THE ROYAL ENGINEERS JOURNAL

Vol LXXXVI DECEMBER 1972 No 4

Published Quarterly by
The Institution of Royal Engineers, Chatham, Kent
Telephone: Medway (0634) 42669

Printers
W & J Mackay Limited Lordswood Chatham Kent
Telephone: Medway (0634) 64381

THE COUNCIL OF THE INSTITUTION OF ROYAL ENGINEERS

(Established 1875, Incorporated by Royal Charter, 1923)

Patron—HER MAJESTY THE QUEEN

President

Major-General Sir Gerald Duke, KBE, CB, DSO, BA, C Eng, FICE, DL 1970

Vice-Presidents

Major-General F. G. Caldwell, OBE, MC* 1970

Brigadier M. L. Crosthwait, MBE, MA, C Eng, MICE, MBIM 1970

Elected Members

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

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

Colonel W. C. S. Harrison, CBE, ERD, ADC, C Eng, FICE, MIHE ... 1970

Brigadier A. E. Arnold, CBE, BSc 1970

Brigadier B. C. Elgood, MBE, BA 1970

Brigadier P. J. M. Pellereau, MA, C Eng, FIMechE, MBIM 1970

Major W. M. R. Addison, RE, BSc 1970

Major D. McCarthy, MM, RE, AMBIM 1970

Captain T. R. Kirkpatrick RE, BSc, (Eng) 1971

Brigadier J. D. Walker, OBE 1972

Ex-Officio Members

Brigadier G. T. E. Westbrook, OBE ... ... D/E-in-C

Colonel H. R. D. Hart, BSc, MBIM ... ... AAG RE

Brigadier S. E. M. Goodall, OBE, MC, BSc ... ... Comdt RSME

Brigadier J. Kelsey, CBE, BSc, ARICS ... ... D Mil Survey

Colonel A. H. W. Sandes, MA, C Eng, MICE ... ... D/Comdt RSME

Brigadier P. F. Aylwin-Foster, MA, C Eng, MICE ... ... Comd Trg Bde RE

Brigadier J. R. E. Hamilton-Baillie, MC, BA, C Eng, MICE ... ... D. Engr Svcs

---

Corresponding Members

Brigadier P. Yonge, *Australian Military Forces* 1972

Lieut-Colonel J. M. Harman, BSc, C Eng, MICE
Royal New Zealand Engineers 1972

Brigadier-General N. C. Brown, DFC, CD
Canadian Forces 1971

Secretary and Editor RE Journal

Colonel E. E. Peel, BSc, C Eng, FICE 1972

Bankers

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

THE ROYAL ENGINEERS JOURNAL

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

VOL. LXXXVI CONTENTS DECEMBER, 1972

4,100

Major-General M. E. Tickell, MBE, MC, MA

Major-General M E Tickell, MBE,MC,MA

Engineer-in-Chief (Army)

On 10 December 1972, Major-General F. G. Caldwell, OBE, MC, will hand over as Engineer-in-Chief (Army) to Major-General M. E. Tickell, MBE, MC, MA.

The new E-in-C comes from a family which is rich in Sapper tradition. His father is Major-General Sir Eustace F. Tickell, KBE, CB, MC, who was Engineer-in-Chief from 1945 to 1948, and subsequently President of the Institution of Royal Engineers and a Colonel Commandant, RE. His great-grandfather was Lieut-General Richard Tickell, CB (1785–1855), a founder member of the Bengal Sappers and Miners; his grandfather was Chief Engineer, Kashmir with the Indian PWD; his uncle, the late Colonel J. K. Tickell, was OIC RE Records; and his brother, Captain R. L. Tickell, served in the Corps from 1951 to 1961. It is perhaps appropriate that his godfather, Lieut-Colonel H. S. Francis, OBE is the present Curator of the RE Museum.

Major-General Marston Tickell was educated at Wellington College and after two years in the ranks was commissioned into the Corps at Newark on 2 April 1944.

As a subaltern he served in the North West Europe campaign with 100 Royal Monmouthshire RE Field Company in 8 Corps. As a section commander, he took part in major bridging operations over the Seine, Maas (four times), Rhine and Weser. He was awarded the Military Cross and was mentioned in despatches.

After the war he served in 253 Field Company in the Middle East before returning for a degree course at Peterhouse, Cambridge in 1946. Here he gained a first-class honours degree in Part I of the Mechanical Sciences Tripos and stayed on for a further year to gain the Archibald Denny prize for the top "civils" graduate in Part II in 1949. (He shared a study throughout, and the Honours, with the present Director of Army Staff Duties, Major-General W. G. H. Beach, OBE, MC, MA, and they even took turns as Captain of Boats.)

From 1949–52 he was an instructor in the Construction School at the School of Military Engineering in Chatham before moving to BAOR to join 26 Field Engineer Regiment of 11th Armoured Division, first as second-in-command of 60 Field Squadron and then as Adjutant.

He was a student at the Staff College, Camberley in 1954 and then went to the War Office for two years as GSO 2 in Military Operations, after which he was awarded an MBE. In May 1957 he became Officer Commanding 23 Field Squadron, serving in Libya, Cyprus and Jordan as well as on Salisbury Plain. In 1959 he became a student at the United States Armed Forces Staff College and returned for a tour as an instructor, first at the RMCS and then the Staff College. He was made a brevet Lieut-Colonel in 1962 and then became GSO 1 in the Defence Planning Staff during the early days of the combined Ministry of Defence.

He was CRE 4th Division in BAOR from 1964–66 and then moved for the third time to the Staff College, Camberley as a Colonel GS.

His next appointment was Commander 12 Engineer Brigade during two years when the Brigade was able to undertake a wide variety of operational and training tasks, from flood and storm relief in the United Kingdom to construction work in some twenty countries in many parts of the world.

After spending 1970 as a student at the Indian National Defence College, he has recently been Chief of Staff in Headquarters, Northern Ireland during two of the more turbulent years in Ulster's history.

He has been particularly involved in organizing Corps gliding and sailing and is an experienced ocean racing skipper.

* * * * *

Lord Mais -Lord Mayor of London

Lord Mais
Lord Mayor of London

WE are proud to record that the new Lord Mayor of London, Baron Mais of Walbrook in the City of London, OBE, ERD, TD, DL, who is an eminent Engineer and Industrialist, is also a distinguished Territorial Sapper Officer.

Lord Mais was born in Southampton, where he was educated at Banister Court School. He attended London University and the College of Estate Management and has qualified as a Chartered Civil Engineer. After serving in engineering appointments in a number of civil firms he became Chief Surveyor of Richard Costain Ltd in 1936. He also served as General Manager of the Parker Construction Company and in management of his own firm A. R. Mais and Partners.

In July 1929 Lord Mais was granted a Territorial Army commission in the 20th London Regiment (Queens Own). He transferred to the Royal Engineers in 1931 when he joined the 47th (2nd London) Divisional Engineers.

In 1938 he became second in command of 221 Field Company, and a year later was appointed to command 502 Field Company.

Shortly after embodiment in 1939 he was posted to the Transportation Branch of the Corps in which he spent the whole of his war service. After a brief period in France in 1940 with 161 Railway Construction Company he returned to the UK where he continued to command the Company until April 1941 when he was posted to the Special Service Section RE. In September 1941 he was promoted Lieut-Colonel and appointed Assistant Director of Transportation 10th Army in Persia.

In January 1943 Lord Mais returned to the United Kingdom and was posted to Combined Operations Staff until April 1944 when he joined the Transportation Branch of 21 Army Group who were at the time planning the construction of the Mulberry Harbour System.

He landed in France in June 1944, was wounded on active service, and was promoted Colonel in November 1944. For his war service he was three times mentioned in despatches, awarded the Order of Patriotic War 1st Class and made an Officer of the Order of the British Empire in 1945. At the end of the war he became Deputy Director General of the Inland Water Transport Division of the Control Commission for Germany, until April 1946 when he left the Service to resume his professional life as an engineer. In 1948 he joined the Board of Trollope and Colls, in which he became Managing Director in 1961 and Chairman in 1963. He retired from the Company in 1968 after successfully merging this Company with Trafalgar House Investments Limited.

Despite an extremely active business life, in which he is currently Chairman of three Companies he has found time to continue his service in the Reserve Army. He rejoined the Territorial Army when it was reformed in 1946 and was selected to command 101 Field Engineer Regiment TA in May 1947 and simultaneously became CRE 56 (London) Armoured Division. Three years later he was promoted Colonel and was transferred to the Supplementary Reserve of Officers.

Lord Mais has served as Alderman, and Sheriff of the City of London and was appointed a Deputy Lieutenant of the County of London in 1951. He was created a Life Peer, in 1967.

* * * * *

The Darien Challenge

(The story of The British Trans-Americas Expedition)

MAJOR J. N. BLASHFORD-SNELL, MBE RE

THE mud struck me full in the face and I felt an intense but momentary pain, as Cromwell trod on top of me, pushing me deeper into the black slime. As I struggled to breathe and extract myself a strong smell of whisky revived me, alas the beast had put his hoof right on my spirit flask and smashed it against a tin of dubbin.

The great bay horse looked down at me and I'll swear he laughed. Unfortunately this was a frequent occurrence, if when leading your pack horse across a ravine, your feet became stuck fast and the animal coming at a rush trampled you into the mud. I began to hate the Darien Gap with a loathing that one might have for a cruel enemy in wartime, but I also respected it.

It seems to be a decade ago, although it was only in 1970 that I was invited to lead The British Trans-Americas Expedition. The aim was to focus attention on the need to complete the 17,000 mile Pan American Highway, connecting North and South America, by taking motor vehicles from Alaska to Tierra del Fuego. At present, it is blocked by this notorious "Tapon del Darien", which previously had defeated all attempts to take vehicles through the Gap and over the great Atrato swamp. The expedition also carried out a large-scale scientific programme involving British, American and Panamanian scientists, who examined the botany, biology, geology, geography, entomology and zoology of the region. Medical and veterinary subjects as well as the Indians were also studied.

Originally the idea for the venture came from the Darien Action Committee in the Americas, and a British Trans-Americas Expedition Committee under the energetic Chairmanship of Lieut-Colonel Julian du Parc Braham was formed in 1970. The senior officer on the Committee was the Engineer-in-Chief, Major-General F. G. Caldwell. Experienced explorers and travellers in this wild land were asked to consider whether such a project was feasible. Most people considered it was sheer folly, especially as several other well-prepared expeditions had failed.

In 1970 the Committee asked my advice on the idea. Looking back I remember that I too, considered that it was madness, but after a reconnaissance party had visited the area, I believed that it could be done, but it would need to be a massive undertaking, fought like a long-drawn-out battle, with a good chance of high casualties and a certainty of great discomfort. Nevertheless, the project got under way and soon the supporters included the British Army and the Governments of Panama and Colombia, the British Museum (Natural History), the Scientific Exploration Society and numerous companies and individuals in Britain and the Americas. With the backing of the Army, the expedition assumed the proportions of a war-time task force: fifty-nine men and five women from Britain and America joined some forty Panamanian soldiers and thirty Colombian servicemen in central America in early January 1972. Operation Darien, as it was known, had begun. Air support consisted of a British Army Beaver aircraft, plus helicopters from the United States Air Force and the Air Forces of Panama and Colombia. Medium range transport aircraft and light reconnaissance planes also helped us.

Amongst our stores was an impressive quantity of engineer equipment, including hand tools, power saws, water filters, theodolites, a special light weight bridging device known to us as "The MEXE ladder" plus an inflatable raft able to carry up to 6,000 pounds. All our kit had been developed and tested in Britain before it was flown by the RAF to Panama. Everything had to be light, robust, reliable and portable.

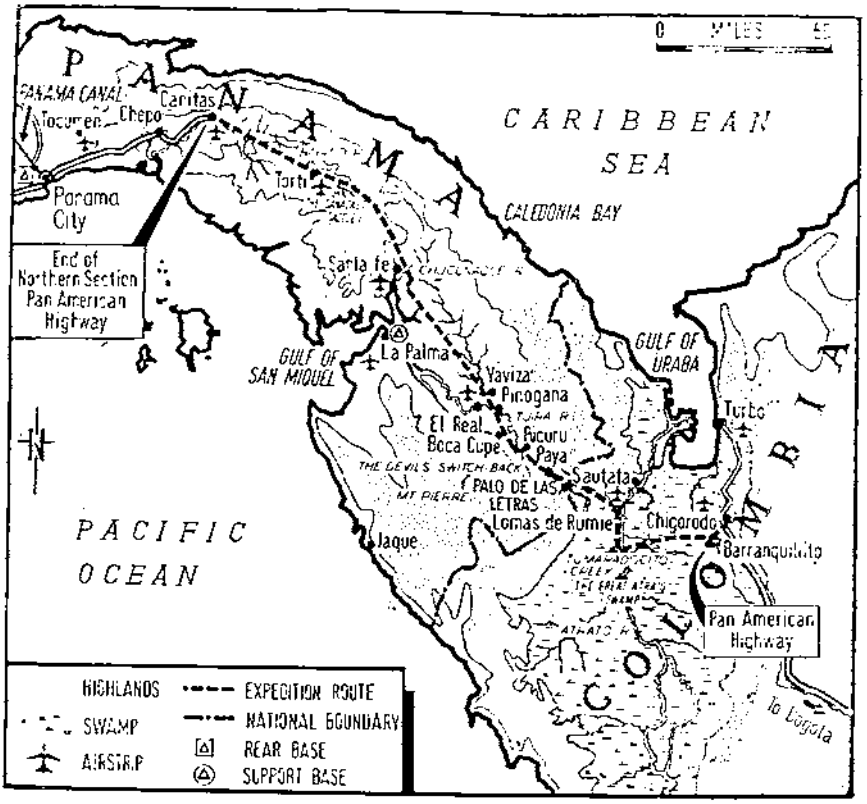
The vehicles chosen for this great drive were two Range Rovers kindly provided by British Leyland and they were to be joined later by a Land Rover pathfinder,

which we purchased in Panama. The Range Rovers with six men as their crew went on to complete the drive from Alaska, which they left in early December 1971, to Tierra del Fuego, where they arrived in June 1972. The Land Rover, having completed its task as a pathfinder, was flown back to Panama and given to the Guardia Nacional.

The rains in Panama usually end in mid-December. One then has approximately three months of relatively dry season to cross the Gap but in 1972 we were out of luck. The rains did not end until mid-January and as a result the ground on the first part of our route was a sea of mud. My first task was to carry out an air reconnaissance. The Beaver flew in on a cool summery morning to the little airstrip at the Military Instruction Centre on the edge of the Gap. Soon we were racing through the cold morning air, the roar of that powerful engine taking us up and above our Base Camp. I looked down; this was the enemy, I thought, about which I had been reading and hearing for several years. Now for the first time I was seeing the Darien Gap, one of the most difficult and dangerous places in the world. We turned above the air strip and headed east-south-east. Beneath us was a gentle country, rolling green savannah, dotted park-like with trees and herds of white cattle. The town of Chepo, with its galvanized iron water tower, slid by under the port wing. Beyond, the sun glinted on the thick brown coil of the Bayano river, glistening like a giant snake. A scatter of white boxes in a square of turned red earth was Canitas. We tilted down as our pilot, Captain David Reid of the Army Air Corps, turned the Beaver once again. Now the grass land was patchier; the green darkened and thrust up towards us. A mist that had lain in "sausage" shaped clouds at tree top level began to clear.

The true shape of our enemy showed, but from 500 feet it still looked oddly innocuous, the ridges that rose steeply beside us were forested, but on the plateau between, the trees that stood out most were widely scattered. All rose straight-trunked, some carrying umbrellas of foliage at their tops, other white and dead looking. Their branches were like spread fingers reaching up to us. We dropped to have a closer look. I glanced at the altimeter. It still read 400 feet, yet we seemed almost to be brushing the tallest trees. I looked again at the green carpet around their base; what we had been looking at was merely the primary jungle; the real problem lay below it. The most prominent trees must have been up to 150 ft high. They rose out of the undergrowth so thick that even from a modest height, it looked solid. This secondary jungle flourished where the tallest trees were sparse and let the sun in. Although it seemed like shrubbery, what we could see were the tops of lesser trees.

The Bayano alone broke up the mass. David throttled back and put the Beaver's nose down. We skimmed between the trees a hundred feet or so above the water over one of the long, narrow outboard-powered canoes that serve as river transport in Darien. Faces turned up and arms waved. The Beaver's nose lifted and with a shattering roar from the engine we were carried over a loop in the river. The neat rectangular palm leaf roofs of an Indian village clustered on the bank. Strangely, not a soul was in sight. We climbed to 1,500 ft and headed for the northernmost of the two mountain ranges that flank the Darien Gap. They and the valley between were laid out tidily and precisely as on the map; a relationship which is strangely surprising the first time one sees it. The Beaver found a winding valley. We followed it at tree-top height, weaving in and out between the timberclad slopes, switchbacking over the ridges that blocked our path. We made a tight turn to take a photographic run, I found myself clutching a Polaroid camera tightly to avoid it being sucked out of the open window. In the back of the aircraft, Captain Peter Marett RE, my Information Officer, quickly processed the film as I handed the camera back to him after each shot, at the same time he was making copious notes, using a special Tandberg tape recorder and watching the countryside flash past. Our eyes searched the ground for any sign of a track. There was none. The hills did not appear from the air to be too steep, but once you got low you could realize that they were not going to be an easy task.



The problem was to recognize the smaller features, such as rivers, which twisted and turned under the green canopy. There were very few villages shown on the map although we saw the occasional houses dotted along the river banks. One of my main tasks in the reconnaissance had been to discover the best place to cross the Bayano river. We flew up and down the river line until our fuel was almost exhausted. Several points looked possible but all would require rafting and the current was by no means slack. We saw a track deep in sticky black mud leading to the river; so this was to be it. We turned for home and landed, deep in thought.

I could not imagine how Balboa in his suit of armour had staggered across this green hell to stand on a peak and discover the Pacific. However, I could easily understand how Sir Francis Drake and his lightly clad raiders had used the jungle to approach the Spanish treasure trail and enrich the coffers of Queen Elizabeth I.

To carry all our stores and equipment as far as the Colombian border Army Veterinary Officer, Major Keith Morgan-Jones (whose ancestor, Sir Henry Morgan, was also well known in the area), bought twenty-eight pack ponies. To comply with foot and mouth regulations they were to be replaced by local mules at the Border. Although only five ponies reached there it is a great credit to our vet and his two lady assistants, Miss Carolyn Oxton and Miss Rosemary Allhusen that even these got so far. Frequently they became stuck in the deep mud, some died of disease, others were driven almost mad by the bites of vampire bats and blood suckers, but the strong kept going and enabled the Expedition to advance. In all some twenty ponies survived and all were sold or given to good homes with colonists *en route*.

The Sappers, whose equipment was largely carried on the horses, developed a strong affection for them. On one occasion a section struggled for some nineteen hours to save a pony from a deep morass.

On the 17 January, David Bromhead and his reconnaissance team moved in to the Gap. We had hoped to find the crossing point quickly but soon we were lost in a range of low hills that run parallel to the great waterway. Using the Beaver aircraft we directed the recce team onto the right track. At the end of this track they discovered the river. Meanwhile, the main body was assembling with its horses, vehicles and stores in Canitas. It was still raining as drenched to the skin, we loaded the horses on the 19 January. The recce party had warned us by radio that the track ahead was thick with mud and bisected by steep-sided ravines, but we could wait no longer, for three months was really very little time to reach the far end of the Gap anyway. So, for the first three days we marched in wretched conditions, through the heat and mud of the open pastureland. At night we camped with our hammocks slung between the trees, cooking on damp wood fires. As yet the mosquitoes were not a plague, but nevertheless, we always hung nets above our beds.

The Bayano river was no mean obstacle, a 150yd wide brown stream of water flowed between the jungle-covered banks at over 3 knots. However, the Sappers were confident and skilled and in three hours they had the men, horses, vehicles and equipment all safely to the other side. The Avon M650 inflatable raft had already proved its worth. Now we stood on the far bank, having crossed the first obstacle. We looked ahead into the darkening jungle of the Bayano valley, the track still fairly clear but still covered in sticky black mud.

Each day we marched on a little bit farther into the forest. Meanwhile outside the Gap the scientific team were working in their own areas, busy making a great collection of fauna and flora.

Through the jungle we moved in a long straggling column. Our prison, for that is what it was, illuminated by a dull green light, which at times gave an almost translucent appearance to this eerie world. Great trees rose up like pillars reaching for the sun, which beat down on the canopy some 150 ft above. Lianas and vines hung down in a tangled mass to catch projecting horse loads and to trip the unwary. The ground was a mat of leaves constantly being re-supplied from above. Underneath we found a layer of humus, from which grew thick undergrowth. Visibility was rarely more than 30 metres and all the time, day and night, the jungle resounded to the drip, drip, drip of the condensed humidity and the occasional crash of some giant tree falling at the end of its life. When the rain came it usually fell in torrents, turning the track into an instant quagmire. The thick black mud, ravines, gullies and dense jungle were augmented by the fast flowing rivers, patches of poisonous palms and stinging plants. All these problems combined against us. It was easy to see how the ill-fated Scots colony that was established on the coast of Darien in 1699 had perished from disease and hunger.

Our sweat-soaked clothes rotted on us. Leather equipment grew mould, even the best jungle boots available began to fall apart. The mosquitoes, gnats and flies became a constant plague; there were inch-long black ants whose bite hurt for hours, there were also stinging caterpillars and in the rivers electric eels. The heat and humidity were oppressive and even the nights brought little relief. Clusters of aggressive and vindictive hornets nested in hollow trees and swarmed out to meet anyone who disturbed them. I have never seen such vicious insects. Within seconds a well-ordered column could turn into chaos under attack from hornets. One of the girls became seriously ill when she developed an allergic reaction to one such assault. Inch-wide centipedes and black scorpions also took their toll, whilst bird-eating spiders as large as dinner plates were certainly fearsome to behold.

When brushing against the foliage we constantly picked up ticks that, almost unnoticed, buried their teeth into our flesh with such tenacity that they often had to be removed by the medical officer. If the head remained in the skin it became a constant source of irritation. On the other hand, snakes, although numerous, were usually shy and it was not until later in the expedition that we came across more aggressive varieties. The larger animals were rarely dangerous and on one occasion a recce party came face to face with a beautiful black jaguar on a jungle track.

There were other cats such as ocelot and margay and also surprisingly large deer.

