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Editorial

ENHANCEMENT OF IMAGES

TRAVELLING from London to Scotland via the Doncaster By-Pass you will see a sign which reads "The North". Not "To the North"—just "The North". An image has been created by newspapers, radio, television and books which has given birth to a new country. The result is that 'The North' deserves at least single quotes. 'The North' has now developed its own brand of nationalism to add to its suspicion of outsiders. The suspicion has been there for generations—a young Doctor from the South (Merseyside!) practised for a while in 'The North' and, although he was liked, as a Doctor it was considered that he was only capable of curing a ham! I did not realise that I was a Northerner until leaving there. Once realised, nationalism took over and I became a Professional Northerner to maintain the image and to show that I belonged there. The escalation of imbalance by imagery is not new but the media and the ability and willingness to travel has increased the awareness of it.

It is a natural human desire to "belong", to take pride in belonging and to enjoy basking in the reflected glory of the whole. We all know that to be a member of the family of Royal Engineers is both a privilege and a pleasure. But basking in the glory is only one side of the coin. To belong is to accept some responsibility for the whole. One also has to suffer the shame should the image become tarnished. For example the unsocial behaviour of a minority of the crowd at an International football match reflects on their country of origin.

Images take time to create and having been created they can be destroyed, sustained or enhanced mainly by those who are part of the image. In a modern society images have to be reshaped as circumstances change, there can be no standing still.

Are we doing enough to sustain the much envied Sapper image?

Without being complacent the answer is *probably*—Yes.

Could we do better and enhance the image?

The answer is *certainly*—Yes.

It is so easy (and natural) to lapse into the habit of doing what others do, or do not do, even when we know we shouldn't. A child on returning from a party was asked if she had thanked the hostess as she had been taught to do. "No", she said, "Felicity left at the same time as I did and when she said "Thank You", Mrs Jones said "Don't mention it", so I didn't".

In his Christmas/New Year Message to the family of the Corps, the Chief Royal Engineer stressed the importance of continuing the momentum of building up all the institutions (the images) of the Corps. It is never easy to create an image, it is relatively easy to sustain it but considerable additional effort is required to enhance it. All Engineers understand the static and dynamic principles behind the stationary, moving and accelerating object.

What can we, as individuals, do to at least sustain and hopefully enhance the image? After WW2 and National Service the "temporary" Sappers returned to civilian life and took with them a knowledge of and, in most cases, a deep affection for the Corps. We had an unofficial PR team. As WW2 ended some thirty-five years ago it will be appreciated that the team is getting smaller! It will soon be time, if the time has not already arrived, to take the initiative and consciously spread the news that the Corps still exists and is still as important to the three Services, and the country as a whole, as it ever was. We can all play a part in publicising the Corps, thus strengthening the image.

"If you are not part of the solution then you are part of the problem".

Arch Bailey Bridge Construction

LIEUT COLONEL A TINNI RAE, BE, MIEAust

The Author is a professional engineer with the Department of Main Roads, NSW. He graduated from University of New South Wales with a degree in Civil Engineering in 1959 and enlisted in the Royal Australian Engineers (Army Reserve) in 1963 as a Sapper. He was commissioned in 1965 and as a Temp Capt was appointed Administering Command of 108 Plant Squadron (Heavy) in December, 1967.

He became a Maj in 1974 and was promoted Lt Col in February, 1976 when appointed CO 21 Construction Regiment RAE(SR). His current appointment is SO1(Plans) in HQ 2 Div, as a member of a special team which writes and conducts Tactical Exercises Without Troops, Command Post Exercises and War Games.

21 Construction Regiment is a Supplementary Reserve (SR) unit in the Corps of Royal Australian Engineers. It differs from other Australian Army Reserve units in that all establishment positions, other than Field Engineers, are filled by people who have equivalent civilian technical skills. Due to this, the compulsory training commitment is only two weeks per annum, although many undertake more than this.

The Regiment was raised in 1950 and has three Construction Squadrons and a Plant Squadron (Heavy) under command. Currently its total strength is in excess of 600. The sub-units are sponsored by major Government Instrumentalities such as the NSW Department of Main Roads and the Metropolitan Water Sewerage and Drainage Board.

A detailed report on this project with Annexes and Calculations is available, (Restricted), for reference in the Corps Library.

SUMMARY

THIS article describes the planning and construction of the arch Bailey Bridge over Punchbowl Creek on Holsworthy Range, NSW, Australia. It describes the construction techniques and records some lessons learnt during the exercise. The original suspension bridge, known as Engineers Bridge, over Punchbowl Creek on Holsworthy Range had been classified as unsafe for some years. Early in 1979 it was decided that it should be replaced with a new bridge to provide access to the western side of the Range. The 19 Chief Engineer Works design, having a 55m long double/single through Bailey Bridge supported on a 34m long double/single Bailey Arch, was approved and 21 Construction Regiment was tasked to construct the Bridge during its annual Camp February–March 1980. 17 Construction Squadron was tasked to support the Regiment.

The work was executed in three phases: Preliminary Operations, Construction of the Arch and Construction of the through Bailey. Detailed planning by 21 Construction Regiment required the task to be completed in twenty-four working days. It was actually achieved in twenty-two, requiring 1,117 man days in total. The work was

Lieut Colonel A Tinni Rae BE MIEA

undertaken by a construction task troop of approximately forty, plus a number of administrative and support elements. A number of the preliminary activities were carried out by 17 Construction Squadron.

Historical Background

The Holsworthy Range has had an Engineers Bridge since 1960, when a cable and timber suspension bridge was constructed across Punchbowl Creek to provide access to the Range from the west. This was a Class 16 bridge of 55m (180ft) span and was a magnificent example of non-equipment bridging undertaken by the Sappers of 1 Field Squadron.

It would appear that over the years it received little or no maintenance effort and, as a result, it was classified as unsafe and closed. By the end of 1979, most of the steel wire rope hangers had corroded badly with a number completely broken. A large proportion of the decking was extensively decayed and the timber side trusses had been damaged in a number of collisions with vehicles. To repair the bridge would have meant complete replacement with the exception of the suspension cable towers in the banks. (Photo 1).

The Concept and Design

The project was born in January 1979 when the Chief Engineer Field Force Command was asked if a Field Force unit could be tasked to remove the old suspension bridge and replace it with another suitable bridge. The design had to be such that the bridge would be clear of floods and have a minimum of Class 16 capacity. The Chief Engineer recommended an arch Bailey configuration and in June 1979 tasked 19

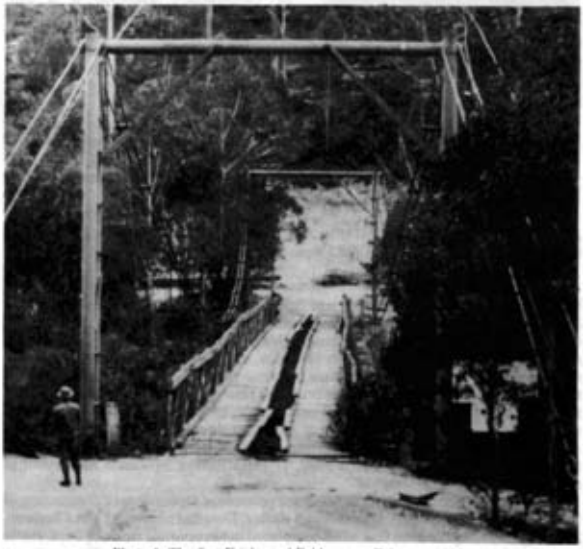


Photo 1. The first Engineers' Bridge as at February 1980

Arch Bailey Bridge Construction 1

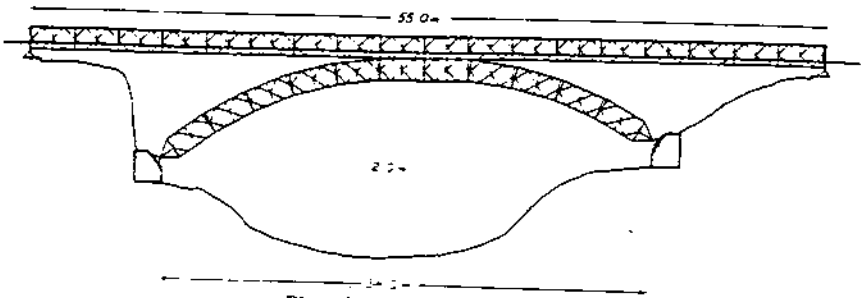


Photo 2. The approved design

Chief Engineer Works with preparation of a detailed design. The design brief required that the bridge had to be simple and incorporate as few specially manufactured components as possible.

The approved design was a two pin double/single arch Bailey of 34m supporting a 55m double/single through Bailey fixed to the two central panels of the arch. This is illustrated diagramatically in Photo 2. The final design documents were issued in December 1979.

The design utilised a maximum of equipment bridging parts, with only the special angle panels to connect the arch to the thrust blocks, the arch base plates and holding down cages having to be specially prefabricated. These are illustrated in Photo 3.

The base plates were designed so that they could be moved up to 150mm "up or down" to assure perfect connection/match of the two halves of the arch in the middle.

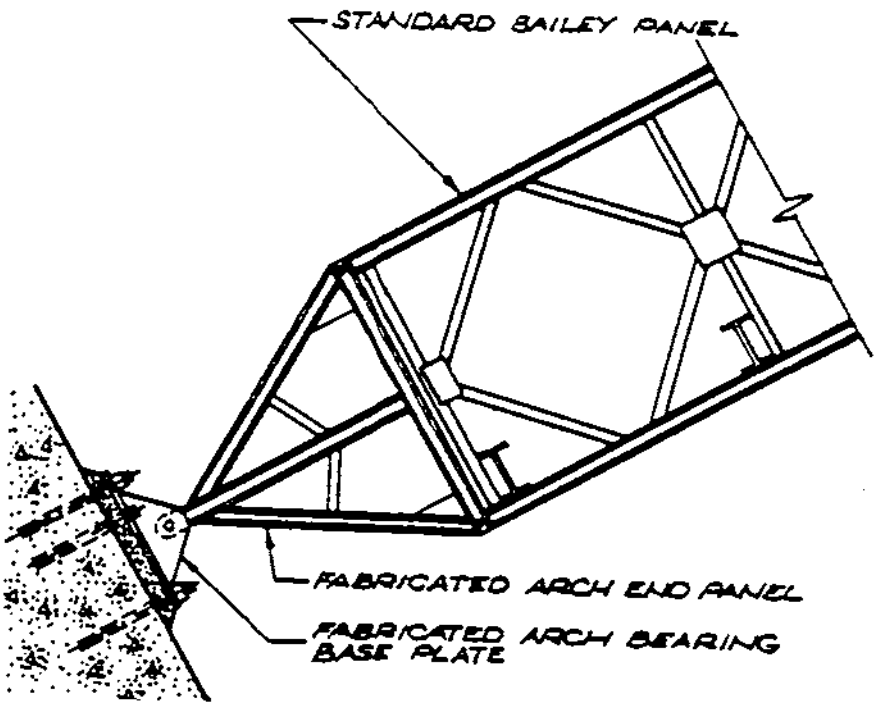


Photo 3. Arch footing

Tasking

Chief Engineer Field Force Command Works Instruction 4/79, dated 10 November 1979, tasked HQ 5 Engineer Group for the overall control and co-ordination of the project. 21 Construction Regiment was then given the task to plan and execute the project with completion no later than 10 March 1980.

17 Construction Squadron was tasked to support the exercise by prefabrication of the non-standard bridge components and provision of plant support to 21 Construction Regiment during its Annual Camp.

Planning

All planning was undertaken by HQ 21 Construction Regiment. The project was designated Ex *Gladesville 2*, as it was similar to a large new concrete arch bridge in Sydney.

The execution was planned as a three phase operation:

(a) Phase 1—Preliminary Operations (November 1979 to 8 February 1980);
(b) Phase 2—Construction of the Arch (9 February to 22 February 1980); and
(c) Phase 3—Construction of the through Bailey (23 February to 7 March 1980).

A detailed construction programme, in the form of a Linkbar Network Analysis and a job priority list, was produced.

For each Phase, a Project Officer was appointed and tasked to ensure that programmed work for the phase would be completed. No delays, regardless of reason, were allowed. This was particularly important for Phase 1, as the rest of the project depended on all the activities having been completed.

For detailed planning, it was necessary to go firm on the construction techniques in the first instance. It was decided that the arch would be constructed from both banks simultaneously as single/single construction, propping panel 3 (from the thrust block) with commercial Cee-Shore adjustable props. The arch would then be cantilevered out until the two sides could be connected in the middle. The second truss panels (forming the double/single configuration) would then be erected. Two flying foxes were to be erected on the existing pylons, just clearing in width the existing bridge. The panels would then be lowered from the existing bridge and connected to the arch.

It was also decided to employ a "task" construction troop of forty plus minimum administrative support.

All work had to be completed during the "two fortnight" Annual Camp of the Regiment, which meant that a total of twenty-four working days were available.

With this background, the first critical path construction programme was produced and it became obvious that certain activities would have to be completed during the Preliminary Phase for the project to be completed on time. It had already been decided that the eight special angle panels, four thrust block base plates and the base plate holding down cages had to be prefabricated. It was now necessary to call on 17 Construction Squadron to carry out the excavation for the four thrust blocks prior to the Regiment arriving on site.

Construction Organisation

A specific construction organisation was laid down. For both construction phases, a Project Officer was appointed, responsible directly to the Commanding Officer. There were also permanent Construction Officers and Plant Supervisors, but the rest of the troops were phased through the project at three or four day intervals. This provided continuity in supervision and construction but still permitted each troop to undertake separate Corps training at the School of Military Engineering.

The "Plans" section provided day to day survey control, design of construction expediencies and progress documentation and reports. The "Support" section looked after all stores (some 110t), plant and field administration (including the turn-over of manpower rosters). (Photo 4).

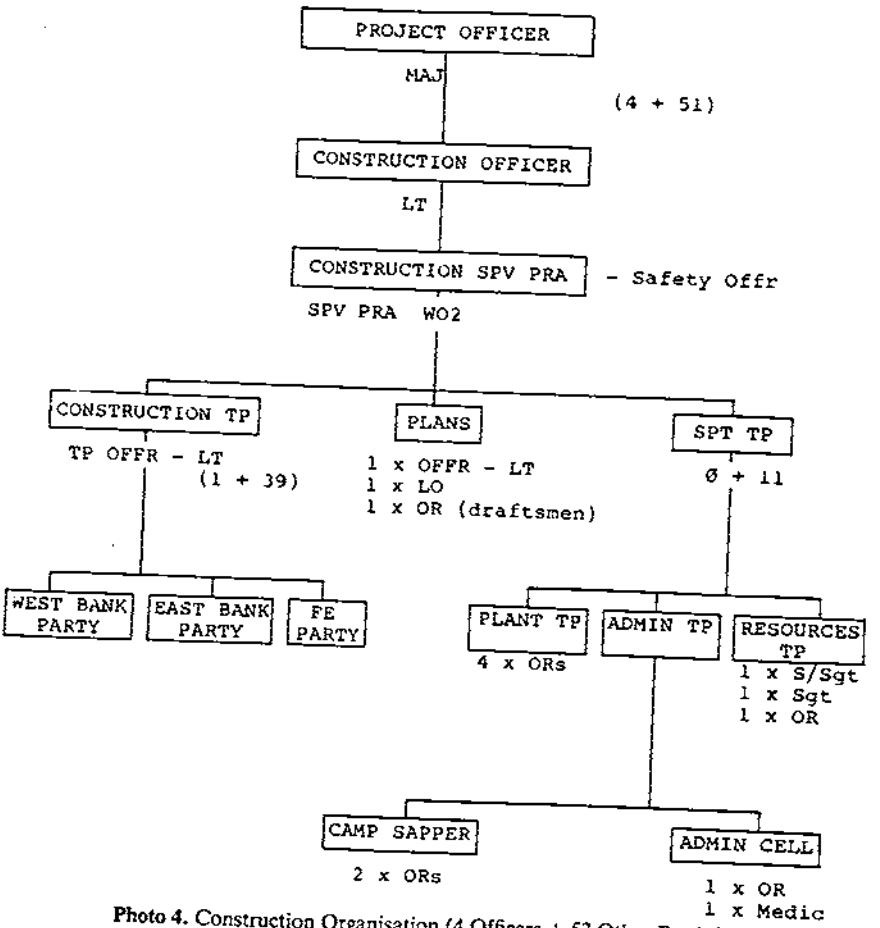


Photo 4. Construction Organisation (4 Officers + 53 Other Ranks)

Construction of Bridge

Prefabrication of Special Components

The special angle panels (8) were fabricated from standard Bailey panels and transoms. The panels had to be carefully disassembled first, cut to shape and rewelded to form the angle panels. Four had to have female connections and the other four male connections to link into the two ends of the arch.

Being high tensile steel special care had to be taken when rewelding. The work was carried out by up to six tradesmen provided by 17 Const Sqn under the supervision of a Department of Main Roads Foreman Boilermaker in one of the Department's workshops. Major structural welds were X-Ray checked to ensure perfection. The panels were cleaned and primed prior to delivery to site.

The base plates and holding down cages were manufactured from new materials. A total of 400 man hours were involved.

Preliminary Operations

There was no reasonable access to the Bridge site as the causeway and the access road from the Range were in poor condition. 17 Construction Squadron undertook to reform the access from the Range to a standard that concrete transit mixers could negotiate.

The original suspension bridge was in a very dangerous state with a number of steel wire rope hangers completely rusted through and sections of the decking most dangerous due to dry rot in the timber. The timber side trusses had been damaged through a number of accidents. Approximately 7m of the eastern end of the bridge was propped from the ground. The hangers from that length were then used to replace the missing ones and those regarded as unsafe. Temporary running planks were placed over the full length of the deteriorated decking.

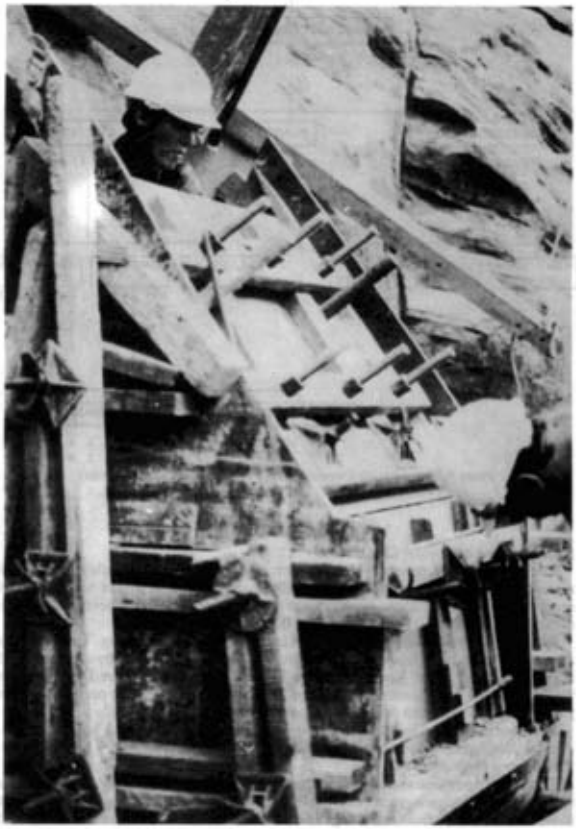


Photo 5. Final adjustments to formwork for arch thrust block being made

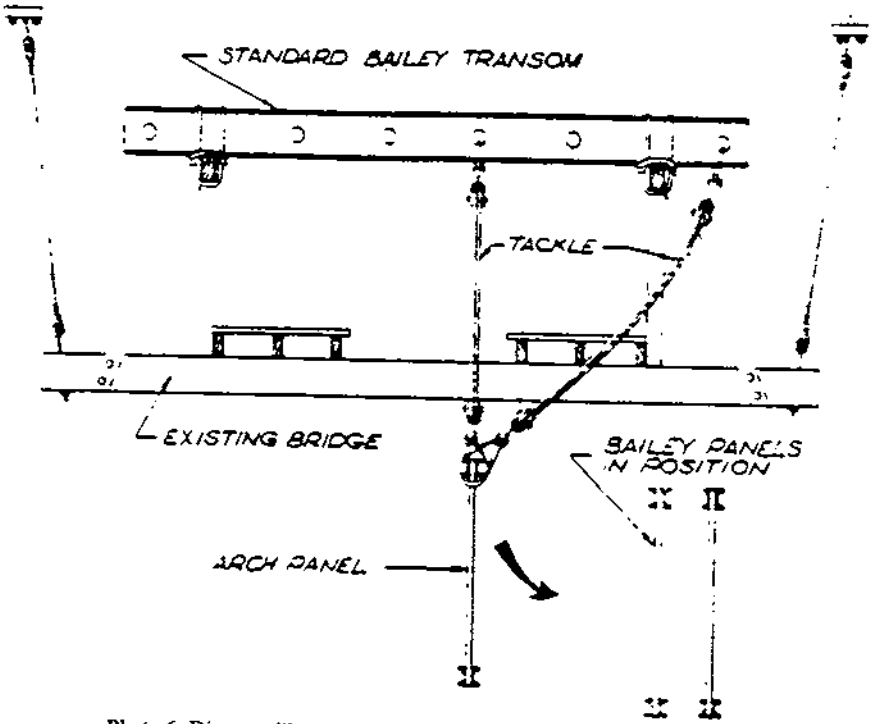


Photo 6. Diagram illustrating method used for lowering arch panels

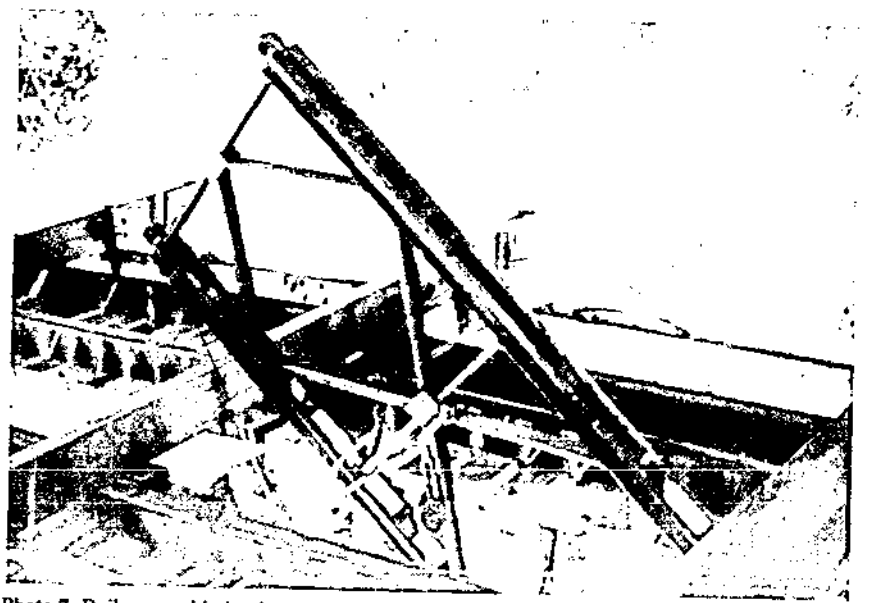


Photo 7. Bailey panel being lowered from the old bridge. Note the tackle from outside of the bridge is used to take the weight of the panel as it is lowered and to position it sideways

Thrust Blocks

Excavation for the arch thrust blocks was carried out by 17 Construction Squac ron. It was essential that the thrust blocks were bearing on solid rock and completel stable to lateral forces. In two cases additional 1m length rock bolting had to b provided.

