the site for the entrance of the canal and the sites for the main civil and military camps. Work proper started on the waterway in the summer of 1827 with the arrival of a team of young Royal Engineer officers and the 7th and 15th Companies Royal Sappers and Miners. They set up their barracks on the high ground above the canal entrance on what is today the site of the Houses of Parliament. This became known as Upper By-Town. The civilian labourers imported for the task, built their settlement below the canal entrance and this was called Lower By-Town.

The canal system was completed and opened to traffic on 29 May 1832. A total of 124 miles of navigable waterway was opened up, involving the construction of 47 locks giving a total lift of 277 ft above the Ottawa River and a descent of 162 ft to Lake Ontario. Each lock is 134 ft long by 33 ft wide and 5½ ft minimum draft. The most imposing and spectacular work is the flight of eight locks at the entrance to the canal which have a total water rise of 80 ft above the Ottawa River. Twenty large dams were built, the largest being at the Hogs Back Falls with a height of over 50 ft and a base of 250 ft width. The 350 ft long dam at Jones Falls was another colossal work. In addition 15 miles of new canal was excavated. The nature of the work involved is easy to appreciate when one considers that excavation was entirely by hand, that except at a few locations where oxen carts could be used, the haulage was by wheel barrow. All the quarrying had to be labouriously carried out by hand, a crew of three men completing on average 12 ft of 1¼ in borehole in a day. Gunpowder was the only explosive available.

Apart from the work on the canal there were many allied engineering tasks to carry out in support of the project. Undoubtedly the most spectacular of these was the bridge which By constructed across the Ottawa River to enable cement and supplies from Hull to pass across to the works site. This comprised eight spans in all,

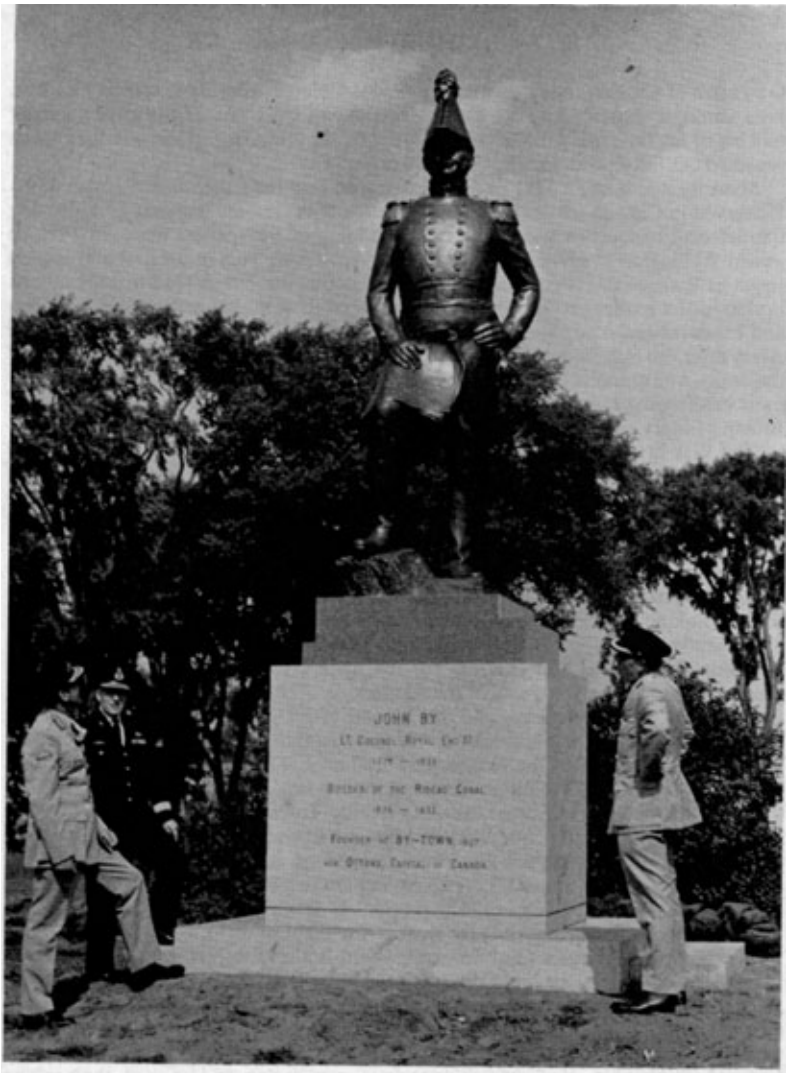

Plate 2. Major-General F. G. Caldwell, Engineer-in-Chief, Brigadier- General N. C. Brown, Director Canadian Military Engineers and Lieut-Colonel P. A. Camp RE at the statue of Lieut-Colonel J. By RE.

Canadian Forces Photo

five of 60 ft, two of 70 ft and the major single span of 200 ft. The latter was a unique timber lattice girder with a 20-ft carriageway designed by By.

The construction of the canal and the subsequent traffic it carried brought rapid prosperity to the little settlement of By-Town. From a handful of settlers the population rose to just over 5,000 with 213 acres of land settled in 1835. Twenty years later the population had risen to 27,000 settled on 884 acres.

In 1855 By-Town was renamed Ottawa and later was designated the capital of Canada by Queen Victoria.

For many years Canadian citizens, and especially Ottawans, have sought to express their gratitude to their founder in some tangible way. The driving force behind their efforts has always been Brigadier-General J. L. Melville, CBE, MC, ED, CD, Colonel Commandant RCE rtd, through the medium of the Historical Society of Ottawa under its able President Dr B. R. Mackay. On Saturday 14 August this year they achieved their aim when a life-size bronze statue of Lieut-Cononel John By was unveiled just a few yards from the place where once stood his home in Canada. The statue, draped with the Union Jack and the Canada flag, was unveiled in brilliant sunshine before a huge gathering by His Excellency The Right Honourable Roland Michener, CC, CD, Governor-General of Canada. For the occasion a guard of honour of one officer and nine other ranks was provided by the CO 36 Engineer Regiment. They were flown to and from Canada under the kind auspices of the Canadian Forces. The RE detachment, dressed in scarlet, formed part of a full guard of honour comprised of detachments from the First and Third Field Squadrons, Royal Canadian Engineers, and of the Mapping and Charting Establishment, Canadian Military Engineers. The participating band at full strength was provided by Canadian Forces Air Transport Command. Present at the ceremony were Sir Peter Hayman, the British High Commissioner, Dr Emile Brunet, the sculptor of the Statue, the Mayors of Vanier and Ottawa, representing Upper and Lower By-Town and Dr Mackay and Brigadier-General Melville who were the principals concerned throughout the ceremony.

The feelings of Canadians were admirably expressed by the Governor-General when, in his speech prior to the unveiling, he said ". . . you have given me, as spokesman for Canadians as a whole in such matters, the welcome opportunity of expressing their appreciation, and I am sure they do appreciate, that a pioneer engineer and builder of unusual competence is being commemorated by such a fine bronze statue. I am happy, too, to express the satisfaction which Her Majesty will feel by reason of this recognition of the contribution to Canada of an officer of her Corps of Royal Engineers. The importance of the role of Colonel By in the establishment of the town which long bore his name deserves to be more generally known than it is. . . . Colonel By did not, in his lifetime, receive the recognition which he might have expected and which his great efforts so well merited. We are delighted that this is now being rectified. I congratulate the Ottawa Historical Society for its imagination and perseverance in the erection of a permanent memorial to Colonel By, as well as M Brunet, the sculptor, for his artistic execution of this important historical commission. It is fitting, too, that the Royal Engineers should be so well represented by Major Chitty and his men, and the Canadian Service and Militia units whose presence in uniform adds so much to this occasion. Je suis très heureux et fier de dévoiler maintenant cette statue du Regiment des Ingénieurs royaux."

The statue is a magnificent work. It stands on a massive granite base rising in all eleven and a half feet from the foundation. John By is portrayed in a relaxed posture, one hand on hip, the other hanging loosely and holding a plan of the canal against his thigh. On his face he wears a smile of content, the content that comes in the realization of having achieved a job well done. It is a very moving statue. In the quiet of the evening one can almost feel the presence of this man standing, as he must so often have done, just a few steps from his verandah and gazing out across the head of the canal. How beautiful that scene is today; how unique it was in By's time is described by Colonel Bouchette, who in 1828 wrote "On the elevated

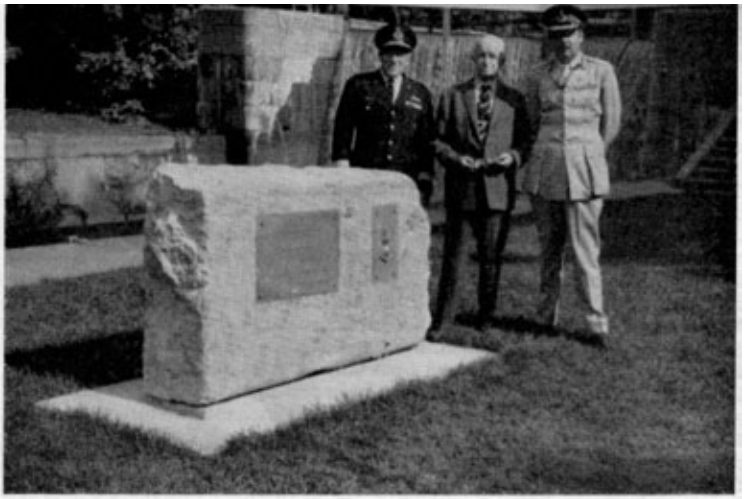

Plate 3. Brigadier-General Brown, Brigadier-General Melville and Major-General Caldwell at the dedicated Canal coping stone.

Plate 4. Rideau Canal Long Island Loch and dam.

Canada's Tribute to Lieut-Colonel John By, RE 3 & 4

banks of the bay, a hospital, an extensive stone building, and three barracks stand conspicuous, and nearly on a level with them, and on the eastern side of the bay, is delightfully situated the residence of Colonel By. From his verandah the most splendid view is beheld that the magnificent scenery of the Canadas affords." Today By looks upon the Houses of Parliament where the hospital and barracks once stood.

The front of the base to the statue is inscribed "John By—Lt Colonel Royal Engineers 1779–1836,[1] Builder of the Rideau Canal 1820–1832, Founder of By-Town now Ottawa Capital of Canada". The south face is engraved with a map of the Rideau Lake system with the place names of the townships as they were in By's day. The east face pays credit to the Historical Society of Ottawa, the city of Ottawa and benefactors who made the statue possible. The north face is engraved with a facsimile of one of By's maps of By-Town.

Two days previous to this ceremony the Corps paid its own tribute when a canal coping stone, dedicated by the Corps of Royal Engineers to the Royal Sappers and Miners under By's command, was unveiled by Major P. O. M. Chitty, RE. It was a simple but colourful ceremony with the scarlet clad RE Guard of Honour standing against a background of sparkling water spilling over the lock gates and the high cliffs rising up to the spot where By's statue stands. The coping stone has been mounted on a concrete base a few yards from the fifth lock at the head of the canal and just a stone's throw from the old RE commissary which now houses the By Museum. The stone bears a bronze RE grenade and an inscribed bronze plate, both produced in the RSME. The plaque is inscribed "This canal coping stone was dedicated here in August 1971 by officers and men of the Corps of Royal Engineers to commemorate the construction of the Rideau Canal, 1826–1832, by Royal Sappers and Miners under the command of Lieutenant-Colonel John By, Royal Engineers."

It was with immense pleasure that I showed the Engineer-in-Chief the statue and coping stone just one month later on the occasion of his visit to Canada, and was able to show him something of the work carried out by John By and his men.

We of the Corps owe a great debt of thanks to Canada for this wonderful tribute to one of our forebears. Above all we are indebted to Brigadier Melville, without whose tireless and dedicated efforts as Chairman of the Lieut-Colonel By Memorial Committee over many years, the tribute would not have been such a permanent one.

[1] The date 1779 is in fact incorrect, By was born in 1781.

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THE Rideau Canal was opened in May 1832 when the steamer *Pumper* passed through from Bytown to Kingston, and Lieut-Colonel By was recalled home in November of that year. He possibly expected some commendation on the completion of his magnificent work, carried out in so short a time under so many difficulties and at a cost by no means extravagant. He was, however, summoned before a Select Committee of the House of Commons which, whilst admitting that the work on building the Canal had been carried out with care and economy, expressed its displeasure at the final excess of expenditure over the estimate and parliamentary Vote. As a result By was placed on the unemployed list and he retired to his residence at Shernfold Park near Frant, Sussex with his wife and two daughters. Failing in health and a broken man he died in February 1836. His wife, also a semi-invalid, died two years later and the younger daughter died at the age of 18 in 1842. The elder daughter married the Hon Percy Ashburnham in 1838, but she too died not long afterwards. Frant Parish Church houses several memorials to this tragic family, which bore all misfortunes with great Christian fortitude, and the family vault and tombstone is in the Church's graveyard.

In 1968, Canada's Centenary Year, Brigadier-General Melville raised a sum of money, mostly from members of the Ottawa Historical Society and the Royal

Plate 5. Wreaths laid by Commander C. R. Burgess and Brigadier J. H. S. Lacey on the By tombstone, Frant Church.

Kent and Sussex Courier photograph

Canada's Tribute to Lieut-Colonel John By, RE 5

Canadian Engineers, for the perpetual maintenance of the By tombstone in Frant churchyard. The Institution of Royal Engineers had for some years previously helped towards its maintenance.

A simple ceremony was held on 14 August 1971 when, in the presence of a number of parishioners of Frant Church, two wreaths were laid on the By tombstone, glistening in the afternoon sun, coincident with the unveiling of the By statue in Ottawa. The first, placed by Commander C. R. Burgess Royal Navy the Rector's Warden, was laid on behalf of the Historical Society of Ottawa, and the second was laid by Brigadier J. H. S. Lacey, the Secretary to the Institution of Royal Engineers, on behalf of the Corps.

From all one reads about John By he must have been a very gentle and lovable man. His family motto was: "Give and Forgive". He certainly gave unstintingly many years of his life to Canada, and one feels sure that he forgave those who treated him so harshly on his recall from that country. He surely would have been overwhelmed at the honour paid to him last August in the capital city of Canada, which he founded, and he would have been deeply touched that he was not forgotten in the English country village where he passed the last few years of his life and with his family is buried in the peace and quiet of the graveyard of the Parish Church.

J.L.

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The Development of a System for Terrain Evaluation over Large Areas

P. H. T. BECKETT and R. WEBSTER
(Department of Agricultural Science, University of Oxford)

SUMMARY

RESEARCH into a system of Terrain Evaluation for large areas with limited access was initiated by the Military Engineering Experimental Establishment (UK), and carried out jointly by MEXE and by research groups at Oxford and Cambridge Universities.

This paper discusses the requirements which must be met by a system of terrain evaluation suitable for the purpose, and the criteria of its success.

It describes the *Data Store* developed by MEXE to hold terrain information in easily retrievable form, and the Terrain Classification in terms of which the stored information is indexed. It outlines the field trials of the classification.

THE PROBLEM

Terrain Evaluation is the art of making useful statements about the suitability of terrain for specified purposes. It is usually assumed also that terrain evaluation procedures lead to economies in time or effort.

The cost of absolute precision is infinite. So every procedure for terrain evaluation represents a compromise between accuracy and precision on the one side, and cost or practicality on the other. The nature of the compromise depends upon what is required. Time or money can be economized (with some loss in precision), by procedures which predict the suitability of terrain for complex operations from simple measurements, or describe large areas by means of a small number of observations. It is often necessary to attempt both.

So the usefulness of a system of terrain evaluation must be assessed not only on the accuracy and precision of the statements about terrain which it generates, but also on whether it requires less effort, and how much less, than direct observation of the terrain over the area of interest. If, for example, the true cost or trouble of predicting terrain conditions by means of a terrain evaluation procedure is no less than the cost or trouble of having the same data collected by untrained personnel on site, the procedure is not very useful.

In the present case the Military Engineering Experimental Establishment (MEXE) required a system of terrain evaluation which could generate useful statements about terrain, over *large areas* from which the *existing information was sparse*, and to do so with the *minimum cost and effort*. The system would have to be able to offer predictions of sufficient accuracy to guide the general and logistic planning of a civil construction job or a military operation, at any site in the theatre of interest. It was accepted that no economic procedure could achieve absolute accuracy at all sites. The military problem of finding out about terrain in hostile or inaccessible territory is formally the same as the civil problem of finding out about the whole extent of an under-developed territory from field observations only in the easily accessible parts of it.

Specifications of a Terrain Evaluation System

To a considerable extent the nature of the MEXE problem determined the nature of the compromise attempted. The system produced was to generate useful statements from limited information, about terrain anywhere within wide areas. The first and most obvious economy is to make the maximum use of every item of terrain information that can be collected. Each item must be used not only to describe the terrain at the precise point of its observation but also all other areas of similar

terrain. Data from one site must be applied to as many other sites on similar terrain as possible.

This requires an organized library, or *Data Store*, for items of information on terrain. It also requires that every item of stored information be indexed not only on its content, and whence derived, but also on the nature or kind of terrain to which it refers. The last, in its turn, requires a scheme of *Terrain Classification*. It must be possible to identify and to record the kind of terrain at every site from which information has been derived; every item of stored information must be labelled with the kind of terrain which it represents.

The idea of storing information, so that every item may be applied to all occurrences of the terrain class it represents, is not new. Less explicitly, and informally, this is attempted in the memoirs of supplementary information which accompany the maps of geological or soil surveys. What is new here, if at all, is the proposal to use the classes of a formal terrain classification to index information in an organized store and to apply them to terrain information of all kinds.

If information is to be extended from the site of observation to all areas of similar terrain, it must be possible to identify the limits of the area to which each item may be applied. The terrain classes must be recognizable. Yet the development and use of a *Data Store* will not have led to economies of time or effort if the identification of the terrain classes in an area of interest requires local information of a kind not generally available or only available from locations specially visited for the purpose. The recognition of terrain classes must not depend on some rare expertise, or on extensive ground check. The recognition of terrain classes over wide areas, and with only limited ground check, will have to depend on existing information, and of a kind available for most areas of interest.

There are not many kinds of information which are both suitable, and available for all areas of interest. Soils are an important aspect of terrain, but soil maps of sufficient detail cover only a very small part of the earth's land surface, so they provide insufficient basis for a comprehensive terrain classification. The world cover of geological maps is more complete, but the geological units mapped are not always very closely related to terrain. In some instances this is because the geological units are defined on their fossils and inferred age, and not on lithology; in others it is because the same rock type gives rise to different ground conditions according to local drainage, relief or physiographic history. Topographic maps have wider cover still, but many properties of terrain are not closely related to the kinds and scales of relief represented on topographic map series with wide cover. There is only limited cover of geomorphic maps. Not all geomorphic units are useful for our purpose, and if precisely defined, their mapping is laborious and costs more time and effort than the *Data Store* is designed to save.

In fact air photography is the only source of detailed information which can reasonably be assumed to be available for any area of interest. Inevitably therefore, if they are to be useful for indexing items of terrain information, the units of the terrain classification must be recognizable on air photographs, with minimal ground check. This is not a new conclusion: it is commonly forced upon terrain evaluators. No matter how precise or detailed the observations we make at points, their extension to a wider area can be made only on the basis of information which covers all of the area. Air photography is commonly the only information available.

Thus a system for generating useful (reasonably precise) statements about terrain conditions over wide areas must comprise:

(*a*) the hardware of a *Data Store* in which items of all kinds of terrain information can be stored in easily recoverable form (on cards, microfilm or computer tape), and each indexed on its content, etc and on its terrain class.

(*b*) A comprehensive terrain classification, the classes of which can be identified in any area of interest by means of air photography and minimal ground check.

When this study was started at Oxford it seemed likely that a suitable classification would be more difficult to develop than the hardware of a *Data Store*. So the classification was tackled first and will be discussed next.

TERRAIN CLASSIFICATION

Further specifications

The only way to obtain completely accurate information about the terrain at a point is to go there and to make direct observations of whatever attribute or activity is of current interest. From necessity we have rejected this in favour of a system which uses fewer observations but achieves greater utilization of each of them.