The white-lipped peccary, a small wild pig, was a different matter altogether. Unlike his timid cousin, the white-collared peccary, this beast was much feared and avoided whenever possible. They moved in the twilight areas of the darkened forest in sounders of up to 100. At nights in the impenetrable darkness only the noise of their snorting and rooting gave us warning of their approach. A machine-gun would have had little effect on the concentrated rush of these ugly-tempered creatures and on one occasion they completely wrecked a camp, scattering the terrified horses into the jungle.

Not surprisingly our Sunday services were well attended and with Keith Morgan-Jones as choirmaster the Sappers, who loved to sing, would give throaty renderings of "Guide me, O though great Redeemer" and other appropriate hymns.

The twenty-two Royal Engineers of our team were commanded by a veteran explorer, Captain Jim Masters. He had been one of the most important men in the conquest of the Blue Nile in 1968 and had also played a leading part in the Dahlak Quest expedition two years later. Army mountaineer, Captain Richard Summerton, who in 1970 climbed Annapurna, was one of the reconnaissance and re-supply officers. The working numbers of the engineer group were organized into two sections of eight, one under Captain Ernie Durey and the other led by Lieutenant Philip Church.

The sappers had been especially selected for their experience and stamina, many were old hands at jungle bashing but there were also two 17-year olds from the Junior Leaders Regiment, RE. Neither had been outside United Kingdom before, but like other youngsters on the trip, they put up a fine show. Also working as an Engineer was an 18-year-old civilian, Simon Wilson, who had just left school and was sponsored by the Project Trust. He obviously enjoyed working with the soldiers because on return to England he applied to join the Army!

Other members included experienced Himalayan explorer, Major Kelvin Kent, Royal Signals, a former member of the Annapurna South Face Expedition; Mrs Kay Thompson, a well-travelled lady explorer, who had been on five major expeditions previously; Mr Robin Hanbury Tenison, an expert on the South American Indian and Chairman of Survival International; a jungle expert was Sergeant Pratapsing Limbu, of the 7th Gurkha Rifles. The Hon. Charles Keyes, grandson of the famous Admiral, was an interpreter and navigator. There were also soldiers from the 17th/21st Lancers, Royal Artillery, Royal Signals, Infantry, Army Air Corps and REME.

In the beginning we had moved in a complete body with the leading recce team working some five to ten miles ahead. Another reconnaissance team worked about two miles ahead, marking the trail. Behind this came the first Engineer section to cut a track some 10 ft wide, using machetes, power saws and dynamite. They must have felled thousands of trees and when they reached a ravine they bridged it with the special MEXE aluminium ladders, two of which were carried on each car. These ladders could be linked together and were used for a variety of purposes from bridging to rafting. I calculate that we used them four hundred times throughout the expedition. How often we thanked our friends at the Central Engineer Park who manufactured them for us! The second Engineer section used Tirfor jacks, blocks, tackles and the capstans on the cars to their absolute limit to drag the Range Rovers up the steep slopes.

Finally the animal transport and Expedition HQ brought up the rear of the column. Rations, petrol, radio sets and medical supplies made up the bulk of the pack horse loads. Meanwhile the scientists moved in independent groups about the expedition area. From time to time they came in to join the column before once again disappearing into the jungle in their quest for knowledge. However, as the late dry season started another setback hit us. The Range Rovers, with their immense power and rugged construction, suddenly began to break their differentials every few miles. In London our rear party officer, Major Bill Egglestone and the staff at HQ E-in-C set in motion an emergency plan. The Rover Company were as determined as we were

that the Gap would not claim another victim and backing the project to the hilt they too fought to solve the problem.

Soon one of the company's Range Rover experts was on his way out from Britain with a massive load of spares and some specially manufactured parts.

Within hours of his arrival he was lifted by helicopter into the jungle, where he worked non-stop for three weeks. At last to our delight the great cars rolled forward again and immediately began to make up lost time.

Plate 1. Sappers clear stubborn hardwood roots with special Husquvarna Power saw, which proved to be the best for the job.

Plate 2. Major E. Durey, MBE, RE drives the pathfinder Landrover. MEXE ladders and winch are aboard this splendid car that led the team to victory.

Plate 3. MEXE ladders and load lok straps used to get Range Rover up a 5 ft vertical bank.

Plate 4. Range Rover capstan used in tropical forest conditions. A vital item of equipment.

Plate 5. MEXE ladders in yet another role, crossing a giant log.

But time was against us and every day counted if we were not to be defeated by the onset of the rains in mid-April. Thus whilst the repairs were carried out the column had lengthened to over 100 miles. Two small motorized tracked load carriers had originally been used to carry the engineer sections heavy stores. Whilst they performed well in the marsh around Hawley Lake, the heat in Darien dried the mud in the tracks like concrete and the machines simply glued themselves up. After they were abandoned the engineers used the pack ponies to carry stores, but we needed another light cross-country vehicle. Thus we purchased a seond-hand Land Rover in Panama for use as a pathfinder and it was flown out in the belly of a giant United States Air Force helicopter. Its purpose was to support the leading Engineer section, which under Ernie Durey, was pressing ahead with all speed.

Plate 6. The Hill Billy tracked load carrier, carrying an Engineer sections G1098.

The climate and pace were beginning to tell; in fact, throughout the whole expedition more than thirty members had to be evacuated by helicopter, light aircraft or boat, because of illness. Our doctor and his energetic SRN wife Suzie, fought a constant battle to keep us fit. To maintain the momentum we employed large numbers of local people and Indians; which added considerably to our costs. With their long machetes these hard-working men continued to hack through the jungle. Navigation was always difficult and from time to time we became lost in spite of our Indian guides.

To keep us alive supplies were brought in by boat, helicopter, parachute, pack ponies and porters. In all, over 10 tons of rations, 15,000 gallons of petrol, 2,400 cans of beer, and 80,000 cigarettes, plus sacks of horse fodder, boxes of dynamite and mail were delivered by these means. These vital items mostly came from our support base in the Pacific coastal town of La Palma. It was not always easy to find the customers, so to help our Army Air Corps team gas-filled balloons were launched on the end of a string to come bobbing up above the tree canopy. These balloons, coloured fluorescent orange, were accompanied by a firework display of rockets and mini-stars. Even so, searching for a small party deep in the jungle was a difficult task for the pilots.

Members of the expedition had been picked for their compatibility, physical fitness and expertise. I planned to form a team rather than a group of prima donnas. However, as our problems increased and the going became more difficult the inevitable minor squabbles and signs of nervous exhaustion, became apparent.

The girls rose high in our estimation, for in spite of living under the same trying conditions as the men and being expected to work the same hours, do guard at night, pull the horse through the mud, push boats up rivers and beat off the hordes of insects, they retained their good humour, rarely complained and always looked smart.

Our horses were a vital part of the team. Lance-Corporal Lee Yeun from 59 Independent Commando Squadron, took particular care of his section's pack horses. I had given him Cromwell to replace a sick horse. The powerful bay was suffering from the bites of vampires and huge blood sucking flies. To prevent him from scratching the ointment-covered wounds Lance-Corporal Yeun cut up a pink parachute and made the horse a protective bonnet and enveloping night dress. Alas, Cromwell, attired in this garb, broke loose at night and disappeared into the jungle. Later, he was found by Indians who had been indulging in an all-night drinking party. On sighting this terrible pink apparition they took to their heels and fled, believing it to be an ancestor come to reprimand them for their drinking. However, the expedition went to the rescue. Cromwell was disrobed and Indians pacified.

There were several narrow escapes. Captain David Bromhead, descendant of Bromhead VC, of Rorkes Drift, was bitten on the boot by a deadly 6 ft Bushmaster snake. Feeling the reptile strike him he drew his ·45 Smith and Wesson revolver and shot its head off with speed that would have done credit to one of the better gunfighters of the West. At Paya an Indian village on the Colombian border, only the timely arrival of a United States Air Force helicopter, flown all the way from the Canal Zone, saved a young soldier's life. Junior Sapper Duffy was suffering from acute appendicitis, brought undetected to a climax in this remote region because he had been taking penicillin for an injury and this had masked the real danger within his stomach. Our medical officer stayed with him throughout and returned to Panama to assist the surgeons in unravelling Duffy's twisted intestines. Near the frontier we had another lucky escape from serious snake bite when Gurkha Sergeant Limbu was struck at by a huge Bushmaster which reared up behind him. It struck twice but each time Sergeant Limbu was taking a pace forward for his next swing at the vegetation and each time the snake missed him. Behind Limbu there was a Colombian cutter who spoke no English and no Gurkhali. Limbu spoke no Spanish and therefore the timely warning went unheeded. However, he raced up and pinned the reptile down with a large forked branch. Even so he could not manage to hold it. But Limbu saw the danger and spun around to despatch the writhing serpent.

The expedition rations had been designed specially for the project by the Ministry of Defence and were very good. Other food was provided by numerous kind sponsors. In addition, to economize and to vary the diet we ate local dishes, which included jungle fruit, iguana, fish, monkey, snakes and wild turkeys. The climate, which was usually between 90° and 100°F with 85 per cent humidity, led one to long for fresh, crisp salads, but the dehydrated food, especially the sliced apple, was a fine substitute.

Although water had caused difficulties for much of the journey, eventually the lack of it became a problem and thus we had to resort to slicing open vines and drinking from them or filtering the water from slimy pools or having our own delivery by parachute. Towards the end when the rains finally came we were lashed with the full fury of the elements to an extent which few of us had ever witnessed. When this happened we were still crossing the most difficult area of all. This was the hilly frontier region known as the Devil's Switchback. Here it was that whilst trying to hurry our reconnaissance we suffered a severe setback by leading the column straight up a "cul de sac". This led to an impenetrable hilly barrier and because our Beaver had suffered damage to its tail wheel at this time and was being repaired, we failed to detect the danger by air reconnaissance. Thus for ten days we floundered and struggled to conquer the Pucuru heights. In the end we took a gamble and motored the cars up the bed of the river Tuira. This was possible because of the low level of the water, but occasionally when we reached deep pools the raft was used to ferry the cars to the next shallow water. By this method all three cars were able to find a way round the obstruction and reached the old smugglers' trail on the eastern side of the Tuira valley after climbing some extremely steep hills. However this risky operation was not without incident. Late one afternoon I was in the "Tug" helping to pull the raft through some rapids when I heard a shout I looked round and to my horror saw the rubber raft rear up like a stricken beast, I tried to shout a warning to the crew, but words failed me and by the time something suitable to say came to mind I heard one of the helmsmen yelling "She's going lads, get away, get away, we're going over". The tow rope from my piragua slackened as the raft and its swaying Range Rover car spun out of control in the foaming water, engines racing and men plummeting over the side. Water was pouring in through a 2 ft gash in the hull of one pontoon.

Plate 7. The M650 Avon Raft, built by Avon Ltd and CEP, being erected on the Tuira river, note MEXE ladders used for decking and ramps. Special Nylon load lok straps were used to hold it all together.

Like a whaler's longboat the piragua, or Indian canoe, with which we had been towing the raft was now dragged backwards by the stricken grey "whale". One man was still aboard, the raft commander, Sergeant Major D. Wright RE, boat expert and formerly a helmsman on the Blue Nile. Already my Panamanian boatman, Canito, instantly realizing what must be done, had sliced through the tow rope with his sharp machete. Somehow the raft was still upright. Men were struggling in the water, clearly visible by their bright red life jackets. Down-stream the great craft spun, but by a miracle it seemed the raft commander was winning control and as we watched he rammed the wreck into a shingle bank. Most survivors had reached the river's edge and were clinging on to the trees, few had the strength to climb out: they had been working for hours in the blistering heat and for some every step, with their feet raw from "jungle foot", was agony. With his usual skill Canito swung the 30-ft boat around and we picked them up. Some laughed nervously, some grinned, others looked very shaken and in spite of a shade temperature of over 80°F, they shivered. Thank God everyone was safe, even the vehicle had been saved; but the raft ripped open by a rock was crippled and would need much work before it could continue.

At last we reached the frontier at Palo de las Letras, a broken concrete plinth on a jungle-covered hill top. This was our summit and now we were going downhill.

Half a mile from the plinth, on the Panamanian side, we found a rusting red car, a sad reminder of the ill-fated Chevrolet expedition that had reached the frontier over ten years ago, and then turned back. Now it lay, a rotting hulk with trees growing up through the engine compartment and an ants nest in the boot. As we poked sticks into the interior a venomous coral snake slithered from beneath the remains of the back seat and a large black spider emerged from the dashboard.

From here on the going got wetter but a new spirit had come into the team and nothing could stop us now, not even a swamp the size of Wales that lay ahead.

In addition to the support from the United State Forces in the Canal Zone, the help of the Colombian Air Force, Army and Navy was superb, and for the crossing of the Atrato swamp a Colombian gunboat became our floating HQ.

It was in Colombia that a great tragedy occurred. Whilst setting out to join the expedition a reconnaissance party of six Colombian servicemen and our Liaison Officer, Captain Groves, were travelling in a small tin boat. After leaving Turbo Harbour the boat capsized in a heavy sea and sank within fifteen seconds. The only survivors were a Colombian officer and Jeremy Groves. To our horror we heard that the remaining five Colombians had been drowned or been sucked down in the mud of the mangrove swamp that fringed the shore near by. Nevertheless, our Colombian friends produced another team within a matter of days and continued to support us wholeheartedly until the very end. So on 10 April the Expedition HQ was established for the last time. By coincidence it stood on a "peak in Darien" looking out, not across the Pacific, but over the steaming green morass of the Atrato swamp. Now we were two weeks behind schedule and the promised rains began. It was a desperate race to cross the remaining 60 kilometres that no motor vehicle had traversed before.

Working ahead of us for some weeks Captain Richard Summerton RE had discovered a possible route through. Much of the area was pure liquid with a coating of water weed, and in this weed there lived countless mosquitoes, snakes and the occasional alligator. To break through we decided to use our raft, which was undoubtedly the most successful single item of engineer equipment we possessed. It was designed to be carried inside one of the vehicles and when inflated could itself carry one car. This unique raft had been specially designed and built for us by the Avon Rubber Company and the Central Engineer Park RE. Forcing a way through the matted weed was a very difficult problem, we tried cutting with machetes, pulling on it with grapnels, and eventually used necklaces of cordtex and high explosive. The side benefit of the latter method was some good fish breakfasts. Indeed the swamp was teeming with numerous fish of all types. As we forced our way through, the foul stench of rotting organic material rose up. In some places logs had mixed

Plate 8. Assault on the Great Atrato Swamp. The Avon raft with MEXE ladders as deck and ramps. Note Colombian Navy Gunboat that was Expedition HQ for the assault in background.

themselves in with the weed to form more obstacles and these were smashed with dynamite or sliced through with the power saws. Gradually the trees began to increase, strange unearthly shapes, growing up from the swamp around us, which was only populated by huge birds, lizards and giant otters. It had the appearance of a primeval forest and was totally uninhabited by man. On one occasion my piragua capsized in the swamp. Luckily it did not sink, because apart from a muddy bank near by there was nowhere to swim for safety. Whilst bailing out we were supported by our life jackets and although we lost some valuable equipment, we managed to reboard the boat and continue our journey, somewhat shaken, very wet and rather smelly.

Eventually the cars were placed on a firmer crust. This slippery surface of matted vegetation and soil would be flooded when the rains came to their height. Now, however, it was about three to four feet thick and would stand the weight of our vehicles fitted with extra wide Firestone tyres. The area, which was forested, had the construction of a giant sponge and you could see numerous holes going down from the surface into the liquid mud, doubtless it was up these shafts the water would rise and flood the area. We were told by engineers and surveyors that they had lowered a drum full of concrete on a wire into the swamp and at 1,000 ft they had not yet reached firm bottom. Many parts of this incredible area looked solid, but one day when landing from a float-fitted helicopter I climbed gingerly out onto the surface. Immediately the area within 10 or 15 ft of me gave slightly and I had the wobbly feeling which I imagine one would get from standing on a giant blancmange.

Although the British Trans-Americas Expedition could not be called the most hazardous of operations, there was always danger around the corner. On the last day we almost lost the lives of two men who were returning to Turbo with the Colombian gunboat. They were working on the raft which was tied alongside the gunboat, which in turn was moving at approximately 5 knots. Suddenly something must have hit the front of one of the inflatable boats, for without warning the bow of the raft doubled up and water swept over the whole construction. Both men were hurled into the river and sucked under the ship. They found themselves bumping along the rusty, flat hull and suddenly being spun with enormous force by the propeller. Fortunately

the gunboat had lost a propeller the previous week and now only had one, which definitely increased their chances of survival. Nevertheless, they were extremely fortunate to be hurled out into the wake of the ship, having lost all their clothes and watches. With only superficial bruises and cuts they were hauled aboard and congratulated on their lucky escape.

On 23 April the sun set with its usual livid orange glow and as it did so a party of ragged, filthy men and women, mules and vehicles, emerged on the far side of the vast bog. Their eyes were hollow and their faces drawn, their bodies were a mass of bites and sores and their feet were in an indescribable condition due to an ailment called immersion foot, but somehow as they staggered up, dragging, heaving and pushing their vehicles on to the northern end of the southern section of the Pan American Highway, they managed to smile. After ninety-nine days in the jungles and swamps of Darien, we were victorious. It was St George's Day.

We were received with fantastic celebrations in Colombia, made Freemen of the local town of Chigonodo, fêted in the provincial capital Medellin and finally formed a motorcade through the streets of Bogota. Messages of congratulations poured in and amongst the first was one from Her Majesty the Queen. The expedition was presented with a gold medal by the Darien Action Committee for their services and endeavours in conquering the Gap and each of us received a gallon of local spirit from the Colombian Army. My Deputy Leader, Major Kelvin Kent, said "comparing this with the 1970 assault on the south face of Annapurna in the Himalayas, the crossing of Darien by vehicle had been as tough, and in many respects more difficult. When I compare this with the jungles of Borneo and Malaya, I find the Darien jungle to be infinitely worse."

The project had been the most ambitious expedition ever undertaken by the British Army and many times during the journey we found it hard to believe that we could win, but still we pressed on.

Complete success for the entire project came on 9 June 1972 when Captain Jeremy Groves of 17/21st Lancers sent the signal "Mission Accomplished" from the Cape Horn area.

The Range Rovers had driven through every type of terrain. The frozen wastes of Alaska had almost stopped the undertaking when our car slid 200 yds on the ice-bound Alcan highway to smash into a huge lorry blocking the way. The Rocky Mountains had presented some challenging drives on roads from which vertical drops of thousands of feet descended into rushing, boulder-strewn rivers.

In Mexico they met desert conditions and in Guatemala the Pan-Americas highway became a rutted track. They beat the jungles and swamps of Darien and climbed up into the high Andes. Rover engineers who inspected them at Bogota were astonished by their almost show room condition.

In May 1972 they sped on through South America, crossing more mountains and once again meeting desert in Chile. Here they covered 2,375 miles in four days, and one day made 800 miles cruising at 90 mph on a straight desert road. In the Darien Gap they only averaged 3 miles in a day!

As they neared their goal they hit snow and ice once more. Many mountain passes were blocked and it took five long days to break through this last obstacle belt. On one occasion they had to cross a lake on a very Heath Robinson local raft to avoid the blocked passes. One can imagine the feeling of achievement as the drivers gazed at Cape Horn and switched off their engines after seven months and 17,000 miles.

Indeed, it has been an incredible adventure, accomplished by determination, flexibility, excellent equipment and good practical engineering, coupled with the generous help of all the sponsors and governments concerned.

Already our track has become known by the Indians as the "Carretera Inglese"—the Englishmen's road—and they are using sections of it to travel to market and visit distant relatives. Now we learn the Pan-American Highway Authority has been given the 150 million dollars it needs and the road will follow our path.

Civil engineers have already started to attack the Gap from both ends. In Panama

the bulldozers are across the Bayano river, whilst in the Atrato swamp a causeway is reaching out into the swamp. In the more liquid areas, I am told, a foundation of oil and sand will help to float the road. The Atrato river bridge will certainly be a challenging task; with the home bank being liquid swamp! I believe the project is feasible, but because of the difficult terrain and weather the major problem will be the administration and logistics. If ever a task was suited to military engineers this is it.

One day I should like to return and motor through the Gap in comfort, but I sincerely hope that the road builders will spare a thought for the animals, people and flora of this strange land, which may now be changed forever.

Rotary Hydraulic Arresting Gear

MAJOR J. D. N. ROOKE, BSc (Eng), MI MECH E, AMBIM, RE (Retd)

INTRODUCTION

THE Corps of Royal Engineers assumed the responsibility for installing rotary hydraulic arresting gear (RHAG) for the RAF on 1 May 1968. In the following four years nearly fifty sets of RHAG have been installed. The saving so far in terms of aircraft damage is estimated at several million pounds. In addition to the financial saving, which increases year by year, RHAG has a valuable effect on pilot morale, particularly when aircraft are tending to misbehave. It has already saved a significant number of lives. Most of the installation work has been undertaken by 39 Engineer Regiment (Airfields) so that detailed knowledge of the equipment outside the Regiment is limited. The aim of this paper is to present a broad outline of the equipment and the scope of Royal Engineer involvement with it.