The four thrust blocks (Photo 5) contained approximately 4·5m^3 of concrete each On the eastern bank they were some 5m below the existing bridge deck level an readymixed concrete was "chuted" down into the formwork. On the western ban the height differential was over 7m and the concrete had to be "tremmied" from th old bridge. In both instances pencil vibrators were used to assist the "mobility" c concrete.

All concrete was delivered by contract to the eastern abutment and then taken b wheelbarrow across the existing bridge. The design called for 20 megapascal cor crete, however, 40 megapascal was used so that arch construction could commenc within twenty-four hours.

The prefabricated holding down cages consisted of 6 × 30mm bolts and 2 × 50mm guide pins.

The excavation and construction of the thrust blocks took 1455 manhours or 16 man days.

Erection of Arch

After the pouring of thrust blocks the base plates were packed (with timbe approximately 150mm above the concrete to allow for final adjustment of the arch They were placed by accurate survey for line, level and distance between them.

It was intended to use flying foxes to lower the panels and transoms from th existing bridge. However, due to shortage of blocks and other equipment it was nc possible to erect the foxes. An alternative system was devised by one of the Senic Non-Commissioned Officers, which proved very successful.

The old bridge had a gap of approximately 1m between the two running track enabling all the arch components to be lowered down through this space. Th method is illustrated in Photo 6.

A standard Bailey transom was lashed to the top chord of the existing bridge. Tw lots of blocks and tackles were attached as shown. (Photo 7). The panel was lowere

Photo 8. First angle panels in position and fixed to the base plate

Photo 9. The main props have now been positioned and the construction continues by cantilevering out the bays. Note the old bridge is about to foul the arch

on the middle tackle and when clear of the old bridge, the outer tackle was attached. With suitable adjustment, and with the assistance of hand held guy ropes the panel could be positioned steadily and accurately in its correct location and attitude and the pin driven in without hassle.

Because of the ease of the operation double/single bays were completed as construction proceeded.

The angle panels (Photo 8) were positioned independently first and then the first bay attached. The end of the bay was propped with commercial Cee-Shore props of 30t capacity. It was essential that panel pins be located in space exactly to ensure that the two sides of the arch would neatly close in the middle. Each panel position was calculated accurately and "surveyed in" during construction.

Each bay was fixed in its final position as completed. Vertical adjustment was by means of the screw legs of the Cee-Shore props and lateral with wind bracing. After positioning the third panels from thrust blocks a longer set of props was installed and clamped to the bottom chord of the panels by an improvised attachment. (Photo 9). From then on the remainder of the bays were cantilevered out until the arch met in the middle. The longest cantilevering was over four bays.

Due to the strict survey control, the upstream arch fitted together exactly and no adjustment of the base plates was required. There was a mismatch of 50mm for the downstream arch, however, this was easily taken out by lowering one of the thrust block base plates by 7mm. (Photo 10).

The need to demolish the middle section of the existing bridge did not eventuate, as it was possible to raise the old structure sufficiently (approximately 450mm) to enable the arch to be completed. This was achieved by tightening the suspension cables using tirfor jacks and adjusting the attachments to anchorages.

The temporary walking strips on the arch were provided by longitudinally placed chesses. 50 × 50mm cleats were nailed on to hold them in place and on top side to provide grip for walking.

After checking that the two middle panels were level, the base plates were locked in position, the timber chocking removed and the void grouted in with sand/epoxy mortar.

The arch was completed in 1635 manhours or 182 man days.

Gabions

The western base plate of the arch was 1·8m lower than the eastern. The design required that the western end of the arch be protected by gabions.

A hasty check on likely flood level was carried out, and it was determined that the

highest flood level due to the Punchbowl Creek catchment would be just below Reduced Level 93, ie approximately 0·5m below the base plate pin level. Higher water level might be expected due to the back-water from Georges River, when it also was in flood. During this condition there would be little flow occurring and damage from debris would be minimal.

The western base plate was protected with 12/1m × 1m × 2m gabions using 36t of 150mm crushed dolerite rock.

Demolition of Existing Bridge

The existing bridge was demolished by first removing the stiffening trusses on the sides of the bridge. The deck and transoms were then removed, a panel at a time, working from the centre of the bridge on two faces towards each abutment. (Photo 11). The hangers were unbolted from the suspension as transoms were removed. Finally the suspension cables were pulled clear of the structure using a bulldozer.

The work took 550 manhours or 61 man days.

Construction of 55m Double/Single Bailey Bridge

The launching and construction of the through Bailey followed conventional practice with the exception that it had to be "rolled" over the top of the arch. Two rocking rollers were fixed to the arch so that the launch plane was just clear of the level section of the arch. The level of the landing rollers was pre-calculated so as to lift the middle of the bridge just off the arch rocking rollers when the bridge proper reached the far bank. The actual deflection of the bridge was 51cm against the calculated 57cm.

It was also desirable to evenly distribute the reactions at the abutments and on the arch. To achieve this it was calculated that the ends of the bridge should be jacked down 150mm above the level at the arch. This also provided a more pleasing profile.

Concrete footing pads were provided for the base plates.

The bridge was protected from road maintenance plant by 3m long concrete approach ramps.

After jacking down, the through bridge had to be connected to the two middle panels (level) of the arch. To everybody's surprise the chord bolt holes of the bridge and arch did not match. It was only then realised that chord bolt holes in panels are

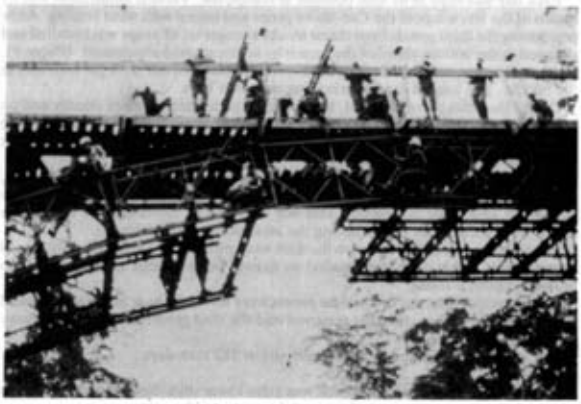


Photo 10. The first panel of the final bay of the arch being pinned in place. The launching link has not been placed in the top left hand corner of the panel. This one fitted exactly

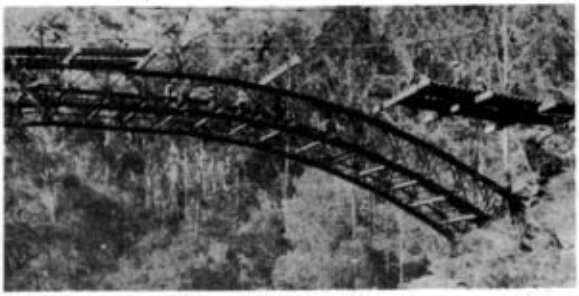


Photo 11 After completion of the arch the old bridge was demolished; working from the centre towards the abutments

not equidistant from panels ends and because the female ends in the bridge panels pointed west, while those in the arch pointed east, they could not line up. The problem was overcome by manufacturing special plates to enable the chord bolts to grip the top chord of the arch panels. The method is illustrated in Photo 12.

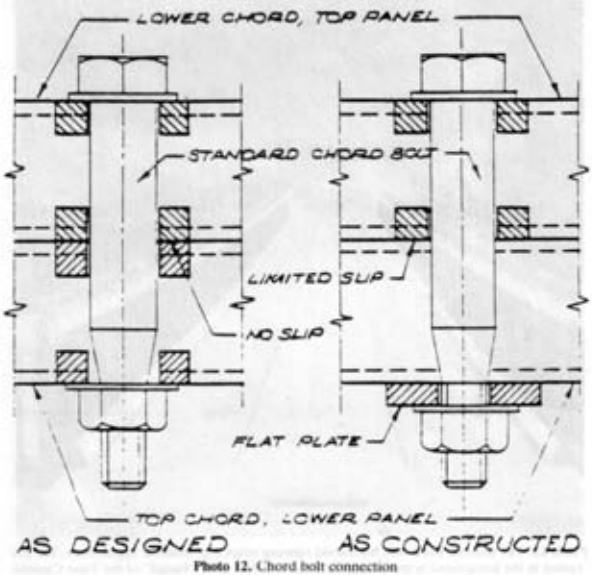
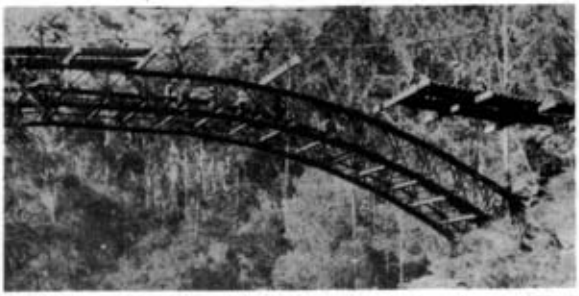


Photo 12. Chord bolt connection



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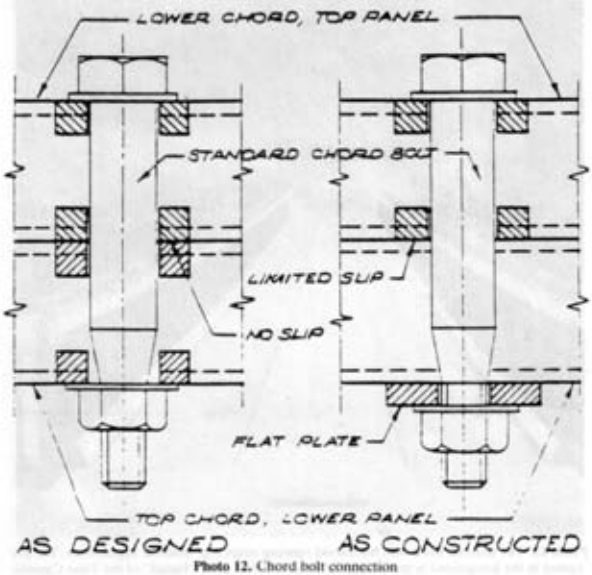


Photo 12. Chord bolt connection

The whole bridge was degreased and a total of 80 litres rust converter applied. It was then washed down with high pressure water hoses by arrangement with the Army Fire Service. All bare areas were now covered by hand using zinc chromate primer. A total of 100 litres of primer was used. The top coat of olive drab enamel was applied by both brush and spray. A total of 250 litres of paint was used. The kerbs and the inner face of the top chord of the bridge were painted white for delineation.

The towers of the old bridge which were left in place were also cleaned and painted to match the new structure. (Photo 14).

These activities required a total of 1373 manhours or 153 man days. It should be noted, however, that this was due to the extreme conditions of difficulty. Most of the undersides of the arch and the bridge had to be scraped and painted from bosun's chairs.

Ancillary Works

The ancillary works consisted of:

(a) Sand bag revetment at bearings using 10:1 sand/cement mixture. Some 700 bags were placed.

(b) Adjustment of drainage on the western side including construction of a new concrete inlet structure.

(c) Provision and erection of the bridge classification signs.

(d) Guide and fender posts.

(e) Restoration of the area.

Resources Available and Used

(a) Plant:

1 × 966B loader	1 × Clark Forklift
1 × P & H Crane	2 × 110cfm compressor
1 × D6 Dozer	

(b) Small Plant:

Air saws	Concrete kibble
Chain saws	Tremie tubes
Jack picks	Cee-Shore props
Jack hammer	Tirfors
Alternators	Survey equipment
Large electric drill	Blocks and tackles
Electric saw	Portable welding set
Oxy-acetylene cutting equipment	

(c) Vehicles:

3 × 5t Dump Truck
1 × 5t GS Cargo (Rations)
1 × 500gal Water Cart
2 × 3/4t GS Landrover (one as safety vehicle)

(d) Local Purchases:

The total cost of local purchases was A $6,470.46

General Comments

Design Comparison

There is no doubt that a number of different designs, utilising Bailey components, could have been used for the crossing.

One alternative would have been to use a triple Bailey Bridge. This would have required 324 panels instead of the 118 used in this design and its weight would have been nearly twice that of the bridge constructed.

Similarly, it would have been possible to have had a lighter structure if special piers from the quarter points on the arch had been provided to support the through bridge. In this instance a lot more special fittings and angle panels would have been required. The actual construction would have also been more difficult.

As far as economy of resources and effort was concerned, it would appear that the design adopted was the best in the circumstances.

Construction Timings

The bridge was completed slightly ahead of the programme in twenty-two working days and opened as planned on Day 23.

A total of 10,132 manhours or 1,117 man days was required.

It is interesting to note that supervision and task support accounted for 19% of the total effort. A higher figure was avoided as hot-box rationing was available and the Construction Troop did not have to establish the Camp itself.

Photo 14. The completed structure

Official Opening of the Bridge

The Bridge was officially opened on 5 March 1980 by Colonel N Sharpe, Chief Engineer, 2nd Military District, in the presence of a large gathering of VIP guests. The latter included senior representatives and heads of the Sponsoring Authorities of 21 Construction Regiment.

In Sapper fashion the opening was effected by cutting a 150mm sapling with a chain-saw. As the logs dropped, the formal opening was also heralded by loud explosions and geysers of water from the creek.

To commemorate the occasion a time capsule was concreted into the special niche provided in the eastern approach slab. The capsule contains, a roll of all members of the Regiment, copies of the commemorative brochure signed by all VIPs, the Corps cap badge and a copy of the Maintenance Instruction for the bridge. (Subsequently, I have been advised that there may also be some cans of various beers for future generation Sappers).

The Bridge was immediately test loaded, by taking the VIP party to the Reception at Camp "Collings" in a Tracked Load Carrier provided by 2 Cavalry Regiment.

Future Maintenance

The main cause of non-availability of the old suspension bridge was the complete lack of maintenance of the structure after it was built in 1960. With all permanent structures it is essential that periodic maintenance inspections and appropriate remedial action be carried out.

Compared to the old bridge, maintenance inspections are even more important now as the arch could be damaged by debris during floods and rust preventative measures are a lot more difficult to achieve. With this in mind a detailed maintenance inspection and action instruction has been prepared. It is hoped that a particular unit be tasked to look after and maintain the bridge as required. If properly maintained and barring accidents, the bridge should last for well over 100 years.

Lessons Learnt

General

(a) When Works Instructions are issued, simultaneously release of equipment from stores systems should be arranged. Early release of bridging for prefabrication of the special components proved a major headache.

(b) Thorough and detailed planning is the corner stone to success. Only minor variations were needed to the Critical Path Programme.

(c) The need for the appointment of Project Officer for major tasks (as distinct from Construction Officer) was verified. Regardless of his rank, he should report directly to the Commanding Officer of the unit undertaking the task. This will ensure both quick feed-back and timely and positive action in case of problems.

(d) High morale amongst the troops leads to a good safety record. Even though the working conditions were dangerous, no serious accidents occurred.

(e) There was a tremendous amount of "hands on" Field Engineering training for the troops; equipment bridging, field machines, holdfasts, a large variety of power tools, working in teams, living in the field, hygiene in the field, etc.

(f) For spectacular projects there is value in establishing a special visitors briefing area, appointing somebody for the task and having a set format for the briefing. This will minimise disturbance and provide quality briefing.

Particular

(a) Having a permanent supervisory team but rotating the troops did not create any problems. Even though some time may have been lost through the normal "learning curve" effect, it was more than compensated by the proportion of fresh troops arriving on site every day. There was no problem working virtually all daylight hours.

(b) The value of detailed organisation chart was obvious from Day 2 onwards. Command and control was practiced strictly in accordance with this. The usual

orders groups were held nightly at appropriate levels, giving valuable training to all ranks.

(c) The realisation that chord bolts holes are not equidistant from the ends of the panel will not be forgotten by Officers and NCOs of the Regiment.

(d) Corrosion removal, neutralising and painting is an extremely difficult and time consuming process once the structure has been erected. In the future, components should be inspected in the stores yards, especially the undersides of stacking, to ensure that field protective work other than possibly patch painting, is not required.

(e) If wearing strips are to be provided, it is a good idea to place a spare stringer on top of the strip during drilling to indicate obstacles beneath the deck. It was also noted that it is essential to have an extension socket spanner with a ratchet handle to tighten the bolts from underneath.

Conclusion

The project may be regarded as an outstanding success both for the Army and 21 Construction Regiment. It provided most of the Sappers in the Regiment with valuable realistic Field Engineering training and the individual pride of identifying oneself with the project.

It proved again that Regular Army and Army Reserve Sappers can work harmoniously and effectively side by side.

The new Engineers Bridge is a fine piece of Military Engineering.

The Class 60 Trailer

WOI D A KERR RE (CW(M))

The author enlisted into the Corps as a direct entrant, on 25 May 1964. Trained as a Fitter Engine and Combat Engineer, he was employed on a wide variety of tasks until becoming a Clerk of Works (Mechanical) in Dec 1970. As a CW(M) he has served in Gibraltar, Malawi, Northern Ireland, Kenya, BAOR and UK. This article was written during his tour with CRE Rhine Area when he was on the planning and quality control staff of EBW. He is now with the British Military Mission to the Saudi Arabian National Guard.

On introduction into service Class 60 Trackway consisted of aluminium panels which when clipped and locked together formed a manoeuvring mat for tanks and heavy vehicles. The mat was laid on soft ground to improve its bearing capacity and at bridge approaches where concentrations of traffic would break up the existing ground surface and eventually make it impassible. Class 60 Trackway was brought into service in 1967 as sets of 133ft. The sets were held in plank form, transported as such on 10-ton vehicles. The intention was that they would be made up into manoeuvring mats on site. In 1971 the concept was revised to take account of tactical doctrine and the more common use of the equipment as a Trackway rather than a manoeuvring mat.