If every item of terrain information is indexed according to the kind of terrain it represents then the identification of the terrain class at a site of interest provides access to all data already recorded for that terrain class whencesoever derived. This may be applied to the site if it may be assumed that data from any point within a terrain class is equally applicable to every other part of the same terrain class. This cannot be wholly true. So the precision of statements about a terrain class must depend upon the variability of its properties. If a measured property exhibits a small range of values within the limits of a terrain class then a precise statement can be made about its value at any site within the class, or vice versa.

There are three main sources of variability between the data on a given terrain class. Firstly the properties of the terrain may genuinely vary over short distances, so that a terrain class had to be defined to comprise the variability.

Secondly changes in some terrain properties may have no expression on air photographs. Since terrain classes are to be recognized on their air photo appearance, such properties may prove to be poorly associated with terrain classes. These causes are always operative to some extent since no kind of terrain is wholly uniform and it is unlikely that all ground conditions of interest will be closely associated with the appearance of the terrain on air photographs.

Thirdly the same statements can only be accurate if the means or modes of the stored data upon which they are based correspond to the true means or modes for the terrain class. There will rarely be many observations recorded for any one terrain property within the area identified as one terrain class. If a substantial proportion of these derives from anomalous parts, or from unrecognized inliers of other terrain classes, their mean is likely to differ from the true mean for the class, and statements based upon them will be inaccurate.

If a particular terrain class lacks consistent air photo or surface appearance, the data attributed to it in the store may have been derived from undistinguished inliers or boundary inclusions of other and different kinds of terrain. The class may also be wrongly identified in areas about which predictions are to be made.

Such inaccuracies will not be discussed further in this paper. For the most part they are faults of the users of a terrain evaluation system and not of its design. The statistical procedures for collecting adequate and unbiassed observations are well established.

These last two errors depend on the *recognizability* of the terrain class, and thus partly upon the skill with which the classes have been selected and defined and partly upon the experience and resources of subsequent workers using the classification to index information on terrain.

But the stored data must be accessible, either directly to the average user of the system, or at the very least to the sort of lesser expert (viz. Report 940[1]) whose aid is readily available to any expected user. These may be personnel with only moderate experience of air photo interpretation.

From all this it is clear that the terrain classification will have to achieve a compromise between *reproducibility* and *recognizability* (see Report 872). The terrain classes must be uniform (reproducible) so that reasonably precise statments

[1] MEXE reports and other publications are listed in "References" and referred to in the text by number only

about the whole extent of a correctly identified terrain class can be based upon observations at a few points. The classes must serve to index information on a wide range of attributes, so the classes must also be uniform for as many attributes as possible. Yet the classes must be simply defined and (as above) recognizable by simple means and without special skills. The two conditions are complementary. The more narrowly we define terrain classes to increase their uniformity, the more difficult it is consistently to perceive their distinguishing features on air photographs, and the greater the uncertainty about their limits.

Terrain classification suitable for our purpose would have to be based upon the finest subdivisions of terrain that could be shown to be consistently recognizable by simple means. Before an operational terrain evaluation system could be erected upon the classification the reproducibility of its units would have to be checked by observations at a large number of randomly located sites.

When this work commenced *it was not even self evident that an acceptable compromise was attainable. This is a point much too frequently overlooked.* Many workers have developed techniques for drawing boundaries on air photographs: few have sampled the individual areas thus separated to verify their uniformity or to ascertain what fraction of each is correctly described by the map legend.

Geographic Regions

On first examination the literature on Geographic Regions suggests that the "regional approach" is the right method for resolving an area into recognizable and reproducible terrain units suitable for our purpose. Closer examination reveals that few of the protagonists of this approach have ever attempted to ascertain the extent to which the subdivision of an area into geographic regions increases their ability to make useful or usable statements about it. Indeed it is not clear that such regions are intended to provide vehicles for information—"a regional textbook can be comprehensive in its chosen field without an exhaustive (or exhausting) statement of the facts" (Henderson 1965).

Forster (1965) analysed all the available regional studies for one much studied area, to determine how many firm statements remained and how precisely expressed, when they had been purged of their literary flourishes. Much of the residue was trivial, very little was precise. Practically none was on topics, or of the precision necessary, to be useful in planning any kind of construction or military operation.

Land facets

In view of this it seemed necessary to develop a new terrain classification. We proposed the *Land Facet* as the basic unit for indexing information on terrain or on land resources generally.

A land facet is an area of simple landform. It has uniform rock, relief, soil and water regime; any variations must be easy to comprehend and describe. It should not be necessary to have to adjust the management practices of any moderately intensive land use (e.g. the construction of minor roads) to changes within the extent of a land facet. Land facets are usually of a size and intricacy that can be mapped from air photographs at scales between 1:10,000 and 1:60,000, and preferably 1:20,000–1:40,000.

Land facets are defined by verbal descriptions, and sections or block diagrams. Apart from adventitious contrasts in land use they show consistent air photograph expression. The natural vegetation of a land facet should be as uniform as its soils and water regime. While vegetation and land use are often too ephemeral for land facets to be defined on them, they may provide aids to recognition. Examples of land facet definitions are given in Reports 872 and 940.

Land facets can be mapped from air photographs with limited ground check (Report 945), though usually for some local or particular purpose only. Facet maps are one of the recognized outputs from a *Data Store* (see "specific local brief"

below): the terrain modules of the store are designed for this purpose. But the store is not intended to hold a comprehensive cover of facet maps.

For planning more intensive land use it may be convenient to identify parts of a land facet, recognizable on the air photographs but too small in extent or not sufficiently different in behaviour to be separated at the facet level. Such recognizable subdivisions are referred to as *elements*. The element nomenclature provides supplementary indexing criteria, but only for properties in which the individual elements differ from the land facet as a whole. *Variants* are occurrences of a particular land facet which differ in non-definitive attributes which may affect their suitability for some purposes. Variants may, but need not, be distinguishable on air photographs.

The definition of a land facet lists its variants and elements, to provide a supplementary terminology to the basic facet classification, useful for special purposes. The development of the supplementary terminology is shown in Reports 872 and 940.

Land systems

A large area contains many land facets, some of them not very easily distinguished. Furthermore many land facets cover too small an area to provide suitable vehicles for the generalized information required for the general or preliminary planning of an operation. Thus, it is convenient for some purposes if land facets which commonly occur together are grouped into larger terrain units.

The distinctness of different landscapes is a consequence of their characteristic pattern: their constituent units and the sense of their interrelationships both change at the boundary between one landscape and the next. So *Recurrent Landscape Patterns* (*RLP*) or *Land Systems* were defined as recurrent combinations of land facets (Reports 871, 872). Land systems are commonly of an extent and intricacy to be adequately mapped at scales between 1:¼M–1M.

Land systems are defined on their form, their constituent land facets, and the sense of their inter-relations, by means of block diagrams (Technical Note 6/66) and verbal description. Report 872 gives some examples. There should be a land system map for any area covered by the *Data Store*.

The land system map is sufficient key to generalized information indexed by land systems. But the user of the store must himself identify (see below: "*Data Store*"), the land facets about which he wants detailed information from the store. The land system map does not directly identify the land facet at any point of interest but it does indicate that the facet is either one of those on which the local land system is defined, or a specified inlier from an adjacent land system.

Even so the user of the system must be given sufficient information to identify its constituent land facets within the mapped limits of each land system (Report 940). This is a general principle, often overlooked. If detailed or local information is indexed or referred to only in terms of terrain units that are not mapped, then the anticipated users of the detailed information must be able to distinguish the unmapped reference units on the ground. Many published maps of soil associations or land systems do not provide sufficient guidance for the identification of their lower subdivisions (soil series or land units).

The terrain module for the *Data Store* was designed to meet this need. In its simplest form the module consists of a cardboard envelope (Fig. 1) of which the front face carries a block diagram and description of the land system, with notes on the environmental conditions of climate, rock and geomorphology under which it occurs. Figure 2 and Table 1 present the front of the terrain module for the Eldoret land system in Western Kenya (Report 1112). On the back of the envelope, its constituent facts are described in terms of landform, surficial materials and cover (i.e. vegetation or land use) (Table 2). Inside the envelope are air photographs annotated to emphasize the appearance of the land system and facets, and also ground photographs, sketches, facet maps of sample areas, and any other aids necessary to the identification of land facets within the limits of the mapped land system. Such aids are crucial. Reports 872, 955, 1024 present stages in the development of the terrain

module; the last two give examples. The module can be recorded on microfilm. Copies of the module can be multiplied from the microfilm copy in the Store.

Reports 871, 872, 945 present facet and land system maps of the Oxford region with comments on their preparation. Reports 959, 1112, 1113 present land system maps and land system—land facet classifications for Uganda, Western Kenya and

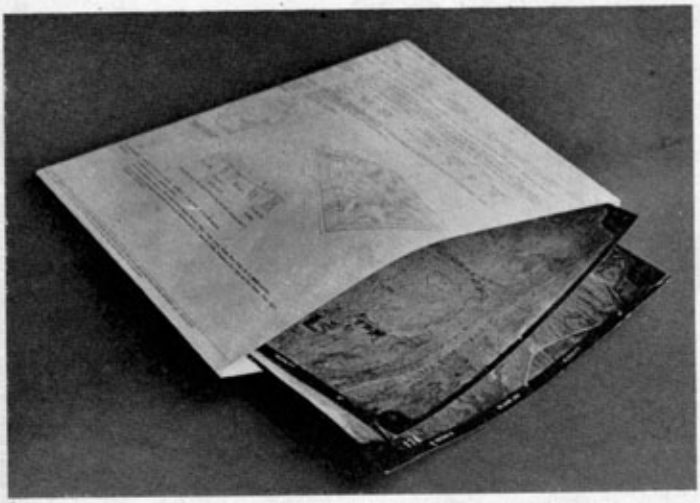

Fig. 1. A terrain module from the Data Store. Note the block diagram (as in Fig. 2) and the land system description (as in Table 1) on the front, and annotated air photographs with other data inside. Land facet descriptions (as in Table 2) are on the back.

Swaziland. Their legends represent the most ambitious attempts so far to convey the nature and appearance of unmapped reference units (in this case land facets) to the users of a *Data Store*. Report 1111 attempts a classification of the terrain of *all* hot deserts.

Other workers

Having developed the classification to the stage represented by Report 940 it was encouraging to discover that other groups had reached very similar positions, notably the Land Research and Soil Mechanics Divisions of CSIRO, and the Soil Conservation Authority of Victoria, all in Australia; the National Institute of Road Research in South Africa; the Terrain Evaluation Cell of the Indian Army; the Land Resources Division of ODA, and the Road Research Laboratory, in the UK.

General agreement on the kinds and magnitudes of the terrain classes that could be and were worth mapping or defining was encouraging. At least three of the groups working in this field had reached the same position independently.

While this intuitive accord on the classification to be developed was encouraging, there was then (1961–2) extremely little evidence to confirm that the classifications by various groups could do what was required of them.

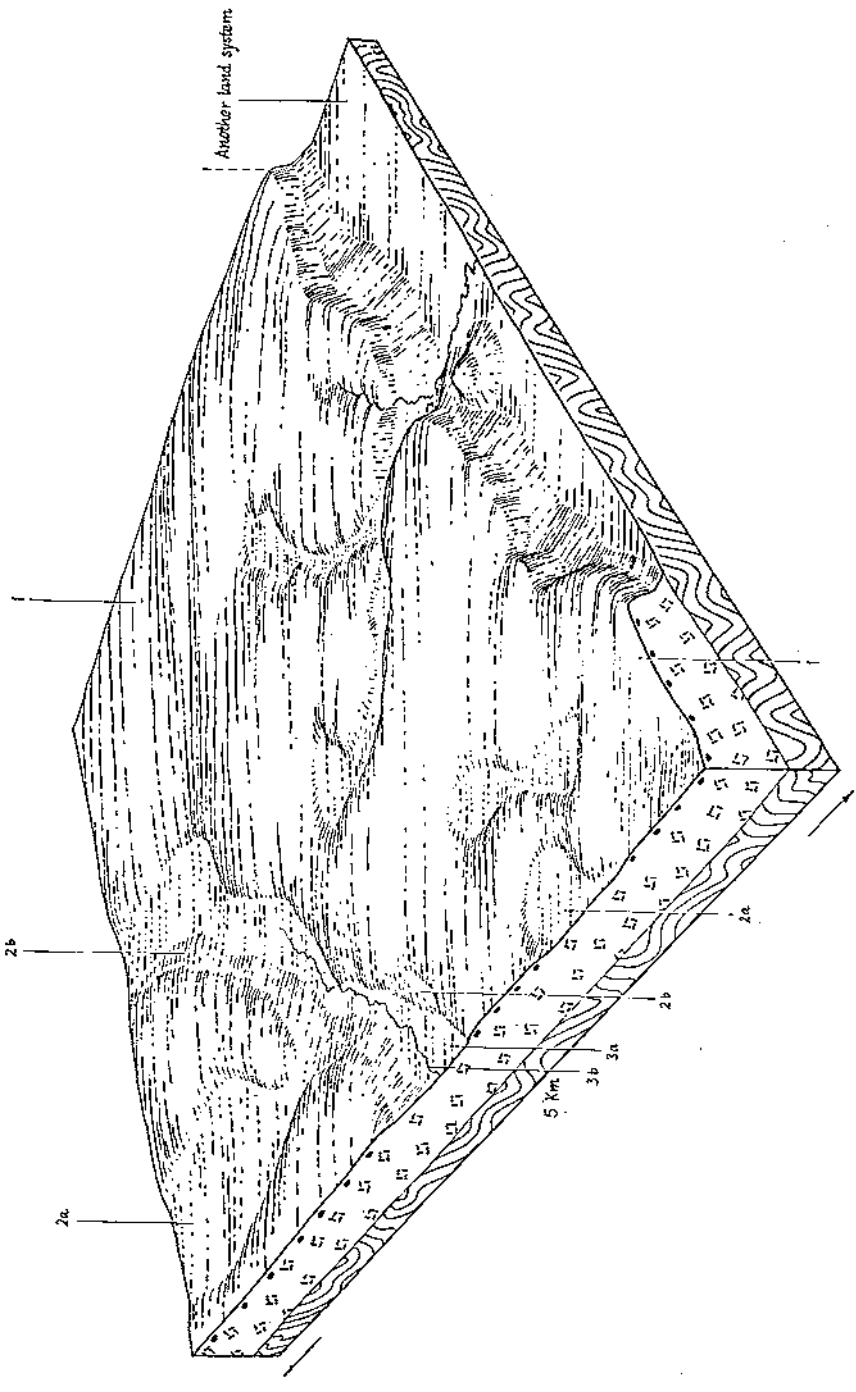

Fig. 2. Eldoret land system, Western Kenya (25 km²) with a small extent of Kitale land system in right front corner. Land facets are numbered as in Table 2. Geological section shows local laterite over phonolite (lava) over basement complex.

Eldoret Land System KE 51

CLIMATE:	Rainfall, 1000–1250 mm March–November
GEOLOGY:	Tertiary volcanics—Uasin Gishu phonolite lavas
LANDSCAPE:	Extensive almost level plateau with broad gentle depressions and infrequent narrow, weakly entrenched streams. The results of floods of phonolite from the East and South-east which buried a more or less level Miocene erosion surface. A prominant escarpment marks the limit of the lavas around the Northern and Western margins of the land system
SOIL:	Red to dark red friable clays with laterite horizon (Ferrallitic soils over ferruginous crust)
VEGETATION:	Open evergreen and *Acacia* evergreen (Eldoret plateau type) bushland or grassland
RELIEF:	2–3 m on plateau, 15 m on scarp
ALTITUDE:	1950–2300 m
Air photos:	15 KE: 6.12.55: f.6″: 26,000′: Nos. 136, 137 82D 461(1): 10.2.44: f.6″: 21,000′: Nos. 5031, 5032

Table 1. Description and Environment of the Eldoret land system; with Figure 1 this covers the front of the terrain module.

Co-ordination

Agreement on principles and practice was furthered by a field conference in North Australia in 1964 (CSIRO Soil Mechanics Section 1965). In the following year representatives of CSIRO Land Research Division, ODM Land Resources Division, National Institute for Road Research (South Africa) and the Oxford and Cambridge (*see below*) Research Groups set up a small working group to explore common ground. Report 940 records its conclusions.

One of the problems discussed was that of long range predictions about terrain in areas which have not or cannot be visited. It was accepted that predictions over long distances must be less precise, and the opportunities for error greater, than within the limits of one land system. Nevertheless there may be circumstances in which such predictions have to be attempted for lack of anything else. If so they will have to be based on information from the least dissimilar area of accessible terrain. This is of course the procedure followed by any expert called upon to make snap judgements about areas with which he is unfamiliar.

The working group proposed a framework of abstract land systems and abstract land facets to minimize the inevitable loss of precision in such a situation. Terrain units recognized and defined in accessible areas were to be called "local forms". The local form of a land facet remained the basic indexing criteria for terrain information. Comparable land systems formed under similar environmental controls in different theatres of interest are grouped into one *Abstract land system*. Comparable land facets in homologous positions in different local forms of one abstract land system form one *Abstract land facet*. The description of an abstract land system specifies its environmental controls as precisely as possible and lists its local forms.

An item in the *Data Store* would then be indexed on both its local form and its abstract, land facet and land system. To predict terrain conditions in an inaccessible

TABLE 2

Landforms	*Surficial Materials*	*Cover*
1. *Laterite plateau* Extensive level to gently sloping areas; locally undulating	Dark brown clay loam up to 15 cms over strong brown to reddish brown friable clay with iron and MnO_2 concretions. Massive laterite occurs at depths from 30–90 cms, but locally deeper where plateau is undulating	Open evergreen bushland with *Olea-Rhus* clumps or grassland
2. *Clay depressions*		
(a) Gentle broad flat bottomed depressions with sharp or diffuse concave margins	Greyish brown mottled clay loam to clay 15–30 cms deep over grey clay more than 170 cms deep	Wet evergreen grassland
(b) Moderately extensive low lying land along river margins, discontinuous; up to 300 m wide	Subject to seasonal flooding	
Both 2 (a) and (b) have frequent regularly spaced termitaria		
3. *Valley floors*		
(a) Broad, about 200–400 m wide, flat bottomed	Peat over mud. Permanently flooded	Wet evergreen grassland
(b) River channel, narrow 5–15 m sinuous	Seasonal to permanent flow	Nil
4. *Scarp* Short, steep, straight, weakly indented slope up to 15 m high on Northern and Western margins of land system and a few occurrences elsewhere	Mainly rock outcrop or boulders	*Dombeya* and *Heeria Combretum* savanna

Table 2. Land facets of the Eldoret land system; on the back of the terrain module.

and unknown area one would first ascertain the environmental controls. From these one would attempt to identify the abstract land systems present. The definitions and air photographs of the local forms of these would be matched with the air photographs of the inaccessible area. Predictions about the inaccessible area would be based on the stored information for whichever of the known local forms of the abstract land system present seemed most closely to match the unknown.

Currently CSIRO Land Research Division is attempting to collate the information available about a considerable number of rather similar land units (local form land facets) in North East Australia, by grouping them into abstract land facets (Gunn and Nix 1969).

FIELD TRIALS OF THE CLASSIFICATION PROPOSED

It was not certain that any classification could meet the opposing requirements of recognizability and reproducibility. So field trials, of the facet–land system classification proposed above, were organized.

Oxford trials

The test area near Oxford (4,000 km²) is a typical scarp-and-vale landscape just beyond the limit of the Pleistocene ice sheet. Pleistocene soil movement and post-Pleistocene modifications of a late-Pleistocene landscape have given rise to numerous unpredictable soil variations. Parts of the area have been under cultivation for 2,000 years.

Land facets (local form) were defined for the whole area. Their boundaries were picked out on air photographs and then about 10 per cent were checked on the ground. A map of twenty abstract facets, each represented by several local forms, was printed at a scale of 1: 63,360. Three abstract land systems, represented by one to four local forms, were mapped at a scale of 1: 600,000 (Reports 871, 872). About 2 per cent of the whole area could not be attributed to any of the classes defined. A subsidiary study confirmed that other workers could identify the land facets by means of the definitions provided.