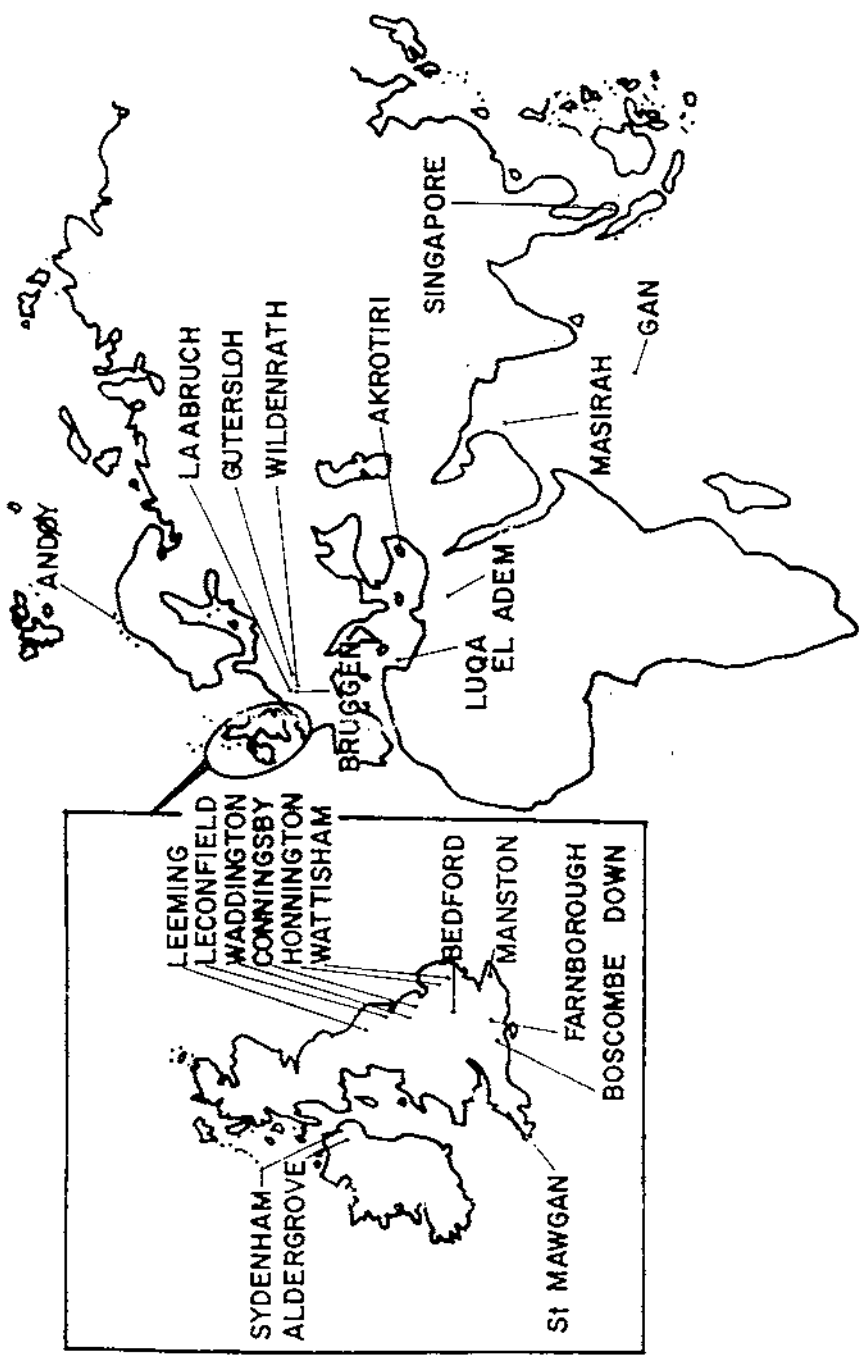
RHAG is designed to stop an aircraft in an emergency. It works on the hook and cable principle used on aircraft carriers. Basically braking is effected by rotating a paddle in a drum of water and ethylene glycol. Before the introduction of RHAG, aircraft unable to stop by the end of the runway were caught in a large nylon net known as an arresting barrier. These nets are still used as a back-up to RHAG, and for aircraft without hooks. Unfortunately barrier arrests invariably damage aircraft, and they are often followed by fire so that the extent of damage varies widely. Furthermore the experience is unpleasant for the pilot. RHAG was first introduced after a spate of barrier arrests by Lightning aircraft, and it is now used by Phantoms and Buccaneers as well as the Lightning MK VI. Jaguar and MRCA will be fitted to use RHAG when they come into service. Plate 1 shows an RAF Phantom taking expeditionary RHAG during an exercise in Norway.

RHAG is an American invention and patented by the All American Engineering Company. It was originally manufactured for the RAF by H. K. Porter Co (GB) Ltd in Glasgow. The first sets were installed by MPBW in conjunction with the manufacturer. The Royal Engineers took over the responsibility for installation work in order:

a. To provide continuity by maintaining trained installation teams.

b. To provide training for these teams so that they could also install RHAG in its expeditionary form in an emergency.

The Corps is now responsible for the total installation of expeditionary RHAG and the installation of permanent RHAG on foundations provided by the Department of the Environment.



Airfields on which Royal Engineers have installed RHAG.

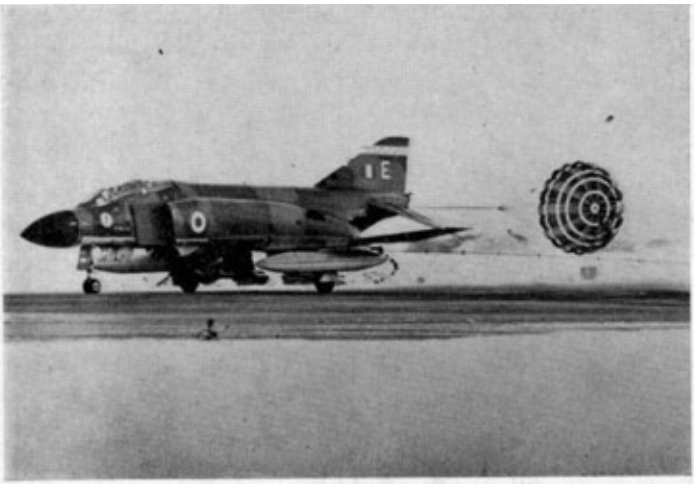


Plate 1. An RAF Phantom takes expeditionary RHAG North of the Arctic Circle in February 1970. This set was deployed from England and installed on improvised foundations in seven days.

THE EQUIPMENT

Figure 1 shows the basic parts of RHAG. They are:

a. The hookcable. This is a $\frac{7}{8}$ in steel wire rope with a breaking strain of 68,000 lb. It is stretched across the runway, under tension, and is suspended 3 in above the surface by rubber supports which are spaced at 6-ft intervals.

b. Purchase tapes. Two nylon tapes 6 in wide and $\frac{1}{4}$ in thick run back from the hookwire to reels mounted on the main shafts of two energy absorber units (EAUs), one on either side of the runway. The tapes have a breaking strain of 70,500 lb, and their considerable elasticity absorbs much of the sudden shock loading which can strike the system. They will stretch at least 10 per cent before failure. About 1,000 ft of tape is wound on to each reel when the gear is set ready for operation.

c. The energy absorber drum. The drum forms the base of the EAU. It contains a 40:60 mixture of water and ethylene glycol. Rotor blades mounted on the EAU shaft are free to rotate in the fluid. Stator blades mounted inside the drum casing improve the hydraulic efficiency of the system. Figure 2 shows the detail.

d. The retrieve drive assembly. The tapes and hookcable are retrieved and pre-tensioned by a 15 hp electric motor. Figure 3 shows the retrieve drive assembly. It includes:

(1) A fluid coupling designed to slip when the tension in the system reaches 1,200 lb.

(2) A backstop or one way clutch which retains system tension when the motor stops running.

The retrieve assembly is automatically disconnected from the remainder of the gear during an arrest. The "break out" mechanism which does this lies between the tape reel and the retrieve sprocket (See fig 2).

Rotary Hydraulic Arresting Gear

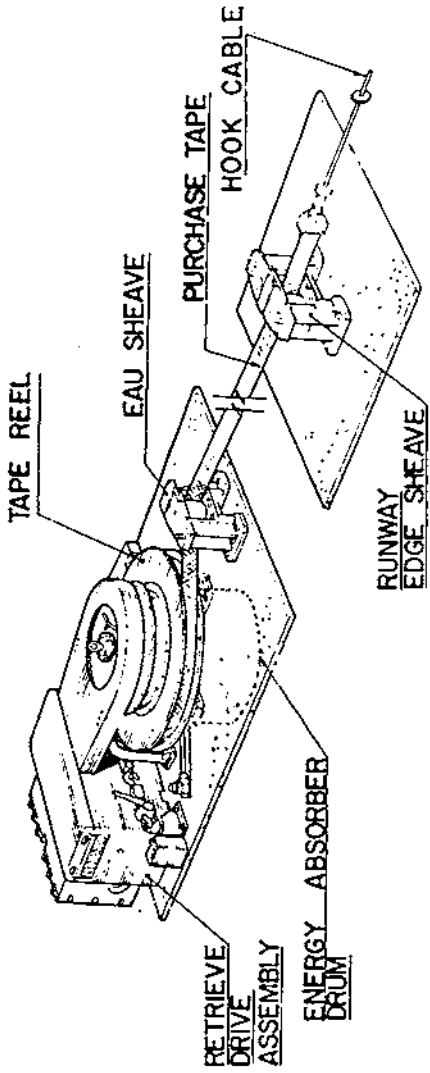


Figure 1. The basic parts of Rotary Hydraulic Arresting Gear.

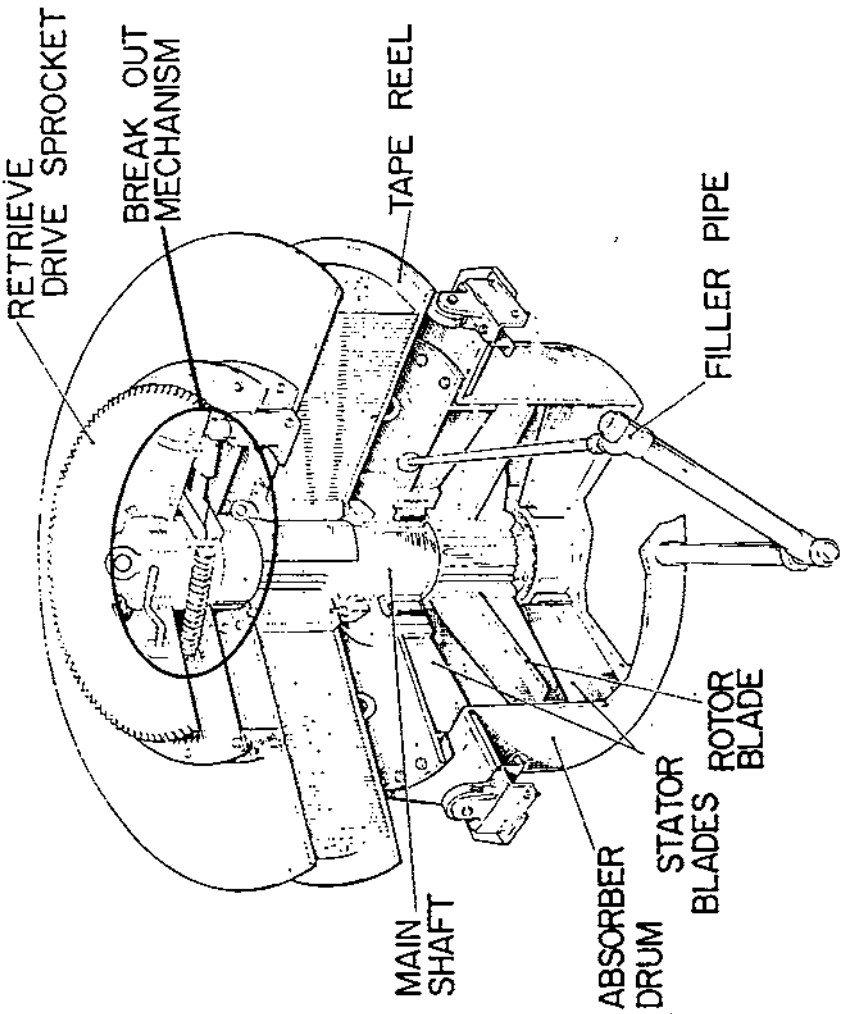


Figure 2. The Energy Absorber Unit drum with the tape reel and the retrieve drive sprocket mounted above it.

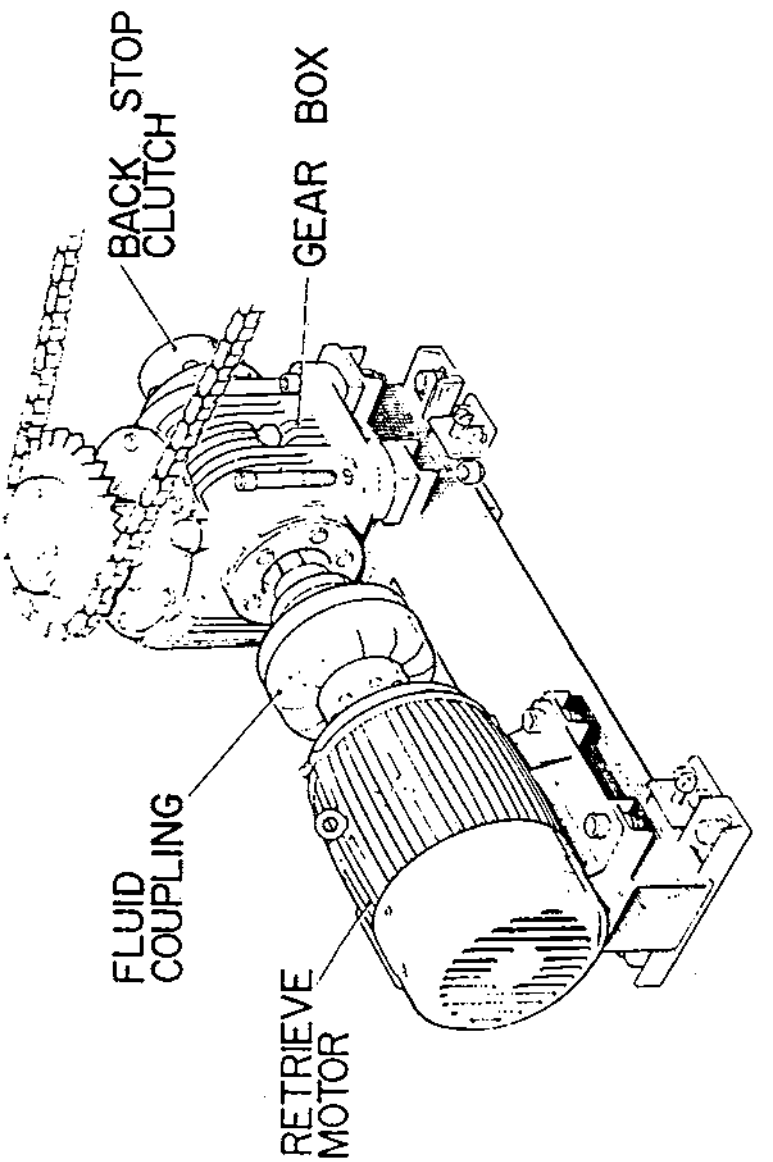


Figure 3. The retrieve drive assembly.

e. Sheaves. The purchase tapes pass through two sets of sheaves between the runway and the tape reel. Those close to the runway are called runway edge sheaves and those adjacent to the energy absorber units, EAU sheaves. Runway edge sheaves are mounted on individual foundations while EAU sheaves are mounted on the main EAU foundations. Correct positioning and alignment of both sets of sheaves is of prime importance.

OPERATION

Before an arrest the hookcable is pre-tensioned across the runway at 1,200 lb. As an aircraft hook engages the hookcable the system tension rises rapidly. When it reaches about 5,500 lb the system breaks out. A spring loaded cam within each breakout mechanism is overcome, disconnecting the two retrieve drive assemblies from the rest of the gear. The tension in the system continues to rise, peaking at up to 30,000 lb. The aircraft runs on down the runway dragging the hookcable and purchase tapes behind it. The tapes pull off their reels, spinning the EAU main shafts and rotor blades. The ensuing turbulence in the EAU drums absorbs the kinetic energy of the aircraft converting it into heat. The aircraft continues down the runway about 1,200 ft when the tapes "bottom". At this point any residual momentum is taken by the elasticity of the tapes. This elasticity may be used to pull the aircraft a few feet back up the runway to release the hookcable from the aircraft hook.

Before retrieving the gear the breakout cams are re-set so that the system is reconnected to its retrieve drive assemblies. The electric motors then wind in the tapes and hookcable with one side slightly ahead of the other. The first side is stopped in its final position. The second side is allowed to run on until the fluid coupling slips. This automatically re-tensions the system to 1,200 lb. Finally, the second motor is stopped and the backstop clutches retain the system tension. It is ready for another arrest.

Plate 2. Base foundations and switch board for a permanent EAU at RAF MANSTON.

CHARACTERISTICS

The American RHAG is intended for purpose built hooked aircraft, designed for carrier operations and capable of being decelerated at about 4g. The braking action of the British RHAG is more gentle and its runout distance is considerably greater than that of its American counterpart.

An interesting feature is the way in which braking effort varies with the speed of the aircraft and its distance down the runway. If the aircraft were to travel down the runway at a constant velocity the braking effort would increase progressively as the runout increased because:

a. The geometry of the system is such that in the early stages a large movement by the aircraft down the runway would pull out comparatively little tape, whereas aircraft and tapes would move at almost identical rates when the tapes were right out.

b. The radius of the tape left on the reel would decrease at an increasing rate as the tape was pulled out. This means that:

(1) The speed of the paddles would increase absorbing more energy.

(2) The lever arm would decrease increasing the tape tension required to overcome the braking torque in the main shaft.

On the other hand, as the aircraft's velocity nears zero so does the angular velocity of the paddles, and the braking effort becomes minimal. An aircraft which is rolling slowly has only to overcome the friction of the system to pull the tapes right out. The net result is a very smooth arrest.

APPLICATION

Current RHAG is only used when aircraft are in trouble. Typical causes are engine flame out on take off and brake or drogue 'chute failure when landing. RHAG can be taken in either direction provided that the runway edge sheaves are suitably anchored. Lightning MK VI aircraft normally take the RHAG at the far end of the runway. Phantoms and Buccaneers frequently make an approach end arrest, taking the first hookcable on landing. This is because both aircraft can suffer an hydraulic failure which curtails their ability to steer on the ground. RHAG, picked up on touch down, holds the aircraft straight.

The theoretical limits of weight and speed combinations are shown at Table 1. These have been exceeded several times without damage to the aircraft and with minimal damage to the RHAG.

SITING

RHAG is normally sited 1,300 ft from the threshold, but a large number of factors must be considered when deciding where to put the gear and on some airfields its installation has been considered impractical. Drawing 1 shows the criteria for an expeditionary installation. The runway edge sheaves are always positioned first since they fix the position of the cable on the runway. They are normally placed 35 ft from the edge of the runway with their bases on the same horizontal plane as that of the runway surface at its edge. If necessary the sheaves may be moved up to 10 ft closer to the runway and lowered up to 8 in to fit the shape of the ground. The EAU bases are placed 50 ft behind the runway edge sheaves, although this distance may be increased up to 200 ft if safety demands. Ideally they should be on the same horizontal plane as the runway edge sheaves but this is seldom possible. Limits of allowable vertical deflection from this plane, measured at the runway edge sheaves, are 1° up and 2½° down. If these cannot be achieved without major earth works the EAU may be swung up to 80° horizontally off the equipment centre line. In this case larger anchorages are required at the runway edge sheaves. The siting criteria for permanent installations are similar except that the EAUs are usually 200 ft behind the runway edge sheaves.

Two other factors can effect siting. One is other equipment and services already in the area. In particular Instrument Landing Systems (ILS), which cannot tolerate

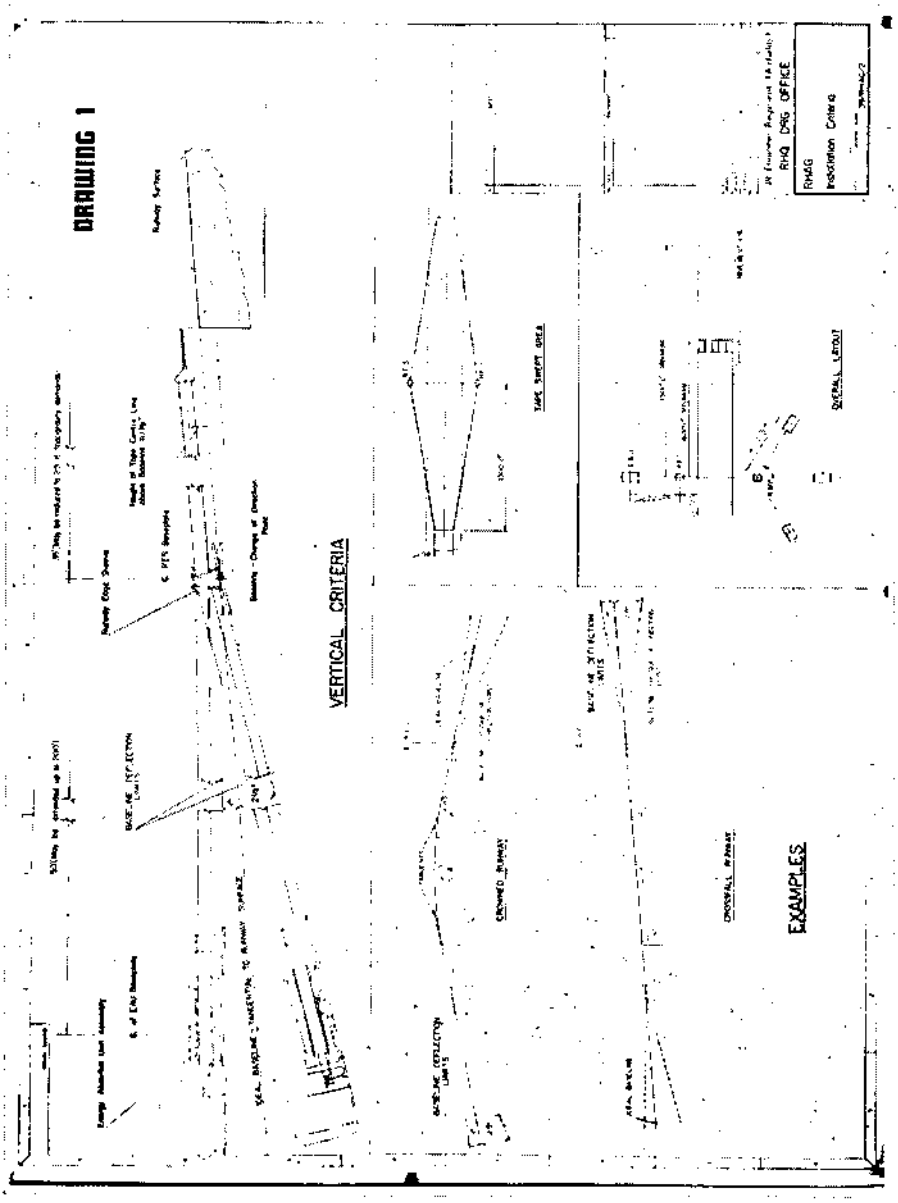
TABLE 1

HOOK LOADS

Aircraft speed (knots)	Weight of aircraft (thousands of pounds)												
	15	20	25	30	35	40	45	50	55	60	65	70	75
100	19.0	20.0	21.0	22.0	23.0	25.0	27.5	30.0	32.0	33.5	37.0	39.0	42.0
120	23.0	24.0	25.0	26.5	28.0	31.0	33.0	35.0	37.5	39.0	43.0	46.5	50.0
130	27.0	28.0	30.0	32.0	34.0	36.0	38.0	41.0	44.0	47.0	50.5	53.5	56.0
140	32.0	33.0	35.0	37.5	39.0	42.0	45.4	48.0	52.0	53.0	57.0	60.0	
150	38.0	39.0	41.5	44.0	46.0	49.0	52.0	55.0	57.5	60.0			
160	44.0	47.0	48.5	51.0	53.0	56.0	59.0	62.0					
170	52.0	53.0	54.0	57.0	59.0		Hook loads (thousands of pounds)						
180	57.0	60.0	62.0										

NOTE:

Hook loads beneath the line, indicate that the purchase tapes have been subjected to more than 40% of the breaking strain.