From 1971 further evolution took place and the Trackway "roll" concept grew. However the method of laying proved too time and labour consuming and soon units

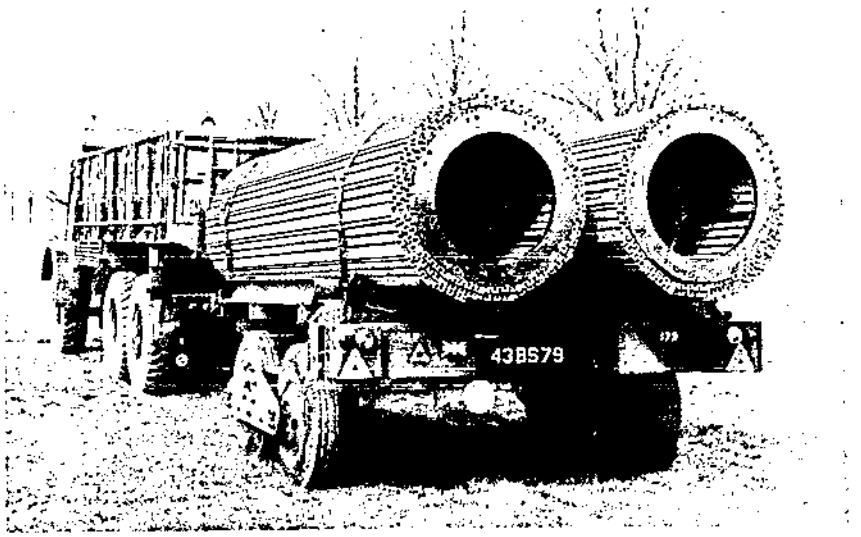


Photo 1. Trailer with two standard rolls of Class 60 Trackway

in BAOR began to develop ideas and laying techniques independently. It was therefore decided to develop and produce the equipment for a Class 60 Trackway Roll system. Since there was very little money available and the normal procurement agencies would have taken up to ten years to develop and produce such a system, it was decided that Royal Engineers BAOR would undertake the project.

As a first step, a meeting was held at Hameln on 29 May 1973 at which all the *ad hoc* equipment and techniques developed independently were demonstrated. The meeting decided that the maximum size of roll would be 50ft long and weighing some 2·34 ton to conform to the practical lifting limits of the Medium Tractor and the Combat Engineer Tractor. It was agreed that some form of trailer was required, as a bridge-site normally requires at least 100ft of trackway. Since a trailer was required and since no money was available for the purchase of new trailers, it was decided to redesign surplus Heavy Floating Bridge/Heavy Ferry (HFB/HF) 5-ton trailers to carry two rolls of Trackway.

On the basis of the Hameln meeting, the Royal Engineers were authorised to commence the development of the Class 60 Trackway Roll concept on 28 June 1973. On 30 July 1973 the Royal Engineers Works Study Team (BAOR) (REWST) were formally given the responsibility for the development of the roll concept as a whole and 522 Specialist Team RE were tasked with the design of new components that were required for the design of the conversion of the HFB/HF trailer to carry two rolls of Trackway. Co-location of the two units at Willich materially assisted in what was, at this stage, essentially an exercise in collaboration and cross-fertilisation of ideas.

In November 1973 522 STRE completed their initial feasibility study offering a number of design options and the circulation of these options within the Royal Engineers brought forward fresh ideas and concepts for design. Although many were too costly or too complicated, or both, they were indicative of the general interest in the project and the wealth of inventiveness available within the Corps. The prototype designs for a spool to carry the roll; a beam with which to lift the roll and a conversion for the HFB/HF trailer were provisionally agreed and on 11 February 1974 the Engineer Base Workshops (EBW) of 40 Army Support Regiment RE, as it was then called, was tasked with their production. Priority of production was given to the spool and lifting beam to enable trials to begin.

However, before work on the conversion of the old HFB/HF trailer could begin it

had first to be refurbished by Willich Workshop REME who were responsible during the project for pre-production inspection, the repair or renewal of lighting and braking systems and for the final "in service inspection" of each trailer. A very good working relationship grew between Willich Workshop REME and EBW and without their sound advice and help the project would not have progressed quite so smoothly.

After Depot trials by REWST and 522 STRE, the prototype spool and lifting beam were trialled by 39 Field Squadron RE on *Ex Helispont* in September 1974. *Ex Helispont* involved the heliborne resupply and emplacement of bridges using US medium lift helicopters, and this worked very successfully. In mid October 1974 they were again used by 4 Armd Div Engr Regt on *Ex Forefront.* During these trials it became apparent that a much lighter and cheaper spool could be used. 522 STRE redesigned the spool accordingly. By September 1974 the prototype conversion of the HFB/HF trailer had been completed by EBW and in late October proof loading, carriage and trafficking trials with the complete set of equipment were carried out by 65 Corps Support Squadron at Hameln. Successful though the lifting beam was with the helicopter it proved unsuitable for use with the Medium Wheeled Tractor. Therefore lifting straps were designed to replace the beam. Other minor modifications were also found to be necessary. As a result of these trials and in anticipation of the initial production run in March 1975, Ordnance Branch HQ BAOR were notified of material requirements for the conversion of twenty-four trailers.

In June 1975 16 Fd Sqn RE carried out User development trials on the modified prototype and, using side ramps, it was found possible to lay the Trackway direct from the trailer and to also recover it using a simple method of parbuckling.

During August 1975 various aspects of the development were being processed. REWST were preparing the first draft of the Provisional User Handbook for the equipment and converting their working drawings for the procurement of new components and for the conversion of the HFB/HF. The old surplus HFB/HF trailers were being inspected by RE Stores and Bridging Inspection Unit (RESBIU) who also acted as the quality controllers and carried out stage inspections of components and assemblies within EBW. During production Ordnance Branch HQ BAOR were chasing the procurement of materials.

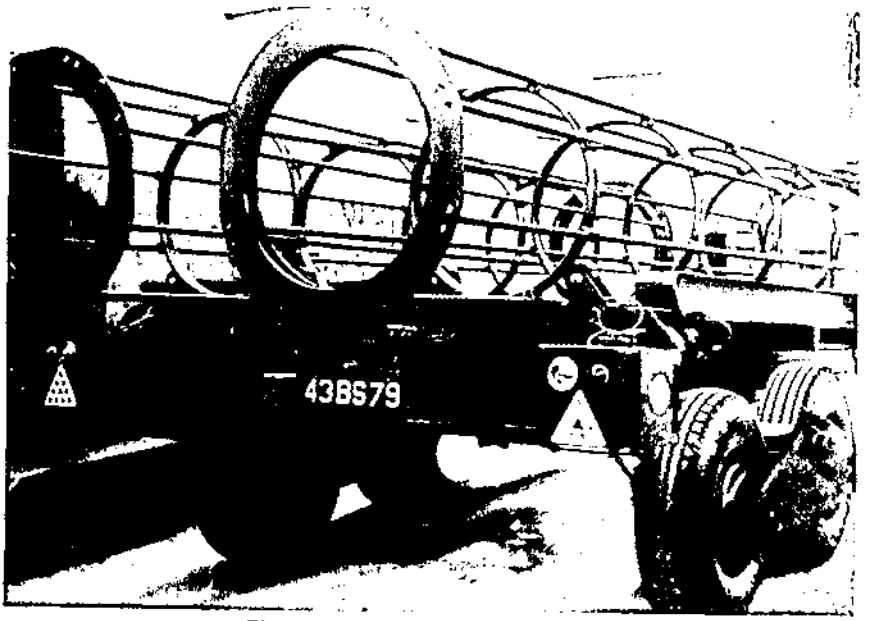


Photo 2. Trailer with two empty spools

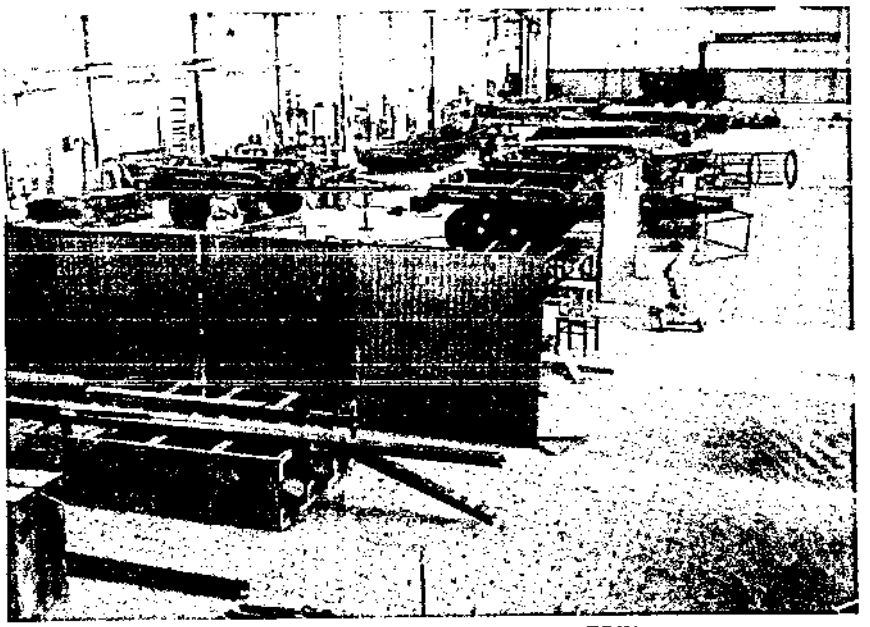


Photo 3. Production area for Trailer in EBW

In December 1975 production planning started and all six BAOR Engineer Regiments in 1 (BR) Corps were called upon to provide welders and fitter machinists to assist EBW in the production run over 1976 and 1977. The response was very encouraging and many tradesmen gained valuable trade experience which they would not have otherwise achieved in a field unit.

At a meeting held at Willich on 13 May 1976 the roll concept based on the use of a converted HFB/HF trailer was accepted into service and the first production set became available in June 1976. 28 Amph Engr Regt carried out the pre-production trials between 21 July and 12 August 1976 after which minor user and production technique modifications came to light and were resolved at the development finalisation meeting held at Willich on 17 August 1976.

Production continued on a batch basis of four trailers every four months with the parts and assemblies being produced on continuous production in the foundry and machine shop. The initial requirement was for twenty-six trailers for BAOR but later a further eighteen were required for UKLF. The last of the forty-four trailers left EBW on 19 December 1980, with the last Class 60 Trailer leaving EBW with CRE Rhine Area Lieut Colonel H E Vialou Clark RE at the helm.

The manufacture of trailers is now complete but EBW are still fully committed to the manufacture of Class 60 Trackway spares for both BAOR and UKLF and it is now becoming apparent that the unit will be heavily committed repairing damaged trailers. It appears that damage is caused by excessive jack-knifing during reversing operations and sometimes repairs require the trailer to be dismantled and rebuilt.

The Class 60 project has been long and interesting and has given many people excellent trade and managerial experience. It enabled all those involved to work as a team and to overcome difficulties quickly and efficiently. It is clear that the project was very popular with all who were involved.

ACKNOWLEDGMENT

Much of the credit for the development of this equipment must be given to the late Major H E Attenborough RE (died 1978)

A History of Steam Road Traction in the Royal Engineers—Part Three

LIEUT COLONEL J E NOWERS RE, B Sc (Econ)

Chapters 1, 2 & 3 were published as Part 1 in RE Journal Vol 95 No 3, *Chapters 4, 5, 6 & 7 were published as Part 2 in* RE Journal Vol 95 No 4, *and covered the History up to but excluding the Boer War.*

8. The Boer War

With War in South Africa inevitable it became apparent that a major problem would be ensuring the support of the Army in the field when it had advanced beyond the rail heads. Horses would have to be imported and all animal transport was vulnerable to *rinderpest.* Mr Robinson, Fowler's representative who visited South Africa, had commented in his reports on the rules and regulations in force there for preventing the spread of the disease.

Accordingly, early in October 1899 the War Office decided to send a number of traction engines to South Africa. A new organisation was created and Colonel J L B Templer was appointed Director of Steam Road Transport (DSRT). At this time Templer was Superintendent of the Balloon Factory at Aldershot. He had been appointed officially to the post in 1887, at a salary of £700 pa, but had been effective head of ballooning since 1878. He was also Chief Instructor in Ballooning to the Royal Engineers and Chief Designer of Army Balloons.

The War began on 12 October 1899 and Templer's new appointment was promulgated on 28 October. He asked for more pay and was allowed £1200pa whilst overseas. Templer was an ideal choice for the post of DSRT. He was very experienced with traction engines, he was used to working with the Royal Engineers and he was well known to the public at a time when public opinion mattered greatly at home and abroad. His staff in DSRT consisted of Captain G F Gardiner, the Gloucestershire Regiment, as Deputy Assistant Adjutant General (DAAG), and Captain H C H Burton, Royal Garrison Artillery, a Special Service Officer.

On 1 November 1899 a new Royal Engineer Company, the 45th, was authorised specifically to operate steam road transport in South Africa. It was commanded by Captain G P Scholfield. Lieutenant E Barnardiston was the only other Officer and there were ten Drivers and 100 dismounted Other Ranks, drawn from units not under orders for South Africa and from the reserves. Only six men proved to be competent traction engine drivers.

Templer handed over his responsibilities at the Balloon factory to his deputy, Lieut Colonel J P L Macdonald RE, and spent October and November scouring the country for traction engines. He also visited the manufacturers including Fowlers. Eleven engines were ordered for delivery to Aldershot on 14 November 1899. Two were Army Service Corps type, three were South African type and four were large plough engines. Two ploughs were also purchased capable of cutting furrows 30in wide by 30in deep to form ditches in road verges and trench shelters for the troops. The remaining two engines were requisitioned. (Photo 6).

During the two weeks before embarkation the engines and crews were put through their paces in Long Valley. Marcus Tindal must have visited the unit about this time and published a colourful, if somewhat inaccurate account in *Pearson's Magazine* for December 1899. He described the living wagons as follows:

"The Officers' cars are large, roomy and well ventilated, making an imposing appearance, with their high roofs and elaborate ornamentation. Inside, each car is handsomely panelled; a folding bed occupies one end; a stove is in one corner; the windows, looking out on all sides, can be easily barricaded if necessary. In such a caravan a gipsy queen would be proud to travel. Less elaborate cars are for the use of the men, containing sleeping berths snugly arranged one upon another".

Photo 6. Six Fowler engines and trains outside the Balloon Factory, Aldershot, in November 1899, before embarking for South Africa

At the beginning of November the engines and wagons moved to Southampton by road. On 3 November the first consignment of eleven engines, including *Doll*, thirty-five wagons and various tools and stores began loading aboard SS *Bulawayo*, supervised by Captain Burton. The ship also loaded some Ordnance stores which caused some confusion at Capetown since some of the trucks had to be unloaded to get at these.

Bulawayo sailed on 16 November and carried nine civilians whom Colonel Templer had engaged for a minimum of six months service in South Africa. The party included Mr Walker, his foreman for many years at the Balloon Factory in Aldershot, Mr McLaren, a near relative of the Leeds traction engine firm, Mr Burrell, a near relative of the Thetford firm who had also worked at the Balloon Factory, and six civilian drivers. Their pay varied from £15 to £35 a month with extra allowances when up-country. Mr Walker was placed in charge of the civilians.

The Company sailed from Southampton on 15 November and docked at Cape Town on 11 December. *Bulawayo* docked the next day and began unloading the stores for Ordnance. This was not completed until 17 December.

Meanwhile confusion arose over how and where SRT was to be employed. The Company remained on ship whilst this discussion went on and eventually disembarked on 13 December and went into camp at Green Point. It was decided to disembark the engines at Port Elizabeth. The Company went aboard once more on 16 December and finally disembarked at Port Elizabeth on 19 December. *Bulawayo* arrived there at the same time and began unloading, out in the bay into lighters. Seventeen wagons were taken ashore during the day.

Whilst in Cape Town it was not clear whether 45 Company would come under command of the Director of Railways or the Director of Transport. On leaving Cape Town the Company was told it was under the Director of Railways. However the Director of Transport had already telegraphed GOC Natal offering him two traction engines. Late on the night of the 19 December a telegram was received ordering *Bulawayo* urgently to Durban to unload two engines. Mr McLaren was sent with six men to work them. On 22 December a message was received from Mr McLaren at Durban that five trains were being unloaded and he needed more men. On 23 December another message said all traction engine gear was being unloaded at Durban. More men were sent to work them, the rest of the Company remaining at Port Elizabeth to await the arrival of Colonel Templer.

Colonel Templer embarked at Southampton on 5 December on SS *Denton Grange* for Cape Town, with Captain Gardiner. Also in the party was a Mr Templer, possibly his brother, and eleven artificers. The *Denton Grange* also carried a second consignment of nine traction engines, including *Florence* and the Burrell, four ploughing engines and forty-three trucks. Three of the engines were carried as deck cargo. *Denton Grange* was a steamer of 9000 tons with large hatchways. As well as the traction engines she carried a detachment of thirty Hussars with 160 horses in stalls below decks. On 11 December she arrived in Las Palmas, Grand Canary, in a storm and anchored in deep water. However the Captain was anxious to save time in bunkering and took up the anchor and slowly approached the mole, guided by a Spanish pilot from a rowing boat. In this process the ship went firmly aground on a rocky bottom. The next morning she resisted all efforts to free her, including a tow from HMS *Furious*, and it was decided to unload as much cargo as possible and send it on in other ships.

A Naval Court of Inquiry into the stranding of the *Denton Grange* decided the Master had committed an error of judgement in entering port in the prevailing wind and sea conditions. The court did not endorse the Master's certificate since the mistake was due to urgency to get to South Africa. No blame was attached to the officers and crew and the stranding was officially held to be due to striking an uncharted rock. Templer had to cool his heels in Las Palmas for several weeks whilst awaiting onward passage in another ship. His enforced stay was made very comfortable by his friend Mr Alarlous Delmard in his lovely Mount Nelson hotel up in the mountains.

On 3 January 1900, the Hospital Ship *Maine* anchored for a few hours in the bay, en route to South Africa. The ship was operated by a hospital committee whose president was Lady Randolph Churchill. Templer rowed out to the ship and begged passage. Lady Randolph Churchill looked over the side, frowned and told him to go away. However Templer climbed aboard, pulled his luggage after him and got to the front, arriving at Cape Town on 20 January and at Frere on 9 February.

SS *Yoruba* sailed from Las Palmas on 5 January with two traction engines and other gear salvaged from the *Denton Grange*. The rest of Templer's party sailed from Las Palmas in SS *Siberian* on 7 January.

During later salvage operations on the *Denton Grange*, a Scot who was watching the proceedings noted "the engines showed to advantage over their competitor the horse, in that when drawn up from the ship's hold after several weeks' immersion, they were in better condition for work than their rivals, recovered from the next hold." One of these engines was a regular Jonah and sank another vessel in the Thames on another occasion. SS *Yoruba* arrived at Cape Town on 24 January and was unloaded under the shear legs. One traction engine began working as soon as it was unloaded, clearing stores and equipment from the docks. The second engine needed some repairs and began working on 31 January. Both engines were so fully employed, working mainly between the docks and Maitland Camp, that two shifts of drivers and steerers were necessary.

This occasioned the only reference to traction engines in the whole voluminous *Times History* of the War: "so great was the volume of freight put ashore from the ships that it exceeded the powers of the land transport contractors and the Army Service Corps to deal with it. By the beginning of 1900 the docks were so seriously congested with baggage and stores that a deadlock might have resulted. At this point Colonel Templer with his steam traction engines and trailers came to the rescue and the docks were cleared within a week."

On 10 February Colonel Templer went to see the GOC Natal and arranged that SRT should return to Cape Colony. Men and machines moved by rail and ship and by about 7 March SRT was installed alongside De Beer's workshops in Kimberley.

The first operational task for SRT was a disaster. Engines were required to assist a column to Boshof. In spite of protests that the road had not been checked for steam transport, three trains started on 10 March. The engines came across heavy sand and

eventually ran out of coal and water, much to the annoyance of the GOC who had to get his rations from Kimberley in mule transport. Two engines had to be sent out with coal to assist the others back to Kimberley. For the next few days SRT had to beg for work since traction engines were considered to be useless. However by the end of March the value of the engines was recognised and they were fully employed. Although the GOC frequently expressed satisfaction at their work he often referred to that first unfortunate trip to Boshof and said he could not depend on them.

About this time Mr McLaren broke his leg. Few details survive but he appears to have been injured in an accident whilst driving a Fowler. He returned to England as soon as he left hospital, made a complete recovery and returned to South Africa in 1903 to resume his career in Fowler's employment.

More engines arrived in South Africa and orders were placed for still more in England. SS *Fort Salisbury* arrived from Las Palmas with three traction engines, one plough engine and various trucks. On 1 March a Marshall crane engine was purchased from a local contractor for £800. *Florence* arrived in good condition having been salvaged from the SS *Denton Grange*. Three others were salvaged after being submerged for several weeks and were in very poor condition. They were repaired in the workshops just erected at Cape Town by Messrs Reunert and Lenz. On 13 April, SS *Queensland* arrived with four traction engines, two plough engines and thirty trucks. About this time two Wallis and Stevens traction engines were hired from the Harbour Board. On 16 May, SS *Johannesburg* arrived with four traction engines, two side-winders and fourteen trucks. The docks were so crowded she was not unloaded for some days.

On 26 April four engines were used for hauling 4·7 and 5in guns from Green Point to Camps Bay, putting them into position and hauling them back again in the evening. This seemed a successful exercise and was repeated once a week for some time. It certainly caught the imagination of the local press. Favourable comment was very welcome since the press had been full of letters complaining about the damage caused to the roads in Cape Town by the traction engines.