A smaller area (1,000 km²) was selected within the area mapped. It contained at least two local forms of each of twelve abstract land facets, some of which were represented by more than one variant or element. Up to six test sites were randomly located within each facet or named subdivision to give 136 test sites in all. Soil profiles and plant communities were recorded at each site. Mechanical analyses and Atterberg limits were measured for each soil horizon. Multiple tensiometers and gypsum block resistance gauges were installed around each site, and thermistors at many sites, at 13 and 38 cms depth. Bore holes were sunk at all sites where the water table was expected to fluctuate to within 1·5 metres of the surface.

Soil water tension (at both depths), soil strength (as cone index measured with a penetrometer at five depths), soil temperature and water table (where possible) were measured at 7 to 14 day intervals throughout the eighteen months from June 1962 to November 1963. The schedule of measurements was devised to give the maximum number of simultaneous intra-unit comparisons. The logistics of the trial are described in Report 873.

Report 874 describes the statistical analysis of the data on soil water tension and cone index, and summarizes the results. Simultaneous variances were calculated for each facet local form, for every property measured for each of the two depths. The calculated variances were then pooled separately for winter and summer. Intra-unit coefficients of variation, calculated from the means and pooled variances, ranged from 2 to 18 per cent for soil water tension, and from 20 to 30 per cent for cone index. Intra-class correlations lay between ·5–·7. Different local forms of the same facet were compared by analyses of variance. Many were shown to differ significantly.

Report 877 describes further studies to ascertain how precise were the statements that could be made about the facet local forms as mapped. Measurements of Cone Index, soil mechanical analyses, Atterberg limits, soil moisture content, and chemical

analyses for soil fertility, were made at randomly chosen points or collected from other sources. Their variances within each abstract and local form facet were estimated and pooled as above. Enumeration surveys of hedgerow composition and type, land use, and gley morphology in the soil profile, were made at random sites within the facet local forms as mapped. Coefficients of variation of soil physical properties lay in the range 20 to 30 per cent. Intra-class correlations were in the range ·4–·7. Soil chemical properties were much more variable, with coefficients of variation up to 100 per cent. Plant species, hedgerow vegetation and land use were indeed shown to be significantly associated with the mapped terrain units, but the degree of association was low. Gley morphology was highly associated. Webster and Beckett (1964) concluded that the classification was not an adequate basis for useful predictions about available K or P in the soils, or of their $CaCO_3$ content, perhaps because these properties are sensitive to the idiosyncracies of individual farmers. The classification allowed more precise statements about the soil pH and organic matter content. The variability of chemical properties is known to be much lower under natural vegetation.

Thus the trials confirmed that local form land facets could be recognizable and comprehensive and yet possess coefficients of variations of not more than 20 to 30 per cent in their physical properties. While disuniformities of this order are not negligible, they are not so great that it is unreasonable to make preliminary plans for operations or construction on the assumption that the mean value of any attribute of a land facet is applicable over the whole of its occurrence. The uniformity is at least sufficient to guide the choice of areas for more detailed investigation (Report 1130), and to guide a rational distribution of sampling effort. In the absence of evidence to the contrary we can assume that any procedure of terrain evaluation which requires the extrapolation of point data, however detailed, by means of air photo interpretation, will give comparable results. Report 995 explores the use of the classification for locating MRT airstrips; Reports 1025 and 1187 examine its use for predicting soil moisture or soil strength.

This work has been summarized in Report 1123 and reviewed by Miller (1967).

Cambridge trials

On the strength of preliminary results from the Oxford trials and some paper studies by the geologists of the Army Emergency Reserve (Report 915) Perrin and Mitchell at Cambridge extended the trials to a complete climatic zone. It was planned to develop a terrain classification for the whole arid zone of the world from a review of published works and an organized sample of the available air photo cover. The classification was to be tested for completeness by a comprehensive stratified random sample of the air photo cover, and the uniformity of the terrain classes was to be tested in selected sample areas.

In the event, lack of material or language difficulties limited the study to hot deserts, and excluded Latin America, the Soviet Union and China. A comprehensive list of terrain units was compiled from the literature on the remaining hot deserts and a tentative classification was produced. A glossary of local geographic and hydrogeological terms was prepared (Report 1124). The comprehensiveness of the tentative classification was checked on a visit to the western United States and by examination of the air photo cover of other desert areas. Mitchell and Perrin (1966) have described the modified classification which resulted.

Much of the available air photography was at scales of 1 : 80,000 or even 1 : 100,000 so the facets defined were inevitably more generalized than those of the Oxford area and some units were defined as composite patterns of distinctly different elements too small or too intricately associated to be separated at the scale of 1 : 80,000 or 1 : 100,000.

Having demonstrated that the classification was comprehensive and yet contained a manageable number of units, the team selected test areas in Libya, the Trucial Oman, and on the Islands of Bahrain, Socotra and Abdul Kuri. Terrain units in the

test areas were mapped. Expeditions were mounted to make field measurements, and to collect soil and vegetation samples (Tech Note 9/66).

The analysis of the data is in Report 1111. The statistical treatment of the data is crude, but the results suggest that land facet local forms as recognized and mapped in the test areas, are sufficiently uniform to allow valid and useful generalizations or predictions about the few properties tested. The uniformity and distinctness of wider groupings, comparable to abstract land facets, may fall below acceptable levels.

Other studies

The next state in the development and testing of a *Data Store* by the Oxford team was to have been the establishment of small pilot data stores of information on road construction and engineering resources for several overseas territories currently engaged on road expansion. It was intended to base small working stores upon the land system maps and terrain descriptions of Uganda and Western Kenya (Reports 959, 1112), and to offer them for local user trials. These studies were terminated before the necessary data could be collected. The classifications and maps remain available, and are currently being used by the Tropical Section of Road Research Laboratory.

THE DATA STORE

Report 940 outlined the three functional parts of a *Data Store*. A *Main Store* would contain information on terrain, stored on microfilm, cards or computer tape, according to the size of the store. The information would be indexed according to its content and the abstract and local form land system and land facet which it represented. A second or *Terrain Store* would contain terrain modules to describe land system and land facet local forms, and any information necessary to enable the user of the main store to identify the land facet at any site within a mapped land system. The terrain store would contain land system maps of all areas of interest. It would be backed up by a conventional air photograph library. Finally an *Abstract Store* would contain descriptions of abstract land systems and land facets, indexed according to their environmental controls, to aid the matching of terrain in hitherto unworked areas to known local form land systems and land facets. This too required an air photograph library.

Subsequently Leibowitz (1966) improved the procedures whereby one air photo interpreter might convey to another his means for identifying land facets. Margaret de Cuanalo (1960) drew up lists of descriptors for the environmental controls of abstract land systems.

A working *Data Store* for the terrain around Oxford was set up on microfilm with the aid of the Recordak automatic selection and print-out system, and demonstrated to an audience of engineers.

Meanwhile McNeil at MEXE developed the hard- and soft-ware of a complete *data store* (Tech Note 5/67). It proved convenient to combine the main, terrain and abstract stores into one "*fast store*" of microfilm. A "*slow store*" of unabstracted data, books etc. cross-referenced to items in the fast store, serves as a repository for data too diffuse or bulky to be included in the fast store, but still potentially useful. The complete store is backed by land system maps for all areas covered and a store of air photographs.

Items in the fast store are indexed by serial number. Data in the fast store may be fact or appraisal, raw or summarized. As information on any particular land system or land facet accumulates, summaries can be prepared and included in the fast store. The original data may then be relegated to the slow store.

The store has an index of centre-punched (feature or "peekaboo") cards, one each for every possible descriptor (of content, source, format, land system, land facet, etc). McNeil developed lists of descriptors. With the aid of a specially developed quick-sorting machine the centre-punched cards can rapidly produce the serial number of every item in the fast store which corresponds to a particular set of specified descriptors.

Logically the retrieval of data from the store is simple (Tech Note 5/67: Report 1130).

1. *Question put to store by user:* What data is held about X (specified terrain property) at Y (specified location)?
2. *Subsidiary question, put by store to user:* What is the terrain class at Y?

The subsidiary question must be resolved before the main question can be answered.

3. *Action by user*

(*a*) Consult a land facet map which covers Y; identify the land facet F directly: if in doubt request from the data store the terrain module of the land facet and land system tentatively identified and compare them with the air photo and/or ground appearance of Y., or

(*b*) Consult a land system map which covers Y; identify the land system; request its terrain module from the data store together with air photo cover of the area round Y; with these identify the land facet F at Y (or make a map of land facets round Y)., or

(*c*) Ascertain or guess the environmental controls round Y; with the index of centre-punched cards produce the serial numbers of all abstract land systems already recorded from similar environments; request their terrain modules from the fast store together with air photo cover of the region round Y; on quick examination reject obviously inappropriate abstract land systems; request the terrain modules of local form land systems of the abstract land systems not rejected; compare the local form land systems with the air photo and/or ground appearance of the terrain at Y; make a tentative identification of F the land facet at Y. (It may be necessary to list several possibilities F_1, F_2, F_3.)

4. *Original question to store by user now rephrased:* What data is held about X on land facet F (or F_1, F_2, F_3, etc)?

With the index of centre-punched cards produce the serial numbers of all items in the data store relating to X and F (or to X and F_1, F_2, etc); in the latter case the range of data produced at least indicates the degree of uncertainty involved in a prediction about an unknown area. Procedure (*b*) is the norm; (*a*) applies to much-worked areas and (*c*) to areas from which little data is so far available. The further the unknown area is separated from the areas where land facets F_1, F_2, etc have been recorded the greater is the chance of error.

The items of information, or terrain modules, retrieved from the fast store are assessed on a viewing screen, and then rejected, copied onto microfilm, or printed out as photographs. They may lead to fuller data in the slow store.

The *Data Store* may be required to provide answers to specific questions about X at Y (as above) or about X over a whole area. Alternatively it may be required to provide minor (or "off-shoot") *Data Stores* for the "lesser experts" already referred to, e.g. the site engineer on a construction project, or the intelligence officer of a task force or strategic reserve. An off-shoot store will consist of land system or land facet maps, and copies of all terrain modules, for the area it covers, with copies of any relevant stored data. The data provided for an off-shoot store may be on microfilm or on edge-punched cards, depending on the size of the store. The "off-shoot" store may consist of no more than a desk-top card index. The descriptors employed will conform to those of the parent store so that off-shoot and central stores are fully compatible. It is extremely important that a parent *Data Store* shall have a capacity for generating *ad hoc* off-shoot stores. It encourages the use of existing information by groups of users who too often do not, and off-shoot stores in the field are important sources of new data for the parent store.

Output from the Data Store

There may be (Tech Note 2/67, 5/67: Reports 996, 1053, 1130) several kinds of output from the same body of material in the parent store. The *National Brief* is the most generalized. It refers to a large area or to the whole of a national territory. It

provides a regional breakdown, and generalized descriptions of every region. It is usually in the form of a book or memoir and contains a land system map, copies of the terrain modules for every land system and land facet present with all the aids necessary to distinguish the land facets within each land system, and brief comments on the geology, soils, landform and vegetation of each land system and land facet. Reports 959, 1112, 1113 illustrate these for Uganda, West Kenya and Swaziland. The National Brief provides information for general planning and for selecting areas for more detailed study. It is also a key to detailed information about the territory held in the *Data Store*. It can be produced at short notice for any area of which the terrain modules are already in the data store.

A *General Terrain Brief* covers a more limited area, but contains more detailed information. The general terrain brief is a folder of standard format which contains: a list of the topographic maps and air photo cover available for the area specified; land system maps to cover the area; terrain modules of the land systems within the area and all necessary aids to the identification of the land facets; and information on a specified range of attributes for all the land facets present.

The general terrain brief provides sufficient information for a preliminary choice of sites for construction or military deployment. It also provides the key to further data in the store. Reports 931, 940 illustrate some early examples. Alternatively, the same material can be provided as the nucleus of an off-shoot data store, particularly if the information on terrain attributes is offered as microfilm or on edge-punched cards. In this case the user is also equipped with standard proformas for collecting extra information, and lists of descriptors for indexing it. The holder of an off-shoot store is in a position to produce specific local terrain briefs (*as below*).

A *Specific Terrain Brief* covers a comparable area but for a more specific purpose. It is a standard folder containing land system maps, terrain modules, and all available information (summarized or raw) on one or more specified terrain attributes. It can be produced from the parent store or from an off-shoot store (e.g. Report 931).

A *Specific Local Terrain Brief* is intended for a specific project in a specified area. It can be produced from the main or parent *Data Store* but is usually produced from a local off-shoot *data store* by a "lesser" (see above) or local expert to meet specific and current problems in land planning or construction. It usually presents the available data in the form of a facet map with a special purpose legend (e.g. Misc Paper 1/67).

The above are all reviewed, with examples, in Report 1130.

Other groups

During the same period the National Institute for Road Research in South Africa has developed a working National Data Bank for Records (NIRR, 1971). CSIRO Division of Soil Mechanics in Australia developed the very similar PUCE system, but this has had little practical use. (Aitchison and Grant 1967; Grant and Lodwick 1968.)

CONCLUSION

The research initiated by MEXE into Terrain Evaluation for large areas is now completed.

The study attempted to isolate those parts of a terrain evaluation system which ought to be subjected to experimental verification, to define the criteria on which they should be assessed, and then to carry out the necessary field checks. Within the limitations imposed by the original specifications the classification and *data store* developed appear to provide an adequate basis for terrain evaluation. The system is being used in the field of civil engineering.

In recent years several other groups have developed similar procedures or systems for terrain assessment over large areas. It is our impression that the systems for which the greatest claims have been made are also those which have undergone the smallest amount of experimental verification.

Note by Editor: A formal presentation on the theme of this article will be presented at the Royal Geographical Society on 14 February 1972.

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REFERENCES

MEXE (MVEE) PUBLICATIONS

Report 871 The Storage and Collation of Information on Terrain—An Interim Report 1962
Report 872 Field Trials of a Terrain Classification System—Units and Principles 1965
Report 873 Field Trials of a Terrain Classification System—Organization and Methods 1965
Report 874 Field Trials of a Terrain Classification System—Statistical Procedures 1965
Report 877 Minor Statistical Studies on Terrain Evaluation 1965
Report 915 The Classification of Terrain Intelligence: Report of the Combined Pool (AER) 1960–4 1965
Report 931 A Terrain Brief—an example of the output from a data store 1965
Report 940 Report of the Working Group on Land Classification and Data Storage 1966
Report 945 A Classification System for Terrain—A Physiographic (facet) map of the Oxford area 1966
Report 955 A Classification System for Terrain: Description of a Land System 1965
Report 959 Uganda Land Systems 1970
Report 995 Field Trials of a Terrain Classification System—Reconnaissance of Air Field Sites 1969
Report 996 Terrain Dossiers—examples of the output from data stores 1966
Report 1024 A Classification System for Terrain—Two Land Systems of Swaziland 1967
Report 1025 The Prediction of Soil Water Tension from Weather Data 1970
Report 1053 Terrain Evaluation—Proceedings of a Symposium 1967
Report 1111 An appraisal of physiographic units for predicting site conditions in arid areas 1972
Report 1112 Land Systems of Western Kenya 1972
Report 1113 Land Systems of Swaziland 1972
Report 1123 A Review of Studies of Terrain Evaluation by the Oxford–MEXE–Cambridge Group 1969
Report 1124 Glossary of Local Physiographic Terms about World Hot Deserts 1971
Report 1130 The output from a terrain data store 1972
Report 1187 Prediction of Soil Strength 1970
Tech. Note 6/66 Block Diagrams of Landscape for Terrain Evaluation 1968
Tech. Note 9/66 The Quantitative Assessment of Terrain Conditions using an Instrumented Vehicle 1966
Tech. Note 5/67 Terrain Evaluation—Data Storage 1967
Misc. Paper TE/1/67 A Do-It-Yourself Kit for Terrain Evaluation 1967
Misc. Paper TE/2/67 Terrain Evaluation: Proceedings of a meeting held at MEXE, July 1967 1967

Other References

G. D. Aichison and K. Grant
The PUCE programme of terrain description, evaluation and interpretation for engineering purposes. Proc. 4th Reg. Conf. Africa. Soil Mech. and Foundation Engng. *1*, 1, 1967.

CSIRO Soil Mechanics Section,
Mobile Field Conference on Terrain Evaluation, CSIRO, Aust., 1965.

M. de Cuanalo,
Indexing attributes for land systems (unpublished report, Oxford), 1966.

J. Forster,
The association between geography and human occupance, (unpublished) 1965.

K. Grant and G. D. Lodwick,
Storage and retrieval of information in a terrain classification system, Proc. 4th Conf. Aust. Road., Board, 1968.

R. H. Gunn and H. A. Nix,
Land Unit Correlation in East Central Queensland, in: Ann. Rep. Land Div. 1967–8, CSIRO, Aust. 1969.

H. J. R. Henderson,
Review of "A geography of sub-Saharan Africa", Geogrl. J., *131*, 401, 1965.

T. H. Leibowitz,
Techniques required to build up a library of annotated aerial photographs U.S. Army research Contract DA-91-591-EUC 3912 (unpublished). 1966.

T. G. Miller,
Recent studies in military geography, Geogrl. J. *133*, 354, 1967.

C. W. Mitchell and R. M. S. Perrin,
The subdivision of hot deserts of the world into physiographic units, Int. Arch. Photogramm. *16*, 89, 1966.

National Institute of Road Research (South Africa),
The production of Soil Engineering Maps for Roads and the Storage of Materials Data. Technical Recommendations for Highways, No. 2, 1971.

R. Webster and P. H. T. Beckett,
A study of the agronomic value of soil maps interpreted from air photography, Trans. 4th Int. Cong. Soil Sci. *5*, 795, 1964.

Engineer Intelligence

MAJOR J. G. GISBY, MInstMC, LBCS, RE (RTD)
MR R. S. MORGAN, MA, MBCS

PART ONE

"... this very necessary adjunct to engineering planning and operation".
History of the Corps of Royal Engineers Vol. VII

INTRODUCTION

ENGINEER Intelligence is one of the many minor activities of the Corps to which much thought and work is given by those who, in the course of a posting have come into contact with it. But perhaps it lacks a consistent over-all policy and organization such that useful and steady progress can be made to enhance its value. It is true that the importance of adequate information is recognized, but the many means by which the information can be obtained, and the very definition of "adequate" are not generally known. There is a shortage of experience and teaching in the subject which has led to an acceptance of a lower standard of product than could be made available. There is no formal training or reference to the subject on any officers' courses, although a few periods were held some years ago. "Time spent on reconnaissance . . . etc." is the basis of a technique whereby successive generations of troop commanders have measured and plotted the same bridges, obstacles, etc, in BAOR. Where has all this material gone and is it not wasted if someone else has to do the work again? Could it be relied on in time of crisis, or would someone have to go and have a look for himself?

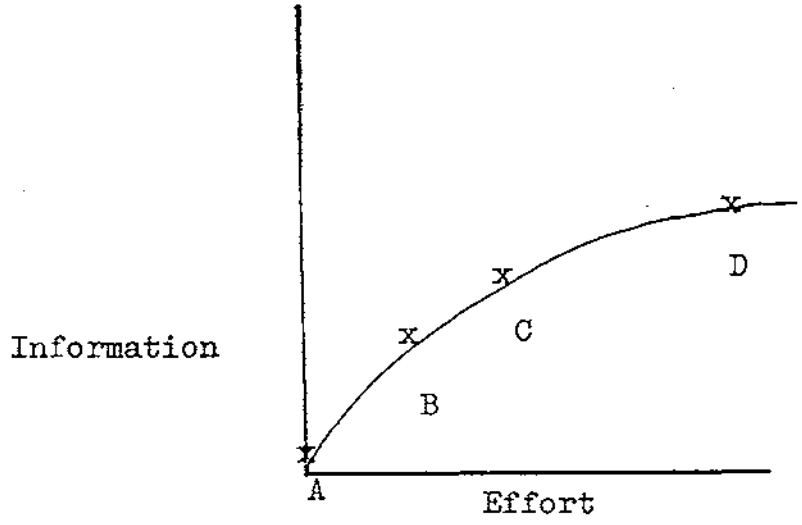
It is interesting to note that no reference was made in the RE Demonstration this year to the need for, and the means whereby, planning data is obtained before operations start. Not many civil engineers ignore this problem and in a Corps which has fathered, or been concerned with, so many new techniques which have grown to be Arms and Services in their own right, it is curious that there is no general effort to deal with facts, whether topographical, technical, or tactical. The era of sophisticated information processing has not yet stimulated any of that original enterprising spirit which the Army has come to expect of Sappers.