DRAWING 1
VERTICAL CRITERIA
EXAMPLES
RHQ DRG OFFICE
RHQG
Indication Criteria

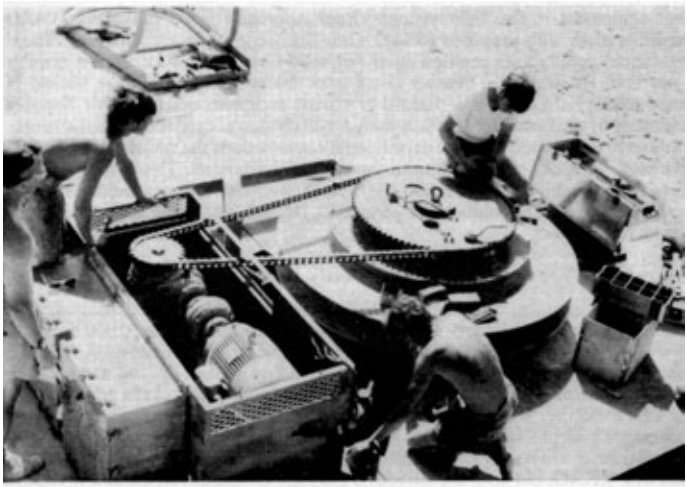


Plate 3. Installing a permanent EAU at RAF MASIRAH.

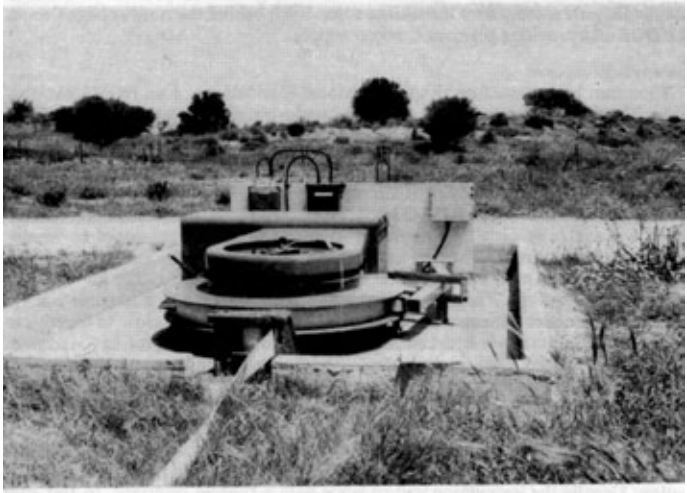


Plate 4. A permanent EAU at RAF AKROTIRI.

Rotary Hydraulic Arresting Gear 3 & 4

other equipment in the vicinity, and Visual Approach Slope Indicators (VASI) frequently clash with proposed RHAG sites. The second is safety. Board of Trade Regulations prohibit the positioning of any solid object within 350 ft of a runway centre line. Runway edge sheaves come into this category. When the airfield is purely military the additional hazard is usually accepted, but when Air Support Command fly civilians into it, or it is shared with civilian authorities, special arrangements have to be made. In some expeditionary installations the runway edge sheaves have been set back some 200 ft from the edge of the runway. This is only possible where the ground is suitable because the tapes fly over the runway shoulders and the surrounding area. The solution for permanent RHAG is to make the runway edge sheaves retractable.

EXPEDITIONARY RHAG

RHAG is mounted on baseplates, and the major problem when installing it is anchoring these to the ground. Design is based on withstanding the 70,500 lb breaking strain in the tape, so that anchorages to take some 30 tons are required. Drawing 2 shows a typical anchorage layout. The main loading is taken by deadman anchors. 4 ft aluminium alloy cruciform stakes are used to pin the plates to the ground in the immediate vicinity, thus increasing the over-all mass and reducing vibration. Future anchorages will probably include the use of the Harvey Aluminium Company's explosive earth anchor or deep drilled earth anchors. Neither system has yet been tried with RHAG, but both are attractive. They are comparatively quick and require less heavy plant. If power is not available on site it is provided by a 30 KVA skid mounted Houchin generator at each EAU.

PERMANENT RHAG

Foundations

The foundations for permanent RHAG are designed and built by DOE. They are invariably constructed in reinforced concrete. Installations vary considerably. In some instances the energy absorber units are mounted in pits below ground level. In some they are mounted at ground level but the ground is mounded over them. Usually they are mounted on the surface some 200 ft behind the runway edge sheave. The DOE also provide a permanent power supply.

Runway edge sheaves

These can be mounted on simple permanent foundations or on retractable platforms. The retractable platform is suspended under a steel top plate by four jack legs. An electric motor raises and lowers the sheaves through a suitable hole in the plate.

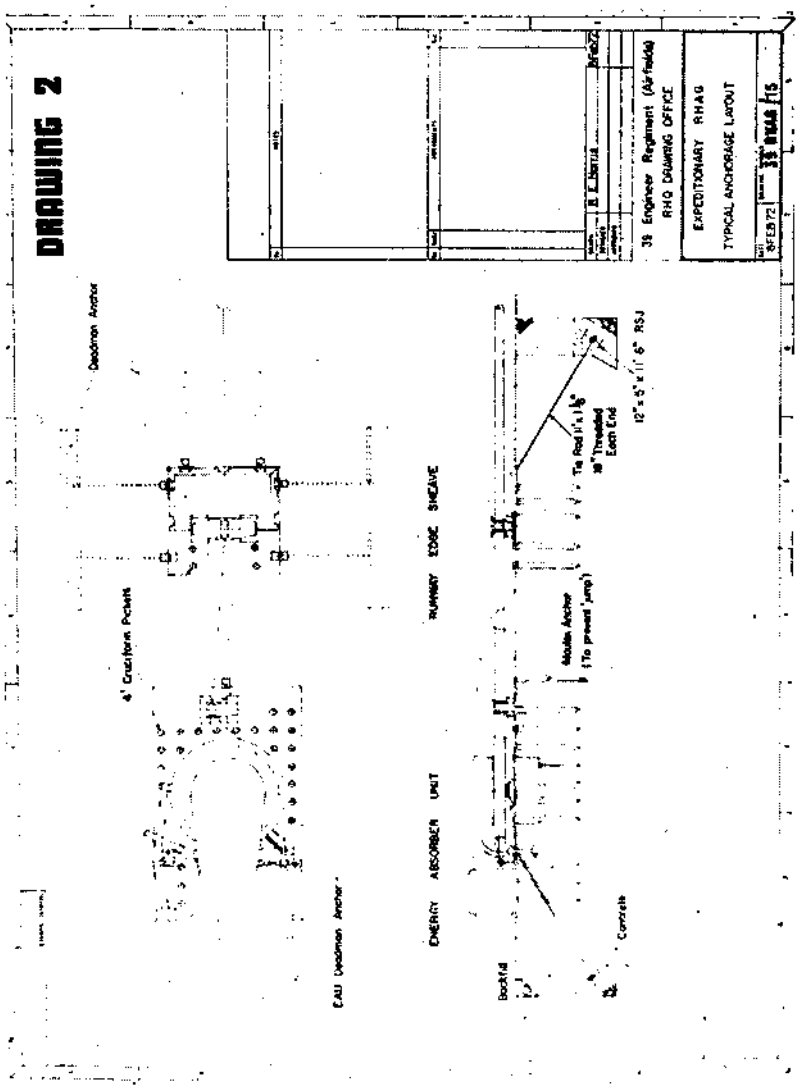
Retractable hookcable support system

Many aircraft, particularly light aircraft such as the Gnat with small wheels, are not allowed to taxi over the RHAG hookcable in the rigged position. A new modification will enable an air traffic controller to raise and lower a tensioned hookcable from the control tower. Thus he can "mix" his aircraft more easily. The entire system is housed in steel boxes set into the surface of the runway. The hookcable is raised on bow springs. These are raised and retracted by a rod and cable linkage system which connects them to an electrically controlled actuator close to the edge of the runway. The system is hydraulically operated using energy stored in the form of compressed nitrogen. Electric control is both local and from the control tower. The first two sets of boxes for the system were let into the runway at RAF Wildenrath in September 1971 and the first complete sets of equipment are scheduled to be installed at RAF Valley in the summer of 1972. The new system is manufactured by Marshall of Cambridge. The division of responsibility between the Corps and the DOE for installing the retractable hookcable system is to be negotiated for each station. Usually the installation will coincide with a runway resurface. In this case the Royal Engineers will place, align, level and fix the boxes. The DOE runway sur-

facing contractor will then surface the runway to them. In isolated cases the Corps may carry out the complete installation.

Maintenance

On the completion of a RHAG installation the Royal Air Force take over the gear and the responsibility for its operation and maintenance.



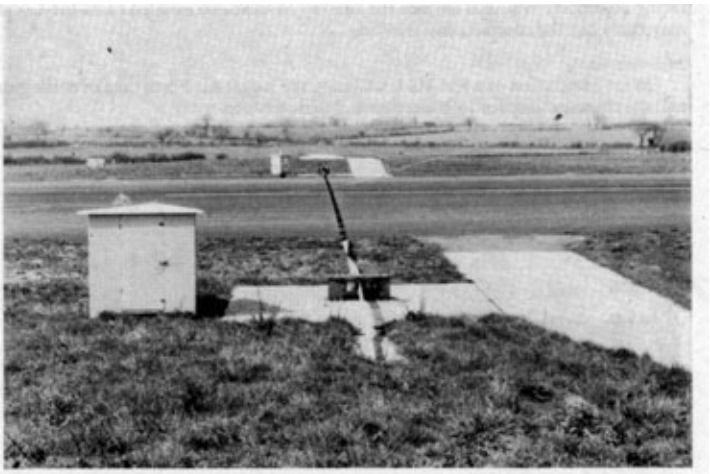


Plate 5. One of the early installations with buried "mounded" EAU's and fixed runway edge sheaves. This is at RAF WATTISHAM.

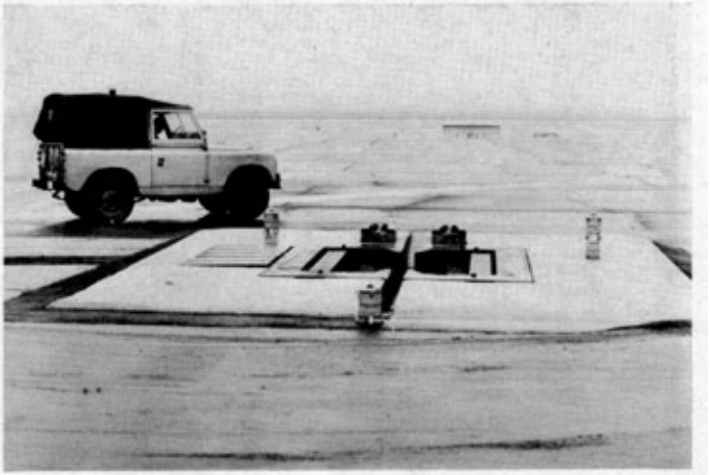


Plate 6. Bare retractable runway edge sheave foundations at RAF MANSTON with the EAU foundations in the background (this RHAG is mounted on a disused paved area).

Rotary Hydraulic Arresting Gear 5 & 6

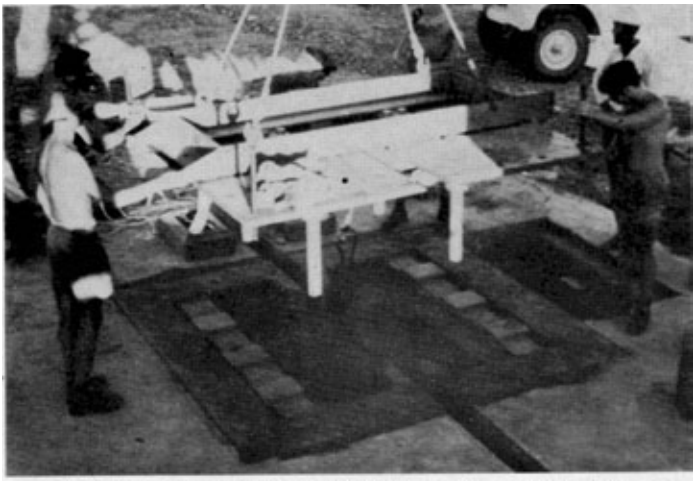


Plate 7. Installing a retractable runway edge sheave at RAF MASIRAH.

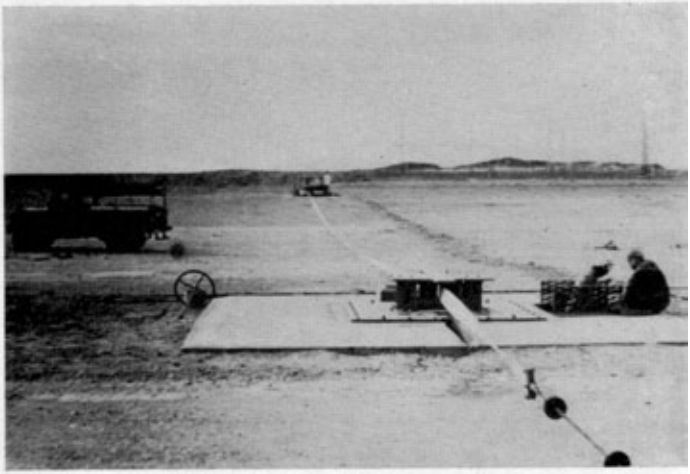


Plate 8. A completed retractable runway edge sheave at RAF MASIRAH—sheaves raised

Rotary Hydraulic Arresting Gear 7 & 8

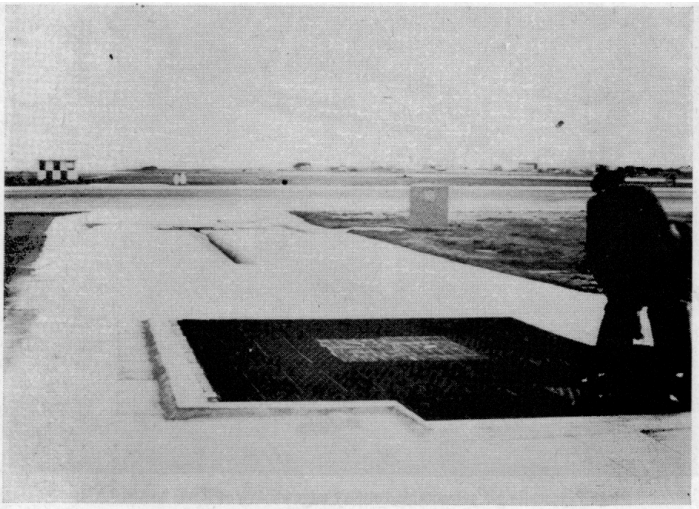


Plate 9. An installation at RAF LUQA with flush buried EAU's and retracted runway edge sheaves.

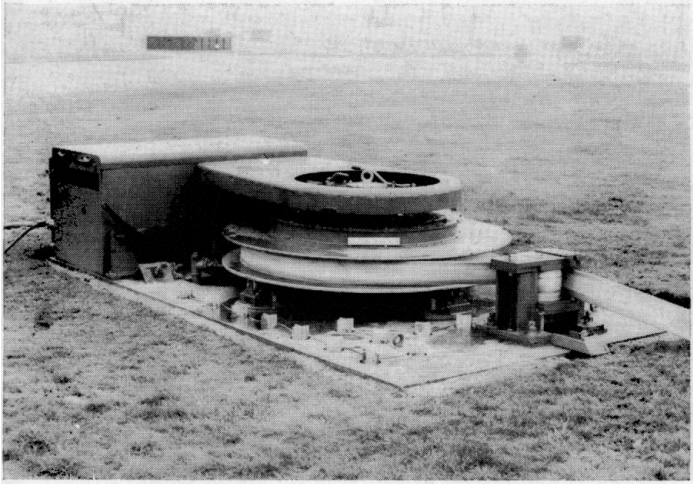


Plate 10. An expeditionary EAU at RAF FARNBOROUGH.

Rotary Hydraulic Arresting Gear 9 & 10

Expeditionary RHAG

Careful alignment and assembly are primary requirements for the installation of RHAG. Expeditionary RHAG is best installed by two sections of ten men working on either side of the runway. If speed is paramount a second team will be required to work shifts. The minimum time required to install one set of expeditionary RHAG varies from forty-eight hours in ideal conditions to about seven days. It depends upon the ground and how well it will accept anchors.

39 Engineer Regiment (Airfields) holds sets of expeditionary RHAG together with generators, installation tools, plant and equipment packed ready for deployment by air direct from Waterbeach. Each airfields squadron maintains a nucleus of men trained in its installation.

Permanent RHAG

This is best installed with a small team. One officer, one clerk of works (mechanical) and twelve men are normal. Two sets are usually installed on each runway and the work takes about three weeks. The task involves most of the basic workshop skills including a considerable amount of drilling and tapping. Good liaison with the DOE, their contractors and the RAF is essential.

Back up Services

39 Engineer Regiment (Airfields) now has a close working relationship with the research and provision organizations concerned with RHAG. It has given assistance with trials from time to time. In 1971 it carried out an inspection and survey of selected installations in order to assess the effects of time, climate and use upon them. Finally it offers advice and, it is hoped, constructive criticism as occasions demand.

Plate 11. An expeditionary EAU on improvised foundations at ANDOYA in North NORWAY with a 27½ KVA generator to power it.

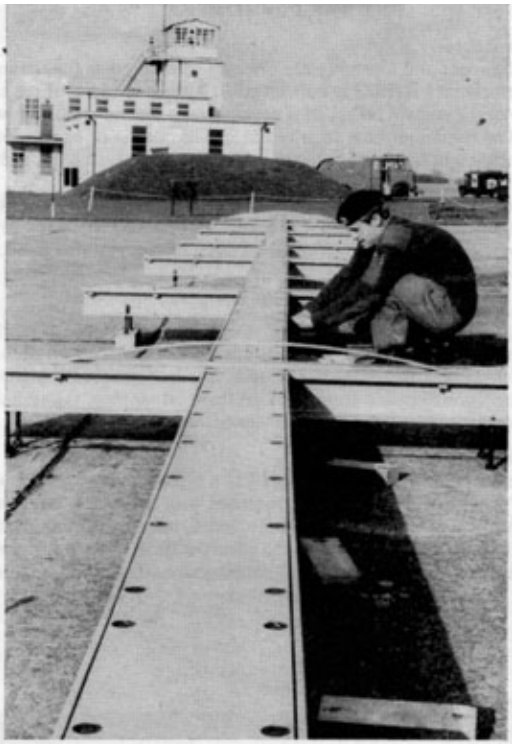


Plate 12. The retractable hookcable support system undergoing assembly trials at WATER-BEACH in February 1972.

CONCLUSION

The installation of RHAG has given the Corps an interesting, rewarding, and sometimes challenging engineering task. The soldiers enjoy the work, and, although there is nothing very difficult about it, each installation presents fresh problems. The real value of this task however must be in our relationship with the Royal Air Force. Royal Engineers have been seen installing RHAG on twenty-four airfields. The map shows where they are. Confidence has been built up as a result of which the RAF are now asking the Corps to take on the installation of aircraft arresting barriers at the ends of runways.

It is suggested that this task has done as much as anything to show the Royal Air Force that the Royal Engineers are filling the gap which was left when their own Airfield Construction Branch disbanded in 1966.

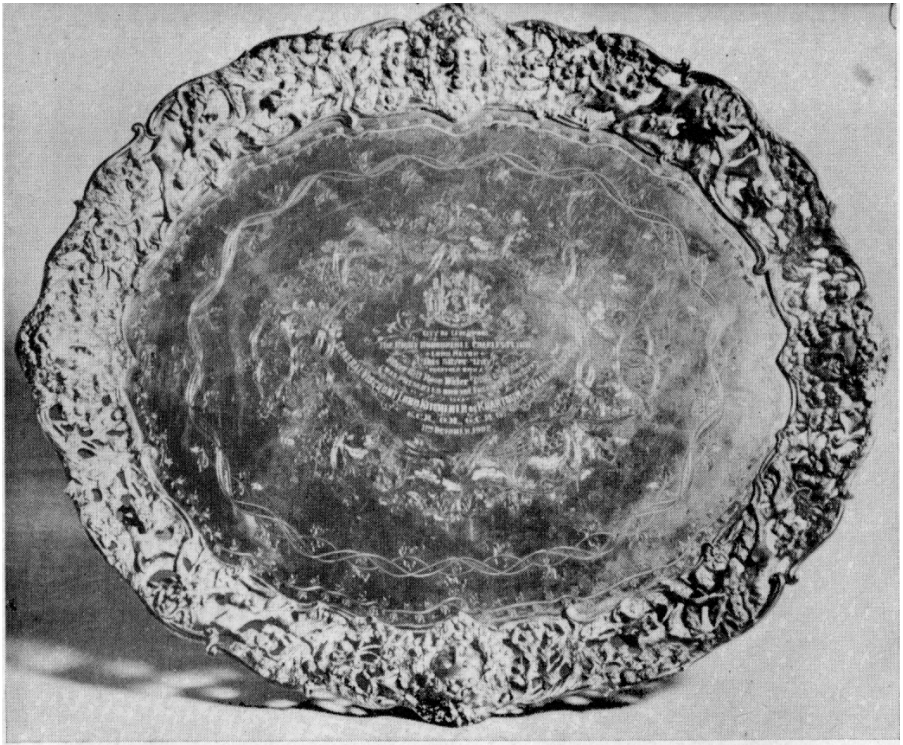


Plate 1. Silver oval chased and pierced "stag-hunt border" tray 27½ in long × 22½ in wide.

Presentation To Corps of Royal New Zealand Engineers 1

Plate 2. Silver gilt chased flower and scroll rose water dish 19½ in diameter with ewer to match.