On 12 May this manoeuvre with the guns was recorded by the new biograph. Mr WK-L Dickson had made his way to South Africa in the SS *Dunottar Castle* arriving on 14 October 1899. Travelling on the same ship was General Buller and his staff. Dickson managed to persuade many well known personalities to submit to his "Kodaking process' including Colonel Templer. Dickson arranged to film the movement of the guns:

"Colonel Templer, my good friend of Aldershot days, has arranged a splendid picture for the Biograph this morning, so we prepare to drive out to Green Point to witness the experiment of using his traction engines to drag the large 6in guns into position for practice. The camera was placed on the road close to the Boer prisoners' enclosure . . .

"A shout from some bystanders warned us of the arrival of the traction engine and gun. My instruction to them was to go like h. . ., which order I discovered later had been literally transmitted, much to the amusement of the kindly Officer in Charge. It was a sight! By going faster than a walk it obliged Soldier and Officer to run as they passed the camera, which they had to go at their utmost speed in order to keep up."

On 25 May, eight traction engines drawing 5in guns, took part in the Queen's Birthday Review in Cape Town. One engine stuck for a moment, otherwise the Review passed off as planned.

Early in 1900, Lord Roberts himself telegraphed England with an order for armoured trains for use in South Africa. Six trains were ordered, each consisting of an armoured engine and three armoured wagons, capable of moving two 6in howitzers complete with crews and ammunition. (Photos 7(a), (b) and (c)). The first train arrived in July 1900 aboard SS *Clan Buchanan*, the second a fortnight later in SS *Clan Fraser*.

The total weight of the engine was 22ton and included 4½ton of armour. The vertical plates were 5/16in thick, the others ¼in, made by Cammell Laird, the shipbuilders.

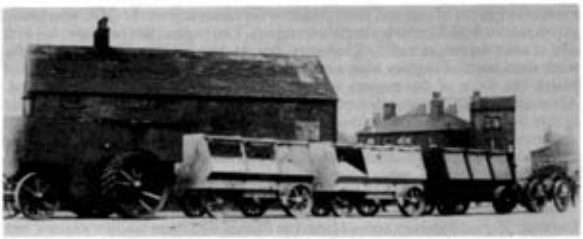


Photo 7a. Complete train of armoured engine, three trucks and a howitzer behind

The driver was completely boxed in with a number of vision slits. A mirror gave him a view forward on the left side of the engine. Captain Nugent of the War Office was involved in the design work and was responsible for some novel innovations. For example, to reduce the rattling and vibration from the armour, he introduced leather strips between the lapped plates. The engines had long copper fireboxes and brass smoke tubes and the working pressure was 180psi. The hind wheels were 7ft in diameter and 24in wide. They were shod with iron strakes which so damaged the metal roads that they were sent straight to Bloemfontein to work up country. However the engines were so heavy that the armour was taken off and handed over to the Imperial Military Railways to make armoured railway trains.

Before being sent to South Africa the armoured engines were tested in Leeds. There is an apocryphal story that during the trial, one engine ran over a bicycle, the owner angrily held up the remains and loudly demanded compensation. The civilian engine driver, a Yorkshireman, eyed the relic critically and retorted:

"Tha's lucky to get off soa leet
Be thankful tha's still o' thi feet
If tha thinks out o't bike
Tek it hooam wi thi, like,
An stick it I't scrap book ter neet."

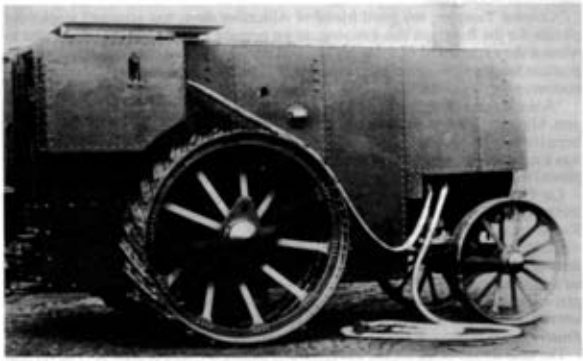


Photo 7b. An armoured engine

History of Steam Road Traction Part 3 7a 7b

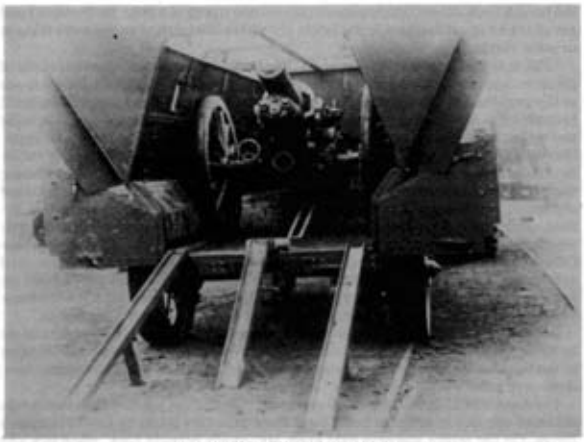


Photo 7c. The howitzer in a wagon

The *Daily Graphic* for 18 May 1900 published a lengthy description of the armoured trains. It surely was guilty of understatement in saying "It must be frankly confessed that Messrs Fowler's new safety boxes are less pleasant for the purposes of travel than are the comfortable restaurant cars of the Great Northern Railway." The engines were known as the *Lion* type, each capable of hauling 60ton. Only two more were built for South Africa and they were delivered without armour. The armoured wagons were used as movable blockhouses in the later stages of the war.

Several accounts of the 45th Company in South Africa have survived. A report was published in *The Sapper* for March 1900:

"Frere, 45th Co, 20 January 1900. We are camped here on the bank of the Mooi River working the engines, which are running stores up to the front. This is an advanced base and everything is kept ready, in bullock wagons, to run up supplies and ammunition as soon as it is received. The 66th Battery RFA is also lying with us—the one that lost its guns. I was talking to the QMS of this battery, who escaped being taken prisoner in the last fight by pretending to be dead. He told me that all the Boers who were walking about around him were either English, Irish or Scots".

Captain Gardiner, writing home on 24 June 1900, described a brush with the Boers:

"I have had one rather exciting experience with the engines: I went out with a convoy taking 75 tons of food with three engines, all Fowlers, to a place which was beleaguered (Lindley) and the garrison was on quarter rations. It was a fifty mile trek and when I tell you we had to cross four times the Vatch River which has three to four feet of water in it, you can judge we had some difficulty. The drifts were over 100 feet deep and the slopes at about 1 in 4 to 1 in 6. In addition to our other troubles the Boers under De Wet attacked us for three days, the Commander having sworn to have the convoy as he was very short himself.

"At last the ox wagons got across the drift which the Boers were holding and towards dusk we started to cross. There were four feet of water in the drift and we had to pull out two over-turned ox wagons before we could cross and a steep *kopje* on

the far side only allowed the engine to take up two trucks at a time. By the time I had got all trucks up on the far side the Boers got within 150 yards of us and were firing at us point blank.

"The rear guard were driven in and I only had time to couple up seven trucks of groceries and biscuits and had to abandon five of oats. You would have smiled to see us slip over the veldt at about 12 miles per hour. We got on about three miles when it became quite dark and we had to go slow. Luckily the Boers do not attack at night and we got in at midnight having to cross the worst drift of all in the pitch darkness. However I set fire to the grass and by its light got all the trucks over. Before daybreak next morning we were out after the five other trucks which luckily we found intact: the Boers had been and looked at them, but expecting a trap or that they contained dynamite, left them alone. This I heard from a doctor who was left behind on the field. The Boers attacked though again, but with only five trucks the engines simply kicked up their legs and left the Boers standing. We had five killed, two Officers and about twenty men wounded. Mine and the men's living vans were used as hospitals and were half full of wounded men. This has conclusively proved that the engines were serviceable under the severest conditions and had we not been hampered with the ox transport we should never have had to abandon the trucks."

Another correspondence referring to the same incident says "Captain X tells me he never knew how fast your engines could go until he saw the Boers after them firing at the drivers. Everybody here comes to the conclusion now that the engines have done very good work".

The Sapper of 11 September 1900 reported: "On the last journey the convoy was detained one day in order to bring back some prisoners taken by Lord Methuen's forces. On the return journeys light loads are usually brought back, often sick and wounded men. We often have engines sink in the ground three or four feet, generally when running into watering places on the road miles from anywhere, but if it took as long to get them out as appears to be at home, we should have been sent back to England long ago".

CSM Tilford wrote in *The Sapper* of 7 November 1901: "The other day for a change I had a "jolt" for a few hours, on a Steam Sapper belonging to the 45th Company. Now, as far as I can recall, this is the first trip I have ever had with the "grease rags" or "spare wheels" as we call them—and may it be the last. Of course the roads here in no way compare with those at home; they are never repaired, simply tracks, intersected here and there by *spruits*. These, our comrades of the Steam Transport Company take quite unconcernedly at a comfortable speed of 12 miles an hour. To see them turn and twist round corners with a train of six waggons is a marvel. I never saw a traction engine at Chatham, or anywhere else for that matter, cut the figure of eight capers which they cut here. Once they get out on the open veldt with a clear course, I reckon they run our main line goods train pretty close. Beyond a doubt, steam road transport is a valuable adjunct to railroad transport; notwithstanding which, no more 'bone shakings' for yours truly".

The Daily Telegraph War Correspondent, Mr Bennett Burleigh, in his work on the Natal Campaign described the passage of the Tugela River by General Buller's Army:

"It was a prolonged and desperate scramble to get the men and about 400 wagons and nondescript vehicles down the steep, slippery bank, through the waist-deep stream and up the sticky opposite slopes. Three ox-wagons were run down into the river and converted into bridge-piers, planks being laid whereon part of the infantry were able to pass over dryshod, but the planks and footings were insecure in places and it came to be like walking the greasy pole at Ramsgate aquatic sports, for numbers of Tommies went hurriedly into the water in the most diverse and eccentric manner, to the surprise of lots of people.

"The much laughed at score of Aldershot traction engines did not stick or flounder in the mud, but lumbered about, doing duty with comparative ease and considerable regularity. Their flanged grips upon the wheels gave them a sure bite of the ground,

Photo 8a. Crossing the Blauwkrantz River, January 1900. The engine in the river is a Fowler B5. The engine in the foreground is Burrell No 2224

which in one or two places they churned up rather deeply.

"A by no means overladen ox-wagon stuck in the middle of Blaauw Kraus Drift, close to Frere Station. Eighty oxen were tried and were unable to move the wagon an inch. It seemed as if the whole column must wait until the vehicle was carted off. A traction engine was requisitioned to try its powers, the enormous span of cattle was taken away and a steel hawser was passed from the engine and made fast to the dissel boom, then steam was turned on and with a snort and a whir the steamer walked away with the wagon, conveying it some distance to a high and dry part of the

Photo 8b. Overturned engine on Fischer's Farm Road, May 1901

History of Steam Road Traction Part 3 8a 8b

roadway." (Photo 8(a)).

SRT operations did not pass without some mishaps. On 7 April 1900 a traction engine was sent from Cape Town to Rondebosch Camp. Close to the camp an old, rotten bridge spanned a stream twelve feet wide. The engine driver failed to take the obvious precaution of inspecting the bridge before venturing across and it collapsed under the engine. Fortunately the front wheels jammed up against the far bank and the back end was hung up supported partly by the drawbar of the wagon behind. The next day, Sunday, was spent in building a grillage of sleepers and jacking up the engine. By midday Monday the engine was back on the level and moved off under its own steam.

On at least three occasions an engine broke into a blind rotten culvert at Kimberley and fell 4 or 5ft. On each occasion it was jacked up in about six hours and driven away under its own power.

On 9 May 1901 a 10hp Fowler was carelessly overturned on Fischer's Farm road near Bloemfontein. All its shafts were bent and the engine was not working again until October. (Photo 8 (b)).

In October 1900 most of the civilians returned to England having completed one year's employment. Also in October, Colonel Templer was told that he was to be released. As a member of the Militia his liability of one year's service was complete. Captain Scholfield came from Mafeking to Cape Town to take over as DSRT.

As the War dragged on into the guerilla phase drafts of men arrived from England, local civilians and natives were taken on and more engines were ordered from England and began to arrive in South Africa.

In early 1901 SRT was placed directly under the control of the CRE Army after which its operating conditions greatly improved. About this time the Commander-in-Chief wrote to the War Office discussing his future plans for SRT in the War. He also said that on the termination of hostilities he did not propose to abolish steam road transport.

Early in March 1902, two 3ton steam lurries or lorries arrived from England. These were the Thornycroft and the Foden which had won 1st and 2nd prizes respectively in the recent War Office trials and were sent out by the Mechanical Transport Committee for what amounted to troop trials.

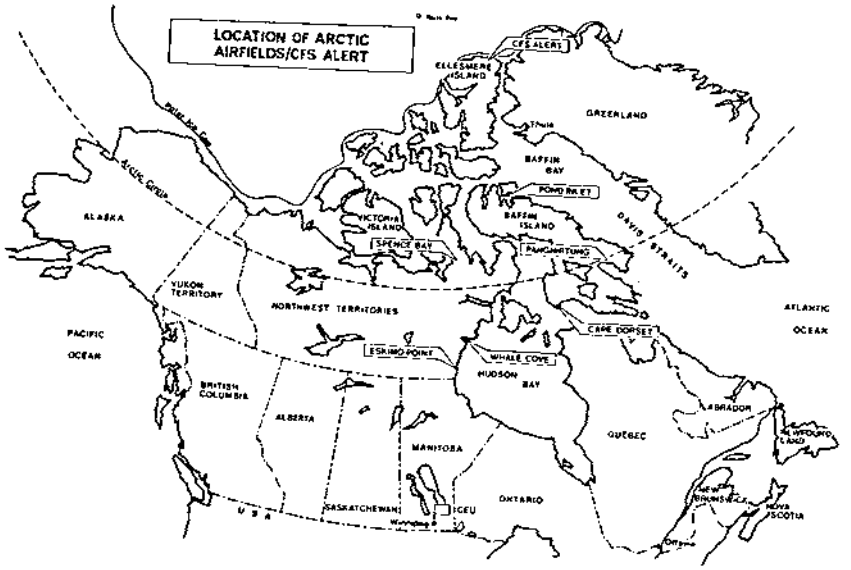
Military and National Development in the Canadian North

No 1 Construction Engineering Unit (1 CEU) is a unique unit of the Canadian Military Engineers. The unit provides Engineering assistance and Construction or Maintenance supervision in support of the Canadian Forces in all theatres of operation. Its major activities have recently concentrated on military and national development in the Canadian North. The following two articles demonstrate the unit's role in providing the organisational nucleus for a mobile work force and in performing construction supervision and engineering projects.

Project Trelar

LCOL E A EVEREST, COMMANDING OFFICER, 1 CEU

PROJECT *TRELAR*, the rehabilitation of Canadian Forces Station Alert in the North-west Territories, was a major development and construction project undertaken by the Canadian Military Engineers (CME). The method of implementation was rather unique and the project provided challenging experience to a large portion of the CME family.



CFS Alert is operated by the Canadian Forces Supplementary Radio System (CFSRS) for Communications Command. The station is the most northerly permanent settlement in the world being located on Ellesmere Island at a latitude of 82° 30′ North (See map). Originally built in the 1950s, most of the station facilities were accommodated in General Purpose (GP) huts which obviously did not provide an "ideal" Arctic environment for the station operations, the personnel or the support facilities. All logistics support for the station is provided by CC130 Hercules aircraft.

A development plan was prepared in 1974 which ascertained initial requirements from CFSRS HQ and from the CME experiences in maintaining the station from a southern base. The development priorities were for new living accommodation, a new transmitter building, additional electrical generating capacity, an updating of the runway lighting system and additions to certain other facilities. The services of an ex-CME Officer were obtained as a consultant Project Manager. Initial approval for the redevelopment program was set at a cash cost of $4·9 million and the project was foreseen as continuing for three years starting in 1975.

The Project Manager had the entire responsibility for the project design, implementation, material procurement, arrangement of transportation, availability of labour, etc. He utilized the expertise available in Air Command HQ design and quartering divisions. It was recognized that the actual construction would be most effectively implemented using military tradesmen, and 1 Construction Engineering Unit, who had experience with remote and northern construction, was tasked with the estimating, certain designs, construction supervision and implementation.

Major lessons of northern construction had to be learned and re-learned. Pier foundations were to raise all major facilities above the permafrost soils; other innovative foundations, including ventilated and insulated berms, were used. The chosen buildings were pre-engineered and capable of being erected by CME tradesmen originally unskilled in large construction techniques. Consideration had to be made for redundancies of the vital heating systems and key plant and distribution systems. Utilities were placed in a common "utilidor", preferably below floors, and finishes respected the station location, environment, resupply by air, skills of the construction crews and future maintenance. A rock quarry crusher operation was initiated to obtain suitable fill and road/airfield maintenance material as well as concrete aggregate.

Crews were made up of 1 CEU supervisors and tradesmen attach-posted from

Canadian bases and units. The crews were changed every two months, due to the rigorous conditions and drop-off of production after that time. Use of unskilled militia members and non-engineers as a labour force proved to be highly satisfactory. Emphasis was placed on completing foundations and closing-in the buildings during the short summer season when temperatures reach a maximum of 10°C, then systems' installation and finishing could proceed through the long, dark Arctic winter.

The original scope was successfully completed in the three years. Approvals were made for subsequent construction of associated special projects including a low-heat Vehicle Garage, a Water Treatment and Storage Plant, a new Lakewater Pumphouse with a revamped water distribution system, and a large POL facility at the airfield capable of unloading and storing the station's year supply of diesel fuel (also used for heating/generating fuel) and gasoline requirements plus a Turbo storage and fueling facility for aircraft using the station. A further project was also approved and implemented, starting in 1978, for the construction of a modern Operations Building. This large sophisticated operations complex, costing $3·2 million for construction materials purchased in the south and taking approximately sixty man-years of work over two years, represented the largest single construction project undertaken by uniformed Canadian Construction Engineers since WWII.

The large-scale planning, design, estimating and procurement for a project of the size and complexity of Operation *TRELAR* required engineering experience and decisiveness. The major accomplishments, however, were the placing of construction crews in a remote and hostile environment and implementing a complete development program. Despite technical problems, doubts and frustrations, the redevelopment of the station to modern standards was successfully carried out. This success is a tribute to the skills, hard work and innovation of all individuals of the Canadian Military Engineers who were involved.

Canadian Forces Arctic Airfield Construction Program

LCOL R V NORDLUND (RETD) AND MWO G H HAMILTON

THE Canadian Forces (CF) and particularly the Canadian Military Engineering Branch had the opportunity during the past decade to participate in a large horizontal construction program which challenged their capabilities in government interdepartmental co-operation, remote construction, logistics and heavy northern resupply by air and sea. The following article details the CF involvement in the Canadian Arctic Airfield Program.

The Arctic Airfield Construction Program was conceived in the late 1960s and began with construction in Pangnirtung in Summer 1970 and was completed in September 1979 at Spence Bay, NWT. It was a joint venture between National Defence (DND), Transport Canada (TC), Indian and Northern Affairs (DIANA) and the Government of the Northwest Territories (GNWT).

The six airfields constructed by DND (Pangnirtung, Cape Dorset, Pond Inlet, Whale Cove, Eskimo Point, and Spence Bay—See map) were part of a larger program sponsored by DIANA to construct or improve airfields at remote settlements throughout the Canadian Arctic. DIANA and GNWT selected the settlements that required improved airfield facilities, TC were responsible for the design and funding, and DND provided the manpower and direct support to construct the airfields.

1 Construction Engineering Unit is located in Winnipeg, Manitoba. Its establishment of Officers and Senior NCOs has had extensive experience since WWII in investigations in most engineering disciplines and in undertaking development and maintenance programs across Canada.

1 CEU was tasked to co-ordinate the construction and direct support required for the continued airfield construction operations. The on-site personnel (Project Officer, heavy equipment operators, mechanics, cooks, etc) were provided initially from various Bases and Stations and more recently from various Field Squadrons and Combat Engineer Regiments. Weekly air resupply was accomplished by 424 Sqn using CC115 Buffalo aircraft with 435 Sqn LAPES from CC130 Hercules aircraft at the start of each construction season.

The basic design provided by TC was for an airstrip 1,000m × 75m with an additional graded and compacted area of 100,000m^2 for an aircraft parking apron, building development and fuel storage areas, and access road to the settlement. To support DND's search and rescue role, four airfields (Cape Dorset, Pond Inlet, Whale Cove, and Eskimo Point) were increased in size to 1,300m × 100m at a cost to DND of $650,000 to enable CC130 Hercules aircraft to use the airfields.

Each construction site was self contained with its own accommodation, heavy construction equipment, and support items. Accommodation was in the form of mobile trailer units (three sleeping, one kitchen, and one ablution trailer) to house the 25-30 military personnel at each site. Heavy equipment consisted of: three 15m^3 dump trucks, three large bulldozers, two front-end loaders, two towed compactors, one grader, two crewcab pickup trucks, and numerous support items.