This article examines some aspects of the subject and then goes on to describe a working system which has been developed to meet the practical limitations for busy military staff who do not wish to use computers or even understand them, but who would value the support they could provide if it is in a convenient form.

GENERAL

The difficulty of proving the cost-effectiveness of information is one of the main reasons why the effort involved in its procurement and processing are limited, and why such work is always one of the earliest victims of economies. There is no formula for proving that money is well spent in such work because results tend to be intangible. It was Mr Paul Getty who asserted that the only thing worth paying for is information, and that given enough good information then the decision-making is a safe and obvious course of action. His line of thought is not easy to refute and does not lack proof of its effectiveness. The difficulty lies in deciding how much of a limited total effort should be allocated. This effort is absorbed not only in many processing organizations but in countless hours spent in getting material or writing reports, etc. These rarely seem to be available or used by anyone else, so that they in turn have to start from scratch.

The graph illustrates a convenient way of illustrating the problem. Neither axis is dimensioned since suitable units do not exist. At point A no effort is made and so no information is available, while at point D increasing effort produces relatively



little extra material and is not economical. It is points B and C that are worth some thought. B represents the position of an information processing system that has "just grown" and been subject to the effects of external limitations of manpower and resources. It is not a position based on the information required but on the manpower and money available, and while this situation is reasonable it has some dangers. It is worth examining the expected benefits and effort required to reach position C. An information system is concerned with the raw material for decision making which is the task of any manager, particularly a technical and military executive. Ideally B and C should coincide as a result of a sensible analysis and balance of the information requirements and the resources available.

What is involved in reaching C? Firstly and obviously a statement of the information requirement. Criticisms are often made about the quality and quantity of engineer intelligence but these strictures lack point because there is not a generally accepted specification of the subject or of the detail which is necessary and reasonable to expect. A questionnaire was sent by one of the authors to units in the Strategic Reserve in 1964 and a fair summary of the replies, which could form a basis of the subject, is at Appendix A.

Secondly how is the accepted system of collection, collation, evaluation and dissemination to be constructed and what resources will be required? Resources may include not only manpower and money but new techniques and developments. The well proven and logical military information handling process is much better than most, but is capable of improvement in detail.

THE INTELLIGENCE SYSTEM

It is worth establishing that the aim of any such system is simply to provide a user with material from which he can comprehend a problem. What he then does in an executive role is a quite separate function. It follows that he should be given the best material and the time-honoured methods of redrafting, writing digests and generally handling the original only tends to eliminate data, introduce errors and produce results which carry the prejudices and insensitivity of middlemen authors.

Collection

In general there is no shortage of material. The problem lies in locating it and in

finding time to retrieve, read and comprehend that which is strictly relevant. The material does not consist only of text, but includes maps, photographs, equipment, video and sound tapes and personal experience, eg officers returning from secondments, which should all be included in the collection plan. How many units going on "bush fire" operations in the sixties had the benefit of a briefing from someone who had actually been to the area concerned? There is also a requirement to be aware when no information on a subject is available, which may be due to a poor collection plan or bad sources.

Collation

For far too long Electronic Data Processing has been regarded as the panacea for information retrieval problems. The time is at last coming when people will no longer credit the computer with the facilities of a super-brain. The following letter written by Professor Ritchie Calder to *The Times* as long ago as 1966 well illustrates what should be evident to everyone today:

"DANGEROUS WAR GAMES

From Professor Ritchie Calder

Sir,—To your Washington Correspondent's salutary article (May 4), 'War Games endanger American foreign policy', may I add the (apocryphal) 'McNamara Equation':

$$\frac{3{\cdot}3\times10^{5}\mathrm{Dp}}{53\,\mathrm{R}\times c^{2}}=22\times10^{3}\,\mathrm{GI}+\mathrm{kr}$$

Students in American colleges used to find this amusing when I explained what it meant: 3,300,000 Dominican people divided by 53 communists (multiplied by the square of the speed of light with which they got there) equals 22,000 U.S. troops with their K rations. Funny? Not really. When a State Department spokesman was asked (sarcastically) why it was necessary to send 22,000 troops to deal with 53 communists his reply was: 'That is the answer the computer came up with.'

Or consider the Secretary of Defence's regular performance. He appears on television, or before Congress committees, and says soberly and with the backing of the Pentagon computers, that 150,000 Viet Cong against 500,000 Vietnamese Government troops plus 230,000 American combat troops plus strategical bombing from Guam plus the US Seventh Fleet is an 'unacceptable disparity'. By numerical prestidigitation, he leaves the impression that it is the other way round.

At a teach-in, a social scientist from the University of Michigan was explaining how he had lived and worked among the Vietnamese peasantry and what they had told him, and throughout he was interrupted by a man from the Rand Corporation, who kept on saying: 'That is wrong. That's against our intelligence. The computer says . . .'

This question of computerized intelligence, I feel, is at the root of much of the danger your Correspondent was stressing. Anyone who has had experience of intelligence work knows how extremely cautious one must be in screening human sources and evaluating not only information but the circumstances which produce it. Feeding intelligence into a computer, on the scale that it is done in the United States, is like feeding vegetables and scraps into a kitchen blender and producing a puree and knowing that it is the more acceptable when it is flavoured with wishful thinking (*eg* The Bay of Pigs).

I am all for the computers and the mathematical models—strictly in their place. The fact-men and the fact-machines, however, are taking over. 'Facts' are masquerading as judgments. Policy-making is becoming like the 'True? or False?' (tick-off) sheets which substitute for examination papers in many American colleges.

And 'true' is vested with computer infallibility. It is guaranteed against human error. When a computer says 'A salvo of intercontinental ballistic missiles is

approaching' it cannot be a flock of Canadian geese. And the human button-pusher becomes a built-in part of the circuit. He cannot say 'Are you sure they aren't geese?'

Yours, &c.,

RITCHIE CALDER, University of Edinburgh, 1 Randolph Place, Edinburgh 3."

Any data processing system is simply an extension of a human memory and not a replacement for his processing, analytical and comprehension facilities. A computer has many severe limitations but it can provide a reliable, rapid memory and effective, simple clerical "housekeeping" functions, thus allowing the human user to conserve his time and energy for more important matters.

Evaluation

The same piece of data has different significance for different users and at different times. A petrol forecourt attendant noted that if he said a customer's car sump was half full he was told to leave it, but if he said it was half empty he was told to fill it. It is the user, by reason of his status as a manager, who should decide what he wants and of what significance the material is to him. In the case where an officer is required to prepare a briefing for the commander he is still an executive deciding what is required, and his effectiveness will be seen from the result. It would be ideal if the commander had time to do this work himself.

Dissemination

Any system which cannot provide either the material, or convenient access to it, is a failure and basically ill-designed. It is far better to spend money and effort on the information that is available so that it can be retrieved than to continue to collect material, the significance, or even the relevance of which, cannot be ascertained by the potential prospective user.

In the early sixties one of the authors was told by his CRE to prepare a brief for him on a small remote district of a certain colony. The area was to be the setting for the Divisional Winter Study Period and the engineer task was to prepare an airstrip near a particular village. Traditional sources of material proved quite insufficient to the task of providing the detail needed for planning, and recourse was made to other libraries, etc. Eventually, and quite by chance, a photograph was found in a United Nations Report on the country concerned which showed, not only the village but a large grass cutter working to a centre line for an actual airstrip near by.

A copy of the unclassified report was obtained and a skilled photographer produced an excellent slide which the CRE was able to use, pointing out, with appropriate modesty, that while the staff were still planning, his chaps had already started the job! A point of more serious interest was that until that photograph was available it was not realized that heavy duty grass cutters would be as necessary as any earth moving plant. Any retired missionary could have told us had we known where to find one and ask him. The consequences of lack of such elementary information are surely too important to rely on such mere chance.

It can be seen that material is plentiful and sources varied and that effort spent in processing it by traditional methods may be misspent since the user should, as far as possible, have access to the original material. Second-hand reports are not "best evidence" in the legal sense.

Having found what he wants, the user must be able to reduce it if necessary to manageable proportions in terms of the time and effort he has available and then comprehend it. At this point the system's responsibility ceases. The second part of this article describes a simple but effective computer-based system which can provide considerable practical support for this purpose.

PART TWO

". . . if an adequate end-product is to be provided, all available data on a given subject must at some point be assembled in one place and in one mind."

Major-General Sir Kenneth Strong
Men of Intelligence, page 153.

INTRODUCTION

The storing, retrieving, cross-referencing, indexing and general manipulation of data are simple logical functions which at first sight would seem to be very appropriate computer applications. If they could be done by such means then the man hours saved could be usefully employed on tasks for which such machines would never be suitable—searching for more material, evaluation, etc. But there are several practical reasons why this approach is not generally sensible. The sheer costs of data preparation, the very restrictive searches that can be carried out, the difficulty that arises if the information is intangible on a magnetic tape and the machine fails, and the unfamiliarity of most potential users with the input routines of a computer are among the most important. However, there are techniques which eliminate or avoid many of these problems and allow the computer to provide valuable support without inconvenience or loss of control by the user.

It is only the important words of the text which need to be encoded for subsequent processing. Furthermore these "descriptors" can be applied to non-text material such as equipment, sound recordings and other sources, and all types of information can then be included in one store for subsequent reference. The descriptors themselves are important for they provide the indexing against which searches will be made. Advantage can be taken of an important fact in this respect, as explained below.

Any specialists, having the same training and background will use similar descriptors to describe a subject. Indeed they will look for the same detail even though the subject matter may appear, superficially, to be about something different. The significance of the detail will vary with different users, times and circumstances, etc, but basically any group of trained individuals using the same material in the same circumstances will work on the same "jargon". For instance an engineer officer will have the same basic enquiry about a bridge, water source or power supply as his contemporaries. If he is entering information into an intelligence library or data bank he will use the same headings as if he was searching that library for retrieval purposes. If he did not he would not be well trained.

BASIC SYSTEM

The computer system to support an information retrieval and storage requirement, operating on the principle of descriptors and utilizing the trained approach of the potential users in this way need only be very simple. Its function would be, at its most elementary, to "read" the important words concerning varied items of information to be held in the store or library, match them against any enquiry by a searcher who wishes to establish what is available, and then list the name, location, type, etc, of the material that is known to be available to meet that particular enquiry.

The basic system is as simple as the description above indicates. However, several refinements can be added without causing undue complication, increasing cost or delaying responses. A form of security check can be applied to searchers by use of personal code checks; a selective dissemination service can be provided so that certain users can be informed if an item relevant to their search profile is entered by someone else. This facility can be extended to cover unit locations or areas of interest. If a user finds that his enquiry results in a mass of references then he can filter them by inserting a date or other form of restriction, *ie* "nothing older than July 1971" etc.

INPUT AND OUTPUT

Figures 1 and 2 show the input and output formats in use at present for the system which has been devised on the lines explained above. The proven software has been written by International Data Highways Limited and is used on a remote access system in their Birmingham offices using machines situated in London. The routines, as shown by the detail at Fig 3, are written to help an intending user either to browse, if he is not sure what to look for, or to identify as closely as he thinks necessary what information material is available for his particular purpose.

It must be emphasized that the system is designed only to indicate what material is available and where it is. It does not attempt to reproduce data in bulk, or to evaluate it. Its sole purpose is to provide a convenient means of identifying and retrieving those elements of data which will allow a user to decide whether he has the time, energy or facilities to look at the material in greater detail. If he has he can then look at the original material, not a digest of it from someone else.

INPUT CONTROL DATA AND DESCRIPTORS

TITLE	ORIGINATOR
RELIABILITY/QUALITY Very Good/Good/Fair/Poor/Unknown	DATE RECEIVED / /
NATURE OF MATERIAL Text/Photograph/Map/Sound Recording/Film/Other	DATE OF MATERIAL / /
LOCATION HELD	SECURITY CLASSIFICATION
REMARKS	MATERIAL ANALYSED BY

DESCRIPTORS

Country	*Main Headings*	*Sub-headings*
	Physical	Terrain. Geology, Drainage, Vegetation. Land Use. Settlements. Climate.
	Communications	Air Landing Facilities (Including Helicopter Pads). Roads and Tracks. Road Bridges. Railways. Waterways. Ports and Coastal Access. Telecommunications.
	Resources	Public and Commercial Utilities. Water. Civil Engineer Resources. Military Engineer Resources. Petrol, Oil storage and installations.
	Combat Intelligence	Equipment and Techniques. Orbats. Defences. Nuclear Effects.
	Personalities	Activities. Personal Details.
	Politics	Parties. History. Constitution. Pressure Groups.
OTHER DESCRIPTORS		(Proper Names, Collective Terms, Slang Words, etc.)

Figure 1

MODISD S.D.I. SERVICE DATE 21/09/71

NAME: COLONEL SNOOKS

LOCATION: MIN. OF DEFENCE,
WHITEHALL,
LONDON S.W.1.

DESCRIPTORS: COVENTRY, RAIL.

REFERENCE TITLE	ORIGIN 'OR	R E L	REC'ED	DATE OF REF'CE	N A T	LOCATION OF REFERENCE	PROCESSOR
RAILWAY TIMETABLE 1971	KKK	V	260471	180471	T	CENTRAL LIBRARY	661X HBM

MODISD S.D.I. SERVICE DATE 21/09/71

NAME: MAJOR TIPPET

LOCATION: ROYAL REGIMENT OF WALES,
MAINDY BARRACKS,
CARDIFF.

DESCRIPTORS: BIRMINGHAM, G-SQUAD.

REFERENCE TITLE	ORIGIN 'OR	R E L	REC'ED	DATE OF REF'CE	N A T	LOCATION OF REFERENCE	PROCESSOR
S.S. H.Q. SHELDON	BCL	U	150771	210441	O	SIR A. B. WHITE	MOD(7) TNT
PROJECT Z—NORTHFIELD	SIT	V	220771	150771	S	SOUND LIBRARY	35/XB LIT

Figure 2

LIMITATIONS

It is well realized that this system is limited, but it is felt that at this stage in the development of information retrieval systems this is a positive advantage. It has been kept as simple as possible so that people will use it and not be frightened or exasperated by it and by inflexible ponderous rules. There is no reason however, why it cannot be developed into a more sophisticated tool when experience has been gained and confidence built up. Of particular interest to military users must be the work on automated cartography being done by Bickmore and others at Oxford. Before much progress could be made in improving the facilities provided by this or similar systems, however, it would be necessary to do some basic analysis of the nature, extent, requirements and value of Engineer Intelligence.

M.O.D.I.S.D.
Test System only

RUNNING INSTRUCTIONS

Start Up

1. Input GO

Security Number

2. When asked please input your Identity Number

Search Descriptors

3. When asked please input your first search descriptor
4. At this pause the forms of input are given under "SEARCH DESCRIPTORS" on the reference card
5. Continue to input, amend, or investigate search descriptors until they are satisfactory
6. When you wish to "SEARCH" on the current search descriptors,

Input *SEARCH or
*S

Search

The search will proceed automatically
Any overriding reference messages will now be printed
The number of retrieved items will now be printed

Printout

7. When asked to specify printout please input one of the forms of input given under "SPECIFY PRINTOUT" on the reference card
8. If there are any more items to be printed, you have the option of printing them:
   Input Y or YES prints rest of items
   Input N or NO does not print rest of items
9. The program will then terminate

To "SEARCH" again, follow steps 1-9

Figure 3

MILITARY ENGINEER INTELLIGENCE
Breakdown of Subjects and Detail Required

SUBJECT HEADING—PHYSICAL

Detail Heading	Detail
TERRAIN	Nature and locations of prominent features. Description of relief. Nature of ground surface. Restrictions to cross country movement by vehicle or on foot.
GEOLOGY (incl. soils)	Location, quality and quantity of usable materials. Water bearing strata and water tables. Digging and related problems. Mechanical and chemical data of soils.
DRAINAGE	Flooding history. System, width, depth, high and low water levels and velocity of rivers. Height and nature of banks. Location of intermittent lakes and marshes. Artificial drainage.
VEGETATION	Types, density, height, distribution, camouflage.
LAND USE	Nature and extent of cultivation. Irrigation.
SETTLEMENTS	Distribution and types.
CLIMATE	Annual rainfall and monthly distribution. Temperature ranges. Humidity. Snow and frost distribution.

Appendix A

SUBJECT HEADING—COMMUNICATIONS

Detail Heading	Detail
AIR LANDING FACILITIES (including HELICOPTER PADS)	Location and Elevation of existing and possible sites. Runways: No., length, width, nature of surface, capacity measured by LCN/CBR or known ac usage. Possibilities for lengthening and widening. Existing water, electricity and accommodation facilities. Fuel storage. Access by road. Maintenance equipment and materials.
ROADS AND TRACKS	Location and length, Estimated capacity by load and vehicles per day. Construction, surface and condition. Points of engineer interest—severe bonds, gradients, bridges, fords and ferries (above 30 ft gaps) with locations and size. Maintenance, equipment and materials. Effects of weather. Current and future developments.
ROAD BRIDGES	Locations, type, load cl, spans, gap width, nature and detours.
RAILWAYS	System and organization. Locomotives and rolling stock. Location and capacity of stations, marshalling yards and workshops. Loading and structure gauges. Fuel, water and electricity supplies. Details of track: gauge, gradients, curvatures, lengths of routes, rail size and fastenings, ballast, axle loads. Distance between block posts or passing loops. Location, construction and span of bridges.
WATERWAYS	General description of system. Organization. Types and capacity of craft and repair facilities. Waterways: location and length, navigable periods, depth, width, current, differences in WL, riverain, bridge clearance, location of locks and dams.

Appendix A— *cont.*

PORTS AND COASTAL ACCESS	*Ports and Landing Places.* Location and function. Military capacity and annual civil tonnage. Weather and tidal data. Limiting lengths and draughts. Harbour craft. Labour. Cargo handling equipment. Stacking and warehouse capacity. Power supplies and fuel storage. Quayage and Hards: location, construction-lengths, widths, depth at high and low water, height above water level. Exits. *Beaches.* Location, dimensions, gradients, beach surface, tracking needs, exits, hinterland.
TELECOMMUNICATIONS	Telegraph and telephone facilities. Radio nets. Communications of commercial firms.

SUBJECT HEADING—RESOURCES

Detail Heading	Detail
PUBLIC AND COMMERCIAL UTILITIES	*Electricity.* Personalities and control authorities, staff and labour, plant—location, types of prime mover and fuel supply. Type of generator and supply frequency. Peak and normal loads. Stand-by equipment. Distribution systems: Routes, capacities, voltages, locations of transformers and switching stations. Line diagrams. *Gas.* Personalities and control authorities. Staff and labour. Location and type of works. Source of fuel and method of supply. Sizes, types and routes of main gas pipelines. *Sewage.* Staff and labour. Location and capacity of systems. Location and installation details of treatment pumping and disposal plant.
WATER	*Raw Water Sources.* Location, quantities with seasonal variations. Quality. Depths to water table. *Developed Sources.* Location and nature of source. Yield with seasonal variations. Quality. Equipment installed or required. Treatment. *Mains Supplies:* Location of plant and area served. Types and capacities of pumping, treatment, distribution and storage facilities. Staff and labour. *Distillation Plant:* Location, nature, type and capacity of distillation and desalination plant.
CIVIL ENGINEER RESOURCES	Location, output/capacity, stocks held, number employed and held/installed equipment of the following: Timber yards, quarries, workshops, industrial gas suppliers, earth moving and construction plant contractors and garages. Skilled and unskilled local labour and capabilities. Location, prices, units of measure and normal stocks of cut timber, builders and construction materials. Location, type and capacity of installed refrigeration and air conditioning plant. Source, quantities and types of special load transport.
MILITARY ENGINEER RESOURCES	Location and normal stocks of bridging and construction materials, plant, stores, mines and unit equipment.
POL	*Bulk Fuel Installations.* Locations, site layouts, pipe, electrical, drainage and fire prevention systems. Staff and labour. Numbers, capacities and construction of storage tanks. *Depots.* Location, numbers and capacities, types and distribution systems. Vehicle tankers.