Presentation To Corps of Royal New Zealand Engineers 2

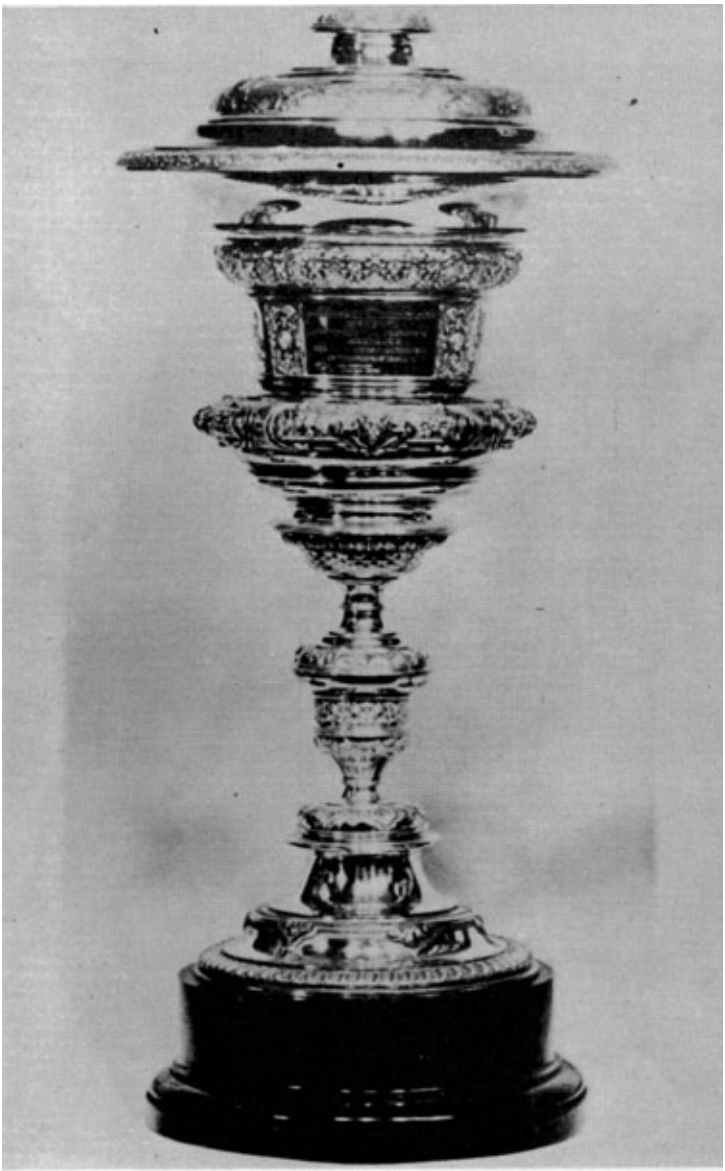
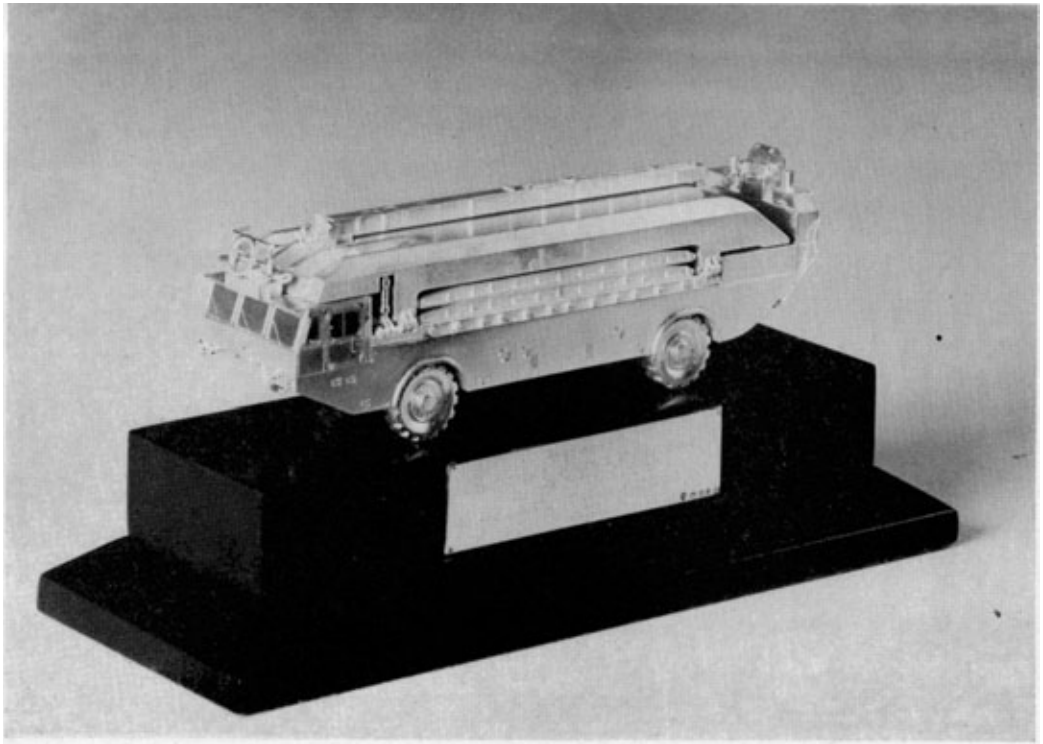


Plate 3. Silver gilt cup.

Presentation To Corps of Royal New Zealand Engineers 3



The M2 Amphibious Bridging and Ferrying Equipment Centrepiece.

Presentation To Corps of Royal New Zealand Engineers 4

Presentation of a Silver Centrepiece to The Corps of Royal Engineers

THE M2 amphibious bridging and ferrying equipment was built by a Consortium of German firms, Eisenwerke, Kaiserslautern (EWK) and Klockner-Humboldt-Deutz, AG (KHD), under EWK direction.

103 M2 rigs have been purchased by the Ministry of Defence and to mark the delivery of the last rig to the British Army, the Chairman of EWK, Doctor H. W. Gehlen, presented a model replica of a M2 rig in the form of a silver centrepiece to the Corps of Royal Engineers. The centrepiece was received on behalf of the Chief Royal Engineer by Major General D. R. Carroll OBE, Chief Engineer BAOR.

The presentation took place at Rheindahlen on 4 July 1972, and the following were present:—

Dr H. W. Gehlen	Chairman, EWK
The Viscount Wimborne	Deputy Chairman, EWK Co Ltd, UK
Mr L. Papirnik	Managing Director, EWK Co Ltd, UK
Dr Ing. F. Jochum	Director, EWK
Dr Jur. H. Zimmermann	Director, KHD
Rudolf, Graf von Buquoy	Managing Director, KHD
Herr S. M. Thieme	Director, British Deutz Ltd
Major-General D. R. Carroll, OBE	CE BAOR
Major-General D. G. House, CBE, MC	COS, HQ BAOR
Brigadier H. S. R. Watson, MBE	BGS HQ BAOR
Brigadier J. D. Kelly, MBE	DEME HQ BAOR
Brigadier A. E. Arnold, CBE	Director of Vehicle Projects, MODUK
Brigadier J. H. Foster	CCRE 1 (BR) Corps
O. D. Jolly, Esq	Deputy Director of Contracts, MODUK
Colonel R. J. Lewendon	Col GS, G OR, HQ BAOR
Colonel D. M. Panton, MBE	Col Engr Ops, HQ BAOR
E. G. de V. Condon, Esq	MODUK (FV 3)
H. Smith, Esq, MBE	MODUK (QAD (FVE))
Lieut-Colonel J. A. Coombs, RE	SO 1 RE Sp, HQ BAOR
Lieut-Colonel H. J. Goodson, RE	CO 28 Amph Engr Regt RE
Lieut-Colonel J. D. Waymark, RE	CO 40 Army Sp Regt RE
Major J. E. L. Adams, R Sigs	SO 2 PR, HQ BAOR
Major (retd) R. C. Ritchie	Interpretariat, HQ BAOR

After the Chief Engineer had welcomed the guests, Doctor Gehlen gave a resumé of the development of amphibious bridging, starting with the ideas of Général Gillois of the French Army, and leading up to the development of the M2 bridge by the Consortium. Doctor Gehlen went on to emphasize the excellent co-operation between the firms of the Consortium, and the various branches of the Ministry of Defence concerned with the purchase and subsequent introduction into service of the M2, and with MVEE, and those Headquarters and units in BAOR since 23 Amphibious Engineer Squadron was formed. He expressed his warm thanks for this co-operation on behalf of the EWK-KHD Consortium.

Doctor Zimmermann then spoke briefly of the excellent co-operation in the past. He said he was quite sure that this would continue in the future. Over a period of fifteen years, each rig will have two base overhauls carried out by the Consortium.

Doctor Gehlen then said:

"As a symbolic token of our link with the Corps of Royal Engineers and as a lasting memento of this British/German comradeship in arms, I now have the honour, on behalf of the EWK-KHD Consortium, to present you with this model of

Dr Jnr H. Zimmermann, Major-General Carroll, Dr Gehlen, Major-General House, and Viscount Wimborne.

the M2B rig and beg you, Major General Carroll, to hand it over to the Corps."

In accepting the centrepiece, Major-General Carroll said:

"I would first like to thank Doctor Gehlen for his most interesting historical review of the development of the M2 and Doctor Zimmermann for his kind remarks.

Doctor Gehlen used the word 'co-operation' time and again pointing to the existence of it as between members of the Consortium, as between the Consortium and MOD London, and as between units and Research and Development Establishments.

If I may, I would like to add another example of M2 co-operation which took place less than one month ago. 64 Squadron of 28 Amphibious Engineer Regiment, which is located in Hameln, was exercising in the Heidelberg area at the same time as 330 Amphibious Engineer Battalion of the German Army. It was quickly agreed that 64 Squadron and a company of the German Amphibious Battalion would build on the Rhine a joint MLC 60 bridge. The first joint bridge consisted of thirteen British and thirteen German rigs and took forty-five minutes to construct. Altogether the Rhine was bridged in this way three times in nine hours. This reflects the greatest credit on German and British engineers who came together at short notice to build these bridges. It also reflects great credit on the equipment and particularly on its flexibility. The advantages of one NATO ally being able to operate with another, and indeed being able to exchange equipment if necessary, do not have to be stressed.

28 Amphibious Engineer Regiment was formed a year ago, and I am glad to say that it is now a thoroughly viable unit which has proved itself on the water, in barracks and particularly in the sporting field. 40 Army Support Regiment at Willich has been in existence for a long time, but credit is due to them for the way in which they have taken on the M2 and provided the support needed by 28 Regiment. I would also like to mention the unfailing and continuous support that we have been given by the Royal Electrical and Mechanical Engineers throughout this time both at Hameln and Willich.

Dr Jnr H. Zimmermann, Major-General Carroll, Dr Gehlen, Major-General House, & Viscount Wimborne.

I would like now to congratulate the Consortium on the timely delivery of rigs and to thank them for their part in dealing with the comparatively minor problems which have cropped up within the last twelve months. I would also like to pay tribute to the assistance we have had from the Ministry of Defence in London in evaluating these problems.

Finally, on behalf of the Chief Royal Engineer, I would like to thank each member Company of the Consortium for this truly magnificent silver centrepiece which I am most grateful to accept on behalf of the Corps of Royal Engineers. I propose to send it, initially, to the Headquarters of the Corps in Chatham, where it will be displayed. After that it will go on loan to 28 Amphibious Engineer Regiment in Hameln and I feel sure that the Commanding Officer of that Regiment, Colonel Goodson, will, in due course, be seeking an opportunity of extending his hospitality so that you may be able to see this centrepiece by candelight in Hameln."

At the conclusion of the presentation, the visitors were entertained to lunch in the United Services Officers' Club.

Commemoration of Formation of 28 Amphibious Engineer Regiment

28 AMPHIBIOUS ENGINEER REGIMENT was formed on 7 April 1971. Its task is to ferry across or bridge rivers with the new amphibious bridge vehicle known as M2. Individual vehicles drive into a river, link up and form either ferries or floating bridges. Each vehicle is large, powerful and complex. Its use demands a high standard of watermanship and technical skill in operation and maintenance.

The officers in the Regiment at the time of the Formation commissioned a centrepiece to commemorate the occasion. The result is a Sterling Silver piece of Neptune riding the waves in a sea chariot pulled by five sea horses mounted on a rosewood base with deep silver band bearing the inscription and names of the officers of the Regiment on its Formation.

The modern design in abstract form was accepted as being in keeping with the times. The piece emphasises the amphibious side of the Regiment and suggests strength, confidence, speed and victory. The five seahorses represent the five sub units—Regimental Headquarters with its reserve of M2, the three Amphibious Squadrons and the Workshop.

The work was executed by Highley of Chatham. The cost was met by a grant from the Royal Engineers Corps Committee and contributions from Major-General J. C. Woollett CBE, MC, the then Chief Engineer Headquarters BAOR, and the officers of the Regiment at the time of the Formation.

A Sterling Silver Centrepiece of Neptune and Five Sea Horses.

Royal Engineers Rugby — Some Random Reflections

COLONEL E. E. PEEL, BSc, FICE

IN the 1870s the Royal Engineer Football Club was a power in the land. In 1872, '74, '75 and '78 they reached the final of the FA Cup and in 1875 they won it, the only Service side ever to do so.

In 1878 the REFC played its first recorded Rugby match against the RMA (The "Shop"), the report on the match reads:

"Played at Chatham on Thursday October 24 and resulted in a draw, the Academy scoring 1 try, four touches against 1 try. The RE won the toss and decided to play downhill for the first half of the game. Darley kicked off for the RMA, but, the wind being down the hill, the game was quickly brought into the strangers quarters, where it stayed for the first ten minutes, and Long getting the ball, managed to run in for the RE; but the try did not result in a goal. After this the ball was kept pretty near the centre post till half time. After half time Gordon kicked off for the RE but the ball was quickly returned by Beever, and the RE were forced to touch down in self defence. The leather now remained for some time in dangeous proximity to the lower goal, and, several scrimmages being formed near the goal line, the RE were forced to touch down three times more. Beever now got the ball and after a good run, gained a try, but the kick was not successful. Nothing more of importance happened before no side was called."

The Royal Engineer team was:—Backs: Lieuts Cairns, Druitt; Three-quarter: Lieut Cowan; Half-backs: Lieuts Bond, Massey; Forwards: Lieuts Hedley, Gordon, Rice, Dumbleton, Leverson, Stanton, Williams, Thomson, Jackson, Long.

This RE *v* RMA annual fixture was the only football match played under Rugby Union Rules until 1885.

In 1886 the fixture list was extended and in 1889 Rugby Union was really established with six fixtures of which we only lost one. The rise in the Rugby skills was unfortunately matched by a fall in the Association skills, both codes being played by the REFC. This gave rise to heated correspondence in the *RE Journal* and for some time the introduction of hockey was blamed. An extract from one of the later letters sums up the situation:

"It would be a great pity if we gave up (Association) football because we have done so badly of late.

"It appears to me that there is another cause besides hockey which may partly account for our weakness. Of late years several RE matches have, I believe, been played under Rugby Union Rules. I think this can hardly fail to weaken us. In the years in which we were strongest most of our men had been accustomed to Rugby Rules; they all however, on joining, gave up Rugby and stuck to the Association Rules. It appears to me that something may be said, in favour of our taking, as a Corps, to Rugby instead of Association Rules; but I cannot help thinking it is a mistake to attempt both."

The results of the 89/90 season which sparked off the correspondence were:

Association Rules.	Played 30	Won 6	Drawn 6	Lost 18
Rugby Union Rules.	Played 6	Won 5		Lost 1

It will be remembered that the REFC was an Officers Club though soldiers were apparently invited to play on occasions.

At this time the Corps could boast of seven International Rugby Players, C. A. Crompton, C. W. Sherrard, F. B. G. d'Aguilar, F. T. Maxwell, H. W. Renny-Tailyour, W. F. H. Stafford, A. Walpole.

Of these seven Renny-Tailyour was also capped for Scotland at Association Football and both he and Stafford were in the FA Cup winning team.

The full list of internationals serving in the Corps is shown in the Honours Annex.

In 1892/93 season the Corps played sixteen Rugby Union matches and the REFC appointed a Rugby Secretary in addition to the Association Secretary. In the 1895/96 Season the Rugby Fixtures (22) outnumbered the Association Fixtures (13) for the first time.

The accounts of matches at this time conjure up pictures which must please the modern young player:

"The services of a referee were procured on the spot. 'No appeal' was decided upon but

not conformed to, indeed tongues readily lent their natural aid, and if the play disappointed the eye, the whistle seldom failed the ear."

"There were no serious accidents and although a College player had to retire in tatters our collaring was too gentle."

"Shortly afterwards an interval of five minutes was found necessary to allow the Wanderers back to effect a change of nicks, his own being somewhat rent. This performance did not take place in public."

"Just before time Kelly had the misfortune to put his knee out and had to be conveyed home on the trench cart."

Blackheath had been regular opponents of the Corps since 1887 and were always referred to as "The Heathens", it is not really clear if this was an affectionate term or not.

In 1906 when the Army Rugby Union was formed the Corps had been playing Rugby for some twenty-eight years and had produced ten Internationals, P. Maud, R. F. A. Hobbs and G. E. B. Dobbs having joined the seven already listed.

In 1907 the *Supplement* to the *RE Journal* reports:

"An endeavour is being made this year to introduce Rugby Football into the Army by the establishment of an Army Rugby Cup Competition. Members of the Committee include Captain R. F. A. Hobbs, DSO., RE and Lieut. R. A. S. Mansel RE".

There were ten entries in this first competition and the draw was:

Royal Scots Greys	*v*	33rd Field Artillery Bde
RE Depot & District Bn	*v*	7th Dragoon Guards
3rd Dragoon Guards	*v*	2nd West Riding Regt
1st Welsh Regt	*v*	Army Service Corps
Kings Dragoon Guards	*v*	RE Training Bn

The Training Bn beat the Kings Dragoon Guards by 11pts to 3, they "had the assistance of seven officers, all well versed in the game, and this advantage ensured their victory". Of these seven officers Hobbs was an England player and both he and Gowlland were Army Caps. The Army Caps of the Corps are listed alphabetically in the Annex.

The next reported result shows that the RE Training Bn met the RE Depot and District Bn in the semi final and won 3–0. "The game was perhaps more of a vigorous than a scientific exhibition, but on the whole there was little to choose between the teams."

The final was played at Aldershot on 6 April 1907 between 2nd West Riding Regt and RE Training Bn.

"The RE were beaten by 1 goal to nil in the final. The prediction of an old Blackheath player that we should see 'plenty of vigour if not much skill' was completely fulfilled. But it was all quite chivalrous vigour, the officers by precept and example showed that it is not so very difficult to tone down the inclination for excess in finishing a tackle.

"Extra fitness went a long way to the winning of the match for the West Riding Regiment, and next to experience and cohesion were the chief qualities that made for success. The West Riding diminutive half-backs were quick and cunning, constantly outwitting White and Shepherd; the pack executed many good rushes, followed up well, and were always on the ball; the three-quarter line was adept at kicking, but it made no headway in passing, for the men pulled up to take the passes and usually in running mistook the touch for the goal lines.

"When the West Riding players had the wind to help them they made good use of it in finding touch at long distances, but the Engineers kept them out—rather luckily in some instances—doing good work in rushes and in following up. It was hard work playing against the wind and rain in the first half, and the Engineers when ends were changed felt the effects, for they were hard pressed right through the second half. They tackled well to the end, and it was only in the last minute that the line was crossed in a rush and from Private Martin's try Private Smith—always an excellent kick in the game—placed a goal.

"Captain Hobbs, of Blackheath did his best for the Engineers, but the trying defence of the first half exhausted the extra energy of his side and left no pace for the time when the wind was helpful. When the West Regt had scored there was a moment left for a forlorn hope by the Engineers, but the attack had not been driven home when 'No side' came.

"The Royal Engineer team was:

L. Cpl W. Black, L. Cpl Sabine, 2nd Cpl Waldron, Spr Williams, 2 Lt. G. C. Campbell, 2 Lt. G. C. H. White, 2 Lt. G. J. V. Shepherd, 2 Lt. Collins, Capt. R. F. A. Hobbs, L. Cpl Price, Spr. Sleightholm, 2 Lt. G. C. Gowlland, 2 Lt. B. T. Wilson, 2 Lt. E. M. Sinaver, Capt. J. O'H. Moore.

"The West Riding side contained only one officer."

The Corps has never done well in the Army Cup series and no RE Unit has ever won the Cup though we have been runners-up on seven occasions. The full record of participation in the final is shown in the Honours Annex.

By 1914 two more players had gained International Honours, Gowlland played for Scotland in 1908, '09 and '10 and Scobie in 1914. The War years virtually brought Rugby to a halt though a few games were played.

Rugby really opened up again in the 1919/20 season and the Corps began most impressively beating Harlequins 21–5, Blackheath 33–6 and Richmond 19–0.

In 1922 the School of Military Engineering (SME) and the RE Depot decided to combine with United Services Chatham and to pool the fixtures. "It will be obvious that this arrangement will be highly beneficial to the RE Officers at Chatham who play Rugger since not only are the facilities for getting a game greatly increased for all, but the more experienced players will get first class football, thereby not only making way for others to play in the A and B sides, but at the same time bringing their own play to the notice of Army and County Selection Committees." Only Corps matches were retained as purely RE fixtures.

In this year US Chatham beat the Army 11–10 with 11 Sappers in the US team, four of whom subsequently played for the Army, Millar, Wilkinson, Kavanagh and Sydenham. It also removed the Corps identity from the top class games and the really good players tended to drift to the London clubs.

In 1922/23 the Corps had a very good season. In the Gunner match which we won 18–8 the Corps fielded seven Army players one of whom, Scobie, was an International and another, Millar, became an International the following season.

In 1923/24 the claims for Millar to be given International honours were being loudly voiced by the press. He was now playing for London Scottish and was in fact capped during the season.

In 1925 the RE Rugby Football Club was formed as a truly separate entity, some forty-seven years after the first recorded game.

In the 1930s the Corps produced three internationals, Withers, Crawford and "Joe" Inglis, and also its first Cambridge Blue, 2 Lt. F. W. Simpson. The '30s were a competent if rather undistinguished period of Corps Rugby.

In 1939 the Records of Corps Rugby were stored for safety in a well known London Bank, they were withdrawn in 1946 and were lost from sight until 1971 when they were rediscovered in the Corps Library.

Rugby restarted in 1946/47 Season. This was the era of the National Service Players and the Corps produced three National Service Internationals, Bazley, Michie and Payne, two other National Servicemen gained International recognition after they had left the Corps, Bartlett and Marques.