On-site construction activity usually commenced in late May and ceased due to frozen ground and snow by late September of each year. The difficulties of working with permafrost in the borrow pits and keeping the heavy equipment serviceable provided a challenge to the most patient and resourceful construction crew. However, the satisfaction of scraping, loading, hauling, shaping, and compacting over 100,000m^3 of earth each season and watching an airstrip, the size of ten football fields placed end-to-end, take shape was reward in itself, but not as great as the last Buffalo aircraft of the season that returned the crew to their home units.

Table 1 details the construction time frame and costs for each of the six airfields.

The Arctic Construction Program provided valuable engineering training and Arctic experience to those military engineers who were fortunate enough to participate in one of the six airfield construction projects. The isolated location, extreme weather conditions, permafrost, geological consideration, equipment maintenance and resupply are only some of the problems that required special consideration. Aircrew personnel who supported the program with Single Otter, Twin Otter, Dakota, Buffalo, and Hercules aircraft also gained valuable experience in Arctic navigation and general flying conditions throughout the Canadian Arctic region.

Upon analysis, this ten-year airfield construction program was of significant training value to the CF and at the same time contributed to Arctic development by providing improved transportation facilities to previously remote areas within the Canadian Arctic.

TABLE 1

Location	*Years Under Construction*	*Equipment Costs*	*Operating Costs*	*Military Contributed Costs*	*Approximate Total Cost*
Pangnirtung	1970–72	$ 417 263	$ 598 000	$1 010 000	$1 850 000
Whale Cove	1971–73	417 263	600 000	1 010 000	1 900 000
Cape Dorset[1]	1972–76	500 000	1 094 222	1 080 000	2 400 000
Pond Inlet[2]	1973–78	Moved from Pangnirtung	1 301 954	1 664 000	3 200 000
Eskimo Point	1974–77	Moved from Whale Cove	867 389	1 114 000	2 200 000
Spence Bay	1977–79	1 109 670	584 293	1 025 000	2 100 000

Note 1. Project extended to 5 years due to extensive rock drilling and blasting.
Note 2. Project extended to 6 years due to extensive equipment repair and manpower shortage due to 1976 Olympics plus difficult working conditions (soil and weather).

At War with the Zulus 1879

The Letters of Lieutenant C E Commeline RE

FRANK EMERY MA, M Litt

Frank Emery started his period of National Service in 1948 at Brecon, the Regimental Depot of the South Wales Borderers. From that unit's well-known links with the Zulu War sprang his interest in the course of Imperial history in Southern Africa. He has been a Fellow and Tutor of St Peter's College, Oxford, since 1962, and University Lecturer in Historical Geography at Oxford since 1959.

His researches into nineteenth-century warfare as a factor in the colonisation and development of Southern Africa have resulted in several books and articles. The Red Soldier (1977), *a profile of the Zulu War of 1879, is based on letters written by soldiers on active service, which he regards as an excellent source of information. He would be delighted to hear of any such letters in private collections, especially for the lesser-known campaigns like Abyssinia (1867–8), Ashanti (1873), the Eastern Cape (1877–8), or those in Burma in the 1880s.*

For the barest outline of the part played by Sappers in the Zulu War we need only to look, for instance, at pages 27 to 38 of Major General Whitworth Porter's *History of the Corps of Royal Engineers* (Vol II). To get behind the cold facts, on the other hand, there is nothing better than to read the letters written by officers and men on active service, where we find at first hand their experiences of warfare in the rigorous environment of Zululand, facing a dangerous and resourceful enemy. The OC of the 5th Field Company, RE, for instance, Captain Walter Parke Jones, wrote some highly informative letters, several of them already published in *The Red Soldier* by Frank Emery (1977). The same book also has a long letter from one of Jones's Subalterns, telling how they reached Durban, after a month's voyage from home, on 4 January 1879, and then slowly made their way up country to the front.

He was Lieutenant Charles Ernest Commeline, some of whose other letters to his father we shall now sample. Commeline was born at Gloucester in 1856, into one of the oldest families in the city; his father was Managing Director of the Gloucestershire Banking Company. Educated at Cheltenham College, he was commissioned (No 1543) into the Engineers on 19 August 1875. He became Captain in 1886, Major in 1895, and was Colonel when he died at San Mamette, Italy, in May 1928. Dozens of his letters, some of them pretty lengthy, are now collected at the Gloucestershire Record Office (D 1233), and are quoted here by kind permission of Mr D J H Smith, County and Diocesan Archivist, Gloucester.

His fellow Subalterns with 5th Field Company in South Africa were J R M Chard and R Da C Porter. By the time we begin to read the letter of 31 January 1879 Chard had gone ahead to join the column with which Lord Chelmsford led the invasion of Zululand, and, indeed, had already won his Victoria Cross. From the Helpmekaar base camp on the Natal side of the Buffalo, we hear Commeline's account of the shattering events of 22–23 January at Isandlwana and Rorke's Drift. Incidentally, he celebrated his 23rd birthday in the midst of all this furore, on 24 January.

"Long before this reaches you you will no doubt have heard of the terrible disaster which happened to our little Army on the 22nd inst and in which I think there can be

little doubt that but for our numerous delays on the march all our Company would have been involved. We have lost 800 white men besides a large number of natives and not a single Officer who was not mounted escaped from the field (ie, at Isandlwana). The 24th Regt lost 6 whole companies with the exception of five men and the whole of the Rocket Battery was destroyed. All the Engineers present were killed, viz Col Durnford, Lieut MacDowel, and the four men of my Company who were sent on ahead of us with Chard.

"I daresay you will see many accounts of the affair in the newspapers but as I have heard all about it from several of the few survivors who are with us here, and also from many who were with the General at the time and saw the field of slaughter that night, I may as well give a short account of it. Lord Chelmsford had crossed the Buffalo at Rorke's Drift and advanced a day's march into Zululand, pitching camp some 9 miles beyond the river. Several reconnaissances had been made by the Mounted Corps during the week before and the enemy were not supposed to be in any considerable force, although they had been seen about on the hills. The following morning a body of Zulus with a large herd of cattle were seen on the hills near the camp, and the General leaving the 6 companies of the 24th and 2 guns and some Mounted Police to guard the camp left with the remainder of his force, some 1200 strong, to pursue the enemy.

"Shortly after he had gone Col Durnford came in with his Native Contingent and the Rocket Battery, and suddenly enormous numbers of Zulus appeared on the hills on three sides of the camp. The latter was not intrenched in any way and was very badly placed to resist an attack, lying on a low piece of ground from which the only line of retreat lay between two hillocks. The enemy made their usual dispositions for attack, which consist of encircling the opposing force and then advancing from all sides at a given signal. When all was ready great lines of skirmishers advanced from the main body and came pouring down on the camp. Our men formed line in front of it and kept up a tremendous fire, the Zulus falling by hundreds. Still on they came like ants, as a man fell another taking his place, in perfect silence. They came on in five lines of skirmishers by rushes in the most approved modern European style, towards the end all lying down at the flash of the guns which had mown them down in rows.

"Our native contingent soon bolted and our men's ammunition becoming exhausted they had to retreat into camp to get more, but there was not time, for the Zulus were amongst them and the butchery began. Our poor fellows then turned and tried to escape but except 20 men of the 30 Mounted Police, and several other mounted Officers and men, none got away, all being *assegaied.* The whole affair lasted little more than an hour. The General was only 15 miles distant and could see that fighting was going on, but of course could render no assistance. When he got the news of what had occurred he at once gave orders for a retreat on the camp, deciding to sleep there and cut his way across the river next morning if possible, though his chance seemed a small one.

"In fact the Army was saved from utter annihilation by the brilliant defence of the little mission house at Rorke's Drift at which Chard of our Company was the Senior Officer. He had with him Bromhead of the 24th Regt and his Company of 100 men and Dr Russell[1], when at 4 o'clock in the afternoon they saw a great force of Zulus coming down on them. These had been detached from the main army as soon as it was seen our poor fellows were done for, doubtless with the intention of destroying the detachment at the Drift and the pontoons for crossing the river, thus cutting off the General's retreat. The fighting was most desperate, lasting till 4 o'clock next morning, and the Zulus probably lost over 1000 men, 367 bodies being counted in the enclosure of the house.

"They were twice repelled at the point of the bayonet, their advance being blocked by the dead bodies of their killed. Our fellows only lost 13, most of whom were sick men lying in a hospital close by, which the Zulus fired just as it was growing dark, thus probably saving the remainder by the sacrifice of these few, as the light from the fire

enabled our fellows to use their rifles on the masses of the enemy with terrible effect. One gallant old soldier of the 24th probably saved them again. He observed a Zulu on the opposite hill light a torch and rush down to apply it to the thatch of the Mission house at a retired corner. The soldier leant out of the window and fired at the man at 5yds distance and missed him, but loaded again and shot him through the head just as the thatch had given signs of taking fire. The Zulu was found afterwards dead with his torch gone out, but raised to the thatch.

"Probably no more desperate and brilliant defence of a post has ever been chronicled among the many gallant deeds of British soldiers than the defence of Rorke's Drift. Its consequences must also be most important, as the General was enabled to bring his little force back over the river, and such a disastrous repulse must in some way have restored our prestige in the eyes of the Zulus. In the two affairs they probably lost between 3000 and 4000 men, though we know nothing for certain. And now here we are bottled up between this camp and Rorke's Drift, some 800 men at each place, not strong enough to advance and with no orders to retreat, until I suppose we get reinforcements from Home. The Zulus if they please can march on Maritzburg[2] or Durban as there is not a soldier to bar their way.

"This Helpmekaar is a funny place. It consisted when we arrived of a row of corrugated iron stores surrounded by a wall of waggons piled above and below with sacks. We Engineers have been hard at work superintending the throwing up of a strong earthwork all round which is to supersede the waggon *laager*. The stores contain ammunition, commissariat stores and sacks of oats and mealies (Indian corn). During the day the men live outside the *laager*, a good many tents having sprung up all round, but at night all sleep inside round the parapets ready for an attack. We Officers sleep in one of the sack stores, spreading our rugs on the sacks and making ourselves as comfortable as we can. I have not taken off my clothes for a night since the 22nd, and am not likely to do so for many nights to come."

Commeline was fated to spend more than two months of tedious duty at Helpmekaar, but then joined the force that invaded Zululand for the second time, as we read in this letter 6–9 June:

"It is, I think, impossible without having seen it to imagine the appearance of even a small Army on the march through an enemy's country, where all the necessary supplies accompany the column. Far in advance and on the flanks, the cavalry scour the country for news of the enemy. Two companies of infantry, two guns, and one company of Sappers, with the native pioneers attached to us, lead the column, followed at some little distance by a battalion of infantry. In rear of the latter is the transport advancing ten or twelve waggons abreast when the country is easy and open, or stretching out into a long single line two or three miles or more long where it is necessary to stick to one track. A battalion of infantry marches on one of the flanks, which are further covered by mounted men, and the remaining regiment brings up the rear.

"The artillery follows the first battalion. Marching with the advanced guard and looking back from the top of some hill, the advancing column presents a most striking picture. The great mass of waggons, with their long teams of oxen and yelling drivers cracking their long whips, coming down the opposite slope, Staff Officers and transport conductors galloping backwards and forwards, the General and his staff superintending the crossing of a drift in the valley, and the patches of bright colour where the troops are marching on the flanks and rear, all go to make up a scene utterly unlike anything to be seen anywhere but in South Africa".

At the very outset this massive invading force was to receive a psychological shock when Louis Napoleon, a Lieutenant of Artillery serving on detached duty with Lord Chelmsford's staff, was killed on reconnaissance. Commeline takes up the story on the evening of Sunday, 1 June:

"Brigadier General Wood and Colonel Buller, who had been out to look at the road we should take next day, came back to camp with the sad news that the Prince Imperial had just been killed a few miles off. They had seen some horsemen riding

down a hill in front of them as if for their lives and on riding to meet them found them to be Lieut Carey 98th and three of the Irregular Horse. The former reported that he had left Gen Newdigate's camp that morning with the Prince and an escort of seven men to make a reconnaissance for the next day's march. At a *kraal* surrounded by a mealie field on the banks of the Ityotyosi River they had off-saddled and sat down to lunch without placing any part of the party on the look-out, notwithstanding they were 20 miles in across the border. Here they remained about an hour when a Zulu was seen crossing the river, so they saddled up and prepared to return to camp.

"Carey and some of the escort were mounted and the Prince in the act of doing so when a volley was fired from the mealies and long grass. No one was hit but the Prince appears in his haste to have seized his holsters instead of his horse's mane, and these giving way his horse broke loose and left him to run for it. The men already mounted immediately bolted, Carey leading, and shame that it should be said don't appear to have drawn rein till they were met by Brig Gen Wood as already described. Had they even after riding 200 or 300 yards turned to fire or charged back again it is quite possible that the Prince's life could have been saved, for there seems little reason to doubt from the position of his body when found that he ran 300 yards before the Zulus were on to him, when he turned and fought till he fell with 18 *assegai* wounds, all in his front.

"The black fellow who was with the escort ran for nearly a mile, and from the number of broken *assegais* found around his body must have fought desperately before they killed him. And yet those who escaped say they were surrounded when they left the *kraal*, and never made the least attempt to aid these poor fellows running for their lives. What excuse for this apparent cowardice Carey will in the end put forward I do not know, but the affair is about as bad a one as can well be imagined. The culpable negligence in placing themselves in such a rat trap becomes quite a small matter in comparison. The body of the Prince was discovered close to the river next day, by Gen Newdigate's cavalry. It was stripped of everything but a small locket, his spurs, one sock, and the holsters being found near the spot. There were no bullet wounds in any of the bodies. The Prince's body has been sent to Newcastle to be embalmed, whence it will be carried to Europe.

"So short a time ago he was in and out of our little Mess tent at Conference Hill, and I shook hands with him last Thursday as I met him riding into camp at Koppie Allein little thinking that I should never see him again. Poor fellow, it is a very sad end for one with such possibly brilliant and great prospects".

Somewhat on edge after this tragedy and the implicit cowardice shown by Carey, the British force resumed its slow progress through Zululand. On the evening of 6 June, Commeline found himself under fire for the first time, but, as he says, "under very peculiar circumstances". In short, he experienced a common enough hazard of being on active service, namely that of being shot at by his own comrades, rather than by the enemy. Even the great Chard was at risk on that night, and Commeline tells the story well, complete with diagram to show the relative positions of the main waggon *laager*; the fort on which he was working; the 5th Field Company's tents; and the sentries and outlying picket (of the 58th Regiment) who caused all the commotion.

"As the 2nd Division was to move the next morning, we were ordered to pitch our little camp near one of the small stone *laagers* which we had come to complete, and the walls of which had been built to about 2 feet high. In case of alarm we were to retire into and hold the latter, instead of retreating to the main waggon *laager*, which was about 200 yards off. About 9 pm, as Porter and myself were sitting in our tent, two shots rapidly followed by a third were fired by the sentry of the picket close to us, and our men made an immediate rush for the fort. Porter and I got them distributed round the low wall and meanwhile the picket fired three volleys, so we concluded the enemy was pretty close. The alarm had been sounded by all the bugles in the big *laager*, and in a few minutes a heavy firing was commenced on the side farthest from us.

"The picket then retired into our fort, saying that the enemy were coming on in thousands, and from the firing on the far side of the *laager* this seemed most probable. Chard and Jones had been dining in the *laager* and came doubling in to the fort just before the picket came in. The Officer Commanding the picket, who happened to be the senior present, then ordered that we should retire on the *laager* with the boxes of ammunition, but no sooner did the men jump over the low wall than they were received by a tremendous volley from the waggon *laager* and came tumbling helter-skelter back into the fort.

"We then lay as flat as possible behind the little 2ft wall while a regular hail of bullets whistled over us. How it was no one was killed I don't know, and our casualties only amounted to 1 Sergeant bullet through the thigh, 4 men slightly wounded in the face, and 1 man two fingers shot off. Two of our horses were shot on the picket line. After some 2000 or 3000 rounds had been fired at us there was a pause, when we kept our bugler blowing the cease fire, and shouted for doctors. Voices from the *laager* answered "alright", and we then stood up very thankful to be alive.

"A more unpleasant predicament is hard to imagine, as we naturally thought the Zulus were coming on in our front and were taken for them by our own people behind. At the same time it was a most disgraceful thing that the troops should thus have fired at nothing. As far as we know there was not a Zulu within miles of us, a nervous sentry having probably fired at an antheap or shadow".

There is a revealing postscript attached to this account. Commeline's father had handed on several letters to the editors of local newspapers, and they had been printed in the *Gloucester Citizen*, *Hereford Times*, and other weeklies. Commeline evidently approved of this, and it was a common practice in 1879 that soldiers' letters were so published, but he had reservations about this particular episode. "If you make any part of this letter public", he told his father "it might be as well to reserve that relating to the scare, as I should not like to tell tales out of school to the general public".

The near-fatal fortification became known to the troops as "Fort Funk", and other false night alarms were to be experienced as the columns pressed on towards a final confrontation with the Zulu Army. One occurred on the night of 1 July, but by then there was more justification for it because they were very close to the royal *kraal* at Ulundi. The battle came on 4 July, and Commeline's description of the engagement that brought the war to a close is one of the best available. Eight Officers of the Royal Engineers were present in the square at Ulundi, during the fight, including Jones, Chard, Porter, and Commeline of 5th Field Company.

"About midnight on the 3rd the Zulus were making the most unearthly howling and yelling in their camps across the river, of which we could see the fires on all sides. We rose at 3.45 am and, having breakfasted, moved into our position in the column at 5 am. The latter was formed on the road between the camp and the drift, the cavalry covering the front and the flanks. The 5th Company RE was in rear of the leading battalion (80th Regiment). The full moon cast a bright light till the sun rose. Some time was taken up in forming the column, which did not advance till 7.30 am. We expected to be opposed at once in crossing the drift, where the opposite bank was some 100 feet high and thickly covered with bush on one side of the road, while on the other side were *dongas* and thick scrub.

"However, the men splashed through the stream without a shot being fired and advanced in parallel columns up the rough bushy ground on the other side. The morning was very cold with a heavy dew. At the top of the rise we halted and got into the formation in which we were to fight. This consisted of a big hollow square of which the front and rear was formed of regiments in line, and the sides of others in fours, the artillery and reserves being inside. About 8.30 we again halted and then observed large bodies of the enemy on the surrounding hills, and then descending down the slopes and *dongas* into the brushwood at the bottom. We were now in an open plain with grass standing about 2 feet high, but with very few bushes.

"We now slightly changed our direction to the right and moved on for about a quarter of an hour, when Zulus were seen in thousands on the hills all round us. We halted and waited for them to come on, the cavalry being on the move against them. Near the right flank by our front was a small ruined brick building, in which was discovered the horribly mutilated body of one of the irregular cavalry killed yesterday. I was sent with a party of Sappers to bury him, while the Chaplain read the burial service over him. Meanwhile the cavalry became hotly engaged and were retiring, firing, before the enemy.

"The Zulus came on with wonderful speed on all sides, and the cavalry had no sooner got inside the square than the infantry fire began all round. The 80th had commenced to throw up a shelter trench, but had no time to do more than cut a few sods. The artillery, who had moved outside the four corners of the square, began to pound away as soon as the cavalry were out of the way, placing their shells beautifully in the midst of the advancing masses, who scattered as they burst in all directions. I could see them through my glasses running in a crouching attitude behind their shields, down the slope and across a big *kraal*, then dropping here and there, though the long grass prevented the effect of the fire being well observed. The Gatlings outside the right front did great execution, though some of the enemy got up to within 40 yards of them.

"Our Company of RE was in reserve near this point and the fire for some time was very warm, the bullets coming in from all sides. We had one sergeant hit but no other casualties. The firing was now heavy and general on all sides of the square, the attack having been made everywhere simultaneously in obedience to a signal given by a Chief with a white shield. The ground on the left being favourable for cover, the enemy had got up to within 100 yards of the square, and we were sent round to reinforce the 21st Regiment at the left rear. However, we had no chance of doing any firing as the enemy were beaten when we got there, and soon after retired, followed by rounds of cheering from our fellows.

"Way was made, though I think not soon enough, for the Lancers to pass through who were loudly cheered as they rode off at full gallop after the retreating Zulus, who had now got some distance towards the hills. Other mounted troops followed and soon we saw the Lancers catching up the rear of the Zulus and doing great execution. One trooper was seen to kill three men with as many thrusts of the lance. Several saddles were emptied as the Zulus frequently turned when close pressed and fired. One Officer was thus killed. The mass of the enemy escaped up the hills. The artillery had some very pretty practice . . . through my glasses I could see them scattering as the shells burst above them and running to all sides. Rockets were being fired on the other side of the square . . . Our losses were about 70 killed and wounded, and from comparison of the most reliable accounts of the Zulu losses in different directions they may be put down as at least 1500 men killed. I walked out after the firing had ceased to some bushes in front of the spot we had been sent to, and found about 30 bodies in a very small portion of ground".