SUBJECT HEADING—COMBAT INTELLIGENCE

Detail Heading	Detail
EQUIPMENT AND TECHNIQUES	Enemy vehicle characteristics, techniques and capabilities for CW/BW, bridging and mine warfare.
ORBATS	Location, strength and equipment of engineer units.
DEFENCES	Location and types of defended localities and minefields.
NUCLEAR EFFECTS	Likely effects of Nuclear Strikes: Fire, blowdown and fallout.

EOD—An Alternative Method

MAJOR C. M. G. de PLANTA de WILDENBERG, RE

IT happened just before Christmas. A new swimming pool was being constructed in the French barracks where I worked. One morning there was a knock at the door of my office and in came three NCOs whom I did not recognize. They were polite but rather apprehensive. I learned that they were ammunition experts called in to deal with a bomb which a mechanical shovel had laid bare among the foundations of the swimming pool. They thought the bomb was British and would I, as British Liaison Officer, care to come and liaise—on site?

My inadequate French prevented me from inventing an immediate reason to visit Paris and so a few minutes later I was staring into a shallow trench at an ugly, rusty and malignant "engin" which they assured me weighed at least 250 kg. I was able to recognize it at once as a bomb for I had seen hundreds just like it in comics during the war. It had fallen well, being 30 yds from the Sergeants Mess, 25 yds from the main workshops and a great deal less from one of the contractor's workmen, who was being diligent with a pneumatic drill. The bomb was surrounded by eyewitnesses who remembered seeing it fall from a Mosquito in 1944—or was it 1945? Near by stood the ammo experts' vehicle, one of those small corrugated Citroëns, loaded with disposal equipment. This appeared to comprise a pick, a shovel and a bucket.

Now at that time, I knew nothing about bombs except what I had learned on a 15-minute visit to the BD Museum on my YO course. But those who organized that visit will be gratified to know that the time had not been wasted, for I was able to say with authority and conviction—and in French—"Be very careful!"

Then, being extremely careful, I took a small piece of wood and descended into the trench and prised off a flake or two of mud and rust from the bomb, hoping to find some well-preserved marks in Germano-Gothic script which would absolve me from any further need to take an interest. But nothing showed and progress was very slow. Too slow, in fact, for "Marianne" and one of the experts showed me a quicker way, using the EOD pickaxe on the pointed end of the bomb. Instinctively, I shut my eyes but remembering my position, I opened them again quickly. I found myself looking directly at the barrack clock, which showed almost exactly midday. Urgently I pointed this out to the man with the pickaxe and realizing it was lunchtime, he at once jumped out of the trench and put his pick into the Citroën, but promised to be back promptly at 2 pm.

No one can dispose of explosive ordnance on an empty stomach, so I went off for lunch, too, taking an additional aperitif to steady me up. During the break I was refused permission to telephone Chatham for advice and moral support, on the grounds of the expense. So I searched distractedly in a large steel cupboard in my office in which generations of BLOs have hidden manuals they did not know what to do with. Salvation came on pages 122 and 128 of *Royal Engineers Reconnaisance Pocket Book* (1944). Here I learned all there was to know about British bombs of World War Two. At 2 pm I was back on the site, full of confidence and knowledge which I planned to pass on to the experts and fade discreetly away while they applied it and found out whether the pocket book had been kept fully amended. I was able to say that the bomb *was* British, that it had two firing pistols (one about an inch away from the pickaxe marks on the pointed end), and it was not fitted with any anti-handling devices. This last point cheered up everyone, for all that was then needed was a truck full of sand, a mechanical loader to put the bomb into the truck and then off across town to the demolition grounds. A minor snag was a 2-kg limit on surface charges in these grounds, but if the mechanical loader dug a bit of a hole first and the bomb was let off in that, it was unlikely that anyone would notice . . . !

Fortunately, before the truck full of sand could arrive, a firm veto from high up

put paid to that particular scheme and it was decreed that the bomb would not be moved without first being defused. I expected the experts to be a bit dismayed by this news as their defusing gear seemed rather elementary, but not at all; they were delighted because it was not part of their job to remove fuses. In France a special civilian organization does that dirty job.

So the civilians were sent for but, of course, it was not quite as simple as that. The civilians were regretful but they were unable to assist because the bomb was on military property. Time passed.

As we all know, when a difficult problem occurs, it must be passed on and if possible, upwards. Regional Headquarters were approached. This, of course, should have been done at the outset for they immediately resolved all the problems of protocol and "who does what" by telling the CO to get on with it and making him fully responsible. But now things began to happen.

Two important steps were taken. The first was to cover the bomb with a sheet of corrugated iron, surrounding this with barbed wire and posting a sentry. He, or someone very like him, stayed there for several days, doing what he could to discourage sightseers and advice-givers, though he had very little effect on the fellow with the pneumatic drill. The second step was generally regarded by the French as the ideal solution to the whole matter. They generously offered to restore the object to the ownership and control of Her Majesty, or at least to Her Majesty's representative in the barracks! Alas, I was compelled to decline this gesture of Franco-British goodwill since, as I explained at the time, my baggage allowance would not be able to absorb the additional weight.

At this point and in order to forestall any similar ideas which might have proved more difficult to counter, I went on leave. When I came back the hole was full of concrete and the foundations were well advanced. A strange unwillingness to talk contrasted strongly with the enthusiastic discussions before Christmas. No one seemed to know anything about it at all. Of course, there were rumours. Perhaps one day, when the pool is being demolished to make way for a supermarket, a concrete breaker may come upon a curious piece of heavy cylindrical reinforcement in the old foundations of the pool. But the most persistent rumour spoke of someone sending for a truck full of sand and a mechanical loader . . .

A Hundred Years Ago

Mata Kacha

To all Royal Engineers the outstanding event of the last quarter of 1871 was the death of Field-Marshal Sir John Burgoyne. This was the man credited with having "trained the first sappers in the British Service that ever acted against an enemy"; who was commissioned in 1798, and who retired, from the post of Inspector-General of Fortifications, in 1868, having completed seventy arduous years of service; who lived to be recognized as one of the great public figures of the nineteenth century, and who died, loaded with honour and affection, in the ninetieth year of his life.

This is no place to recite the many and diverse claims to fame of one who was Commanding Engineer at the storming of Alexandria in 1807, at the sieges of Salamanca and Burgos in the Peninsula and at the attack on New Orleans in 1815; who missed ("by the rules of the Ordnance") the battle of Waterloo; and survived to act, in the rank of Lieut-General, as deputy to the Commander-in-Chief in the Crimea. To his career, both military and civil, the *History of the Corps* devotes no less than twenty-eight pages, besides many textural references; a more hastily assembled summary, together with an account of his funeral, occupied five columns of the November *Journal*, the whole of which appeared set, in the Victorian idiom, in heavy-leaded frames as a mark of deep mourning. He was buried in the church of

St Peter ad vincula in the precincts of the Tower of London, of which he was Constable. To his memory the officers of the Corps erected a statue hard by the Duke of York's Column; a silver replica adorns the table of the Headquarters Mess at Chatham, and the plaster cast of the statue, on a massive wooden plinth, dominates the main vestibule of the Corps Museum.

It is with no disrespect that we here offer a reflection on a remarkable constitution. After the fall of Alexandria, Burgoyne was affected by opthalmia, and during the retreat to Corunna, suffered so severly from exposure that he was rendered deaf for nearly five years. When the advance from Torres Vedras began, he was lying with a fever in hospital in Lisbon, whence he escaped in time to be present at the second and third seiges of Badajoz. In battle he "seemed to bear a charmed life" until, before San Sebastian, he was severely wounded in the neck and jaw. Nevertheless, when, at the age of 63, he became Inspector-General, "his vigour had as yet shewn no sign of abatement" and ten years later, in Gallipoli, French officers found him acting "like a sub-lieutenant of hussars". At the Alma he "never felt in better health" and complained only of being "fatigued and muscularly feeble" after some twelve hours in the saddle. Is it not a sobering thought that a man who could experience so many vicissitudes and who, by all accounts, continued to enjoy the most perfect health and strength until he had long passed four-score years of age, should succumb at the last to an attack of eczema?

A peep behind the scenes confirms the suspicion that all was not "*fas et gloria*" even in this great hero's journey through a long life, and it is comforting to find, in the joints between the vast blocks of achievement on which his reputation rests, an endearing mix of those experiences which many suffer and enjoy and which contribute to transform a "character" into a human being. As an instance, Sir John once became engaged with acrimony with his former chief when a letter addressed to him by the Duke of Wellington on the subject of national defence was published by the *Morning Chronicle*; nor were matters improved when the "leak" was traced to Lady Burgoyne. This affair did not prevent His Grace from putting forward the General's name—somewhat tardily perhaps—for a GCB. Burgoyne, however, "with much sacrifice to his reasonable pride and ambition" felt it his moral duty to decline the distinction on account of the crippling fees attached, which (he observed) added up to several years of his widow's pension. This was a risky gamble which paid off; for Queen Victoria, on hearing of the matter, directed that the rules of the game be altered in his favour and to the advantage of all who followed him on to the higher planes of "ribbon development". In some quarters his appointment as deputy to Lord Raglan was criticized on the grounds of his age; while he himself was in doubt as to the viability of the whole expedition to the Crimea, confessing that "I do not understand on what sound principle it is undertaken". But he managed to hold on there long enough to prove himself and to see his plan (for the attack on the Malakoff—a subject of bitter controversy) adopted for the subsequently successful assault on Sebastopol. "I can't give you no hot water, Sir John", his servant told him when he spent a night in bivouac with the 3rd Company Royal Sappers and Miners, "because there ain't no water nor no fire." During his lifetime the Field-Marshal had his share of both, and must have enjoyed the experience of reading his own obituary in *The Times* when it appeared in error some years before his death. If we seek a moral in all this, it is surely that, to be truly great, a man needs good health, must stand up for his convictions, and possess a sense of humour.

The Corps appears to have been uncharacteristically slow off the mark in the field of mechanical equipment. As early as 1845 the late Inspector-General of Fortifications had put out a memorandum on the probable effect of modern applications of steam-power on military and naval operations. But, up to the date of his death, little had been achieved except for the installation of stationary engines to drive machinery in the Royal Arsenal at Woolwich and in some other stations. In the early days the state of the roads seems to have deflected effort in steam traction almost exclusively to the railways. Even that great sapper innovator, Sir Charles

Pasley, stands charged with advising on the "hopelessness of applying steam locomotion on common roads", and legislation seems to have been directed more towards the width of wheels than to the surface on which they had to run. This is the more remarkable since Macadam had been hard at work for more than half a century and a Committee of the House of Commons had, way back in 1831, given "every encouragement to the locomotive on the turnpikes". Meanwhile, inventors turned their attention increasingly to agricultural applications, in which transportable steam-engines hauled by horses gave way progressively to self-propelled prime-movers. The first experiments with track-laying machines evidently failed to attract the attention of Chatham, even though in 1857 a man named Bethell demonstrated one employing this principle and able to "travel over the land without unduly compressing it", hauling a cultivator, a plough, or a trailer carrying produce or manure.

The tasks and problems of the farmer are in many respects cognate to those of the sapper and, as in other developments of mutual advantage, agriculture led the way. At the Royal Show of 1858 John Fowler's ploughing engine was awarded the £500 prize of the RASE and, by the end of the following year, despite the difficulties of "negotiating narrow clay lanes into the fields", ten pairs of these engines had been supplied to forward-looking farmers. By 1867, some 250 traction-engines were in private ownership and there were, besides, eight contractors operating an unrecorded number of machines. By this date steam-navvies were in general use on the heavy earthwork associated with the prodigious extension of the railways, some of them self-propelled (though mostly on rails), while the terms "drag-line" and "back-acter" were already part of the civil engineer's vocabulary. Yet the RE Park at Chatham disposed of nothing more adventurous than a horse-drawn stationary engine until 1871, when the first "road steamer" entered Her Majesty's Service under the euphemistic title of "No: 1 Steam Sapper".

In the pages of the *Journal* for October, we are treated to an account of the performance of this machine and of its companion, "No: 2", which had just followed it into experimental service. Both came from the shops of Aveling and Porter in Rochester and were considerably lighter and less powerful than the massive engines produced by Fowler and others. Each required but one man to drive it and, from their description (and a photograph in the *Journal* of September 1970) were little different from the traction engines familiar to all until comparatively recent times. The specification for the "Steam Sapper" laid down that it should be capable of driving a 36-in circular saw, a grindstone, a lathe and a general joiner; and that it should be capable of drawing a load of 5 tons up a 1 in 12 slope. "No: 1" successfully dragged a train of three trollies weighing altogether 16 tons 15 cwt up Star Hill, Rochester, but came to a halt half way up Brompton Hill, on a gradiant of 1 in 10. On "paddles" being fixed to the wheels it drew 6 tons through a patch of very soft ground, and at the Royal Show that year a similar machine to "No: 2" demonstrated the value of winding-gear by "recovering" (an early use of a now familiar term) a three-wheeled Thompson steamer which had become bogged down. Incidentally, "No: 2" differed from "No: 1" by being driven through spur-gear instead of by chains, but it seems short-sighted that the Army version was not provided with winch and cable. Both models were tried with and without rubber "tires". Without them they failed under heavy load on the cobbled streets; and with them they skidded on wet ones.

Perhaps it is not surprising that the Steam Sappers were used predominantly in their stationary role; what is difficult to comprehend is that, with the prodigious amount of earthwork involved in the current programme of defence works, no attempt was made to use steam power to replace man power in the sapper companies. True, a light-duty jib-crane became an optional attachment, but the earliest recorded earth-moving machine in the Service was a rail-mounted steam-powered face-shovel introduced at Longmoor thirty-five years later. In due course the first internal combustion-engined tractor made its agricultural debut at the Royal Show in 1904; the Corps first used a bulldozer at Quetta in 1935, after another interval of thirty years. To what are we to attribute these generation-long periods of gestation if not

to hesitancies induced by fixed ideas and an imagination blinkered by tradition? Meanwhile, when the "Steam Sapper" first proceeded on active service in the Ashanti Expedition of 1873–4, it caused "much disappointment", proving incapable of moving off the limited road system in the vicinity of Cape Coast Castle, so that its usefulness was restricted to sawing "a good deal of timber" and hauling water—chiefly for its own consumption. One cannot help feeling that a great opportunity had been missed. The "Steam Sappers" weren't really sappers at all.

Extensive Siege Operations were carried through at Chatham in October 1871, in which all the obsolescent techniques of the Crimea were re-enacted, including "left" and "right" attacks, mines and countermines, ladder-parties and even a charge of cavalry. Seven-inch siege guns were dragged from the Gun Wharf to the RE Park and thence into position by the Steam Sappers; HM ships steamed up the Medway into a barrage of submarine mines; and the proceedings terminated with attackers and besieged uniting in a march-past on the square at Brompton Barracks. Their scarlet coats can not have looked very smart at the end of such a day, but the spectators seem to have enjoyed it all. Was this the precursor of all RE Days?

By contrast the funeral of Sir John Burgoyne is described as "of a very simple nature", notwithstanding which, the procession included a semi-state carriage of Her Majesty the Queen, followed by those of Their Royal Highnesses the Prince of Wales, the Duke of Edinburgh and the Duke of Cambridge, and many others. A battalion of 17 officers and 453 men from Chatham furnished the Guard of Honour and the Foot Guards in duty at the Tower lined the route. The Field Marshal who had so narrowly missed the great goings-on at Gillingham, might have liked his coffin to be carried on one of the new pontoon wagons and drawn by a Steam Sapper. "No: 2", I think—with "tires".

Articles for the Journal

THE *Journal* depends for its existence on articles submitted for publication on historical, professional and technical subjects of interest to Military Engineers.

They may be of any length, but preferably not more than 6,000 words. They should be typed in duplicate on one side of the paper only, double spaced with one-inch margin. A third copy should be retained by the author for checking with proofs.

Photographs to illustrate an article should be black and white prints on glossy paper. Usually not more than four photographs will be published to illustrate each article. More photographs may, however, be submitted from which the Editor will make a selection. The size of the photographs does not matter as they can be reduced in size for publication. Line drawings, maps, etc must be in black ink, and all lines, lettering, etc must be bold and clear to allow for reduction in size when reproduced. Scales must be drawn and not worded.

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Payment for articles is at a rate decided by the Publications' and Library Committee. An extra £10 award is made at the discretion of the Committee for articles of particular merit published in each issue of the *Journal*. In addition two prizes, the Montgomerie and Arthur ffolliott Garrett Prizes, are awarded each year for outstanding articles by RE officers, not above the rank of substantive major, published in the *Journal*.

Articles may be submitted at any time and correspondence is always welcome. However, the following dates are normally the latest for inclusion in the issues shown:

March issue	1 December	September issue	1 June
June issue	1 March	December issue	1 September

For articles requiring clearance attention is drawn to Military Security Instructions Part 1 Army Code No 14610 Appendix B to Chapter 5.

"PQE March"

[Thoughts on a Church Parade at Chatham]

(May be sung as an Anthem on technical occasions)

Men of concrete, men of steel,
Men of piston ring and seal
All those led by Eddie Peel,
"By the right! LEFT wheel!"

Men of noble oak and larch,
Men of open spandrel arch,
Men whose throats will never parch,
"By the right! SLOW march!"

Men of twisted knotty pine
Who can its roots with squares combine,
And yet distinguish TAN from SINE
"By the right—INCLINE!"

Men who can at PISA stare
And wonder at its jaunty air,
No PQE was ever there!
"As you were! Form square!"

Men of learning, BSc,
Can with their pens gain PhD,
Or with practice they can be
ASSOCIATE MEMBER ICE!
And thus they serve in TTG
At our Royal SME . . .

By the right! Not me!

B.C.

Correspondence

Major J. T. Hancock, RE,
RE Record Office,
Ditchling Road,
Brighton
BN1 4SH
13 September 1971

1815 FROM THE ENGINEER ANGLE

Sir,—One of the aims of Lieut-Colonel J. G. O. Whitehead's article was to defend Wellington's reputation in the conduct of the campaign. It therefore seems unfortunate that in one of his closing paragraphs he assumes that Wellington was content to leave the infantry to their own resources for retreat. This assumption ignores the existence of the Royal Staff Corps who were the "combat engineers" of the army at that period.

Apart from articles on the "Royal Staff Corps 1800–1837" by Lieut-Colonel F. S. Garwood in the June and December 1943 editions of the *RE Journal* and occasional minor references in Conolly's "History of the Royal Sappers and Miners", their existence has been ignored by our own Corps since their formation at the start of the nineteenth century, and to the present day very few RE Officers realize that a rival Corps ever existed.

Despite their misleading title their role, in present day terms, was equivalent to that of the combat engineer. Their role is clearly defined in a Memorandum by the Quartermaster General's Department to His Majesty King George III, dated 5 May 1803:

"—when it is meant to fortify a village or secure the avenues of a position—to direct the profile and ensure the solidity of field works, as also to prepare materials for their construction—at other times—to facilitate the movements of an army over enclosed or intersected ground using the material at hand for the purpose of bridges—repair of roads—passage of swamps etc, or where it becomes necessary to impede the progress of the enemy by the felling of timber, destruction of roads and bridges."

They were organized in companies of artificers with almost identical trades to those of the Royal Sappers and Miners, but had the advantage that they were also trained and armed as infantry soldiers. The Sappers and Miners were unarmed and their role was the construction and repair of permanent fortifications, seige work and manning the pontoon trains.