Of recent years the outstanding players were Hamish Bryce and Andy Hoon who captained both the Army and Combined Services. Bryce also captained Scotland "B" and was permanent reserve for Scotland for several seasons.

These random reflections show that the Corps has had some great players and many good players but has never yet managed to win the Army Cup Competition. Seven times as runners-up is no compensation for a win. Some redirection of our efforts would correct this omission.

HONOURS ANNEX

International Honours

1871	C. A. Crompton	England
1871 and '72	C. W. Sherrard	England
1872	F. B. G. d'Aguilar	England
	F. T. Maxwell	Scotland
	H. W. Renny-Tailyour*	Scotland
1874	W. F. H. Stafford	England
1888 and 89	A. Walpole	Ireland
1893	P. Maude	England
1899 and 1903	R. F. A. Hobbs	England
1906	G. E. B. Dobbs	England
1908, 09 and 10	G. C. Gowlland	Scotland
1914	R. M. Scobie	Scotland
1924	R. K. Millar	Scotland
1931 and 32	H. H. C. Withers	Ireland
1934	J. A. Crawford	Scotland

1938	W. M. Inglis	Scotland
1953 and 55	R. C. Bazley	England
1956	E. J. S. Michie	Scotland
1960	G. W. Payne	Wales
1970	R. D. H. Bryce	Scotland "B"

* H. W. Renny-Tailyour was also capped for Scotland at Association Football in 1873.

Army Caps gained by Corps players 1907–1970

W. H. H. Aitken	1924
R. P. G. Anderson	1925–26
J. T. Bartlett	1947
R. C. Bazley	1954–55
K. R. F. Bearne	1956
F. R. Beringer	1951–53–54
R. Braybrooke	1961–62–63–64–65–67
R. L. Brown	1921
G. S. Bryan	1924–25–26–27–28
R. D. H. Bryce	1964–65–66–67–68–69–70
H. J. Bulkeley	1909
M. D. Calvert	1934–35
G. B. L. Campbell	1965–67–69
G. C. Campbell	1909
J. A. Crawford	1932–33–34–35
K. N. Crawford	1921
A. J. Croston	1933
G. E. B. Dobbs	1907
R. L. France	1939
G. C. Gowlland	1907–09–10–13–14
D. Greenwood	1955
M. R. Hanfield-Jones	1959–60–61–62–63–64
L. J. Harris	1931
M. J. Hartley	1956
M. H. S. Heath	1961–62
R. F. A. Hobbs	1907
R. N. B. Holmes	1939
A. J. Hoon	1966–67–68–69–70
J. R. Hornby	1926–27
W. M. Inglis	1936–37–38
A. M. Jackson	1914
A. G. C. Jones	1950–51–52
G. C. Mac M. Kavanagh	1923
R. J. N. Leonard	1959–60
I. G. Loch	1925
R. W. D. Marques	1954
L. Martin	1967–68
W. McGrath	1939
E. J. S. Michie	1956–57
R. K. Millar	1923–24–25
S. Morris	1924
G. W. Payne	1960–61
J. R. Phillips	1948
K. Pontin	1957
N. C. G. Raffle	1957–58–59–60
S. T. A. Ratcliff	1931–32–33–34–35
J. R. Rawlence	1936
L. T. Ricketts	1926–27–28
E. S. Rideout	1913
G. G. Roche	1950
H. Roddan	1957
J. H. Rohde	1910
D. Saunders	1966
R. M. Scobie	1914–20–23

F. W. Simpson	1931–32–33–35
R. M. Stancombe	1964–65
J. S. W. Stone	1920
P. S. B. Sydenham	1923
H. G. R. Taggart	1969
L. G. Thomas	1924
J. G. Vaux	1961–62–63
W. A. Vinycombe	1934–35–36
F. W. Whitcombe	1934
A. Whitehorn	1957–59
P. L. Wilkinson	1923
H. H. C. Withers	1928–29–30–31–32

Army Rugby Cup Final Results

1906/7	Training Battalion RE	Runners-Up
1921/22	Training Battalion RE	Runners-Up
1927/28	RE Aldershot	Runners-Up
1930/31	Training Battalion RE	Runners-Up
1931/32	Training Battalion RE	Runners-Up
1947/48	RE Hamelin	Runners-Up
1948/49	9 Independent Airborne Squadron RE	Runners-Up

Tung Chung Footbridge

MAJOR T. S. SNEYD AND CAPTAIN E. FOX

INTRODUCTION

THIS article describes the building of a 150-ft footbridge over a tidal river on Lantau, one of the islands of Hong Kong. It was a very small project compared to those normally recorded in this journal but it may be of interest as an example of the kind of job that combines almost all the best characteristics of small military assistance (MACC) tasks. It lasted one month. It involved one field troop with virtually no alteration to its normal manpower. The task was sufficiently demanding to stretch the NCOs and tradesmen of the troop but simple enough to be carried out without technical supervision from outside, apart from occasional checks by the Clerk of Works. The site was remote from Squadron HQ so that logistic support needed careful planning, but with helicopters available from RAF and Army Aviation, generous assistance from the RCT Maritime Troop, and a Heavy Ferry available, the problem was co-ordination rather than scarcity of transport and the work was not delayed for lack of stores.

The Tung Chung bridge was built in March 1971 during Exercise Sunbeam. For this exercise 11 Field Squadron, reinforced by a section of Royal Pioneer Corps, deployed from Ripon to Sek Kong, a camp sited roughly in the centre of the Hong Kong New Territories. The squadron moved at a total strength of 195 in a VC10 and two Hercules. Air freight was limited but a generous scaling of vehicles, stores and equipment was available in Hong Kong.

The primary task of the twelve-week exercise was to relieve the Gurkha Engineers and 54 (Hong Kong) Support Squadron working on the Luk Keng road. This provided particularly good training for those employed with plant. A camp site was established on the road and shifts kept the main machines working throughout daylight hours on a six-day week. The field troops built three large concrete culverts and our construction targets on the road were comfortably exceeded. However it was not feasible to use the full field troop effort on this project nor did the work provide a sufficient variety of training or adequate opportunity for delegation of responsibility to junior ranks. For these reasons a number of small tasks were taken on; a small river diversion, construction of a reinforced concrete section post at a

border crossing, an electrification scheme in a small remote village, construction of an assault course and a fully welded trainasium, and last but not least the Tung Chung footbridge.

DESIGN AND PREPARATION

The requirement was for a footbridge 5 ft wide capable of taking handcarts of up to 400 lb weight over the river at Tung Chung. It must have a life of ten years and require minimum maintenance. The bridge would provide a much shorter route to this important village and ferry terminal for a population of about 1,000 in the small agricultural communities farther up the coast.

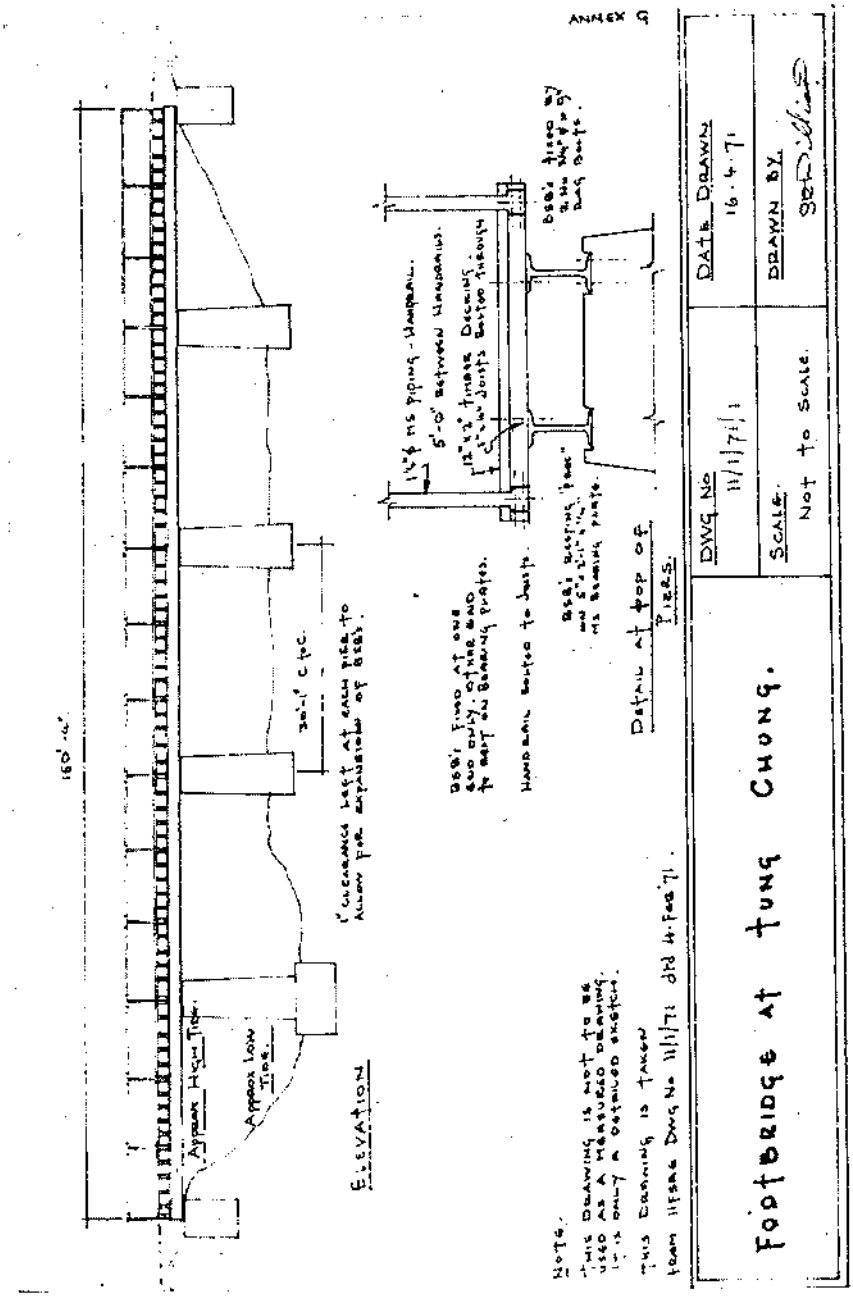
The proposed alignment of the new path gave little choice for the bridge site. This was some 50 yds from where the river flowed into the sea across a gently shelving shingle beach. At high tide there was a wet gap of 120 ft, and a maximum depth of 12 ft but at low tide there was only a water filled depression 30ft wide and 3 ft deep. The flow was almost negligible at that time of year. The initial recce was carried out in the first week of the twelve-week exercise. This dictated a design using readily available materials and capable of rapid construction on a remote site. The funds available were strictly limited. First thoughts were for a suspension bridge or for a modified Bailey, stocks of which were available through 54 (Hong Kong) Support Squadron. The former was abandoned because of the vulnerability of such a bridge to typhoons and the probable need for considerable maintenance. The advice of MVEE (Christchurch) and 62 CRE was sought on the Bailey idea. A quick response to the signal showed that a pier would have to be constructed within the permanent water gap and the labour in cutting and welding parts would be very considerable. It was clearly not a good way to use the limited stocks of bridging. We had hoped to avoid much concrete work since, with no road access to the site, aggregate would either have to be collected from the beach or imported by boat. However we now examined the feasibility of constructing concrete piers more carefully.

Excavations along the line of the bridge showed a sound gravel bottom with cobbles and small boulders. A variety of evidence pointed to there being little danger of scour in this part of the river and it was decided that shallow footings some 2 to 3 ft into the gravel and boulders would provide satisfactory pier foundations. The final design was for 5 spans of 30 ft with timber decking on pairs of 10 in × 5 in × 30 lb BSBs. One of the four piers would be in the depression, and a total span of 150 ft would give abutments well back from the banks. The deck of the bridge was to be level with the southern bank. A ramped approach would be necessary from the more low lying paddy fields on the north, but this should ensure that it would be clear of the water even in flood conditions.

For aesthetic reasons it was decided to taper the piers, making them thinner at deck level than at foundation level and to bevel the upstream edges to resist any tendency for debris to be lodged against them. The dimensions were 4 ft 6 in. (4 ft 0 in.) × 2 ft 0 in. at the top, and 5 ft 0 in. (4 ft 6 in.) × 2 ft 6 in. at foundation level. It was decided to make two substantial shutters that could be erected on prepared bases, and to concrete each pier in a single pour. The shutters were of ¾ in. external quality plywood on 4 in × 2 in. timber frames with polystyrene strip at each corner to waterproof and prevent grout loss. Acrow type straps were fabricated to secure them tightly.

CONSTRUCTION

The task of construction was given to 2 Troop commanded by 2 Lt P. R. Read. As they set off on a sunny afternoon from Gordon Hard on a Heavy Ferry loaded with a Michigan Light Wheeled Tractor, BSBs, concrete mixer and wide variety of stores the hills of Lantan 6 miles away looked rather too far and the mainland of Communist China rather too near for comfort. The crossing however was uneventful. The camp site had been set up the day before by a party which had moved in by LCM,


ANNEX G
ELEVATION
Approx High Tide.
Approx Low Tide.
30'-0" c/c.
1" Clearance left at each pier to allow for expansion of RSJ's.
Detail at top of Piers.
RSJ's fixed at one end only, other end to rest on Bearing Plates.
Handrail bolted to deck.
Footbridge at Tung Chung.
DWG No 11/1/71/1
DATE DRAWN 16.4.71
SCALE: Not to scale.
DRAWN BY
NOTE:
This drawing is not to be used as a measured drawing. It is only a dimensioned sketch.
This drawing is taken from Hesse Dwg No 11/1/71 dtd 4 Feb '71.

and site preparation started at once. A dam was built across the mouth of the river against the tide. It had been hoped that four No 4 Pumping Sets might have coped with the seepage and the small fresh water flow. Their effect was negligible but by breaching the dam at the end of work each day and closing it at low tide it was possible to keep the water level on the site up to 4 ft lower than on the seaward side. There was soon considerable foot traffic over the dam, a visible proof of the future value of the bridge.

The collection of sand created little problem but gravel and shingle had to be searched for at low tide with the Michigan and screened by hand to provide a satisfactory 1 in. maximum size coarse aggregate. This proved the critical and certainly the most laborious task of the project. About 60 yds of gravel was produced in this way in two weeks.

Excavations were made by the Light Wheeled Tractor into the river bottom at each pier position and sand bags filled with a very dry and rich mixture of concrete, using rapid hardening cement, were laid prior to the erection of the shuttering. For the pier built up from the depression it was necessary to concrete a base below the 12 ft shutter. This was done by building walls of the concrete filled sandbags to above low water level and in filling with a similar mix. With the base prepared the shutters were erected and checked for line and level. Concrete was brought in the Michigan bucket and shovelled into the shutter by men standing on a scaffolding platform. Small quantities of water always remained in the shutters after pumping so the first mixes were made with very low water cement ratios, again using rapid hardening cement, and vibrated until it was evident that the water was thoroughly dispersed in the concrete. The remaining concrete was placed using a 2 in. slump and normal Portland cement. The shutters were struck after forty eight hours giving an excellent finish.

While work continued on the piers, carpenters, welders and plumbers were prefabricating and preparing the bridge components. 6 in. × 4 in. joists were to be bolted across the BSBs to take the 12 in. × 2 in. decking and the handrails were of galvanized water pipe. The BSBs were lifted into position on the completed piers

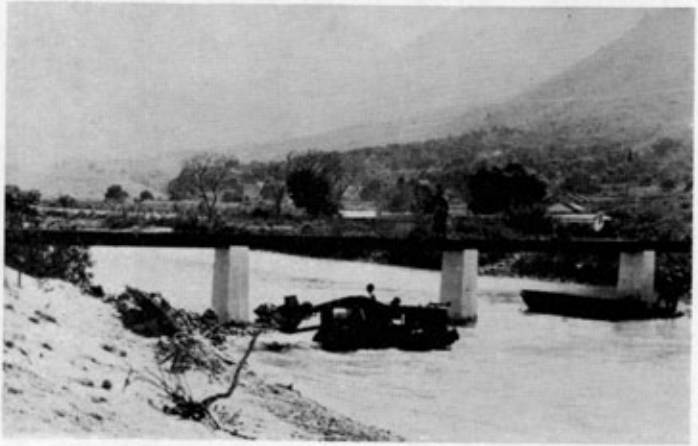


Plate 1. Tung Chung Footbridge nearing completion. Light wheeled tractor leacring river bed and in-filling round pier foundations.

Tung Chung Footbridge 1

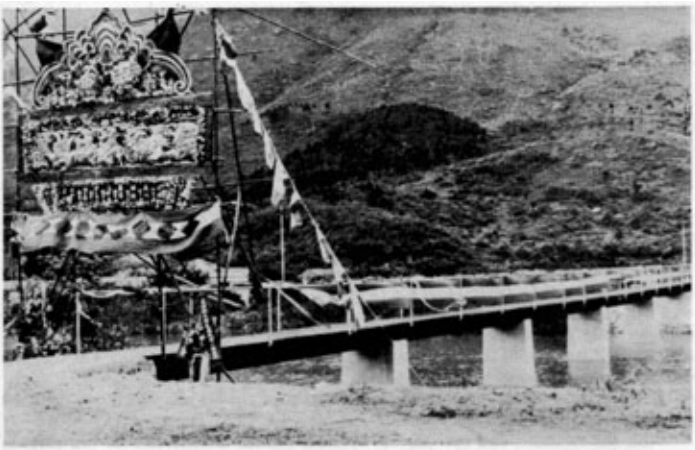


Plate 2. Tung Chung Footbridge decorated for the opening ceremony. The bridge was constructed by a Troop of 11 Field Squadron in twenty-eight days.

using the Michigan bucket, the fixed ends being secured with 9 in. × ¾ in. diameter ragbolts and the free ends resting on bearing plates.

The outline progress of work was as follows:

Days	1– 2	Set up camp and import equipment and stores.
	2– 7	Damming of river and preparatory work.
	8–16	Construction of four piers.
	17–18	Concreting of abutments and approaches.
	19	Final BSBs placed.
	24	Heavy Ferry collects most of heavy stores from site.
	26	Michigan taken off by LCM.
	27	Decking and hand rail completed.
	28	Painting and creosoting completed.
	29	Strike camp and clear site.
Notes:	1.	Three rest days were taken during the period.
	2.	Troop strength on site was maintained at just over 30.
	3.	Construction of shuttering took two weeks for a team of four before moving to site.

The troop lived in reasonable comfort on the site. The PWD provided a small generator for lighting. Helicopter resupply was available on a plentiful scale. A cinema screen was built in the camp and at least two films were shown per week, for all who cared to attend. Radio communication, all VHF in Hong Kong, was via a relay station on Robins Nest, one of the highest peaks in the New Territories, which also provided the link from Squadron HQ to the road project.

Major-General Horsford opened the bridge shortly before our departure to UK in a lavish ceremony, including "lion dancing", organized by the local people who had earlier shown their gratitude to the troop by providing a roast pig and beer. It had been a thoroughly rewarding project. Good logistic backing had enabled the impetus to be maintained, much of the work had been interesting and demanding, and every man involved could feel that he had made an important contribution to its success.

Tung Chung Footbridge 2

Rockets and things

WERHNER VON BETZ

WAR usually has its funny side. The Korean war was no exception. Certain activities took place in one small unit which, if generally known at the time, would have resulted in the area being given a very wide berth by all passers-by.

Rockets and things were the main trouble.

The Commanding Officer remarked one day that it would be a very good thing if we had some sort of a grapnel which we could fire at large lumps of debris in the river before they became entangled in the bridges. The Workshop Officer, who happened to be there, heard this and asked if he might undertake a little research into the subject. The C.O. agreed and the project was under way.

First efforts were aimed at producing a sort of harpoon gun. A small oxygen cylinder was "procured" and was given to the welders to have one end cut off. Just as the torch was about to bite into the metal, someone thought to ask whether the cylinder was full or not. It was.

A slight delay ensued while the oxygen was used up—it was much too precious to waste—and then plans went ahead.

With the rounded end cut off, the cylinder looked exactly like an old cannon barrel. A small hole was drilled in the breach end, just large enough to take the leads of an electric detonator. It was decided to test the barrel before we went any further and the method chosen was nothing if not logical.

The barrel was stood upright in the bottom of a slit trench. It was charged with 28 ounces of cordite, a primer and an electric detonator. The missile selected was a 25 pounder brass shell case for no other reason than that it was the right size and weight.

Some fifty yards of cable were reeled out. The gun crew took cover and the gun was fired. A healthy sort of report was heard and everyone looked up expecting to see the missile revolving lazily through the air. There was no sign of it. Some muttered conversation ensued, soon followed by a general advance on the slit trench. When about twenty yards away, a whirring noise was heard and everyone ducked rather quickly. A heavy thud announced the arrival of the missile in the immediate vicinity.

A careful check of our actions during the period immediately after firing, elicited the information that the missile had been airborne for some twenty-five seconds. A quick calculation thereupon revealed that it had reached the encouraging height of 1,600 ft, passing through the cloud base in the process.

Our first reaction was to hope that no light aircraft had been passing over at the time. This had us a little worried until someone pointed out that a pilot seeing an empty shell case float up beside him and then go down again, would not believe it anyhow and that we had therefore nothing to worry about.

Our second, and somewhat belated reaction, was to go and examine the barrel. To our delight we found it completely undamaged.

Work then proceeded apace. A bipod was designed and fitted and a tail spade welded on. A rather novel form of sight was evolved which looked more like one of those window catches with holes in it than anything else. It worked though. Next, a mock-up grapnel was made consisting of a 1 in mild steel bar with a circular plate welded on one end of the same diameter as the barrel, and some rough flukes on the other end.

Steel cable was attached to the grapnel and everything was ready for the first full scale test. The gun was loaded with only half the charge this time, that is 14 ounces of cordite and half a primer. Again, it was fired from well behind cover.

The test was reasonably successful, the grapnel going about 180 ft and the gun about five yds in the opposite direction. The latter fault entailed a redesigned tail spade. A slight swelling of the breach end was remedied at the same time by binding it with steel plate.

The next test was rather inconclusive as the rope let go of the grapnel which was last seen disappearing over a saddle between two hills some 800 yds away. A search was unproductive so a second grapnel was made with a redesigned shackle for the rope.

Test number three was fairly successful except that the shank of the grapnel was found to have achieved a smooth S-bend. This indicated a weak shank and Mark III was produced with ribs welded to the shank to strengthen it.