Ulundi was not to be the last bit of hot action experienced by Commeline in 1879. By November he was in the thick of the fighting that crushed Sekhukhuni, the hostile leader of the Pedi people. That was in the Transvaal, and he stayed on to work at various garrisons there throughout 1880. By the end of the year the First Anglo-Boer War had broken out, and Commeline was trapped in Pretoria when the Boers besieged it. He was then serving with 2nd Field Company, Royal Engineers, and together they suffered many privations before the conflict petered out after Majuba. At the close of 1881 he was posted to Pietermaritzburg, and there he remained for two years, his duties in Natal being enlivened by such incidents as joining the escort for politicians who met Cetshwayo, the deposed Zulu King, on his return from exile in 1883. In these later phases of his five year stint in South Africa, just as he had during the Zulu War itself, Commeline wrote letters to his father on a dutifully regular basis. They are full of interest, and perhaps we can read extracts from some of them on another occasion. Nor should we forget the discomforts under which he

wrote these letters. As he observed (15 May 1879), "I have not written to Cheltenham for a long time, but letter writing is often very difficult, one's knees or a biscuit box frequently doing duty for a table, and now candles are exhausted so one cannot write after dark".

Notes:
[1] Russell is wrong: he means Surgeon J H Reynolds, Medical Officer to the 2/24th Regiment, who won the Victoria Cross for his part in the defence of Rorke's Drift.
[2] Pietermaritzburg, the colonial capital of Natal.

Railway Construction Past and Present—Is there a Future?

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INTRODUCTION

Part of the role of the Corps[1] is given as "construction or repair of railway facilities . . .". Our efforts in all theatres of World War II showed that we were fully capable of this. Today, some thirty-six years later, we have a practically non-existent capability—yet the role remains. We will look at our capability; discuss the possible present day requirements; follow the development of equipment bridging over the past eighty years and finally suggest how the Corps could go part way to meeting its role with the modern bridges available.

CORPS CAPABILITY

During World War II we had many Railway Companies covering survey, bridging, construction and mechanical equipment. With the restructuring and reduction in size of the Armed Forces all of these specialist units and their equipment have been lost to the Army with two exceptions. In BAOR we have one PQE/GE (Professionally Qualified Engineer/Garrison Engineer) post with a Permanent Way Troop who maintain track within British installations in BAOR and the Low Countries. The other unit is 507 STRE(V) (Specialist Team RE) who again have a permanent way role. Neither team has any responsibility, and therefore capability, for railway bridges. It is worth noting that not only have the US Army maintained stocks of railway bridging equipment, albeit dating back to the last War, but they also train on

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it.[2] The situation in our Army is unlikely to change with the British economy under severe pressure. It is therefore reasonable to expect reluctance towards maintaining skills that may be infrequently required.

THE REQUIREMENT

Railways played a vital part in and after both the World Wars. Between the Wars only the Germans developed their railway networks around possible military requirements. The British and French, with no aggressive military plans, organised their railways for emergency supply and evacuation roles only.

When World War II broke out both sides discovered how vulnerable railways were to increasingly accurate air attack. For this reason, if for no other, military strategy has turned away from the railway except perhaps for stores and outloading purposes during periods of tension before air attacks start. At this time all possible means of transport will be required and will be under strain. Sabotage will occur, not only to the railways but to airports, motorways and docks. Thus, whilst railways may not be as important as they were before the advent of the motorway, there still exists a requirement for an emergency bridge building capability, regardless of who maintains it.

What is the requirement in peacetime? A disaster may be accidental, as in the case of the Anglesey Britannia Rail Bridge, or may be caused by sabotage at the hands of an extremist group. Whereas accidental damage could occur anywhere, sabotage, if properly planned, will occur where it will maximise disruption for minimum effort. British Rail's repair capability centres on its use of way beams in lengths of up to 12m and ex-military wartime stocks of trestling (piers). Spans up to 25m are possible with Auto-fab beams or specially designed welded sections. With this equipment the aim is to resume a limited service within twenty-four hours of a failure. Skilled labour is found from internal resources. There are however limits to the practicalities of using these equipments. Deep valleys present not insurmountable problems, but deep water, such as that at the Menai Straits is a barrier. The Britannia Bridge fire there stopped all rail links to the Holyhead passenger and freight terminals for two years. In a similar way Scotland or industrial South Wales could be isolated with reasonable ease. It is interesting to note that during the 1939–45 War the Ouse Valley Viaduct on the London–Brighton line was provided with a full time guard against possible sabotage. British Rail would have to implement massive pooling of their resources even to attempt to deal with such large scale emergency repairs.

We have then a situation where British Rail is responsible for all its repairs in peace and war but, in the short term, it can only tackle the larger/more difficult repair jobs by re-routing. We should look further than the UK however. If hostilities occur in NATO we could have a critical interest in the affected country's rail capability. Within NATO the maintenance of lines of communication are a host nation responsibility. We know for example however that the German Territorial Commands have practically non-existent stocks of railway bridging equipment.[2] The Deutsches Bundesbahn have "Kombinations-Hilfsbrücke" of up to about 25m span for short span repairs but doubts must exist about their capabilities to deal with widespread organised disruption. West Germany is after all in the forefront of NATO, and must be considered a prime target for attack. There appears therefore to be a requirement and a role for the military, left unbalanced by minimal expertise and a complete lack of equipment.

EQUIPMENT BRIDGES 1900–1945

Equipment bridges have a short history, the first being designed around the turn of the Century. Since then, within Europe, there have been two quite distinct design and development processes. On the one hand were the Austro-Hungarian and German, and on the other the British designs. Table 1 gives outline details of most bridges used in the two World Wars.

The Germans did not produce any lasting designs for the 1914–18 War. Their bridges suffered from being either too heavy, too complicated to construct, or had deflection problems with timber/steel composite construction. On the other hand the

Photo 1. SKR-6 railbridge of three 91m continuous spans over the Rhine at Mannheim (1946). *Acier-Stahl-Steel*

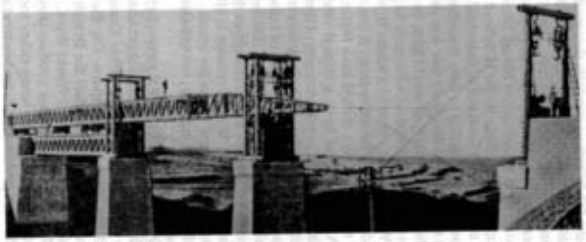

Photo 3. Roller-launching a 72m three-span UCRB

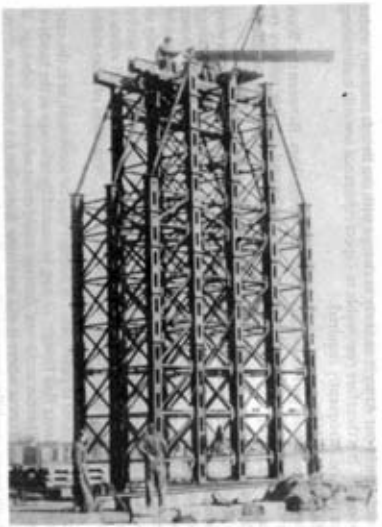

Photo 2. Standard trestling being erected.

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Photo 4. A 70m ESTB at Deventer, Holland 1945

Photo 5. Single span 76m Type "C" Callender-Hamilton Bridge under construction over the R Manas, Assam in 1942. *Balfour Beatty Power Construction*

Photo 6. SKB road and rail bridge with steel decking. *Acier-Stahl-Steel*

Photo 7. Launching a 120m span SKB. *Acier-Stahl-Steel*

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Photo 8. 120m span SKB erected as an emergency bridge over the R Toce in Northern Italy 1978. *Acier-Stahl-Steel*

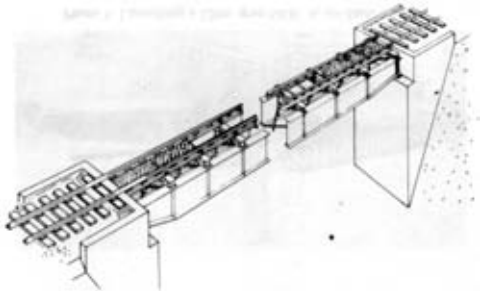

Photo 9. The Fairfield-Mabey modular bridge. *Mabey Group*

Photo 10. Two 82m Acrow Heavy Bridge spans. *Acrow Group*

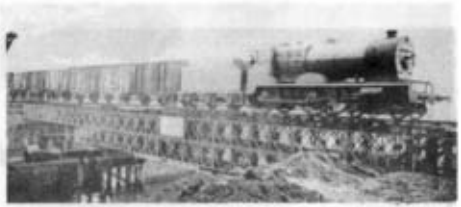

Photo 11. The 97m three-span emergency Bailey Bridge over the R Tolka, Eire. *Acrow Group*

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8,9,10,11

Austro-Hungarian Kohn Bridge (Table 1, ser 1) was considered a brilliant design[3] which, although designed in 1900, was still competitive forty years later.

The Austrians' other bridge, the Roth-Wagner Bridge (Table 1, ser 2), also survived into the Second World War. The complexity of Germany's High Command in the late thirties was the cause of no less than seven different bridges being produced by different organisations. Eventually the Germans standardised on the Schoper Krupp Reichsbahn Bridge better known as the SKR-6 (Table 1, ser 15 and Photo 1). Production of this bridge was continued in German factories by the Allies to help get Germany back on its feet after 1945.

The British World War II effort was headed by Lieut Colonel Everall, a Sapper of much railway experience in India during and after World War I. He and his staff developed a series of complementary equipments all of which were designed to take a 20 BSU loading.[4] (Table 2 gives an explanation and comparison of the various loading standards.) The series started with RSJ spans and Sectional Welded Plate-Girder Bridges (Table 1, ser 7 and 8) for spans up to 17m. Backed up with Unit Trestling (Photo 2) for building piers, this was versatile equipment. The remaining bridges were the Unit Construction Railway Bridge (Table 1, ser 9 and Photo 3) and the heavier Standard Truss Bridge[5] (Table 1, ser 10). These two were eventually superseded by the Everall Standard Truss Bridge (Table 1, ser 16 and Photo 4) whose design was inspired by that of a Roth-Wagner Bridge (Table 1, ser 2) captured in Italy. The trestling[6] was in fact used for all the bridge types. It was designed to either a 5ft (standard) or 6ft (heavy) grid of columns. The trestles were supported on either grillages or camel's feet which were adjustable for height, could take 40t, and could accommodate a 15° tilt from the horizontal.

There are two other British Bridges requiring a mention. The first is the Bailey Bridge[7,8] (Table 1, ser 11). This was developed as a road bridge and was used comparatively little at first for railway applications mainly because of deflection problems. There were later, however, quite a number constructed in India, and the Americans who had also overcome these difficulties, actually published designs for 16-truss deck railway bridges of up to 30m span.[7] The other bridge was the Callender-Hamilton Bridge.[9] It was originally designed in the 1930's to allow road access for oil exploration in Iraq. A rail version was developed in 1938 (Table 1, ser 6 and Photo 5) for use mainly in India.

POSTWAR BRIDGES

These bridges are again summarised in Table 1. Outstanding amongst the German designs is the Schaper Krupp Bundesbahn or SKB Bridge[10,11,12] (Table 1, ser 19) which is shown in its single and double tier forms in Photos 6, 7 and 8. It is a direct development of the SKR-6 (Table 1, ser 15 and Photo 1), which takes advantage of improvements in materials and manufacturing techniques. It is lighter and easier to build than its predecessor. It is extremely versatile being roller launched and adaptable to road and/or rail use in single or multispan configurations with piers.

After World War II Britain's development of equipment bridges took a severe downturn. The market for purely emergency bridging is small and, as we have seen, British Rail rely on wartime stocks and items of their own design of limited span. For permanent bridges, British Rail tend to favour concrete rather than steel, however they have had installed a number of Fairfield Mabey modular steel bridges (Photo 9). Being available from stock these bridges can be regarded as being almost within the category of emergency bridging, as their installation requires only 4–6 hours of track possession. With spans from 10·5 to 22·5m they are in effect the modern equivalent of the Sectional Plate-Girder Bridge (Table 1, ser 8).

The Callender-Hamilton Type "C" Rail Bridge has continued in production almost unchanged from its original design. It is not a particularly fast bridge to construct possibly because it consists of so many small components. For economics of design over a wide range of spans it is perhaps the most adaptable of any bridge made today. Unfortunately though, it does not seem to compete as an emergency bridge. This is because Callender-Hamilton have a policy of individually designing bridges

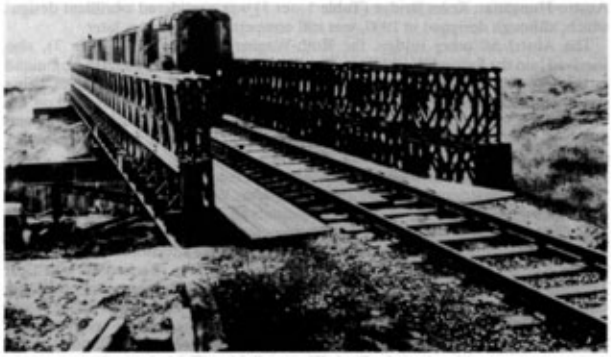

Photo 12. Two 21m Acrow Panel Bridge spans at Telford, Shropshire. *Acrow Group*

according to span and loading, and so recipe book design and erection are not possible.

The Acrow Heavy Road/Rail Bridge[13] (Table 1, ser 22 and Photo 10) does not have the load capacity, and therefore span, of the German SKB but it is simpler to construct. Its pinned construction makes it more suited to military erection than the bolted SKB. It is roller launched, using Bailey Bridge panels for its launching nose.

There remains one more design concept, that of panel bridges. These bridges are manufactured by two separate companies. They both produce Bailey Bridges (Photo 11) which differ only slightly from one another and from the original Bailey Bridge (Table 1, ser 11). Mabey and Johnson, one of the companies, produce Super-Bailey panels[14] for increased loads whilst the other, Thos Storey (Engineers), an Acrow Company, produce the Acrow Panel Bridge[15] (Table 1, ser 21 and Photo 12) as their uprated version of the Bailey. Its panels are the same size as Bailey panels but are considerably stronger, as are its transoms. These transoms, of which special railway versions are available, are positioned in the base of the diamond bracing, a distinguishing feature of the bridge. The use of expanding panel pins and transom shims reduce deflection problems and allow pre-cambering of the track.

The Mabey Universal Bridge[16] (Table 1, ser 23 and Photo 13) is an enlarged version of the Bailey Bridge, with a considerably wider roadway than its competi-

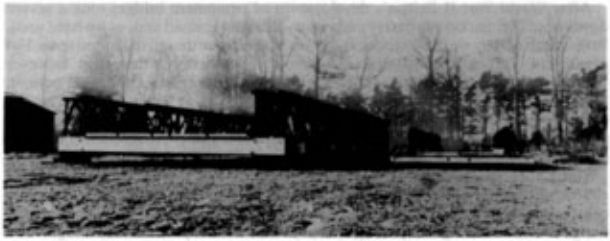

Photo 13. A 7·5m wide Mabey Universal Bridge compared with a 3·28m wide Bailey Bridge. *Mabey Group*

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tors. Its transoms remain locked to the panel verticals with knee braces. Thus it may possibly be better suited than the Acrow Panel Bridge to resisting the not inconsiderable nosing/braking forces associated with trains. The Heavy Girder Bridge[17] could presumably, with special parts, be converted to a deck bridge as with the US Bailey Bridge (Table 1, ser 11). As a through bridge it lacks shear capacity at useful spans. The Medium Girder Bridge[17] is altogether too elastic, being made of an aluminium alloy. All the panel bridges and the Acrow Heavy Bridge have a panel constructed pier capability for multi-span use.

All these current UK designs, except the Modular bridge, are basically road bridges which can be adapted to rail use. They could be, and some have been, used by the military in emergency for replacement road links.

EQUIPMENT FOR THE FUTURE

There is a feeling amongst the manufacturers that the market for replacement railway bridges will expand. Not in Europe where planned maintenance is good, but rather in Third World Countries. They believe that many bridges in these countries built around the turn of the Century will soon reach the end of their useful lives. Callender-Hamilton, with their R6 and R8 bridges, and Mabey and Johnson, with their Unit Construction Bridge, are in advanced states of design. Other manufacturers will presumably follow suit, but it will be intriguing to see how they have made design and construction for both emergency and permanency economically compatible. These new commercial designs cannot but influence the Army's potential capability to act in an emergency.

THE SOLUTION

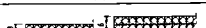
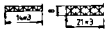
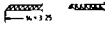
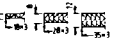
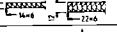
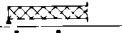
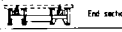
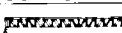
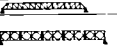
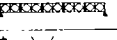
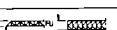
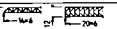
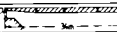
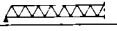
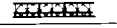
The Corps has limited permanent way and no bridge repair/reconstruction capability. If we believe that British Rail and host nations in NATO will be able to maintain services under attack then there is no requirement and our role as described in ME Volume 1 should be adjusted accordingly.

We would be fooling ourselves if we believed this. Host nations are expected to keep roads open, yet we train in road and road bridge repair and construction. We need therefore expertise and equipment. Expertise can be cheaply obtained by the training of selected personnel, perhaps from the two permanent way teams, on the various types of commercial bridge available. Equipment is expensive to buy, maintain, and store, but manufacturers hold limited stocks of their equipments. In wartime, economics take a secondary role and so equipment would be available if required. In peacetime we must be satisfied with maintaining limited expertise only, thus keeping costs to a minimum.

REFERENCES

[1] *ME Vol 1 1973—Organisation, Employment and Training of the Royal Engineers.*
[2] DE Linn—*Something New in Bridges—Engineer (US Army)*—Winter 1980–81.
[3] H Sedlacek—*Eisenbahnbrückengeräte in Stahl-früher und heute—Bauingenieur 51*—1976.
[4] *The Civil Engineer in War Vol 1*—The Institution of Civil Engineers—1946.
[5] *The Standard Through Truss Railway Bridge*—War Office—1945.
[6] FS Bond—*Standard Military Railway Bridges—The Railway Gazette*—1946.
[7] *TM5-277-Panel Bridge, Bailey Type, M2*—US Dept of Army—1948.
[8] *Bailey Bridge Adapted for Rail Traffic*—Bridging School CTWTn Tc—1944.
[9] *Callender-Hamilton Bridging in Asia and Africa*—BICC—1952.
[10] H Sedlacek—*New Prefabricated System-Built Bridges with High Loading Capacity Over Wide Spans*—Acier-Stahl-Steel—10/1973.
[11] *SKB*—Brücke—Krupp-MAN.
[12] KF Koch and J Saulter—*120m Span Rail Bridge*—Acier-Stahl-Steel—2/1979.
[13] *The Acrow Heavy Bridge Technical Handbook*—Thos Storey (Engineers) Ltd—1976.
[14] *The Super-Bailey Bridge Mini-Manual*—Mabey and Johnson Ltd.
[15] *The Acrow Panel Bridge Technical Handbook*—Thos Storey (Engineers) Ltd—1977.
[16] *The Mabey Universal Bridge Data Manual*—Mabey and Johnson Ltd—1980.
[17] KPM Turpin—*The use of the Existing Range of Military Component Bridging in Railway Bridge Replacement*—RSME—1979.