It is of interest to note that before they moved to a permanent depot at Hythe they were stationed at Chatham. There they trained in their engineer role on the ground adjoining the barracks (Chatham Barracks at that period). This was of course prior to the setting up of Pasley's Engineer Establishment at Chatham, and at a time when the Royal Engineers headquarters was at Woolwich.

All except a few of the original records of the Royal Staff Corps have been lost and it is now extremely difficult to establish the part that they played at Waterloo. However, five of their companies were in the area and it is a reasonable assumption that they took some part in the battle, since they were awarded the battle honour of "Waterloo" on their colours. Nine of their officers were granted the Waterloo Medal and two were wounded while on regimental duty.

It is clear from the presence of these companies that Wellington was not content to leave the infantry without engineer resources in a retreat.—Yours faithfully, J. T. Hancock.

Major-General R. L. Bond, CB, CBE, DSO, MC,
The Dykeries,
Compton,
Guildford,
Surrey.

21 September 1971

LIEUT-GENERAL SIR FRANCIS NOSWORTHY

Sir,—May I be allowed to add a few words to your obituary notice on Lieut-General Sir Francis Nosworthy. He and I were good friends for nearly sixty years and he was a man for whom I had an enormous admiration and affection. His outstanding characteristics were his remarkable enthusiasm for battle and his irrepressible sense of humour. He was a dedicated fighting soldier. I first met him at the end of 1915 when he was sent to the RE Training Centre at Newark, convalescent after his "hole in the heart" wound. To be in England when fighting was going on in France was an exasperation: he took a few days leave, got to Dover and in some way which was never explained got himself passed fit for service and was back in France in quick time. We met again in the battle of Passchendaele in 1917, when I was Brigade Major of an infantry brigade. Conditions were appalling, continuous rain, mud everywhere, heavy shelling. My Brigade Commander and I were in a tiny pill-box where I was trying to write orders for an attack. I heard a burst of bubbling laughter and in came Frank Nosworthy in a streaming water-proof sheet. His Corps (he was, I think, GSO II) was in a quiet sector so he had come up to see what was going on on the battle front, and enjoying every moment of it. It was a tonic shot in the arm for us. "Isn't this fun!" he said.

We next met during the great German break-through in March 1918. Our Division (the 66th) and the 24th Division next door were nearly surrounded. Frank was brought in as our GSOI and at once made his presence felt by his tremendous energy, his imperturbable demeanour and indeed his characteristic relish of a hard and difficult battle. Again when, the situation was really very grim, it was a tonic to go to Divisional Headquarters and to experience Frank's optimism, firmness and cheerfulness. It is, in passing, interesting to remember what a Sapper Division we were. Frank Nosworthy our GSOI, Gordon Macready RE our brilliant 28-year-old AA and QMG (afterwards General Sir Gordon Macready), Guy Williams who was brought in the day before the battle began to command our Brigade (afterwards General Sir Guy Williams Chief Royal Engineer), and myself, Brigade Major.

Finally in 1944–5 I found myself, first, GOC Sierra Leone, then GOC Nigeria, with Frank as my C-in-C, where his generosity and firm support made this a memorable and happy experience. A truly great soldier whose memory should be honoured by the Corps for all time.—Yours faithfully, R. L. Bond.

Sir Brett Cloutman Kt, VC MC QC

SIR BRETT CLOUTMAN, Senior Official Referee of the Supreme Court of Judicature 1954–63 and a Sapper officer during both World Wars, died suddenly at his home on 15 August 1971 in his eightieth year. He won the last Victoria Cross awarded during the First World War, only five days before the Armistice, when in command of 59 Field Company RE.

Born on 7 November 1891 Brett Mackay Cloutman was the elder son of Albert Cloutman who was a life governor of the furnishing firm of Maple and Company. He was educated at Berkhamsted School, Bishop Stortford College and London University where he read modern languages and obtained an Honours Degree in 1913. While at the University he served for three years in the Officers' Training Corps.

Within five weeks of the outbreak of the First World War on 4 August 1914 he enlisted in the Territorial 12th Battalion The London Regiment (Rangers) and in March 1915 he was commissioned into the Royal Engineers and joined the Kent Fortress RE at Gillingham. He was promoted acting captain the following July. He served on the Western Front and won the MC for gallantry and devotion to duty in the field and, when in command of 59 Field Company RE during the final advance to victory, he was awarded the Victoria Cross. The citation reads:

Lieut (Acting Major) Brett Mackay Cloutman MC, 59th (Field) Company RE
For most conspicuous bravery on 6th November 1918, at Pont-sur-Sambre, Major Cloutman after reconnoitring the river crossings found Quartes Bridge almost intact, but prepared for demolition. Leaving his party under cover he went forward alone, swam across the river and having cut the 'leads' from the charges returned the same way despite the fact that the bridge and all approaches thereto were swept by enemy shell and machine-gun fire at close range. Although the bridge was blown up later in the day by other means the abutments remained intact.

After the First World War he returned to the managerial staff of Maples and worked in London and South America. Later, however, he took up a legal career and entered Gray's Inn as a student. He was called to the Bar in 1926 and joined the Western Circuit where he built up a considerable practice and also frequently appeared in the North London Sessions. He returned to the legal profession after his Second World War service in the Royal Engineers and became a Divorce Commissioner and took silk. His later appointments were Chairman War Pensions (Special Review) Tribunal and Official Referee of the Supreme Court 1947–54 and Senior Official Referee 1954–63. He was knighted in 1957. He was Chairman of the Metropolitan Union of the YMCA and President of the Hornsey Branch. He was also a Governor of Eltham College and a Master of the Worshipful Company of Glass Sellers of London.

Recalled for service in 1940, he arrived at the RE Mess Aldershot, then temporarily housing a number of Sapper officers each one of whom had undergone some pretty shattering experiences during the evacuation from Dunkirk and other places. Cloutman's remarkable serene composure and unshakeable optimism was an inspiration to those whose morale was at the time rather shaken. Shortly afterwards he was posted as Second-in-Command 26 Field Company reforming at Dumfries after most of the unit had been made prisoners at St Valery. He later served in Syria and commanded the RE Training and Reinforcement Depot in Egypt. He then became CRE Levant Engineer Battalion RE, consisting of one Road Construction Company and two Artisan Works Companies. The personnel of this volatile, multiracial unit comprised Arabic speaking Syrian/Lebanese and Greek-speaking Cypriots with British Officers and senior NCOs. An account by Sir Brett Cloutman of how these men of "little education and less manners" were welded into a relatively "well-behaved body of men" and of the sterling work they did in Italy was published in the June 1950 issue of the *RE Journal*. What was suppressed in the article was any reference to the author's great powers of leadership that brought about this remarkable metamorphosis.

Since leaving the Sappers for a second time Sir Brett retained a close connexion with the Corps. He was a member of that select body known as the Blyth Sappers and he maintained ties with 59 Field Squadron, now 59 Independent Commando Squadron RE. When serving recently in the Far East 59 Field Squadron lived in Cloutman Lines, Singapore, and their present address in Cloutman Lines, Crownhill Fort, Plymouth. Recently Sir Brett set up a Trust to provide a tankard engraved with the name of the most promising Lance Corporal of the squadron during the year—to be presented on 6 November annually, the date of his 1918 VC. Should the squadron ever be disbanded the monies of the Trust will pass to the Royal Engineers Association (Corps Benevolence).

Sir Brett also made in November 1970 a Deed of Gift to the Institution of his decorations and both World War medals, his badge of the Imperial Order of Knight Bachelor and the Jewel of a Past Master of the Worshipful Company of Glass Sellers of London. Also included in the gift were the 1914–18 War medals of his younger brother Lieutenant W. R. Cloutman, RE, the Royal School of Mines medals won by him and the Memorial Plaque presented to the family. Lieutenant W. R. Cloutman served in 178 Tunnelling Company RE. He was twice mentioned in despatches and was killed on 21 August 1915 in rescuing a sergeant whom he carried on his shoulders 45 feet up a ladder from the bottom of a mine shaft. As soon as the sergeant was safely lifted from his shoulders Cloutman, overcome by foul gas, fell to his death at the foot of the ladder. Under the terms of the Deed the collection remains in the care and custody of Lady Cloutman and her son-in-law during their respective life-times.

Sir Brett and Lady Cloutman were married in 1916. They had two daughters. Our deepest sympathies are extended to Lady Cloutman and the family.

Only three Royal Engineer VC holders are now still living: Lieut-General Sir Philip Neame, VC, KBE, CB, DSO, Brigadier C. G. Martin, VC, CBE, DSO and Hon Colonel Arnold Waters, VC, CBE, DSO, MC, CEng, FICE, FIMechE, P/P IStructE, MInstWE, FGS, MConsE, DL, JP.

Major A. C. Newman, VC, OBE, TD, DL, now of the Engineer and Railway Staff Corps R & AVR, won his Victoria Cross as a Lieut-Colonel in the Essex Regiment in command of a Commando, for gallantry during the raid on St Nazaire on 27/28 March 1942.

* * * * *

Major-General C de L Gaussen CB MC

MAJOR-GENERAL C. DE L. GAUSSEN, Chief Engineer XIII Corps during the Eighth Army's campaign in North Africa and the last Engineer-in-Chief India before Partition, died on 18 July 1971 in his seventy-fifth year.

Charles de Lisle Gaussen, son of the Reverend C. E. Gaussen, was born on 1 August 1896. He was educated at Berkhampsted School and the Royal Military Academy, Woolwich and was commissioned into the Royal Engineers in 1915. He served on the Western Front as a company officer in 73 Field Company, as Adjutant 15 Divisional Engineers and on the staff of HQ 25 Division. He was twice mentioned in despatches and was awarded the MC.

After a Post War Supplementary Course at Chatham he went to India where he was employed on the Engineer Staff at Army Headquarters. In 1923 he was given command of 19 Field Company Royal Bombay Sappers and Miners then on active service in Waziristan where the unit built the first Inglis Bridge ever erected on the North West Frontier for permanent as opposed to temporary use. He received the Waziristan 1921–4 Medal and Clasp. Returning to the home establishment in 1926 he became Adjutant of the Railway Training Centre RE at Longmoor and the following year he passed into the Staff College. On graduating from Camberley he was given command of 55 Field Company then stationed at Catterick. From that appointment, after a short time on the SME staff at Chatham, he was posted to the Military Operations Branch of the War Office.

He returned to India in 1935 and once again joined the Royal Bombay Sappers and Miners at Kirkee where he became Superintendent of Instruction. After a year away as Brigade Major Nowshera Brigade he returned to Kirkee to command the Training Battalion.

In the spring of 1940 he was sent to Egypt, at that time being reinforced mainly by Indian, Australian and New Zealand formations, to be deputy E-in-C to Major General H. B. W. Hughes. The following year he became Chief Engineer XIII Corps which, with XXX Corps, took part in General Auchinlech's November offensive in the Western Desert. Gaussen was never far from the forefront of the battle and on one occasion had his car shot from under him. He was also Chief Engineer XIII Corps during the Battle of El Alamein in October 1942, and during the mopping-up operations following it.

Returning home in 1943 he became a Chief Engineer in Home Forces before going back to India. From May to December 1945 he was Chief Engineer Central Command. Next he was Deputy E-in-C until September 1946 when he became Chief Engineer Northern Command. In July 1947 he was appointed E-in-C India under the old regime and so remained until the post ceased to exist as part of the British administration after Partition.

His final military appointment was Deputy Engineer-in-Chief at the War Office. He was created CB in 1949 and retired in June 1950.

In May 1952 General Gaussen was appointed the founder Bursar of Welbeck College the pre-Sandhurst sixth-form college which is now a main source of officers for the technical corps. The college is situated at Welbeck Abbey in Nottinghamshire the seat of the Duke of Portland. The first sixteen months of his appointment saw the conversion of the Abbey into a boarding college complete with all the attendant facilities required to accept a first entry of forty-eight boys. Over the next sixteen months conversion continued and the college reached its full complement of 150 in January 1955. Despite the flurry of activity during these early years in the College's history his activities were by no means solely concerned with the college's building fabric and its administrative staff. He took a keen interest in a wide variety of affairs particularly those concerned with the welfare of the boys all of whom he seemed to know personally. He was also able to continue his lifelong interest in painting and took an active part in the College's Art Club.

He retired in March 1957 but still maintained a close link with the College and its old boys. Whenever possible he attended all the main old boy gatherings and in June 1960 became the founder President of the Old Welbexian Association. Although

keenly involved in the affairs of the Association he firmly believed in the need for the President to be an old boy and therefore was anxious to hold office only long enough for the Association to become established. He retired as President in 1966 handing over to Major (then Captain) J. L. Barker RE a member of the first intake. His close association with the College and its old boys continued until his death.

He was an accomplished artist and was for many years the Honorary Treasurer of the Army Art Society. He was asked by the Corps Committee to make a series of black and white pen sketches of some of the thirty-three RE War Memorial Homes built at Belfast, Cardiff, Edinburgh, Leeds, Gloucester, Chalfont St Peter, Norwich and Portsmouth as a result of donations from all members of the Corps as a fitting and tangible memorial to their comrades who had fallen in the Second World War. His framed sketches are now in the Corps Museum.

After leaving Welbeck College, he settled in the little village of Singleton, near Chichester in West Sussex, where he made himself extremely useful to the British Legion, WI, Parish Council and Singleton School as Correspondent and Manager. He also served on the Rural District Council and as Churchwarden.

In 1967 he moved to a small bungalow in the North Bucks village of Weedon, where he politely refused to take on any further public duties other than the PCC. The last four years of his life were spent in getting to know his grandchildren and performing such simple tasks as digging a new garden in the local heavy clay, putting up a double garage of concrete blocks with the aid of his son-in-law, chopping wood, and helping to excavate a sizeable duck pond.

His last illness was an extremely disagreeable and depressing one, but he bore it with patience, humour and great courage, refusing to give in to it until the very end.

In 1927 he married Karen, daughter of A. de Linde. They had one daughter. His wife pre-deceased him and our deepest sympathies are extended to his daughter Mrs K. J. Edwards of Tumbling Acre, Weedon, Aylesbury, Bucks.

* * * * *

Major-General G N Russell CB CBE FRSA MInstT

School and the Royal Military Academy, Woolwich and was commissioned into the Royal Engineers on 28 September 1918.

After a short Junior Officer Course at Chatham and the School of Electric Lighting at Gosport he joined the 2nd QVO Madras Sappers and Miners and served with them in Mesopotamia and Iraq. He was awarded the Iraq 1919–20 Medal with two clasps and after these operations he returned to Bangalore where he served with 1 Field Company.

Returning to the home establishment in 1924 he attended a Supplementary Course at Chatham and went to Trinity College, Cambridge. From there he was posted to the Railway Training Centre RE at Longmoor, where he played hockey for the Corps in the winter and went ocean racing in *Ilex* in the summer, and started his long and distinguished career in Movements and Transportation. In 1931 he was given command of 8 Railway Company RE.

A brief interlude away from Movements and Transportation followed and, between 1932 and 1937, he was a Company Commander in 1 Training Battalion, RE at Chatham and an Instructor in field engineering at the Canadian Royal Military College, Kingston.

On returning from Canada he went on a Railway Course at York before becoming an Instructor at the Railway Training Centre RE at Longmoor.

On mobilization he went to France as AD Tn with the British Expeditionary Force, and he remained in "Mov and Tn" throughout the war. He was AD Tn Middle East Command 1940–1 and Director of Movements throughout the critical years from 1941 to 1943 in that theatre of operations. He was Director of Movements India 1943–4 and DQMG Mov and Tn 1944–6. He was thus responsible for the complicated movement and transportation backing for the Battle of El Alamein and the subsequent Eighth Army's advance to Tunis and the invasion of Sicily and for the Fourteenth Army's reconquest of Burma. Every conceivable form of transportation had to be used and exploited to the full—air, road, rail, river and sea—to maintain the momentum of these two campaigns.

For his war-time services he was awarded the OBE in 1940 and made CBE in 1943 and CB in 1946.

After the Japanese surrender he was employed by the Foreign Office as Transport Adviser to the Special Commission for South East Asia until he retired in April 1948.

Retirement, however, did not end his transportation activities. He was Chairman of the Road Transport Executive 1948–53 and British Road Services 1953–9 and a Member of the British Transport Commission 1959 to 1962, and of the British Railways Board 1963–4. He was Chairman of the Eastern Area Board 1960–2 and was largely responsible for the Railway Board's property interests.

He was a Member of the Royal Society of Arts and President of the Institute of Transport for the year 1958–9. He became a Trustee of Sutton Dwellings Trust in 1951 and Chairman in 1962. He was one time Chairman of Strand Management and Haymarket Housing Society and a member of the National Federation of Housing Societies, and for the last ten years played a very active part in the housing world.

He married twice. In 1927 he married Iris Margaret, daughter of Charles Mills of Wimbledon, and they had two daughters. In 1946 he married Jocelyn Delia, only daughter of Dr F. C. Harvie Bennett of Walton-on-Thames. They had a son and two daughters. Our deepest sympathies are extended to his widow and family.

G. H. B. M. writes:

The greatness of "Charles" Russell lay perhaps equally in his high achievement and also in the manner in which this was attained.

He was quite exceptionally clear thinking and had a habit of deciding in the simplest and shortest terms what he would do. So that even when driving hardest it was apparently without effort. This, with a complete lack of pretentiousness and with an ever present dry humour which, to those who knew him well, had a bouquet of its own.

When it came to personal contacts, there was no declamation. But those working with him knew exactly what he designed, knew how much was expected of themselves in co-operation, and if he was in charge, knew that he would be equally just in praising success and in clearly and kindly analysing short-coming. At such times he would often use his own adjectives—'decent'—for good work, and, if things had not gone well—'moderate'. The style was invigorating.

He was, however, a man of healthy likes and dislikes with a directness which sometimes swept convention aside. Hence, not all found it easy to agree with him. But there was never any doubt that just what he said was what he thought. There were, in consequence, seldom any lasting hard feelings.

Charles never seemed to change over the years. As a subaltern there was clearly that maturity and stability of character which perhaps showed more in later life. And there was that streak of kindness and gaiety in his young days which latterly showed less on the surface, but which never deserted him.

His passing is mourned; for he was a loyal friend, a born leader and among the most able of his contemporaries—a great man in whom greatness was becoming.

"Nunc dimittis"

Mr G. W. Quick Smith of the National Freight Corporation wrote the following tribute published recently in *The Times*. It is republished with his permission:

The death of Charles Russell (as he was affectionately known to all his many friends) serves to recall the fact that what is now the National Freight Corporation virtually started its life in 1948 as the Road Transport Executive (a statutory body forming part of the British Transport Commission) of which he was the first chairman.

Only those who were close to him can have any idea of the tremendous verve, energy and enthusiasm that he brought to the mammoth task of creating "British Road Services"—one national road haulage organization with 40,000 vehicles at its peak, formed out of nearly 4,000 separate road haulage businesses. He was a born administrator—quick thinking, quick moving and above all a dynamic driving force. Sometimes known as "Cyclone Charlie", the epithet was a well deserved one which aptly describes his characteristic exuberance and creative energy.

The eleven years during which he acted as chairman—with all the ups and downs of BRS and the upheavals caused by the political changes—must have been the most eventful in his life and certainly represent the years best known to his friends in the road haulage industry. The NFC stands as a lasting monument to his creative ability.

Yet he had an equally distinguished career both before and after this remarkable period. During the war of 1939–45 he served throughout on Movements Staff, first with the BEF in France, where he was responsible for all rail and road movements, secondly in GHQ Middle East, where he was a Director of Movements at the time of the battle of El Alamein, in the invasion of Sicily, and finally in India, where, as Deputy Quartermaster-General Movements and Transportation he was responsible for the activities of the transportation service, as well as for the co-ordination of movement plans in the India Base in support of forces operating in South East Asia Command. Thereafter he acted as Transport Advisor to the Special Commissioner for South East Asia until he was appointed to the Road Transport Executive in 1948.

When he became a member of the British Transport Commission in 1959 he relinquished the chairmanship of British Road Services, and applied his mind with equal enthusiasm to the wider and perhaps even more baffling problems of transport as a whole; the BTC was split up at the end of 1962 and he then became a member of the British Railways Board until he retired in 1964; at an earlier stage he had been a member of the Eastern Area Railways Board.