Test number four was quite successful and a range of about 250 ft was achieved. As our target range was 300 ft, it was decided to try again with an increased charge.

Test number six would undoubtedly have been completely successful but, unfortunately test number five caused the gun to burst. This was due solely to the design of the shackle which caused the grapnel to jam in the barrel.

As there were no more small oxygen cylinders to be procured, the project had to be abandoned. This was most disappointing since we were all convinced that we had the problems solved and that the redesign of the shackle would have been simple.

We now turned our attention to rockets.

The rocket out of the Rocket Propelled Holdfast was our main source of power. It presented a rather peculiar problem however. The range of the R.P.H. is about 1,600 ft. We only wanted 300 ft. Answer: cut down the charge to one-third?

The question mark is intentional and was to recur many times before we were finished. We attempted always to be completely logical in our deductions but somehow the true answer always seemed to be one more logical step further on. Rather like "The Goon Show".

It is worth digressing a bit here to explain what the inside of an R.P.H. rocket looks like. It consists of a plain steel tube about 3 in in diameter and 4 ft long. One end is sealed off with a steel plate. The other end has a "choke" built into it like a short venturi tube. The charge itself looks like candle grease and, in section, is similar to a Maltese Cross but with all the faces stepped. At the sealed end is a small flash tube with fine electric wires running down the length of the charge and coming out through the "choke".

When we first pulled one to pieces we could not understand this rather curious arrangement. Any fool knows you light a rocket at the tail end. Still, we decided to leave it as it was.

Anyhow, we cut off two-thirds of the charge, put what was left back in the tube and set it up for firing complete with cable.

When the button was pressed, the rocket fizzed frantically and just managed to heave itself off the end of the launching ramp before collapsing on the ground in a welter of sparks.

The answer suddenly presented itself. The clue of course was the peculiar arrangement and shape of the charge. It did not burn from the end, but over its whole exterior surface. Hence the steps to increase the burning area. It was lit at the top end and the flame washed down over the whole length igniting it as it came. Obvious when you really come to think about it.

The next stage then was to reverse the ratio of reduction and take off one-third instead of two-thirds. In fact we left on nearly three-quarters.

Everything was again set up and we prepared to fire towards a range of hills about a mile and a half away. This was our usual direction, used so that the hills formed a backstop. Just as the button was pressed, someone started to say something. A roar and a swish drowned his words and, to our astonishment the rocket vanished at high speed towards the hills leaving the cable lying on the ground. When last seen the rocket was approaching the crest of the hills and was still going strong.

(The person who had been about to say something when asked later what it had been, replied that he merely observed that he hoped someone had remembered to hitch the cable on as he had not.)

A rapid bearing was taken with a compass and a swift check of the map revealed only one small workshop unit on the other side of the hills on the line of flight. A

very guarded telephone call disclosed that they had heard and seen nothing. We heaved a sigh of relief.

The next trial involved a rather more careful check of the flight plan before take off and this time we were quite successful. However, the range, with a three-quarter charge was about 800 ft, much more than we wanted.

Trial number four with a two-thirds charge produced under 200 ft range. Obviously we were up against something rather critical.

Someone then had a bright idea. Why not stick a holdfast earth anchor in 300 ft from the point you want to hit. Stretch the rope backwards for 300 ft, hitch it onto the rocket and then fire it vertically.

The idea appealed to us. The rocket would try to go straight up but the rope would restrain it, forcing it to travel in a vertical semicircle, landing 600 ft from the firing point and 300 ft from the holdfast.

No need to tamper with the charge. It would not matter how much charge we had as it positively could not go more than 600 ft.

Rapidly the new set-up was prepared.

When fired, the result was startling to say the least. Everything worked more or less according to plan but about three times as fast. The rocket duly described its flight path, but in about the first one fifth of a second of its life. It roared over, buried its nose in the ground and proceeded to behave like an overgrown roman candle.

No harm was done of course but the principle snag was that the rocket had landed about 35 degrees off course. The difficulty was obvious. Unless the rocket was exactly vertical, the chances of landing it accurately on the target were very slim indeed.

Regretfully we abandoned the idea even though it was rather fun.

Around this time, a fairy godmother, in the unlikely shape of the United States Air Force, produced for us some target indicator rockets. These were much more to the point. They were identical in principle to the R.P.H. rocket, but about one-third the size.

Happily we set to work again. Fins were made and fitted, and a new kind of shackle designed. A special launching ramp was built with our patent window latch sight incorporated. Soon, everything was ready for what we were sure was going to be a most successful trial.

The button was pressed. There was a hiss and a roar and the rocket completely vanished! All that was left was the frayed end of a 300 ft length of rope.

It was clear what had happened. The rocket had simply been too strong for the rope. What had us completely baffled was where had the rocket gone? It certainly had not disappeared gradually towards the hills. We would have seen it. It had just upped and vanished.

We were not long left in doubt however.

An irate telephone call came in from a Canadian B Echelon down the road. The caller, expressing himself in no uncertain terms, claimed that one of our unprintable devices had landed in his "Backyard". Fortunately, someone looked at the location map and we were able to point out blandly that his backyard was in precisely the opposite direction to which we had been firing. We were, of course, very sorry about his backyard, but really it was not we who were responsible and he had better take the matter up with the Chinese who had a habit of throwing things at our side.

The next test took place a few days later. This time we made sure by using steel wire rope. The result was rather a foregone conclusion. The rocket took off, turned over backwards, and landed 300 ft away in precisely the opposite direction to which it had been pointing.

We did not tell the Canadian B Echelon.

The last test, to our great delight was an outstanding success. A large brass nose weighing about 6 lb was fixed to the front of the rocket and kept the nose pointing in the right direction. The range was almost exactly 300 ft and the accuracy, aided by the window latch sight, was within a foot or two of the target.

It only remains to say, regretfully, that the device was never used in action. Still, if anyone ever wants to know how to fire a rope accurately 300 ft by means of a rocket, we can tell them exactly how to do it. A comforting thought in this technological age.

Correspondence

Colonel D. E. Townsend-Rose
North Eastern Road Construction Unit
(Unit Headquarters)
Block 8, Government Buildings
St George's Road, Harrogate, Yorks.
23 August 1972

AIRBRIDGE TO THE MISTY ISLE

Sir,—1. I much enjoyed reading Major Hogben's article about Broadford Airstrip (June 1972), as I was concerned with the initial reconnaissance and with some of the later planning of the job. The article raises the perennial question of how much effort should go into reconnaissance.

2. The background to the reconnaissance may perhaps be of interest. In 1967 524 STRE reformed in Barton Stacey after a tour in the Persian Gulf. Most of its members were new, and some, who had not been to the Gulf were on permanent loan to other organisations. 523 STRE was in Aden, and 522 STRE in the Far East. At that time we were short of work! The reconnaissance of Broadford Airstrip was part of an exercise whose primary objects were to get the unit working together and to provide design and planning work for the winter. HQ 62 CRE and 524 STRE moved to Scotland for three weeks and undertook the reconnaissance of twenty-three tasks all over Scotland. Six or seven of the twenty-three tasks have subsequently been constructed by units of the Corps. Broadford Airstrip was considered one of the less likely to be built, but even so took the greatest number of man-days reconnaissance. It poured with rain for the ten days that the party were on the Isle of Skye. There was much muttering from some of those who had been winkled out of comfortable jobs with MPBW for the exercise, and one or two of our E and M experts found the design of access roads and concrete dams a little outside their normal experience, but the primary objects of the exercise were achieved. After the exercise was over, morale was well up, and I do not believe that 62 CRE have ever been short of work since.

3. At the time we had very little equipment—no drilling equipment and no soils laboratory. We knew there was peat, and we probed the peat with steel rods on a 50 ft grid. The following year—still with no drilling equipment—a party went to Skye, hired a tractor with back actor and dug a number of trial pits to prove the probing system. The results appeared to agree. What we did not find at all was the silt mixed up with the hard rock.

4. Two small points I would like to raise. Firstly Major Hogben rightly says that the original plan was made without consultation with the squadron. This was the case with all our jobs at that time. Our reports were to the Commander of 12 Engr Bde, and were intended to show how long a unit of a given constitution might be expected to take to complete the task. We hoped that they might be of some help to the units eventually tasked, but we always said that the unit concerned *must* make its own plan to suit its own men and machines.

5. Secondly, I have no quarrel with the figures he quotes for imported fill *per se*, particularly as I cannot remember the original ones, but I would be interested to be able to compare his figures with the change of total cut and fill from the original plan to the finished job. I feel sure they will not show an increase of 2,800 per cent.

6. How far should one take site investigation? I know of a building in London where a professional site investigation was carried out with deep borings. The building was designed to be founded on a raft on London clay at about 50 ft below street level. When the foundations were excavated, there was no London clay at one corner of the site. The design had to be altered and 6ft diameter bored piles put down a further 65 ft at considerable cost, so it happens to civilians too. There are all sorts of tags about this subject. "Time spent on reconnaissance is seldom wasted." "You pay for site investigation whether you do it or not." But site investigation is expensive, especially if the job may never be built, and there comes a time when the engineer responsible has to say "enough". The more construction work we, as a Corps, do, the better will we be able to pick that point wisely.—Yours faithfully, Colonel D. E. Townsend-Rose.

Major-General F. W. J. Cowtan, CBE, MC
Commandant
The Royal Military College of Science
Shrivenham
Swindon, Wilts. SN6 8LA
12 September 1972

VISION OR NIGHTMARE RE TRAINING AD 2000

Sir,—Please tell "SAM" that even in AD 2000 it will be quite unacceptable to talk "Shop" in the Brompton Mess, although probably still permissible to dream it.—Yours faithfully, F. W. J. Cowtan.

Brigadier P. St. Barbe Sydenham, CBE
Langley, Misterton
Nr. Crewkerne, Somerset
13 September 1972

VISION OR NIGHTMARE RE TRAINING AD 2000

Sir,—I should like to thank the last Editor for his kindly, if unintended, tribute to those of us who worked at the H.Q., S.M.E., & R.E. Depot in the days before "Parkinson's Law" came into effect. However like "old Caspar, whose work was done" may I put the record straight by pointing out that:

(a) The Commandant, Chatham Area, had a D.A. & Q.M.G. and a Staff Captain; I lunch and gossip with Philip Teasdale (the D.A. & Q.) over old times periodically.

(b) The I.R.E. had the part-time services of a G.S.O. 2—in M.T.2—(hight "Bill" Porter) and of a G.S.O. 3—in MT3—(hight P.St.B.); it is true that both had other masters in their GSOIs and also in the DMT. My G1 was Colonel, later Lieut-General, Grove-White; the DMTs were Alan Brooke and "Hobo"; the latter insisted that I should drive him around on visits of inspection in my M.G. saloon instead of taking a War Office staff car, which made it difficult for me to make notes.

(c) A few weeks before the outbreak of war in 1939 an Assistant Commandant was appointed; however we did not have time to find out what he was going to do before he departed again.

On the debit side Brigadier Lacey has omitted the A/T unit which had recently been formed at Darland under the command of Lieut-Colonel "Dan" Perrott.

Grossly overworked as we were, I still managed to play some tennis and to take a few days' leave in the summers of 1938 and 1939 and to play a little squash and have an occasional day's rough shooting in the winter of 1938/39. I did hear that within 2 years of my leaving MT3 for the BM's office four officers had been appointed to carry out the duties which I must have failed to perform adequately single-handed. Or was Parkinson at work?

Major-General Kirby in his book on Singapore does a great injustice to General Bond; the latter was certainly not desk-bound; he insisted on seeing things for himself, as "Pepper" Crawford, "Peter" Pepper and I soon discovered when the General was ordered to conduct a War Office TEWT on "defence against tanks in open warfare" in the area Bourton-on-the Water—Fosse Bridge—Andoversford.

His difficulty was that he disliked delegating work to his staff and that he would not, or could not, dictate his reports, even in draft form, but insisted on writing everything out in long-hand. In MT3 I normally called in three typists in succession from the pool to the intense fury of the Superintendent.

As I have already taken much of your valuable space, I will refrain from expanding on mobilizing the SME & RE Depot in 1938 and again in 1939. Fortunately the first turned out to be a "dry run" (USA vernacular) and proved a useful test for the second one, although certain YOs who were basking on the beaches of the Riveria with their girl friends were very indignant at receiving a telegram.

Not long after the second mobilization I received eighteen hours notice that HM King George VI would pay us a visit; I had to dictate orders on to a typewriter to assemble six thousand Sappers on parade. No major disaster occurred, but the representative Colonel-Commandant did come down from London dressed in major-general's uniform and wearing the hat of a full colonel; there was no time to take any corrective action; HM seemed to think that I was responsible and gave me a very old-fashioned look but said nothing.—Yours faithfully, P. St. Barbe Sydenham

Memoirs

MAJOR-GENERAL P. A. ULLMAN, CB, CBE

PETER ALFRED ULLMAN was born on 14 June 1897 and died on 12 August 1972. Educated at Cheltenham and the Royal Military Academy, Woolwich he was commissioned into the Royal Engineers on 28 July 1915. The eighteen-year-old Second Lieutenant was first posted to the Signal Service Training Centre RE, Woburn, Bedfordshire and in 1916 joined the Signal Service Headquarters East Africa Force. A year later he was back at Woburn and then in 1919 he was posted back to Africa this time to Sierra Leone.

The First World War and its immediate aftermath over, he returned to UK in 1920 to attend the Supplementary Course and went to Cambridge University to complete his formal education.

In the six years 1923–29 he filled various RE appointments in Waziristan District where in 1924 he was promoted to Captain.

In 1929, having completed his Works tour he was appointed 2 IC 11 (Field) Company stationed in Aldershot. This respite from Works ended in 1932 when he was posted to Dover as DCRE and gained Field Rank. A tour in the War Office (DADFW, QMG7) was followed in 1938 as DCRE (Haifa Projects) and SORE to Chief Engineer, Palestine and Trans-Jordon.

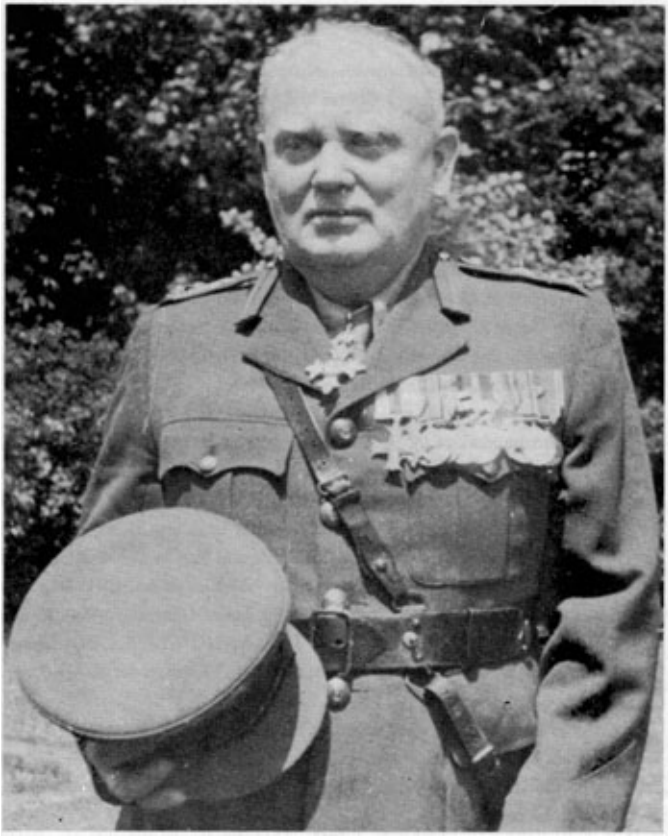
Just after the outbreak of the Second World War he became CRE of 7 Division Egypt in the Western Desert and in 1941 was appointed one of the Chief Engineers (Colonel) in MELF and then Deputy E-in-C MELF as a Brigadier and was awarded the OBE. In 1942 he returned to UK as Chief Engineer 2nd Corps Home Forces. His travels were not yet over, 1943 found him in Persia and Iraq as DW and CE, 1944 in Germany as DDW (E & M) 21st Army Group NW Europe and 1945 as Deputy E-in-C in the War Office, with the rank of Acting Major-General. In 1946 he was awarded the CB and was appointed Chief Engineer HQ ALFSEA as a Major-General. This was his last appointment as he retired on 13 November 1948.

A career involving much travelling also covered a wide range of Sapper activities. He knew what he wanted and made sure he got it. Although not always easy to get on with he did not make enemies. Our deepest sympathies are extended to his brother, son and daughter.

BRIGADIER G. R. GILPIN, CBE, MC

GEORGE RUDDELL GILPIN, who died on 29 October 1971, was born in 1895, the son of Major George Gilpin. He was commissioned into the Royal Engineers in 1915, served from the beginning of 1916 with 1/2 East Anglian Field Company in Gallipoli, and later with the Egyptian Expeditionary Force in Palestine, where he won the Military Cross.

After his Supplementary Course at Chatham he was posted to India where he joined QVO Madras Sappers & Miners in Bangalore. He commanded 10 Field Company of that Corps during the Waziristan/Razmak campaign of 1924, and took it to Shanghai in 1927, where it formed part of the Defence Force. Their task in Shanghai was the construction of a wide variety of Defence posts, often under the most arduous conditions.



Brigadier G R Gilpin CBE MC

In 1930 Gilpin became Garrison Engineer Kirkee, where he remained for three years. He then was posted as SORE to Western Command, but returned to the Madras Sappers in 1935 to command the Training Battalion. He was posted as CRE of the Waziristan Division during the operations on the NW Frontier of 1936/37, returning to Bangalore once more, at the conclusion of operations, to command the Training Battalion. For a time he officiated as Commandant.

In 1939 he became CRE Peshawar District where he remained until he was posted as Chief Engineer to Assam; charged with the task of opening up road Communications, not only from Dimapur to Imphal, but from Imphal forward to Tamu and the Chindwin River. Had it not been for his drive and skilled knowledge of the use of earthmoving plant, there is little doubt but that the Army in Burma would not have been able to find its way back to India before the monsoon broke in May 1942. After the setting up of IV British Corps at Imphal in May 1942, he became Chief Engineer (Rear) IV Corps, responsible only for Works from Dimpaur to Imphal.

In 1943 it was apparent that the rheumatism and arthritis from which he had been suffering for some time, would not allow him to remain in a damp climate, and he was posted to Northern Command India as CE (Works). From there he was posted as Chief Engineer to Mountbatten's SEAC Headquarters in Ceylon. For his War Services he was created CBE. He retired in 1946.

In 1922 he married Sophia Margaret Pillman who died in 1970. They had two daughters, with one of whom, Mrs Lewis-Barned, of Greystones, Long Harborough, Oxford, Mike spend his last days. Our deepest sympathies are extended to the family.

JFDS, DCTS, NEVP and others write:

No official account can possibly give a real picture of one of the most colourful Sapper Officers of his generation. The number of stories concerning him are legion (some of them apocryphal!). Space does not allow of their repetition in this memoir.

Those who served under him, whether British or Madrassi, got to love him; he drove them hard in their work (and on the sports field!), but his high leadership qualities and his humanity earned him this love and respect. Everyone knew that they would get a fair deal, no matter what, and that with some excitement on the way! His outbursts of rage from time to time were part of his character; they were generally justified and always ended with the soft look and voice of kindliness. At the same time, woe betide anyone from outside his command who dared to criticize any of his subordinates! He fought tooth and nail for them at all times, in order to get what he considered to be their due.

It must be admitted that this trait did not always endear him to his superiors, or to those who considered themselves to be his superiors, but this was part of his staunchness of character.

After leaving Assam in 1943, he was in continual pain with arthritis, but no one visiting him or working with him was allowed to know of this; he had to do his job with a smile, was always the perfect host and attentive listener to other people's troubles.

There can be no Sapper Officers who served with Mike, who do not owe him a debt of gratitude for his example to them and for the qualities with which he inspired them.

* * * * *

Book Reviews

MARTELLO TOWERS

SHEILA SUTCLIFFE

(Published by David & Charles: Newton Abbot. Price £2·95)

The Martello tower took its design from the watch towers erected along the Mediterranean coasts as a defence against corsairs. England adopted this form of defence after the Navy had found it a considerable task to capture the tower at Mortella Point in Corsica in 1794 when seeking a safe anchorage for the Mediterranean fleet. Shortly after this when Napoleon threatened England with invasion a rash of similar towers were thrown up in Ireland, the Channel Isles and along the south and east coasts of England.

Royal Engineer officers had much to do with the siting, design and building of these towers, both at home and overseas. Lieut-Colonel John By was a member of the Defence Committee in Canada which recommended the building of Martello towers at Kingston, on Lake Ontario, as late as 1851. The Royal Engineer report of the towers built on Guernsey said they were almost useless due to the smallness of their diameter and, in view of this report, guns were never mounted on the towers. A Royal Engineer officer was in charge of the building of fifteen Martello towers on Minorca during the period of British occupation after 1798—and Sapper officers were greatly involved in every aspect of the towers erected along the south and east coasts of England.

Not one of the 103 towers built to repulse French invaders ever fired a gun in anger in the nineteenth century, nor was their strength ever tested. The toughness of their walls was terrific. Experiments carried out at Woolwich by Royal Engineer Officers with a mortar of lime, ash and hot tallow produced a skin so hard that cannon balls just bounced off, and the walls were so thick that they would have stood up to any bombardment the ships of those days could have offered.

After the Napoleonic wars the south coast towers were used as signalling and coastguard stations, but many fell into disrepair and some were washed away by the erosion of the sea. It was not until the Second World War that some of the towers came into useful employment as guard stations, observation posts and AA gun emplacements, radio and rangefinding stations.

This book provides excellent reading for students of military history, especially that of the Corps of Royal Engineers. There are many excellent photographs and the text gives an enormous amount of detail of the design and construction of these towers.

H.J.

SCARLET FEVER (A LIFETIME WITH HORSES)

JOHN CUSACK MM and IVOR HERBERT

(Published by Cassel of London. Illustrated. 163 pages. Price £2·75)

Scarlet Fever, by John Cusack and Ivor Herbert is a "ghosted" autobiography of John Cusack MM, who is now a Chelsea Pensioner. The book describes a career in the Army that began at 14, ended some months later when his age was discovered, and began again the next year when Cusack was enlisted into the Scots Greys.