TABLE 1. EQUIPMENT BRIDGES

Serial	Bridge name	Country of origin	Into service	Classification (see notes)	Width (m)	Panel length (m)	Tier height (m)	Construction truss/tier	Max span (m)	Span increment (m)	Weight (t/m)	Heaviest item weight (t)	Bolts/ pins/m	Speed of erection (m/hr)	Remarks	Main girder profile
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
1	Kahn	Austro-Hungarian Empire	1900	TSHX TS/CHX DS/CHX DX	4 27 4 27 3 5 3 5	3 3 3 3	3 3 3 3	1·1 2·1 2·2 2·3	15 30 45 57	1 5 1 5 1 5 1 5	1 65 2 20 3 60 4 20	0 51 0 51 0 51 0 51	- 147 191 -	- 2 2 1 6 -	1 Considered a brilliant design Still met military requirements after World War 2 2 2 3 Construction not recommended 3 Design loading was Aust-Hung Goods Train Std 1889	
2	RW	Austro-Hungarian Empire	1912	TS/CE DS/CE	4 7 4 0	3 3	4 4	1·1 1 2	42 63	1 5 1 5	3 15 4 40	0 63 0 63	162 247	3 0 2 2		
3	MZ	Germany	1936	TS/CE DS/CEX DREX	5 0 4 53 2 64	3 25 3 25 3 25	2 89 2 89 2 89	1·1 1·2 -	45 5 67 -	0 25 0 25 0 25	3 15 - -	1 58 1 58 1 58	124 - -	3 5 - -	1·1 2 Construction not recommended 2 Welded construction	
4	R	Germany	1937	TS/CE DS/CE DS/CE	5 1 4 3 4 3	3 3 3	4 4 4	1·1 1·2 1·3	54 84 105	2 2 2	3 45 4 10 5 15	1 51 1 51 1 51	232 255 281	1 5 1 0 0 6		
5	SZ	Germany	1938	TCE DCE	5 2 4 4	6 6	6 6	1·1 1·2	102 132	1 66 1 66	7 65 9 13	6 14 6 14	56 64	3 0 2 5	1. Special drilling required for 68mm ø bolts	
6	Callender Hamilton	UK	1938	TSPX TSPX	- -	3 1 4	3 66 4 34	2·1 2·1	76 2 106 7	- -	- -	- -	- -	- -	1. Used mainly in Far East to Indian Railway loadings 2 Types C & D.	
7	RSJ span	UK	1939-45	D/TrHP 20 BSU D/TrHP 20 BSU	X X	NA NA	X X	2·1 3·1	7 9 10 7	0 3 0 3	- -	1 12 1 51	- -	- -	1. Width depends on track gauge 2 RSJ 18in or 24in deep	
8	SWPG	UK	1939-45	D/TrHP 20 BSU	X	NA	0 89	2·1	17 1	0 3	-	0 91	-	-	1. Sectional welded plate girder 2 Width depends on track gauge	
9	UCRB	UK	1939-45	D/TCP 20 BSU DCP 20 BSU D/TCP 20 BSU	X X X	4 57 4 57 4 57	2 08 2 08 2 08	2·1 3·1 4·1	21 3 27 4 32	1 52 1 52 1 52	- - -	1 03 1 03 1 03	- - -	- - -	1. Width depends on track gauge 2 Column(m) assumes max speed of 65 km/hour	
10	STB	UK	1939-45	TCP 20 BSU	6 6	3 1	4 17	1·1	46 9	3 1	3 20	3 86	148	X	1. 46 9m bridge took 12 days - arrival to clearing site	
11	Bailey	UK	1939-45	TRHPE-40/20BSU DCHPE-40	6 07 6 07	3 05 3 05	1 55 1 55	1·1 - 4·2 3·1 - 8·1	27 4 30 5	3 05 3 05	- -	- -	- -	- -	1. Data for deck bridge from U S Army book TM5-277 *1948 2. 8·1 Bridge had 16 trusses	
12	V	USA	1939-45	TCHE-40 DCHE-40	5 8 2 9	3 05 3 05	2 9 2 9	1·2 1·1	27 4 -	3 05 3 05	- 1 16	0 18 0 18	- -	- -	1. Has only four main components	
13	RE	Germany	1939-45	-	-	-	3 25	1·1 - 1·4	-	-	-	1 82			1. Few details available	
14	ST	Germany	1942	TCaE DCaE	5 5 4 9	5 5	6 5 6 5	2·1 2·2	65 100	- -	3 5 4 3	3 46X 3 46X	100 140	3 9 3 1	1. Launching cable is heaviest item	
15	SKR6	Germany	1942	TCPE DCPE DCPE	5 5 5 0 8 25	6 6 6	6 6 6	1·1 1·2 1·3	72 120 150	1 1 1	4 0 6 3 7 5	2 8 2 8 2 8	200 255 305	1 5 1 0 -	1. Not known if 1·3 was ever built 2. A development of SKR3 bridge but with 6m panel instead of 3m 3. Wartime Germany eventually standardised on this bridge	
16	ESTB	UK	1945	D/TCP 20 BSU TCP 20 BSU TCP 20 BSU		3 1 3 1 3 1	4 57 9 14 13 72	1·1 1·1 1·1	54 9 100 6 121 9	0 15 0 15 0 15					1. Type 45 (tier height 13 72m) was planned but may never have been produced	
17	Metre Beam	Germany	-	DE-40	X	NA	1	3·1	29	-	2 0	0 3	-	-	1. Width depends on track gauge 2. RSJ's rolled only in Germany/Luxembourg 1m x 0·3m wide up to 29m long	
18	SE	Germany	1954	TRHPE DRHPE DRHPE DRHPE	5 34 4 8 4 8 4 8	2 1 2 1 2 1 2 1	2 1 2 1 2 1 2 1	1·1 1·4 2·4 2·6	15 8 48 3 66 8 75 6	1 05 1 05 1 05 1 05	1 64 2 70 4 50 5 80	0 69 0 69 0 69 0 69	90 141 246 308	- - - -	1. Type 1·4 can be increased to 69m with special parts. 2. Type 2·6 is non-standard	
19	SKB	Germany	1966	TRPO-85 S TRPO-85 S	5 5 5 5	6 6	6 6	1·1 1·2	84 120	0 5 0 5	3 42 4 61	2 86 3 47	82 115	5 0 4 0		
20	VT	Germany	-	DRE DRE	1 5 1 5	9 8	1 5 1 5	2 3	26 34	- -	1 35 1 85	5 5 5 5	12 18	-	1. Similar in concept to Serials 7, 8 & 17 using 1·5m deep beams	
21	Acrow Panel	UK	-	TRHPE-30-72 TRHPE-30-72 TRHPE-30-60 TRHPE-30-55 TRHPE-30-40		3 05 3 05 3 05 3 05 3 05	1 55 1 55 1 55 1 55 1 55	2·1 - 4·1 3·1 - 3·2 3·1 - 4·2 4·1 - 4·2 3·1 - 4·2	6 1 12 2 21 3 24 4 30 5	3 05 3 05 3 05 3 05 3 05		0 82 0 82 0 82 0 82 0 82	16 21 46 52 69	up to 3 0	1. An improved version of Serial 11	
22	Acrow Heavy	UK	1970	TRPE-30-60 TRPE-30	6 3 6 3	9 1 9 1	8 8	1·1 1·1	73 1 91 4	9 1 9 1	3 78 2 83	5 77 5 77	47 36	1 0 1 0	1. Stronger top chord would permit E-40 loading up to approx 100m span.	
23	Mabey Universal	UK	1975	TRP-E40	5 4	4 5	2 5	2·1 4·1	20 3 36 0	2 25	2 2 3 0	1 0 1 0	16 30	4 0 2 0		
24	Mabey Modular Railway Bridge	UK	1980	DX-20 BSU E40-E72	2 7	12	X 0 92 2 42	NA	22 5	1 5	1 16	2 1	50	2 0	1. Crane erected 2. Plate welded girder	
25	Mabey Unifi Constr Bridge	UK	-	TPCR 20 BSU E40-E72 DPS 20 BSU E40-E72	4 8 8 7	3 3 3	4 4 8 8 13 2	1·1 - 2·1 1·2 - 2·2 1·3 2·3	60 120 150	1 1 1	2 75 3 1 4 7	1 8 1 8 1 8	180 250 300		1 Only in design stage	

Notes

1 Classification

Type T=Through
D=Deck
Tr=Trough
P=Pier capacity

Erection method S=Scaffolding
C=Cantilever
R=Roller
Ca=Cable
H=Hand erected

Design loading E, 0·85 S, 20 BSU, E-40/60 } See table 2

X=See remarks

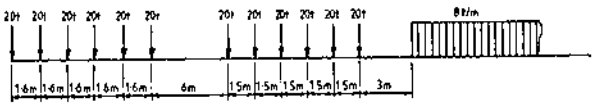
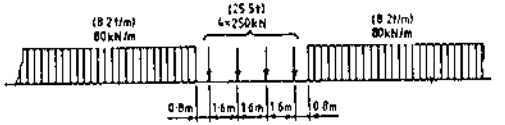
2 Speeds of erection take no account of site preparation, and in some cases are thought to be optimistic

3 Serials 7, 8, 9, 10 & 16 used the standard/heavy trestle unit for piers

4 Pinned type bridges require more maintenance than bolted bridges

5 Max spans are for loadings around E40/50 Higher loadings are possible at shorter spans

TABLE 2. RAILWAY BRIDGE LOADING COMPARISONS

LOADING CATEGORY	USED BY	LOADING	NOTES
E	Germany		1. E and S are freight loadings. 2. RA loading to BS 153. 3. Other RA and Coopers loadings by direct proportion. 4. RU loading to International Union of Railways Loading Committee. 5. 0·85 S ≈ E45 ≈ 20BSU 6. RU ≈ E55 – no direct comparison should be drawn. 7. Most loading categories have alternatives for short span members with the effect of 25t axles.
0·85 S	Germany		
20BSU (RA 20)	UK		
Coopers E45	USA and Worldwide		
RU	UIC		

History of 71 (Scottish) Engineer Regiment (V)

EDITED BY CAPTAIN J D BEAUMONT RE, B Eng

Derek Beaumont first joined the Corps in 1971 as a Sapper in 75 Engr Regt (V). On going up to Sheffield University to study Civil Engineering he transferred to the OTC where he gained a TA Commission in Dec 1972 and commanded the Sapper section of the OTC. After graduation he was granted a Regular Commission and went to RMA Sandhurst and YO training at Chatham. In 1975 he went to 28 Amph Engr Regt as a Tp Comd and in 1977 to the Junior Leaders Regiment. In 1979 he returned to the TA as Adjutant of 71 (Scottish) Engineer Regiment (V).

Capt Beaumont wishes to emphasise that he appears here only as the Editor of much work carried out by past and present TA Officers.

INTRODUCTION

The history of the TA part of the Corps mirrors that of its Regular counter-part. Regiments are formed, renamed or disbanded during a succession of reorganisations, but the individual Squadrons maintain a continuous thread, even though they also may be re-named, or change location. 71 (Scottish) Engineer Regiment (V) was formed during the last major re-organisation of the TA on 1 April 1967. It now comprises 102 (Clyde) Field Squadron, based in Paisley, 124 (Lowlands) Field Squadron in Coatbridge, 104 (City of Edinburgh) Field Squadron in Edinburgh, and Regimental Headquarters and Workshops REME (V) in Glasgow. Each of these had previously been a Regiment in its own right, and so the history of 71 (Scottish) Engineer Regiment (V) is really one of its component Squadrons.

102 (CLYDE) FIELD SQUADRON RE(V)

102 Fd Sqn (V) is the descendent of 102 Field Engineer Regiment, which had comprised 238 Field Park Squadron, 276 (Renfrewshire), 279, and 540 (Clyde) Field Squadrons.

Of the four, 540 Sqn has the longest history. Formed in 1884 as the 9th (Submarine Mining) Coy of the 1st Lanarkshire Engineer Volunteers, it was based at Greenock on the Clyde. Over the next twenty years or so, Submarine Mining in the Corps expanded until there were seven companies in the Clyde Division, Submarine Miners Royal Engineers (Volunteers). In 1907, however, Submarine Mining was handed over to the Royal Navy and the Division was reduced to one Company and became Electrical Engineers. Following the Haldane Reforms of 1908, there was a further expansion and the 49th (Coast Battalion) Company as it became, served as a Fortress unit in the defence of the Clyde and Forth during World War 1. The Company continued as Fortress Engineers until World War II and served in the early years of the war in Norway and Iceland. They returned to the UK as 540 (Renfrewshire) E & M Coy RE before moving to the Middle East. At the end of the war 540 Sqn was placed in suspended animation. At that time, it had one Troop in Germany, one in Austria, one in Trieste, and one with the Coy HQ in Italy.

238 Field Company was formed after World War I and formed part of 51 (High-

History of 71 Scottish Engineer Regiment Captain J D Beaumont RE B Eng

Photo 1. The main road bridge at Simmonsbath after completion of Class 9 and during the operation of strengthening the bridge to take Class 30 road traffic (1952 West Country Floods)

land) Division Engineers. In 1938, 276 was raised as a twin Company. 238 Coy served in France and Italy during the Second World War as part of 1 Division Engineers. 276 Coy served in Africa, Sicily and NW Europe. They were the first troops to enter Tripoli in January 1943 and captured the Governor's Standard which is now in the RE Museum. 279 Field Company was raised in Bellshill in Lanarkshire and served in Home Defence from 1939 to 1944 when it went to NW Europe as part of 15th Scottish Division.

The TA was reformed in 1947 and 102 Field Engineer Regiment finally came into being in 1950. The four Squadrons, 238, 276, 279, and 540 suffered various fortunes over the next few years and some moved locations in an attempt to improve recruiting. In a major re-organisation in 1961, 279 Fd Sqn was finally disbanded, and 276 absorbed a TA Gunner Battery. The three Squadrons, 276, 540 and 238 Field Park continued as 102 Regiment until April 1967 when they became 102 (Clyde) Field Squadron.

Although 102 Field Engineer Regiment never saw active service, it provided Sapper assistance in more than one emergency. In 1952 it helped during the flood disaster at Lynmouth in Devon, and whilst on Annual Camp in Belgium in 1954 provided aid to victims of a hotel disaster. (Photos 1 and 2).

124 (LOWLAND) FIELD SQUADRON RE(V)

In March 1903, the 2nd Lanarkshire Royal Engineers (Volunteers) was formed. This comprised nine Companies of 100 men each, all located in the Airdrie-Coatbridge-Motherwell area of Scotland. The Haldane Reform of 1908 saw the re-organisation into two Field Companies and a Telegraph Company as the Lowland Division Engineers (T).

The 1st Lowland Field Company left Scotland for France in December 1914 and was the first Sapper Territorial Company to arrive in France. During the Great War, the Company served with the 1st Division. In 1917 the 1st Lowland Field became the 409th Field Company. During its service in France and Flanders the Company became one of the most decorated of any Territorial Engineer Unit, gaining amongst its honours one Victoria Cross, thirteen Military Crosses (two with bars), and thirty Military Medals.

Between 1920 and 1939, the Company became 240 Fd Coy and served as part of

the 52 (Lowland) Division. In Oct 1939, the Company again went to France with the BEF, and served with II Corps until it was evacuated from Dunkirk. From 1940 to 1944 the Company helped prepare defence works in various parts of the UK. On 6 June 1944 the Company, as part of I Corps, took part in the Normandy landings and were part of 49th Div during the capture of Le Havre.

On 1 January 1947, 240 Army Field Company became 240 (Lowland) Field Squadron (TA) and in May 1940 became 240 Army Engineer Squadron as part of 126 Army Engineer Regiment (TA). During the 1950's further re-organisations saw them become part of 124 Field Engineer Regiment (TA) and in 1961 they became the 52 (Lowland) Division Engineers (TA). In 1967, 124 Field Squadron was formed in Coatbridge, where it remains today.

104 (CITY OF EDINBURGH) FIELD SQUADRON RE(V)

The history of volunteer engineer units in Edinburgh dates back to July 1860 when the 1st Edinburgh City Engineers Volunteers were raised. In March 1888 two Companies of the Forth Division Submarine Miners Royal Engineers (Volunteers) were raised with their Headquarters in a floating hulk named *Dido*. The Squadron has had a link with subsequent ships of the same name and the Squadron have the Ship's Bell of the 6th HMS *Dido*. The most recent bearer of the name, the 7th HMS *Dido*, has the side number "104".

Following the loss of Submarine Mining, and the 1908 Haldane Reforms, the City of Edinburgh Fortress Squadron was formed. At the outbreak of World War 1 they became the 1st City of Edinburgh Field Company and after training in England during 1915 were sent to the Middle East in early 1916 to become part of the 10th Indian Division. Their stay in the desert was only short, however, and after a few months they returned to France as part of the 56th London Division. In France they took part in the Battle of the Somme, Ypres and Cambrai.

Between the Wars, the Company became a searchlight unit and was expanded to a Regiment during the Munich Crisis in 1938. In 1940 the searchlight role was handed over to the Royal Artillery, and the unit became 3rd Army Troops Engineers, comprising 585 Field Park Company, and 586 and 587 Field Companies. The Regiment joined First Army and sailed with them to North Africa. Subsequently they became part of Eighth Army and served with them in Italy and Austria. During the Italian Campaign 586 and 587 Companies were involved in building the 1,126ft Bailey Bridge over the River Sangro, a painting of which hangs in the Headquarters

Photo 2. The Regiment assisting the Civil Community after the Belgium hotel disaster (1954).

Mess at Chatham.

When the TA was reformed in 1947, 585 (Edinburgh) (Independent) Field Squadron became part of 155 Brigade Group but in 1950 became part of 124 Field Engineer Regiment. In 1961 a Light Anti-Aircraft Artillery Regiment in Edinburgh was rebadged as 432 Corps Engineer Regiment, and 585 Field Squadron was transferred to it. This Regiment became 104 (City of Edinburgh) Field Squadron on the reorganisation of the TAVR in 1967.

CONCLUSION

A brief history such as this is inevitably a list of dates, title changes, and locations. Many incidents and campaign details have been left out; many non-Sapper units that I have not mentioned have contributed to the Companies and Squadrons that eventually came to make up 71 (Scottish) Engineer Regiment (V).

For any of the readers who come from the central area of Scotland, I hope that this short article gives an insight into the Corps in their area. Perhaps when they retire, they may care to come and help make its future history by adding their experiences and skills to its present ranks.

Operation Sheba—Carrickmore 7–14 September 1981

CAPTAIN D R BILL RE. B Sc

The author was commissioned from RMAS in 1973. On completing his YO Course he joined 24 Fd Sqn as a Tp Comd. Three years at RMCS Shrivenham were followed by a tour with the Queens Gurkha Engineers in Hong Kong. At the time this article was written he was serving in Northern Ireland as Operations Officer of 33 Indep Fd Sqn. He is currently serving as a Sqn 2IC with the Queens Gurkha Engineers.

THE village of Carrickmore in Co Tyrone has long been an area of Provisional IRA dominance. So much so that it was the scene for a BBC filmed IRA takeover of an entire village in 1978. The original RUC Station was demolished in 1967 for economic reasons, but the absence of a firm base made it extremely difficult for the security forces to exert firm control of the area. Following the death of hunger striker Bobby Sands in May 1981 a group of Republican vandals from the village broke into the country home of a local Protestant landowner and set it on fire. The owner of the house arrived back from holiday to find it completely gutted.

The house was left in its burnt out state until late August when the RUC requisitioned the property for conversion into a permanent RUC Station. The first stage of this conversion required the securing and fortification of the perimeter as soon as possible; this stage was known as *Operation SHEBA*. 33 Independent Field Squadron RE was tasked with the construction work and to this end the OC and I went on a

Operation Sheba Carrickmore 7-14 Sept 1981 Captain D R Bill B Sc

preliminary recce of the house and grounds on Saturday 30 August 1981. It soon became apparent that there were many constraints on the execution of the task. The site itself was very restricted; the general level of violence in the area was such that we were required to take all engineer stores to site on initial deployment; there could be no resupply. An outline plan ws drawn up of an outer Type I catwire perimeter fence and an inner twelve foot corrugated iron cover from view fence or "12' CGI CFV". In addition to this we were also asked to demolish the house, build some sangars and clear fields of fire. A more detailed list of the jobs to be done can be seen by looking at a bar-chart of the operation (Fig 1). The bar-chart also shows the actual sequence of events as well as the planned.

The design of the catwire was standard but it was decided to slightly modify the normal design for temporary 12' CGI CFV by using a 4ton earth auger to drill holes and then concrete in the fence supports so as to give a neater and more permanent solution. Working on the basis that some of the fence might have to be of standard design incorporating Universal Concrete Blocks (UCBs) a stores list was drawn up and submitted to 325 Engineer Park for local purchase. The total cost of the task was estimated to be £40,000. The Squadron did not have enough vehicles to transport the stores to site so extra vehicles were provided by 325 Engineer Park, 48 Field Squadron and some were hired.

After four days of furious activity, which included some prefabrication work, the morning of Saturday 5 September saw thirty-four vehicles lined up in Antrim ready to go. The convoy left Antrim at 0200hrs on 7 September and after a puncture and one total breakdown of an Aveling Barford and Tilt trailer we arrived at Lisanelly Barracks, Omagh at 0730hrs.

Overall coordination of *Op SHEBA* was undertaken by the Queens Dragoon Guards; their Barracks in Omagh was used as the mounting base. It was from there that the six Sapper search teams from 48 Field Squadron set out to clear the twelve mile route to Carrickmore. This took most of the day of the 7th and passed off without incident. An advance party consisting of myself and five men were flown in to site at about 1830hrs where close protection was provided by Support Company of the Royal Scots. It was a salutary warning to us all that our flight was delayed by thirty minutes due to an incident between Pomeroy and Cappagh which resulted in the tragic death of two young RUC Constables. The culvert bomb, estimated to be in excess of 1000lb, was situated only five miles from Carrickmore.