But how can mere words describe so unique a character? Truly as so tremendous a dynamo grinds to a halt, lights go out in the lives of many friends and colleagues. Memories will live long; and his life has left its indelible mark in our country's history.

EDWARD ERNEST (NED) STENHOUSE, soldier, sportsman and farmer, died peacefully in the Musgrove Park Hospital, Taunton after a short illness on 15 July 1971 at the age of 68. The only son of Lieut-Colonel V. D. Stenhouse, who commanded the West Somerset Yeomanry during the 1914–18 War and was for some years Master of the Minehead Harriers, he was educated at Rugby School and the Royal Military Academy, Woolwich. He was commissioned into the Royal Engineers in January 1923 and, following his young officer training at Chatham and his mounted duties course at Aldershot, he was posted to 59 Field Company, then stationed at Catterick, after which he was employed on works duties at Colchester and Shoeburyness. During his various postings in England he whipped-in to the RE Beagles and hunted and rode in point-to-point steeplechases whenever the chance presented itself. In all during his lifetime he hunted with no less than thirty different packs of hounds.

His posting to India early in 1930 marked the beginning of his long and outstanding service with Indian Sappers and Miners and gave him the chance to enjoy polo, shooting and trekking in the Himalayas. Joining the KGVO Bengal Sappers and Miners at Roorkee, where he remained for a year, he was selected to attend a course at the Indian Army Equitation School at Saugor—a rare distinction for a Sapper officer. From there he returned to Roorkee as an Assistant Superintendent of Instruction and later went with 3 Field Company Bengal Sappers and Miners to

Lieut-Colonel E E Steinhouse DSO

Peshawar where the Company was engaged in the operations taking place in the Mohmand territory.

When home on leave from India in 1934 he was married at Burtleigh Church, Somerset, by Bishop De Salis, to Marion Hamilton, younger daughter of Major and Mrs Paton of Wooton House, Butleigh, Glastonbury. They returned to Peshawar together where they stayed for a year before he was posted as Adjutant 3 Divisional Engineers at Bulford where their son Edward was born in 1937. Edward is now a Major in the 1st The Queen's Dragoon Guards serving at Catterick where his father first served and where he was able to re-live his experiences of forty-eight years ago only two weeks before he died.

Stenhouse was posted to a staff appointment in Palestine in 1938 and in 1940 returned to India where he became the Commanding Officer of 1 Training Battalion Bengal Sappers and Miners at Roorkee at that time expanding rapidly to deal with the vast wartime increase in size of that Corps.

In September 1942 Stenhouse went to the Middle East to take over the appointment of CRE 4 Indian Division, then resting after its arduous operations in Eritrea and the Western Desert. The Division arrived in Italy in December 1943 landing at Taranto to rejoin the British Eighth Army. Thence they moved to the Potenza area and their Sappers spent some weeks in bridging, constructing diversions and removing road blocks. In January the Division took over a sector on the Adriatic coast north of the River Sangro, but later in the month it was transferred to the west coast to join General Mark Clark's Fifth Army engaged in the bitter struggle raging at Cassino fifty miles north of Naples. The towering Monastery Hill, stubbornly defended by the 1st German Parachute Division, was the key to the defensive position known as the Gustav Line. For more than six weeks the Sappers of 4 Indian Division were heavily engaged on making mule tracks towards the monastery and a jeep track, known as Roorkee Road, and another jeep track, called Cavendish Road in honour of their former CRE, which was eventually widened for the passage of tanks. Work was carried out mostly in pouring rain and under sniper, mortar and heavy shell fire. Many deeds of bravery were carried out by officers and other ranks and Subedar Subramaniam of 11 Field Park Company Madras Sappers and Miners was the first member of the Indian Forces to be awarded the George Cross. It was a posthumous award. On 24 February 1944 he was in charge of a party engaged on clearing enemy mines on the Cavendish track. One of the party accidently trod on an anti-personnel mine and Subramaniam, hearing the small initial detonation and knowing that within four seconds the canister of the mine would be thrown in the air and explode with great violence, deliberately flung himself on the mine sacrificing his own life to save the lives of his party.

On 25 March 1944, 4 Indian Division left the stalemate at Cassino and returned to the Adriatic front held by V Corps. In recognition of gallant and distinguished services in Italy Stenhouse was awarded the DSO and was mentioned in despatches.

In October 1944, 4 Indian Division went to Greece in Brigade Groups as part of the occupation force, commanded by Lieut-General Sir Ronald Scobie, after the withdrawal of a considerable portion of German forces from the Balkans. However things were far from peaceful; before withdrawing the Germans carried out widespread and thorough demolitions and civil war broke out between Greek Government troops and a Communist element, known as ELAS, which had formed the backbone of the resistance movement during the German and Italian occupation. Divisional Headquarters, together with the CRE and one field company were sent to Salonika where Stenhouse and his few Sappers started on clearance work in the port area. A truce was arranged between the Greek Government and ELAS in January 1945 when it became possible for the engineers of General Scobie's force, then up to three divisional strength supported by Army and Works units, to start on the re-establishment of communications throughout the country. By this time Ned Stenhouse had spent almost six years overseas and he was posted home and then to North West Europe where he was present at the Rhine Crossing 23–4 March 1945.

Returning home again he was appointed Commanding Officer 6 Training Battalion RE, and was selected to command the Royal Engineer Marching Contingent on the Victory Parade, held in London on 8 June 1946. A splendid article, written by him, describing the parade appeared in the June 1971 edition of the *RE Journal* to mark the silver jubilee of the event. Short postings as a CRE in Southern Command and as a Divisional CRE in BAOR followed before he resigned his commission on 10 May 1948.

After retirement he settled at Yatford Farm, Broadway, Ilminster which he farmed for almost twenty years, raising a fine herd of Ayrshires. He was actively engaged in the affairs of the Church and the Parish Council, the National Farmers' Union, the Conservative Association and local field sports. He was also a Governor of the Ilminster Grammar School. In 1967 he gave up farming and moved to Chard where he lived only four years to enjoy his new surroundings. His funeral at St Andrew's Church, Chardstock on 27 July 1971 was attended by family mourners, the Deputy Lieutenant of Somerset, representing the Lord Lieutenant, many service friends and representatives of the Conservative Association and the farming, fox-hunting and beagling world. They came to pay tribute to a brave and great-hearted man. Our deepest sympathies are extended to his widow and son.

Lieut-General Sir Harold Williams wrote:

I should like to add to your tribute to Ned Stenhouse. We served together in the Bengal Sappers and I met him afterwards from time to time. I recall in particular a short and very happy holiday spent with him and Patty in Garhwal on the southern slopes of Trisul.

No one who knew him can easily forget him. Warm-hearted, enthusiastic and always apparently in the best possible humour, he inspired confidence and admiration in all around him. He had the qualities of a natural leader but they sat lightly on him and he took life cheerfully as it came. It was no surprise to hear that he did magnificently as a CRE in war.

He was at heart a countryman and when the war ended he took up farming. From all one heard he did so with equal vigour and enthusiasm. Tributes to his thoughtfulness and consideration for others, the useful part he played in the local Parish, and his happy disposition all rang very true.

The Corps has lost a fine officer, his friends and relations are the poorer of his passing, but all who knew him value the privilege of having experienced his friendship.

J.R.G. writes:

It was with deep regret that I saw in the *Supplement* that Ned Stenhouse had died. I had the honour of serving under him for nine hectic months in Italy when he was CRE of 4th Indian Division. As a Wartime CRE he was supreme, knowing how to get the best out of people and producing results with the minimum of fuss. Whatever the crisis, and there were quite a few, he appeared unruffled and ready with advice and help of the sort that was wanted.

Probably his greatest achievement was the widening of "Cavendish Road" for tanks, leading into the Cassino feature from the North and behind the "Snakes Head" towards Albaneta Farm, during the March battle. It was ready some days before it was used and it seems a fleeting opportunity was missed of capturing the Monastery from the rear. A bald description of the work appears in RETM No 18 published in October 1945. Later, he was to be responsible for opening-up a Divisional axis through hills East of the attack towards Arezzo. The result was a spectacular ladder through terraced vinyards which drew surprised comment from H.M. King George VI when visiting the battle area.

That the Germans were caught off-balance and before they had manned the section of the "Gothic Line" on the Divisional front, owes much to his efforts.

He was the sort of man whose real qualities become most apparent in wartime and whose services should not be forgotten.

Book Reviews

THE REGIMENTS DEPART. A HISTORY OF THE BRITISH ARMY 1945–1970

GREGORY BLAXLAND

(Published by William Kimber. 22A, Queen Anne's Gate, London. Price £6·25)

When Germany surrendered in May 1945 there was a vacuum in Europe and, when Japan followed suit in the following August, another vacuum was formed in the Far East. The British Army was sucked into both, so that in a short while British troops found themselves in occupation of greater areas of the earth's surface than ever before in British history. Had Britain been in the hands of a megalomaniac dictatorship, she could have helped herself to a greater slice of power throughout the world. But in Britain there was no will to wield this power; the will was to bring the soldiers home. This was not to be a glorious fulfilment of British Imperial design. Other influences had long been at work and it was, paradoxically, the signal to disengage from the Empire.

The process of disengagement was politically controlled and motivated; but it had to be carried out as a series of military operations. In the book under review, the author, Gregory Blaxland who was himself a Regular Officer for fifteen years, tells the story from the British Army's point of view. In *The Regiments Depart* he tackles the period 1945 to 1970 from both military aspects: on the one hand there were military operations to be conducted all over the world as the British presence was withdrawn; on the other the reorganizations deemed necessary as the scene changed. He avoids political controversy and sticks to what happened.

First we have a glimpse, though a brief one, of the three million men in battledress, khaki drill or jungle green pouring into the vacuum left by the collapse of Germany and Japan. Thereafter the tale is taken up in chapters on each scene as it occured: India, Palestine, Europe, Malaya, Korea, Egypt, Kenya, Cyprus, the Caribbean, Borneo, Africa and Aden. Each describes the military actions that took place. He gives a wealth of detail and mentions many regiments and men—from Commanders in Chief to private soldiers. He quote contemporary accounts and gives every proof of having done his homework carefully and well. In the last chapter he brings the story up to date under the haunting title of "The Lone Sentry" in Northern Ireland.

Interspersed between the chapters of military operations are chapters devoted to the organizations, reorganizations, disbandments and regroupings that took place. One feels, reading these chapters, that some decisions that in retrospect seem ill-considered (such as trying to establish a Base in the Middle East) could hardly have been avoided in the light of knowledge then prevailing. Your reviewer also got the impression—though whether the author would agree is not certain—that some of the arrangements made for reducing the Infantry to lesser numbers were not always happily tackled by Whitehall. Naturally in all this the Infantry take a prominent part, for the work is dedicated to the Regiments departed; but the other arms are not forgotten. Throughout the author keeps in the forefront of the reader's mind the mystical value the infantry soldier attaches to his regiment and the extreme caution that must be exercised by anyone, however distinguished as an infantryman, who seeks to tamper with the regimental system. (One of the outward signs of this is the portmanteau nature of the names of some modern Infantry Regiments. For example, The Worcestershire and Sherwood Forresters Regiment (29th/45th Foot). Reading this one may be sure that the 29th and the 45th Foot did not like the amalgamations in the last century—if then it was—any more than their grandsons in this). Your reviewer commends the author for his understanding touch in his record of all this.

To some this book may tell a story that is sad. Some may think that the British Empire should have gone down fighting. In a way, they may console themselves in the knowledge that it did. But unlike other Empires that have passed away, the British *won* their last two wars as an Empire; they then conducted events with a detachment and poise only made possible by the courage, discipline and competence of the Regiments Departed.

It is hard to say how a future Gibbon will view the period covered by this book; but he will be lucky if he has it by him to help him record what actually happened. A good book and considering its size, 532 pages, not a costly one.

M.C.A.H.

ACROSS THE PIAVE

NORMAN GLADDEN

(Published by Her Majesty's Stationery Office. Price 65p net)

This book is the second in the Imperial War Museum's "personal experience" series, the first being George Coppard's plain soldier's tale *With a Machine Gun to Cambrai*, which was reviewed in the September 1969 issue of the *RE Journal*.

The author was born in 1897. He entered the Post Office Savings Bank as a boy clerk in 1913. In 1915 he attested under the Derby Scheme to raise manpower without resorting to conscription and just before his nineteenth birthday he was called up, 19 years being the official enlistment age. He served as an infantry private on the Western Front on the Somme and at Ypres and in Italy. His book deals with his experiences in Italy. "There is nothing heroic or exceptional about my story" he writes: "What happened to me happened to millions of others, too many of whom were less fortunate." However his story is of absorbing interest. He writes honestly and dispassionately about what it was like, as a very young man, to be subjected to hardship, fatigue and hunger, the terrors and horrors of battle, the fear and anxiety over what the next day might bring and the moral temptations that beset young soldiers in Italian towns when resing out of the line.

The book is based on a series of diary notes which the author was somehow or other able to maintain and, as such, bears the hall mark of authenticity. A short historical introduction by the author prefaces each section of the book, which covers the events following the despatch of French and British troops to Italy after the Caporetto disaster to the victory of Vittorio Veneto and the complete collapse of Austria-Hungary, and gives an excellent resumé of the little-known 1917–19 Italian Campaign.

J.L.

EARLY AVIATION AT FARNBOROUGH, VOLUME I

PERCY B. WALKER

(Published by MacDonald, London. Price £6·50)

The author of this book, Dr Percy B. Walker, CBE, MA, PhD, FRAES, was a former head of the Aircraft Structures Department and Special Consultant to the Director of the Royal Aircraft Establishment, Farnborough and his work is the first comprehensive history of the development of flying in Britain. This Volume covers the development, mostly for military purposes, of balloons, man-lifting kites and airships from 1878 to 1910 when the RE Balloon School at Farnborough was reconstructed to include flying in heavier-than-air machines as well as the operation of airships, balloons and kites.

During the period covered in this Volume the Royal Engineers were responsible for "military aeronautics". The Volume, therefore, naturally deals very fully with the activities of the Corps in the early development of flight and the name of Colonel (later Major-General Sir John) Capper, KCB, KCVO, figures most prominently. This remarkable officer was commissioned into the Corps in 1880 and served for sixteen years in India with the Bengal Sappers and Miners and Military Works Department, taking part in the Tirah Campaign where he built the first road for wheeled transport up the Khyber Pass. During the South African War he was Assistant Director of Railway Transport and later Chief of Staff of the Rand Rifles, an unruly force of some 14,000 collected for the defence of Johannesburg and the Rand Mines. Although he had not served with the RE Balloon Sections in the South African War, he was in 1903 given command of the Balloon Sections (later Companies) RE at Aldershot and in 1905 he was appointed Commandant and Superintendent of the Balloon School and Factory at South Farnborough where he was virtually the head of the Air Service of the Army. He flew in man-lifting kites on Army Manoeuvres and held the first (British) Airships "Pilots" Licence and was the pilot of the first military airship, the *Nulli Secundus*, on its flight from Farnborough round St Paul's Cathedral on 5 October 1907. He was also engaged on the design and construction of later airships, including the *Baby* the most successful of all non-rigid airships which had a streamline shape and ballonet inside the envelope. During his time at South Farnborough man-lifting kites were perfected for use in conditions when balloons could not be used, and Balloon Companies RE, equipped with both balloons and kites, could operate in conditions from calm to winds up to fifty miles per hour. The first glider capable of making a soaring flight was developed and wireless communications between air and land and air photography were perfected.

Capper's time at Farnborough came to an end when he was appointed Commandant School of Military Engineering in April 1911. During the First World War he was Chief

Engineer III Corps and GOC 24 Division and in 1917 he was selected to become Commandant of the newly-formed Training Depot of the Tank Corps. He later became Chairman of the Tank's Committee and Director General of the Tank Corps. He showed the same enthusiasm, drive and foresight when dealing with these huge leviathans as he had at Farnborough with its delicate lighter-that-air equipments. From 1920–5 he was Lieut-Governor of Guernsey and in 1923 he became the first Colonel Commandant Royal Tank Corps. During the Second World War he was a Company Commander in the Home Guard. He died in May 1955 in his ninety-fourth year.

Other Sapper officers who served as early military aeronauts were, for the good of their military careers, not allowed to spend over-long in this very specialized branch of the Corps. The postings were reserved mostly for active young officers who could stand up to the hazards, buffeting and exposure to be expected in the pioneer days of flying, and more mature officers were selected to command the Balloon Companies. Many of these officers later reached high rank in the Army and aeronautics seems to have been a good preparatory school for subsequent advancement.

There were, however, two men who provided the continuity at Farnborough in the development of flight. One was the para-military Colonel J. L. B. Templer, a Militia Officer, and the colourful S. F. Cody a one-time American cowboy who set up a successful vaudeville company in England and who, although he could neither read nor write, was given officer status at Farnborough at a salary of £1,000 a year and free forage for his famous white bronco. Templer was the "father of ballooning" and Cody was famous for his kites and for carrying out the first recorded aeroplane flight in Great Britain in 1908.

In 1878 Templer, then a Captain in the Middlesex Yeomanry and who had for several years taken an interest in flying and had his own balloon, was appointed to carry out with Captain H. P. Lee, RE the experimental construction of balloons for military flying in Woolwich Arsenal. In 1880 military balloon training started at Aldershot under Captains Elsdale RE and Templer with personnel and transport from 24 Field Company RE. Two years later a School of Ballooning was set up at the SME and Captain Templer was placed in charge of the Balloon Factory there. He then accompanied a Balloon Detachment RE in the 1885 Suakin operations. In 1891 the Balloon Section and Depot moved to Aldershot and was supervised by Templer, now a Major. By 1897 a Balloon Factory, the forerunner of the RAE Farnborough, containing an electrolysis plant for the manufacture of hydrogen for balloons, was in operation with Lieut-Colonel Templer as its Superintendent. He also interested himself in the use of RE steam tractors (Steam Sappers) for hauling balloon trains. In November 1899 he was sent to South Africa as Director of Steam Transport where Steam Sappers towing a train of trailers were extensively used for clearance of ports and the haulage of ammunition and stores. They were also at times used by the three RE Balloon Sections employed operationally on a variety of reconnaissance tasks. He returned to Farnborough after the war, with the rank of Colonel, where he took the greatest interest in the advent of power-driven aircraft and was responsible for the inception of the first military airship later brought to practical fruition by Capper. Unhappily during this period he displeased the C-in-C Aldershot Command and his contract of employment was terminated in 1906 on reaching the age of sixty. He was, however, retained as a part-time Consultant for a further two years before his services were finally dispensed with in April 1908. It was ironical that Templer was forced to retire on his sixtieth birthday whereas his German counterpart, Count Zeppelin, was some eight years his senior and did not achieve any real success with his airships until he was seventy.

Both Capper and Templer were highly educated professional men. The third hero of Dr Walker's Volume, however, was illiterate yet, despite this, his contribution to early military flying was perhaps the greatest of the three.

Although the use of man-lifting kites for military purposes had been experimented with as far back as 1894, it was not until 1904 that Samuel Franklin Cody perfected a system which was used successfully on Army Manoeuvres. His kites became standard equipment for RE Balloon Companies in 1906 and Cody was engaged as Chief Instructor in Kiting and employed at the Balloon Factory on the construction of kites. Very considerable altitudes could be obtained and the observer sent aloft for aerial observation was in telephonic contact with the ground. Cody's kites were tried out by the Royal Navy in 1908 but they were not accepted for use on His Majesty's sea-going ships. He subsequently became one of the earliest pioneer aviators. He assisted in the completion and mechanical operation of *Nulli Secundus* and flew with Capper on his maiden flight around St Pauls. After experimenting with gliders and flying a modified kite with a small engine and propellor, he built a full-scale pusher bi-plane in the Balloon Factory. The fifty horse power engine from the *Nulli Secundus* was used for

the machine and on 16 October 1908 he accomplished an historic flight of just over a quarter of a mile, brought to an untimely end by Cody having to turn sharply to avoid a clump of trees and landing on a wing. It was, however, claimed as the first authentic sustained power-driven flight in Great Britain. On 8 September 1909 he flew a distance of forty miles at an approximate average speed of forty miles per hour and in July 1912 he won the first prize in the British Military Aeroplane Trials.