The Army took him from Glasgow to Egypt, from India to South Africa and then to the battlefields of Flanders in World War I, where he won his Military Medal for bravery in the field. His description of this event illustrates the wry humour that pervades the book. His medal was presented by an ancient General whose hand was too shaky to pin it on and the duty was performed for him by another officer. The Author reminds us that if the medal had then carried the gratuity, subsequently awarded, of sixpence a day, he would now have collected some £400 since his discharge in 1927.

Cusack had a passionate interest in horses all his life, as the sub-title of the book tells us, but he avoids the mistake of allowing this to overshadow the rest of the book. Horses form, so to speak, the backdrop and are only brought to the front of the stage in the last few chapters, which deal with a riding stables the Author opened in Canada. This was a calculated risk, which through his own incredible efforts, turned out to be a massive personal success.

Cusack re-enlisted in the Second World War and served in the Royal Canadian Engineers in the UK and Europe. He rose to the rank of Regimental Sergeant Major, and must have been a tower of strength to his Commanding Officer.

Perhaps the most interesting part of the book deals with his time after leaving the Army, when he was working as an under-cover agent, briefed to infiltrate the Communists in Toronto. The description of his life at this point is graphic and detailed; there is a feeling of involvement for the reader which comes through too rarely in the book as a whole. Possibly because of the necessary compression of the narrative, there is a tendency for the events described to take on a flat aspect; to become a procession of events, interesting enough in themselves, but somehow lacking in light and shade.

The book is nicely set out with ten pages of photographs showing the Author in various stages of his career, and of contemporary scenes. We see him as a Red Cap and as a prize-winning horseman. There are photographs of a horse-drawn tram, a Hotchkiss gun team going into action and some of that most exclusive club, the Royal Hospital in Chelsea, with In-Pensioner John Cusack MM in the scarlet coat that gives his book its title.

The dust cover describes Mr Cusack as "one of Nature's gentlemen", with which the reader will agree. Your reviewer believes that this little book will give pleasure and interest to a great many readers. It is an easy book to read and the slight remoteness can be excused.

J.C.H.M.

A CALL TO ARMS. Interlude with the Military

Edmund Ions

(Published by David & Charles: Newton Abbot. 249 pages; Price £3·25)

When the curate told his bishop that the boiled egg before him was excellent in parts, he implied that the egg was a bad one; but your reviewer does not wish to imply that *A Call to Arms* by Edmund Ions is a bad book, because he can only describe some of it as excellent.

It is an account, written from a journal twenty years after the events, of the experience of the Author when a soldier between 1948 and 1953. He was a clever schoolboy, pushed to the extreme by grinding study, who felt he wanted a complete change. He did not agree with his parents that National Service might fill the bill, and he enlisted on a regular engagement in the Black Watch: five years with the Colours and seven with the Reserve. In the recruiting office in Newcastle they saw at once that he was a potential leader and sent him to a Training Battalion in Ulster intended for promising youngsters. From there he went "through the usual channels" to Eaton Hall and Sandhurst to be commissioned in the Border Regiment. He volunteered for service in Korea and fought as a platoon commander in the Ulster Rifles during the period when fighting was still taking place although armistice talks were in progress. He was wounded and evacuated (against his will) to a base hospital, but returned to his battalion and remained until they were withdrawn from the theatre and sent to Hong Kong. He claimed a posting back to his own regiment and re-joined the Border Regiment in the Suez Canal Zone at a time when conditions approximated to active service. Here he completed his five years with the Colours; and after some exchanges with Authority he resigned his Commission. Later he went to Oxford and, so the dust-cover and the flyleaf tell us, he became an academic at York with a number or erudite books to his name.

Now, why is this book only partly excellent? First, let us consider what is shocking; for that is not the note on which your reviewer cares to end. The book is shocking because there is so much obscenity. Obscene incidents are described; obscene talk is recorded verbatim; and bawdy songs, of the type sung at rugger drinking clubs and some guest nights, are set out in full. Filth and four-letter words frequently occur; and a reader of your reviewer's generation who must also be aware of these things in an imperfect world, is shocked by seeing it all in print. The Author says in his Foreword that he has "excluded four-letter words and their variants except for those occasions where the particular context requires its special savour". It seems to your reviewer that where the savour is really worth preserving, a better way of preserving it may be possible without mauling the reader.

So much for that which is shocking. Now for the more agreeable task of saying what is excellent. First, the Author's heart is in the right place. He was never a military type, but he did his duty with courage and common sense. He took care of the men under his command, and he understood the ethos of the British Army. He describes magnificently the pageantry and the romance of the Black Watch beating retreat on the lawn of a Scottish castle when they returned from their last tour of duty in India. He perceived the standards of self-respect, and the tangible pride of the sun-tanned veterans. The sense of history carried by the regiment was not lost on him. He could see the purpose of the harshness of military training and the virtues of the martial spirit. He is sometimes critical but there is no trace of malice. His

descriptions of officers whom your reviewer happens to know are recognizable and kind. He describes with admiration his brigadier in Barnard Castle, who later became Chief Royal Engineer; and Hugh Stockwell, the Commandant at Sandhurst is described with humour and affection.

Perhaps one of the most perceptive vignettes is of his farewell to the Second-in-Command of the Ulster Rifles:

"He rose from his desk and came round to shake hands. He was a man of few words, little sentiment, and rarely smiled. He said in matter of fact tones: 'We're grateful that you joined us. You've been very loyal.' That was all. Coming from him it was much more eloquent and it meant much more than friendly toasts. . . ."

It is only a pity that somehow the Second-in-Command's surname has been mis-spelled. But there is no doubt who it was. Another small matter surprised me. The Author is describing the search with binoculars for a sniper in Korea "awaiting the tell-tale *puff of smoke*". (Reviewer's italics.) It has always been his experience that there is no puff of smoke. Powder is now smokeless and that is the difficulty. However, it is a minor criticism of an account of active service that must recall to many who have experienced it what it is like. He conjures up the feeling of physical fitness, sleeping in the open, taking hard exercise, marching, digging revetting and so on. He recalls the comradeship of the men, their fears and their grumbles. He pays tribute to the staunchness and example of the older men in the ranks. He knew the boredom, the doubts, the fears, and the uncertainties that beset the junior leader with a sense of responsibility for the men in his care. He takes a charitable view of the muddles of other people; as for instance a parachute drop of boots when the battalion wanted ammunition and rations. He describes how he was sent to command another platoon whose morale had been lost, and how he set about (in a perfectly orthodox way) putting things right. He describes the daily problems of the platoon commander on active service with the sure touch of one who knows what he writes about.

All this is very well done and the Author is to be congratulated on his skill and the general level of interest of his book. It would be pleasant to be able to recommend the whole thing unreservedly; but a caveat must be entered; or the reader, perhaps buying a present for someone, will wish he had read the book first. On the whole, that is what he should do.

M.C.A.H.

THE CHALLENGE OF WAR: SCIENTIFIC AND ENGINEERING CONTRIBUTIONS TO WORLD WAR TWO

GUY HARTCUP

(Published by David & Charles, Newton Abbot. 295 pages. Price £1·50 net)

Many are the obstacles that must be overcome by a scientist before his brain-child sees the light of day upon the battlefield; and Guy Hartcup in *The Challenge of War* follows the fortunes of over forty scientific and engineering inventions that were used by the Services in the war of 1939–1945. He excludes the atomic bomb for adequate reasons that he explains in the book.

Perhaps the greatest obstacle to be overcome is secrecy. In the end the enemy is certain to learn all there is to know about a new device; but one hopes he will learn too late. If, however, an inventor's project is imprudently disclosed too soon, the enemy's counter-measures may be ready to meet it when it gets into production. Conversely, if perfecting the device is unduly slow, the enemy may, by his own endeavours, get there first. He is also thinking.

As soon as a scientist discovers something new, his instinct is to publish scientific papers so as to advance the frontiers of knowledge. (Perhaps that is also why a hen cackles when it has layed an egg; it too has produced something new.) It is this admirable tendency to publish results that keeps every advanced country more or less abreast of scientific thought. Costly technology may restrict the development by poorer nations, but it is not as a rule until open war is declared that an absolute blanket of secrecy can be drawn over scientific achievement.

It thus came about in 1939, when the Second World War began, that British and German scientists both comprehended the principles that governed radar (then known as radio direction finding) and the magnetic mine. Both must have understood the sort of counter-measures likely to be effective against them. It seems, therefore, quite natural that Britain began de-gausing ships within a few weeks of the German introduction of magnetic mines; whereas it is incredible that the Germans were surprised in the Battle of Britain by the radar

chain used to foretell the approach of raids. Particularly is this so when one considers that the radar chain depended on a series of steel towers, built before the war, visible to trippers on the beaches, airmen overhead and mariners round our coasts on their lawful occasions. Indeed the Germans even sent Zeppelins on a series of electronic reconnaissances before the war to survey our East Coast area. For some unexplained reason they derived no profit from the exercise. Perhaps it was the frailty of human nature; their authoritarian methods were less suited to coping with scientists than were our more free and easy ones.

Scientists are not always easy people to handle, and a scientist of genius may be like a prima donna. Tizzard and Lindemann, we are told in this book, were barely on speaking terms; and Higher Commanders who are, so to speak, their customers may not be easy customers either. They hold strong views, sometimes wrought in the crucible of actual war, and they may not be very receptive. The War Office, for instance, only abandoned the listening devices for detecting aircraft some seven years after the scientists had told them of the greater possibilities of electronic methods. Luckily. the same scientists were still available when the urgent requirement arose.

The whims of the rank and file also have a bearing on the adoption of a new scientific device. The Inglis bridge, we are told, was not only turned down on technical grounds; the sappers did not like humping tubular members; they preferred panels. And if aircrews got a notion that a navigational apparatus would enable enemy night-fighters to "home" on them, they may be pardoned for resisting it till their fears were set at rest. This, we are told, was one of the afflictions of H_2S, which became a Bomber Command navigational aid of the greatest value.

There is an element of luck in the timing of an invention. If I may be permitted a personal experience, not mentioned in the book, I recall a strange dishevelled civilian entering my office when Adjutant RE 2 Division in Aldershot in 1938. He wanted to see the CRE who was an *ex-officio* member of the RE and Signals Board, about an invention. The CRE was on leave and I was furtively shown some grubby plans of a vehicle that looked like a boat on wheels. I sent him on to the Board, and what luck he had I never discovered; but I must confess that I did not see the significance of the invention. It seemed to be ten times as heavy and far less buoyant than a folding boat and could only be got into the water down a concrete ramp. A few years later, even the most fatuous Blimp would recognize an embryo DUKW and jump for joy.

A scientist is sometimes so in love with his brain-child that he will continue research, even though told officially that it is stillborn. Such was the fortune, we are told, of Donald Bailey and his design for a bridge. The idea was conceived in 1936—having, presumably evolved from the Martel box girder principle—but the War Office "displayed no interest". Bailey worked on quietly alone till 1941, when the Inglis Bridge failed in tests in January and was rejected. Because of Bailey's private work, a prototype was ready in May. It was accepted in July, and your reviewer remembers his Field Company building one on an exercise in September or October of the same year.

Many other examples illustrating the effects of luck, personalities, timing and so on are quoted in this book. It seems to your reviewer that the Army made less use of scientific thought than the other Services. It seems that the discoveries that helped the Army most were in the medical field of prophilactic treatment of soldiers against malaria. The book says (charitably) that less money was available for the Army than the Royal Navy or the RAF; but the reader may be tempted to think that soldiers were less insistent upon the need for new ideas between the wars than were the other Services. He must ponder that for himself.

It will thus be seen that *The Challenge of War* covers an interesting field of thought; and the Author is to be congratulated on making it easy for the layman to understand. Perhaps the organization of the book leaves something to be desired; because it deals separately with sea, land and air, and there is inevitable overlapping. There are also some curious mistakes in the binding of the book. If the reader looks at the List of Plates he will see that page 51 should be photographs of Sir Charles Goodeve and Lord Blackett. In fact the page shows something totally different, and is set upside down, with men clinging to the deck of *HMS Repulse* like flies on a ceiling.

The Foreword is written by Lord Bowden in graceful prose that makes one wonder if a gift for expressing himself so well was not a help in putting across to laymen the fruits of his high scientific ability. The Author, too, writes well; and your reviewer commends this book as background reading for thoughtful soldiers as well as scientists, so that the country may continue to benefit by their joint endeavours. It is easy to read, and the short time taken is well spent.

M.C.A.H

THE SOLDIER IN MODERN SOCIETY

The June issue of the *RE Journal* carried a review of the book the *Soldier in Modern Society*. The Author was Lieut-Colonel J. C. M. Baynes not Byers as shown.

The error is regretted.

Technical Notes

Notes from Civil Engineering and Public Works Review, May 1972

1. A TEST METHOD FOR THE STRUCTURAL INTEGRITY OF BORED PILES. Difficulties in ensuring the structural integrity of bored piles have come to light in recent years, and various test methods have been put forward, but have not gained general acceptance. The author of this article proposes a test method which, it is claimed, makes it feasible to prove the soundness of a large proportion of, or even all, piles on a contract. The test method is also utilised to measure skin friction values on a specially constructed pile. Actual tests of both forms are described and an indication of the costs given.

2. THE QUEST FOR CONSTRUCTION MATERIALS OVERSEAS. In this country we are well endowed with deposits of sand, gravel and rock deposits of good quality which can be quarried readily for any construction task. However, in tropical areas where the weather conditions are more severe the winning of construction material can be a problem. This article demonstrates that the location of suitable sources of material for construction can have almost as much importance in site selection as topographical and ground conditions, and that attention must be paid to this aspect at the investigation stage.

3. LARGE SCALE GUNNITING TO RESTORE RETAINING WALL. Seafront retaining walls can be more subject to severe weathering than is usual elsewhere. The effect of salt laden moisture, direct wind attack and large diurnal range of temperature can be seen in the form of cracking and defacing. The possibility of using gunnite for reconstructing a retaining wall at Brighton seafront in Sussex was investigated and Cementation Projects Ltd has undertaken the task. The article describes the methods used.

4. CONSTRUCTION OF PORT AND HARBOUR AT ABU DHABI, PORT RASHID DUBAI. These are 2 general articles describing the construction of 2 ports. Both articles highlight the construction of breakwater with tetrapods (Abu Dhabi) and stabits (Dubai), and the problems associated with the winning of construction materials and methods by which these were overcome.

Notes on Civil Engineering and Public Work Review, June 1972

5. FORMWORK. Formwork costs can amount to 60 per cent and more of the total cost of a structure. Its importance in good design cannot be overstressed. This article discusses current practice in the design and use of formwork and associated equipment. It lists extensive bibliographical references to the more important published works of recent years.

6. ACCESS SCAFFOLDING. CP 97 is a fairly recent Code of Practice, coming into being in 1967 and now consisting of 3 parts. Part 2 was published in 1970 and Part 3 in 1972. In this article the author considers the development of scaffolding practice through the ages and the thinking behind these developments which have eventually led to CP97.

7. RELEASE AGENTS. In recent years architects have tended, more and more, to use concrete as a finish material, and without doubt some of the most attractive buildings today owe their success to the imaginative use of concrete. However, good concrete finishes can only be achieved with the aid of good formwork and release agents. In this article the author discusses the trends in surface treatments of concrete, selection and use of agents, recent developments and the effects of agents on new types of concrete.

8. STABILITY OF TUBULAR SCAFFOLDING. This article describes a series of model tests to verify that the accepted theory of elastic stability may be applied to ½ full size tubular steel struts subjected to loading conditions similar to those of the "standards" in typical tubular scaffold structures. The results indicate that an ultimate strength approach for the design of tubular scaffold standards based on considerations of elastic stability should provide a more realistic basis for calculation which at present tend to rely on the individual engineer's judgement regarding the effective length factor. This factor is related via effective length, slenderness ratio and permissible stress to permissible working load as recommended in BS 1139 and can vary from 0·7 to 2·0 giving a considerable range for error of judgement which it is hoped this article will help to reduce.

THE MILITARY ENGINEER
MAY/JUNE 1972

THE TEGERNSEER–LANSTRASSE PROJECT MUNICH
A brief report gives the method of construction used for this road. Excavation for the project took place between "bored pile" retaining walls, anchored back at the top by "injected anchors". Undisturbed soil was used to support the bridge soffit forms. The soil was excavated when the concrete had reached the required strength.

Soil Cement. This article gives some useful practical points on design, mix design, construction and quality control. The method of design is to use CBR design curves to find the thickness of flexible type pavement required to protect the subgrade. This thickness is then reduced in the ratio 1 to 1·7 to obtain the thickness of soil-cement and asphalt wearing surface required. This thickness has then to be checked to ensure it meets the minimum thickness for the traffic type.

Plastic Wrapped Roads. This method of construction consists of twelve inches of soil compacted at optimum moisture content on a lower polythene membrane and completely sealed in using an upper membrane of polypropylene-asphalt, which is also the wearing surface. Information is given on construction and the tests which have been completed. These tests indicate that this type of road is suitable for wheeled traffic up to 5 ton.

Two other articles of interest are "Desalination Methods for Military Use" and "Roofs for Cold Regions". The desalination methods mentioned are distillation, electrodialysis, reverse osmosis and freezing. The roofs consist of the structural deck, a waterproof membrane, an insulating layer and a protective surface which is not waterproof. This method protects the membrane from extremes of temperature.

Forthcoming Events

12 January	RSME Guest Night	RE HQ Mess
25 January	49 YO Batch Night	RE HQ Mess
8 February	Ladies Guest Night	RE HQ Mess
21 February	Dinner	RE HQ Mess
10 March	29 Bde (V) Dinner	RE HQ Mess
22 March	Corps Guest Night	RE HQ Mess
29 March	REYC AGM and Dinner	RE HQ Mess
3 April	Band Concert	RE HQ Mess

SPORTS AND GAMES FIXTURES

RE RUGBY FOOTBALL CLUB

6 December	RA	Woolwich
20 December	RM	Deal
17 January	RAMC	Chatham
31 January	REME	Arborfield
7 February	Cambridge LX Club	Cambridge

RE HOCKEY CLUB

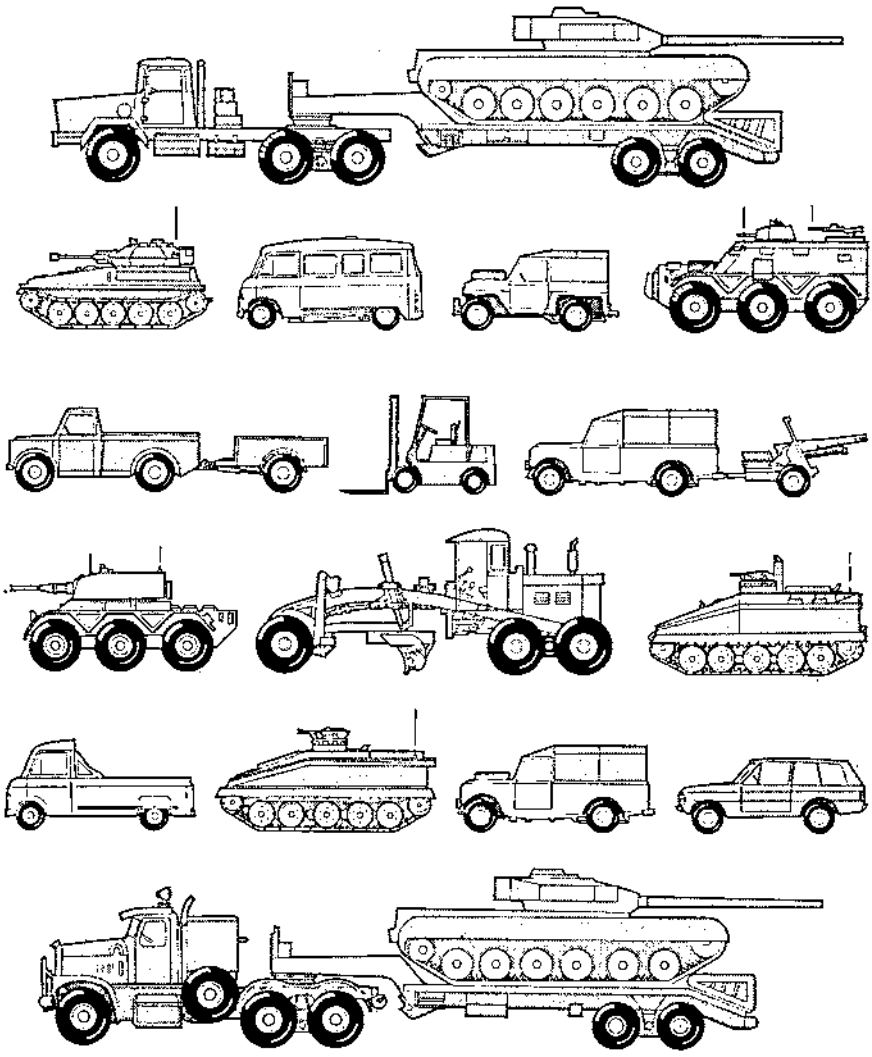
9 December (L)	Old Edwardians	Eastliegh
10 December	Blackheath	Chatham
16 December	Hampstead	Chatham
21 January	Hawks	Whiteley
27 January	Surbiton	Chatham
28 January	Southgate	Southgate
3 February (L)	Havant	Havant
5 February	Cambridge University	Cambridge
7 February	London University	Chatham
17 February (L)	Chichester	Chichester
18 February	Cheam	Cheam
25 February	Maidenhead	Longmoor

RE ASSOCIATION FOOTBALL CLUB

19 January	RCT	Dover
9 February	RAMC	Aldershot
2 March	RAOC	Bicester
22 March	RAPC	Worthy Down
2 April	REME	Catterick
4 April	RSigs	Catterick
6 April	RA	Catterick
1 May	Rochester & District Football League	Brompton

RE SQUASH RACKETS CLUB

8-10 December	Inter Corps Championships	Aldershot



BRITISH LEYLAND MILITARY VEHICLES

Back-bone of the modern army

An army today must be totally mobile. As well as armoured vehicles, it needs transporters to carry them, heavy lorries and transport of every shape and size for the movement of troops and equipment, fork lift trucks to relieve man power, road making equipment to smooth out difficult terrain.
British Leyland makes them all. Plus the power systems to keep them going.

BRITISH LEYLAND **Military Products**

MILITARY SALES * BRITISH LEYLAND MOTOR CORPORATION LTD * 41-46 PICCADILLY * LONDON W1V 0BD

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.

The copyright of all articles published in the *Journal* is assigned to the Council of the Institution of Royal Engineers.

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 Lieut-Colonel, 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 60723 Appendix B to Chapter 5.