Sappers engaged on airfield construction today might smile at the requirements that the machine had to fulfil, namely that it "had to be capable of taking off in a short distance from long grass or harrowed ground and to land on rough ploughed land without damage".

Cody was killed in August 1913 whilst testing a machine over Laffan's Plain. Although the Royal Engineers were then no longer responsible for military flying—the Royal Flying Corps having been formed on 13 May 1912—they gave Cody a military funeral with full honours befitting the flamboyant cowboy from Texas USA who had rendered such an exceptional contribution to military aviation and had instructed so many RE officers and soldiers in the art of becoming airborne.

Besides writing in detail on the activities of the three heroes of his book Dr Walker has also described in a most lucid way the engineering and aerodynamic problems that were overcome, or partly overcome, during the pioneer days of flying. He has also recorded many other wonderful things that happened at Aldershot and Farnborough during those halcyon Edwardian days when flight was exciting, novel and in its infancy, and children and grown-ups would look upwards in astonishment, amazement and awe whenever a flying machine could be seen in the sky.

J.L.

FIELD SERVICE POCKET BOOK (1914)

A Reprint

(Published by David and Charles (Publishers) Limited. South Devon House, Newton Abbot, Devon. Price £2·50 net)

When the British Expeditionary Force went to France in 1914, every Officer was expected to carry a copy of Field Service Pocket Book (1914) in his kit. His kit was in two categories: that carried "on the person" and that carried "in Train Transport". That carried on the person weighed over 40 lb. When one considers that the marches on foot during the Retreat from Mons averaged twelve miles a day, over and above fighting rearguard actions, it makes one realize what giants the Old Contemptibles were.

In the Divisional Engineers every Officer had a horse, though no doubt he usually lent it to a footsore Sapper; and every Field Company had eighteen horsed vehicles of various kinds into which ingenious Officers Commanding no doubt contrived to lessen the loads on their men's backs; but even so a lot must have been carried by Officers and Other Ranks, marching on their feet. Many must have yearned for the Flying Corps, then a part of the Army, and covered in this Field Service Pocket Book (hereafter abbreviated FSPB). In the Flying Corps, horses and motor cars were abundant. There may even have been aeroplanes as well; but these are not mentioned. Kites, incidentally, were to be found in a Kite Squadron at Flying Corps Headquarters.

These figures are to be found in Chapter I of FSPB (1914), reprinted between hard covers in 1971. Scanning this volume recalls boyhood memories of my father, who joined the Army in 1914 at the age of forty-eight, and was posted to the Cambridgeshire Regiment (although a Balliol man) in Peterborough. I can see him now, poring over his "military books" in the evenings—perhaps even over this FSPB under review. He must have been perplexed by many things. He was, as I see from one of his surviving books, in H Company; but in FSPB (1914) only battalions in India had eight companies. He must also have been impressed by the variety of facts he might be called upon to handle: that an elephant requires twenty-five gallons of water, and that "a gentleman's calling card is 3" × 1½" in size". Today, one surmises (if FSPB is still published), that neither elephants nor gentlemen have any part to play in it.

Having mastered some of these statistics, the newcomer to the Army might be instructed in a wide variety of subjects. The Chapters cover everything from Camp Cookery to Sanitation; or from Overseas Operations to Map Reading. Field Engineering, Demolitions, Transport, Supply, Pay, Clothing, Office Work, Discipline, the Armies of Foreign Nations and the Points of the Compass all come within the scope of the volume. To summarize all this would be tedious for the reader; but a few glimpses may show what a rigid, professional Service the civilian was entering in August 1914.

The Sections on discipline make one wince at the number of offences in the Army Act that were punishable with death. The process known to a later generation as "liberating" was described in 1914 as "going in search of plunder" and as such might warrant the death penalty—particularly if a man deserted his commanding officer for the purpose. Your reviewer can well remember reflecting in 1944 what an anomaly it seemed that the few rogues who deserted their units might, at the worst, be caught and sent to Maidstone Prison; whilst their stauncher comrades, who faced the enemy, might meet death at any moment. In 1914 a sterner rule prevailed and the death sentence was freely resorted to. FSPB (1914) does not say what was to happen to the generals of the vanquished; but one cannot help thinking that in the next world war they may receive short shrift at the hands of the victors; so perhaps our forebears were more civilized than we always give them credit for.

Whether civilized or not, however, they were very efficient. It took only forty minutes to entrain a whole squadron of cavalry, and the men were enjoined not to waste time "dealing timorously with a jibbing horse". They were to link arms behind him and "simply hustle him into the truck". One feels sure they were most of them quite accustomed to horses and knew just how to do it.

All officers were required to understand codes and ciphers. One of the ciphers recommended was known as the Playfair Cypher, and an example of a message enciphered in it is displayed. Looking up a logarithm is child's play compared with this. FSPB states that it is "if not insoluble" very difficult to decipher in time to be of use to the enemy; and your reviewer feels that even the authorized recipient, with the key word before him, might not manage to make sense of it in time either. But then, one feels, they were a very thorough sort of soldierly type.

There is evidence that in 1914 men were stronger than perhaps they are today. A sack of coal, for instance, weighed 2 cwt whereas today they usually hold one—or even a half hundredweight. Butter was measured by the firkin (56 lb), and coffee might be encountered in bags weighing 1½ cwt.

There is plenty of common sense in FSPB (1914). For instance, if you are made Commander of a patrol "you must make sure you understand what you have to do"; and when you "send in" (not "submit") your report, you must not waste time writing "a long story". The authors of FSBP (1914) had evidently deduced (without the advantage of actual experience) that the air battle must be won first, for they remark that "it must not be forgotten that the enemy will himself possess aircraft which must first be defeated". In view of this it is curious that they never mention any need for protection or concealment from the air; and they illustrate designs for camps of various kinds without any regard for either.

A section on the strengths of Foreign Armies reveals that in 1914 the American Army consisted of 85,000 men, whilst the army of a Balkan State such as Rumania, consisted of seventeen divisions. (Incidently, the practice of distinguishing the First Division—written 1 Division—from a single division—written one division—had not apparently been devised. Nor was the term *Infantry* Division used: it was merely a Division as opposed to a Cavalry Division).

Your reviewer is impressed by the precision of thought and the intellectual grasp of the authors of the book under review. There was no lack of brains in the compilation of this book, and there is evidence of a lively experience of active service conditions. It seems all the more extraordinary, therefore, that this wonderful body of men came to be set in the strait jacket of trench warfare. One wonders why they had not already seen the possibilities of the mechanical age that had dawned, and had not harnessed it more to their needs. The book illuminates many aspects of the life and conditions of the Service in those bygone days; and for that reason it will be of value to those engaged in historical research. The general reader may derive some quiet entertainment from skipping through the pages; but at £2·50 it seems that many readers will prefer to get it from a library rather than buy it.

M.C.A.H.

MONTGOMERY AS MILITARY COMMANDER

RONALD LEWIN

(Published by Batsford. Price £3·50)

It is not easy to write another book about Montgomery; but because he is such a controversial figure, there is bound to be potential interest. Whether that interest is held depends upon the treatment and, in my opinion, Mr Lewin does succeed in holding it. He has an easy style and endeavours to select only what is relevant to his theme from the mass of material. It is always difficult to know how much detail to include in describing military actions. The

feeling given here is that there is more than is strictly necessary, but this may be because the maps are unfortunately not good enough to follow it.

Mr Lewin served as a regimental officer in the Gunners from, as he says, "the Nile to the Baltic". It is therefore rather surprising that he seems to go out of his way to mention the Sappers. Among other things, he quotes at length an account of minefield clearance at Alamein by 3 Fd Sqn (OC Major Peter Moore) when accompanied by their CRE (Lt Col McMeekan).

In assessing Montgomery as a military commander, he tries to remain detached and "to consider coolly the hot expressions of opinion by those who have taken sides". His conclusion is that in the final analysis, the plea of those generals he talked to must be granted: "he is our finest commander since Wellington". But he makes no attempt to gloss over what he considers to be Montgomery's shortcomings, particularly in the matter of his relations with Eisenhower, about which he is severely critical. How much this should detract from his reputation as a military commander is perhaps arguable. He was not politically minded and as a very professional soldier and the most experienced allied commander at the time of Normandy, it is not surprising that he should have believed that the war in NW Europe would have been conducted more efficiently and brought to a quicker conclusion, if the allied armies had been kept under the control of a single land force commander, namely himself.

One of Mr Lewin's military criticisms is that Montgomery had no clear cut operational plan for the pursuit after Alamein and because of this, there was no properly organized scheme of maintenance. He was, however, always very much aware of the need for good administrative backing and in this case had to tailor his operational plan to what was administratively feasible.

The author brings out very well his emphasis on balance, his careful planning and control of a battle, forcing the enemy to dance to his tune and his appreciation of morale as the most important single battle-winning factor. What perhaps he does not stress sufficiently is Montgomery's farsightedness. He was always planning the next battle or the next battle but one. He does, however, give due credit to his appreciation of the value of General Hobart's special tanks in the Normandy landings and later.

I would recommend this book to anyone who is interested in the study of generals and generalship. It is a worthwhile contribution to the already considerable collection of books on Montgomery.

R.O.H.C.

ALEXANDER OF TUNIS AS MILITARY COMMANDER

W. G. F. JACKSON

(Published by B. T. Batsford Ltd, London. Price £3·60)

In the words of the already well known Sapper author, this book is "a personal assessment of Field Marshal Alexander as a commander". It is based upon the most thorough research, brilliantly and lucidly portrayed. As a result it is far more than an assessment of the personal attributes and military abilities of one of the most outstanding military commanders of his day. The backcloth for Lieut-General Sir William Jackson's analysis provides us with setting after setting for the examination of the qualities required of a commander in every rank, from 2nd Lieutenant in 1911 to a Commander-in-Chief of soldiers of many nations in 1945.

Alex was bred for the job of thirty-four years of self-effacing duty to King and Country as a soldier. But this alone does not make an endearing, respected and outstanding commander. The author shows how, in World War One, he had soon served his apprenticeship and learnt the basic essentials of his trade; what men can endure if properly led, the consequences of poor leadership and the dangers of preconceived ideas. He describes how, between the two World Wars, Alex obtained invaluable experience in command of other nationals and of politico-military problems in Latvia, Constantinople and on the North West Frontier, which were to serve him in such good stead in later years.

His sound and imperturbable leadership as a Divisional Commander in the retreat to Dunkirk as a Corps Commander during the evacuation resulted in him becoming marked by Churchill for further advancement. The author describes the settings and actions which portray Alex's strength and weakness through the retreat from Burma, the holding of Rommel in the Western Desert and his defeat at El Alamein, the operations in Tunisia leading to the rout of the German and Italian armies in North Africa. The offensives in Sicily and all the

way up Italy culminating in the final surrender of the German forces in Lombardy. He carefully diagnoses the reasons for Alex's successes and few mistakes.

This is a book which will become a classic amongst the analytical studies of successful command against a fascinatingly told background of relevant military history during the period 1914–45. How General Jackson, as DCGS and now as an Army Commander, finds the time to undertake great works of this sort is a subject which in due course will merit independent study.

E.C.W.M.

Technical Notes

CIVIL ENGINEERING

Civil Engineering & Public Works Review

JULY 1971

CLIFF STABILIZATION. Instead of building a sea wall, a new method of cliff stabilization developed by an architect, Eric Gregory, and a chartered engineer Arthur White uses a system of galvanized steel trays supported on plastic coated 0·76 in steel strand. The strand is anchored at top and bottom and spaced at 10-ft centres along the cliff face. After installation a granular top soil is tipped over the face and is retained by the trays. The top soil is stabilized by mulching with a seed/fertilizer/resin mixture sprayed onto the surface. The resin binder gives immediate protection until the grass has established itself.

WINTER WORKING. This short article by J. R. Smith, ARICS, the adviser on winter building at the Department of the Environment, discusses some of the problems associated with Civil Engineering during bad weather. He deals with health, protective clothing and standards of electrical illumination. A second article "What's wrong with winter working" comments on Smith's article and discusses how government should assist. As a postscript there is a mention of the Jeltex two-piece polyurethane coated nylon suit.

AUGUST 1971

CRITICAL PATH METHODS. In this short article, P. A. Cox of Rendel, Palmer and Tritton, Consulting Engineers, discusses improvements to the standard type of Critical Path programming as taught and practised by the Corps. He suggests that modified network diagrams are preferable to Precedence *Diagrams* which are currently in vogue at 62 CRE (Construction).

TUNNELLING. No less than thirty-six pages of this issue are devoted to the subject and the several articles give an up-to-date review of current practice in all types of tunnelling. Rock tunnelling is covered by T. J. O'Brien of Mitchell Construction Kinnear Moodie who are well known for their work on Scottish hydro-electric projects. The Mersea (Kingsway) Tunnel is described by T. M. Megaw, senior partner of Mott, Hay and Anderson. An article about the Brixton Extension of the Victoria tube line describes the use of ground freezing to cope with difficult conditions. D. J. Venan of Scott Wilson and Kirkpatrick describes the totally different tunnel sunk across Hong Kong harbour.

PRECAST DIAPHRAGM WALLING. Most engineers are aware of the technique of using a bentonite slurry during excavation for a diaphragm wall. A new technique, called Panosol, has been developed by Soletanche the French geotechnical firm. This uses interlocking precast panels so that a perfectly smooth wall is produced without the expense of fair facing the normal diaphragm wall.

CONCRETE RAIL BRIDGE SLID INTO POSITION. British Rail engineers slid into position a 6,500-ton bridge built by A. Monk and Co Ltd to allow the Derby inner ring road to pass under the four-track Derby–Leeds railway line. It may interest readers to know that Captain J. A. Jennings-Bramly is involved in a similar project at Sharston near Manchester.

SEPTEMBER 1971

GROUND ENGINEERING AND THE SUPPORT OF UNSTABLE GROUND. This subject is the major feature of the issue and comprises many short articles each dealing with particular aspects of the general problem.

A. L. Mieville, DSO, MC, CEng, FIMechE, LMEI Canada contributes a most interesting article on mining subsidence. He describes mining methods in outline and continues with

Site investigation and Drilling for further information. After considering the use of Grouted Columns he describes Modern Mining and Subsidence. The article concludes with a discussion of foundations for use in subsidence-prone areas.

Anyone who has seen the coal mine tips of South Wales will welcome the conversion of the Letty Shenkin Tips at Cwmbach, Aberdare into a housing site. The article by B. O. Corbett and J. A. Lord of Ore Arup and Partners describes how the work was done.

R. N. Craig of Sir William Halcrow and Partners writes about the stabilization of the cliffs at Barton-on-Sea, Hampshire. In principle the works consisted of an interceptor drainage trench with a deeply piled cut-off into the Barton beds, Collector systems for surface water drainage and gravel blanketting of the toe.

R. Kee and H. G. Clapham of Ground Engineering contribute an Empirical Method of Foundation Design in Chalk, while G. P. Foley and A. G. Davis describe Piling in Keuper Marl at Leicester. The final article on the Design of Tunnel Linings is by D. A. Howells of Howard Humphreys and Sons.

CONSTRUCTION DIGEST. Amongst the many interesting equipments reviewed are the following: a 20·5-ft tunnel borer, a rotating skip dumper and a diesel engine powered Alimak raise climber.

W.G.C.

THE MILITARY ENGINEER

JULY–AUGUST 1971

An interesting article on Underground pipeline installation entitled "Laser-aligned Moling Operation". It describes the laying of 5,000 ft of a main storm sewer by moling and hydraulic jacking. The diameter of the pipes varied from 72 in to 96 in. The alignment of the whole operation was maintained by the use of a laser beam and variation in actual and theoretical line and grade achieved was only 0·10 ft.

"Computers for Military Engineering" is an article describing how the US Army Corps of Engineers use computers. It deals with their systems, the engineering application from which computers are used, the present status and their thoughts for the future.

For the field engineer there are notes on the protection of a shore line embankment using Riprap panels for stability, the construction of a chain link fence as a barrier against rocket fire for the protection of helicopters and a simple expedient for converting a scoop-loader into a crane.

"Heavy Concrete Placing" is a short article on a simple but effective method of placing heavy concrete construction below ground level when the sinking of caissons and dewatering is impracticable. The system consisted of sand filling the excavation, building the 235-ton concrete construction on the sand base, and then using air/water jetting in conjunction with pumps gradually to sink the construction to its final position of 30-ft below ground level.

Other articles of minor interest are "Mapping in South-East Asia", "Seismic Safety of Dams", "Anchor Chain Land Clearing" and "Land Clearing in the Delta, Vietnam".

M.F.R.C.

Forthcoming Events

14 December	Joint Meeting Institution of Royal Engineers and Kent Branch Institution of Civil Engineers	Brompton Study Centre
17 January	47 YO Batch Night	Chattenden Mess
28 January	Ladies' Dinner Night	RE HQ Mess
29 February	Corps Guest Night	RE HQ Mess
6 March	Parade to Commemorate the Bi-Centenary of the Formation of The Soldier Artificers	Gibraltar
23 March	REYC AGM and Dinner	Brompton Study Centre and RE HQ Mess
12 April	University Symposium on Engineering	
	Cocktail Party	RE HQ Mess
30 April	Memorial Service and Luncheon	Rochester Cathedral and RE HQ Mess

SPORTS AND GAMES FIXTURES

RE RUGBY FOOTBALL CLUB

8 December	RA	Chatham
12 January	RCT	Aldershot
2 February	Cambridge LX Club	Cambridge
16 February	REME	Chatham
1 March	RAMC	Mytchett

RE HOCKEY CLUB

8 December	RMA	Sandhurst
11 December	Hampstead	Hornsey
18 December	HAC	Gillingham
16 January	Hawks	Whiteley
19 January	US Porstmouth (L)	Longmoor
22 January	Surbiton	Surbiton
29 January	Havant (L)	Longmoor
31 January	Cambridge University	Cambridge
2 February	London University	London
12 February	Blackheath	Forrest Hill
13 February	Cheam	Gillingham
19 February	West Hants (L)	Longmoor
20 February	Maidenhead	Bray

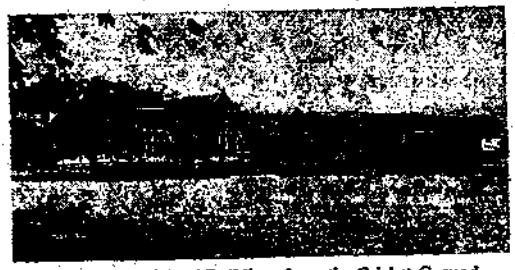
RE SQUASH RACKETS CLUB

13 January	REME	Borden Officers' Club
16 January	RMA Sandhurst	Minley Manor
20 January	Trojans (Southampton)	Minley Manor
2 February	RCT	Minley Manor
9 February	RAEC	Minley Manor
21 February	Old Bradfieldians	Naval and Military Piccadilly
23 February	Para Bde	Aldershot Para Bde Courts

THE GORDON BOYS' SCHOOL

The National Memorial to General Gordon

Founded 1885



A view of the School Buildings from the Cricket Ground

WEST END · WOKING · SURREY

Telephone: Chobham 8084 *and* 8085

The Gordon Boys' School, a voluntary aided school, is conveniently located 25 miles from London. It offers a good boarding education and boys who make the necessary progress are able to take the G.C.E. "O" level examination at the end of the course, at the age of about 16 years. Boys may also be helped to take the G.C.E. "A" level examination subsequently, if they are able to reach this standard.

The fees are moderate by present-day standards and fathers who are serving in the Armed Forces may draw the Service education allowance to help with the payment of the fees.

The School has a high proportion of sons of Servicemen and it is particularly sympathetic to their educational needs. It can be especially useful when fathers are liable to be posted overseas.

The age of entry is 12 to 14 years. There is a simple entrance examination, which is held in June and October, for admission to the School each September and January.

Full details may be obtained by writing to The Headmaster The Gordon Boys' School, West End, Woking, Surrey.