BAR CHART FOR OP SHEBA

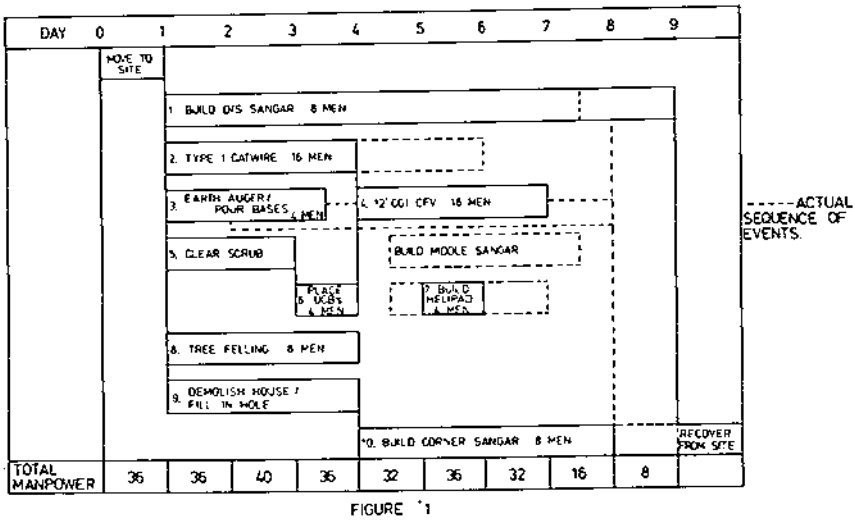


FIGURE 1

Photo 1. The worksite looking at its best! The Christchurch crib base for one of the single storey sangars can be seen on the left.

Due to the restriction of the site, a large amount of machinery and equipment had to be off-loaded in as short a time as possible to allow empty vehicles to return to Omagh. The advance party went over the off-loading plan on the ground and were then ready to receive the convoy the following morning.

The first vehicle passed through the gates of the Rectory at 0600hrs 8 September. Most of the stores could either be tipped or were palletised and two Light Wheeled Tractors were employed to unload them. By 0930hrs on the 8th a total of 385 tons of stores and equipment had been dumped on site.

The work parties set to with a will and soon had trees being felled, the earth auger drilling holes and the base being prepared for the double storey sangar. We had brought three concrete mixers full of inert mix in with us but we needed more concrete than that. Much to our surprise a local contractor agreed to supply some "readimix". We were a little sceptical about whether he would turn up or not. Not only did he turn up but declared that he was quite happy to provide us with as much as

Photo 2. Armoured Medium Wheel Tractor (MWT) demolishing the house.

Operation Sheba Carrickmore 7-14 Sept 1981 1,2

we wanted. He was certainly a brave man in search of an honest profit.

By the end of the first day on site we were very happy with the progress we had made. The sangar base had been poured, some holes had been drilled and filled with concrete and large areas had been cleared. We found that the 4-ton earth auger worked very well but a wearing plate required replacing. 325 Engineer Park got on to it straight away and had soon identified the spare parts and a supplier in Camberley. A "03" demand was then put through Longmoor to obtain the parts.

The weather was still fine on the second day (Photo 1) and everything went very well. We demolished two thirds of the house, prepared half the perimeter fence holes, and put in half the catwire. (Photo 2).

The morning of Wednesday 9th brought the rain. It rained hard all morning and Sappers began to look bedraggled, although still working with a will, output inevitably deteriorates under such conditions. The cleared area quickly became a quagmire and we had to resort to dragging the earth auger with a D6 to get it into position. The spare parts for the earth auger had followed a tortuous route from Camberley to Longmoor to Liverpool and were being put on the night ferry to Belfast. Even with the bad weather good progress had been made on the sangars. (Photo 3). We found by using metal shims it was possible to lay ten courses of HD (High Density) blocks a day.

The saga of the spare blades for the auger continued. It appeared that they had not been put on the ferry that night but it was promised that they would be there for the following day. We worked out that if I had flown from site and then to Heathrow via the Shuttle I could have been back on site with the bits within twenty-four hours. The joys of the 03 demand! The auger blade finally ground itself into submission and it was decided to try and fabricate a new one in 325 Engineer Park Workshops. Our REME Corporal was flown from site at 1900hrs on the 11th and was back from Antrim with two new blades by 0700hrs the next morning. It must be said that the willingness of 325 Engineer Park to meet the most irregular demands that we placed

Photo 3. Constructing the double storey sangar.

Photo 4. Part of the Cover From View (CFV) Fence nearing completion. Note the "Christmas Tree" lattice braced fence supports.

on that organisation played a great part in the success of the operation. It is also rather sad that if we had less faith in the system we could have had our spare parts very much quicker.

We had to give as much notice as possible to the QDG of our estimated time of completion since they had to plan a withdrawal in the same manner as the insertion. Not wanting to stay there any longer than was necessary we had said "Monday night" and it was up to us to meet that deadline. (Photo 4).

After two more days of comparatively dry weather we were well on schedule to complete the task in time for the recovery phase the following day. The Monday morning broke with light rain. Within an hour we could see that this was in for the day. Our original estimate was to have had all work completed by lunchtime and the recovering convoy was expected between 1600–1700hrs. Four o'clock saw sodden Sappers still beavering away putting the finishing touches to the job. (Photo 5). With a sigh of relief we left Carrickmore RUC Station at about 1900hrs bound for Omagh and then on to Antrim that night.

The result of seven days work on site was that we had left behind:
430m of Type I catwire;
435m of 12' CGI CFV with 3-vehicle entrance gates;
1 × Double storey HD block sangar;
2 Single storey HD block sangars on Christchurch cribs;
A cleared area suitable for operating 2 Wessex SH.

All that remained was to get the photographs developed so that we would all have something to show our grandchildren and have a party to celebrate a weeks hard work. We also reflected on what we had learned from *Op SHEBA*.

We were really very lucky that all went so well. Once on site it became obvious that many things could go wrong when attempting to mount such an operation at very short notice. Also the lack of recce facilities available made detailed planning a slightly hit or miss affair.

The average working day was sixteen hours long and towards the end of the task everyone was very tired. It was found that it was important to pace the workforce to achieve the best results. Working very long hours could prove to be a self defeating exercise over long periods. It was also found that the work output very much depended on the weather. When all was going well and the weather was fine a very

Operation Sheba Carrickmore 7-14 Sept 1981 Captain D R Bill B Sc 4

Photo 5. The task completed.

high output was achieved. The minute the Sappers became cold and wet the work slowed to snails pace and it was extremely difficult to provide more motivation. The individual Sappers were not even aware that they had slowed down. It may be more cost effective to take shelter during periods of bad weather rather than try to work through them.

The age old lesson of not allowing the site to deteriorate into a sea of mud was brought out again. In hindsight we should have worked as fast as possible while the weather was good to complete all works on the cleared area and then ceased to traffic it.

Although we did not really appreciate it at the time, *Op SHEBA* was essentially an airmobile operation. Once we had moved to site all resupply of rations, mail and the move of personnel had to be by helicopters. This provided its own problems and brought out the necessity of good preplanning. It did have the advantage, however, of keeping visits by senior officers to a minimum! Finally we also learnt the very high output that a body of men can achieve. The individual Sapper is capable of working extremely hard under very adverse conditions. I think everyone was surprised at the speed at which the task was completed.

Operation Sheba Carrickmore 7-14 Sept 1981 Captain DR Bill B Sc 5

Memoirs

MAJOR GENERAL G N TUCK CB, OBE, C Eng, FICE

Born 18 December 1901, died 1 July 1981, aged 79

GEORGE NEWSAM TUCK was born in England of a family involved in public service for many generations. His father, whom he saw rarely during his school years, was a District Commissioner in Burma. Educated at Cheltenham College, of which he rose to become Head and Captain of both Hockey and Cricket, he passed 2nd of his year into the Shop. His record there, where he won the Sword of Honour, the King's Gold Medal and the Pollock Memorial Prize, stamped him, from the very earliest days as an outstanding Officer in both the regimental and academic fields.

He was commissioned in 1921 and from the SME joined 38 Field Company in 1923. He became Asst Secretary to the RE Board 1923/25 and then served in Egypt with 42 Field Company until, in 1930, he became an Instructor at the Shop. In 1936 he went to the Staff College.

During the 1939–45 War he was successively GSO1 Scapa Defence; DDRA (not exactly expected of a Sapper!); in 1942 CRE 46 Division; in 1943 Military Deputy to the Scientific Adviser War Office; and in 1944–45 Commander 12 AGRE responsible for Forward Airfield Construction during the Normandy landing and throughout the advance to and across the Rhine and thence to the Elbe. When the British took over the occupation of the Ruhr he was appointed DCE Rhine Province.

After the war he became Director of Selection of Personnel, War Office and in 1946 attended the first post-war course at the Imperial Defence College returning afterwards to the War Office as DDSD. From 1949–51 he was Chief of Staff BAOR and then Engineer-in-Chief until 1954, where he made a notable contribution to the close relationship between the Corps and the professional institutions. It was during this tour that the Institution of Civil Engineers awarded him the Telford Premium for his paper "The Engineers' Task in Future Wars". In 1954 he became Deputy Controller of Munitions Ministry of Supply till his retirement from the Active List in June 1957.,

The appointments he held indicate the breadth of his experience and his allround ability and success. During his service life he gained a reputation as a cheerful, unassuming, approachable man of complete integrity and great strength of character. A man of exceptional intellectual ability combined with an equable temperament he was seldom, if ever, shaken out of his calm. The deliberate fitting of a cigarette into his long holder was a sure sign that he had given a subject full consideration and was about to deliver a well balanced opinion. It was impossible to think of him behaving selfishly or acting in an underhand way. He was a complete fulfilment of the motto "Service not Self".

On his retirement from the Active List he was appointed Colonel Commandant RE (1958–66) and in 1962 became Representative Colonel Commandant. He joined the Board of Stelcon Ltd as Technical Director. He will be remembered by many as the Propagandist and Director of Liaison between the British Hydromechanic Re-

Major General G N Tuck CB OBE C Eng FICE

search Association and Industry. His quiet sense of humour and his experience in the Ministry of Supply was particularly valuable and these combined with his quiet spoken winning personality and his diplomatic approach made him uniquely fitted for this task.

All this activity still left him both time and energy to involve himself with local affairs, particularly in the field of education with Dorset Rural District Council and the Governorship of three schools.

As a family man he was exemplary. His strong Christian convictions were never more apparent than in his love and devotion to his wife Nell to whose care his later years were given without stint as illness made her increasingly helpless. They celebrated their golden wedding in June 1979 and she died in March 1981.

Though his family of three sons, one of whom is in the Corps, and all who knew him will be sad at his passing, they must all feel privileged to have known him.

GCC, HRL, EEP, WHS, JCW

COLONEL A MURRAY OBE, C Eng, MICE, FNZIE, MNZIS, FRICS, FIHE

COL COMDT RNZE (Rtd), HON MEMBER INSTITUTION OF ROYAL ENGINEERS

Born 16 October 1899, died 4 May 1981, aged 81

ANDREW MURRAY was born in Glasgow and was brought to New Zealand by his parents in 1904. He was educated at Gisborne High School and completed his tertiary education at Victoria University, Wellington. During these formative years, he gained distinction in the scholastic and sporting fields. In addition to his cricket and rugby Blues for Victoria University he represented the Provinces of Wellington and Wairoa in rugby and Poverty Bay in both rugby and cricket. He was Dux of Gisborne High School in 1917.

Andrew Murray chose a career in surveying and civil engineering. He trained initially as a survey cadet and after becoming qualified he worked with government departments and local bodies. In 1931 he set up his own surveying and civil engineering consulting business. The consulting firm of Murray, North and Partners still exists today as Engineers, Architects, Surveyors and Town Planners with offices in five major NZ centres and one overseas office in Singapore.

During his career, he was actively engaged on the design and installation of water supplies, sewage and drainage systems for twenty-one cities and boroughs. Many provinces benefited from his expertise in the construction of roads and bridges (traffic and railway). The highlight of his professional career was his involvement in the planning of Auckland City's central motorway system and the Auckland Harbour Bridge.

His early military training at Gisborne High School as Sergeant Major in school cadets prepared him for service in the NZ Army during World War II. Andrew enlisted on 24 June 1940 in the rank of 2 Lieutenant, 1 Field Company NZE and with accelerated promotion reached the rank of Captain 10 October 1940. He was promoted Major on 1 June 1941 on assuming the appointment of OC 1 Fd Coy.

On 3 July 1942, he was appointed CRE 1 NZ Division and promoted to Lieut Colonel 21 September 1942. Prior to his embarkation to the Pacific Theatre on 7 November 1942 he was appointed CRE 3 NZ Div. His service at New Caledonia was

Colonel A Murray OBE C Eng MICE FNZIE MINZIS FRICS FIHE

interrupted by a brief return to New Zealand in June/July 1943, and on return to the Pacific Theatre he served in Vella Lavella, Nissan and Treasury Islands.

Lieut Colonel Murray's active service ceased on 25 March 1944 when he relinquished the appointment of CRE 3 NZ Div because of an acute duodenal ulcer (which he had since 1919 and concealed from the Medical Board at the time of enlistment).

In the post-war years, Andrew enlisted in the Territorial Force on 1 December 1949 and served as CRE 1 NZ Div/CO 1 Fd Engr Regt until 1 April 1952 when he was posted to the Retired List as a Lieut Colonel. In later years he was appointed Col Commandant Corps of Royal New Zealand Engineers for the period 1 May 1957 until 1 March 1965.

His ties with the Corps were never severed. During his tenure as Col Comdt he conceived the idea of erecting a Memorial Centre for the Corps at SME, Linton Camp. Subsequent years saw the modification and development of his concept into a chapel, library and museum, the final stage of which was officially opened on 30 January 1982. During the twenty years from conception to his recent death, Andrew Murray worked tirelessly in raising the necessary funds to complete the Memorial. Even in death his involvement did not cease as his final wish was that donations be made to the RNZE Corps Memorial project instead of flowers at his funeral.

As well as his commitment to public life and his support of various community activities, Andrew found time to write two engineering reference books; *Bridges and Culvert Design* and *Cement Penetration (Highways)*. His professional competence was recognized by his Directorship or Chairmanship of four New Zealand companies. On 29 July 1944 he was honoured by the award of the OBE in recognition of distinguished service in the South Pacific including Fiji, New Caledonia and the Solomon Islands. In 1954 he was awarded the Fulton Bequest Gold Medal of the NZ Institute of Engineers for a Technical paper on the Auckland Harbour Bridge.

In 1964 he was elected an Honorary Member of the Institution of Royal Engineers and in 1975 travelled to England to attend the Centenary Dinner in REHQ Mess at Chatham.

During Andrew's military career in late 1946, he loaned the Army a Chevrolet car for use by the Adjt 1 Fd Coy to overcome the lack of transport, and a concrete mixer so that the Fd Coy could have some equipment. Later the mixer was returned in a damaged condition, for which he claimed recompense. This was paid in a magnanimous gesture by someone in authority saying that it was a cheap rental. He also loaned to the Army in December 1941, two theodolites and a chain. Prior to posting overseas in November 1942, he asked that they be purchased for the sum of ninety-two pounds or returned. In March 1943 he requested further action for the return or disposal of these instruments but nothing further has ever been heard of them. Could it be that NZ Ministry of Defence still owe him for the two theodolites and chain?

Andrew is survived by his wife and two daughters, to whom we extend our deepest sympathy.

DJO'B

MAJOR D R ENGLISH BA

Born 5 February 1912, died May 1980, aged 68

DANIEL ROWE ENGLISH ("Dan") was educated at Stowe and Kings College, Cambridge and entered the Corps as a University Candidate. He saw service in many parts of the world including India and Greece.

His many friends will remember him as a remarkably kindly man with a highly developed sense of humour, an endless fund of stories and songs, and a great love of the countryside. In spite of his tall and slightly stooping appearance he was possessed of great physical strength and a tremendous amount of personal charm. Few probably realised he was intellectually so well qualified; he had a good working know-

ledge of ten languages, was fluent in several and had a number of scientific papers published in international journals.

He retired from the Active List in 1949 to take over a ranch in Matabeleland which he inherited from his father. He ranched for ten years and then taught Physics, Chemistry and Mathematics in a High School in Rhodesia. After lecturing at the College of Technology in Cambridge he took a post as lecturer in Applied Mathematics at Rhodes University, Grahamstown, from which he retired in 1978 to return to UK which had always been his dream. It is tragic that he was only to have sixteen months here before dying as a result of an accident and ironic that his elder brother Tony, a Gunner Major, also died a few years previously as a result of an accident.

To his wife Kitty and two sons and daughters we offer our deepest sympathy; the world is a poorer place without "Dan".

CRN

MAJOR GENERAL SIR ROBERT W EWBANK KBE CB DSO MA(H)

Born 20 July 1907, died 28 April 1981, aged 73

ROBERT WITHERS EWBANK, the son of a Sapper, Brigadier General W Ewbank CB CIE, was educated at Weymouth College, the Shop (where he was awarded the King's and Pollock Medals and the Armstrong Memorial Prize for Science) and at Christ's College, Cambridge where he took a First in the Mechanical Sciences Tripos.

Commissioned in 1927 his career followed the typical pattern of the time and included a works tour in Ceylon and a tour as Adjutant Kent Fortress RE TA. In 1939 he was a GSO2 at the War Office and after a brief spell as an Instructor at the Staff College he returned to Whitehall as a GSO1. After some manoeuvring he managed to extricate himself from a "desk job" and became 2IC 43 Assault Engineer Regiment and later CO 50th GHQ Engineer Troops. In the assault crossing of the Rhine his Sappers constructed the Caledonian Road, a road built the night before the assault, along the river bank which enabled "Buffaloes" and rafting equipment to reach the bank beyond a flooded area south west of Rees. Under heavy, and occasionally intense fire, and with some interruptions it was a successful operation. Later his Sappers constructed one of the piled Bailey Bridges across the Rhine; at nearly a mile long, it was one of the two longest dry Baileys built during the war.

After the War a succession of Staff appointments and studies followed including Director of Movements and, from 1958–60, Chief of Staff Northern Army Group. His last three years before retirement from the Active List were as Commandant Royal Military College of Science, a tour which gave him much satisfaction.

Although some found him shy, possibly a little distant and difficult to get to know, all speak highly of his professional attitude to all that he tackled. A devout Christian he was President of the Officers Christian Union of Great Britain for over ten years. He may have lacked some worldly ambitions but in spiritual matters his aims were quite clear.

To Lady Ewbank and his children we extend our sympathy.

JOMA, TT, CL

Major General Sir Robert W Ewbank KBE CB DSO MA

BRIGADIER D L GRIFFITH OBE

Born 1 July 1918, died 15 June 1981, aged 62

DAVID LLEWELYN GRIFFITH was educated at Wellington, where he was a member of the Shooting VIII, before going on to the Shop with a Scholarship. Commissioned in January 1938 he was up at Peterhouse College Cambridge from September of that year until October 1939. He served with 560 Field Company before being posted to HQ 18th Divisional Engineers, whose Adjutant he became in 1940, before the Division sailed for Singapore in 1941.

The Division called at Bombay and it was there that he was knocked down accidentally and broke his leg, thus luckily being prevented from continuing to Singapore and almost certainly the POW Camp. His leg did not set properly and had to be reset on return to UK, which left him with a permanent limp. However, he never let this injury interfere with his work, even if hills were to be climbed during his later career in Military Survey.

Towards the end of 1945 David joined John Rawlence, Michael Cobb and Arthur Walmesley-White on the first Regular Officers post-war Survey Course at the Survey Training Centre at Ruabon, where Lieut Colonel John Hudson was Commandant. At that time nearly all the Officers under instruction were National Service Subalterns. The Commandant thought that it was quite something to have four Regular Temporary Majors and invited them to make such suggestions as they thought appropriate for the better running of the Centre. These suggestions did not entirely please the Chief Instructor, Major Jimmy James, who was heard muttering about "those bloody Brigadiers". Needless to say the sobriquet "The Brigadiers' Course" stuck! Before the Course had finished Lieut Colonel Lew Harris arrived as the new Chief Instructor and the standard of training began to look up, perhaps the real beginning of the modern instruction at what was to become the School of Military Survey at Newbury.

AW-W writes: "David and I served together at various times. First at Newbury where he was OC of the Student Holding Squadron and later Senior Instructor in Cartography and Air Survey while I was a fellow Senior Instructor. We used to find ourselves, all too often it seemed, commanding Squadrons on Regimental Parades (the old firm). Later when I was AD Survey 2 I returned from a visit to BAOR as a passenger in his car at the time he was returning at the end of his tour as AD Svy BAOR. He had a trailer, behind his old left-hand drive Mercedes, apparently largely filled with guns, shooting being one of his hobbies. Evidently his documentation was in order as we had no difficulties with the Customs at Dover. As we drove away the Officer at the adjoining booth appeared about to have his kit and car stripped, having aroused suspicion. We were glad to get away—but David had a disarmingly genial manner and no doubt this also helped. David became AD Survey 1 and so there we were, the old firm again.

"After that he returned to the School of Military Survey as Commandant while I went to Cyprus as CO 42 Svy Engr Regt. Later on, returning from AFCENT, I took over from him as Deputy Director at the Ordnance Survey in charge of small scale

Brigadier D L Griffith OBE

mapping at Crabwood House, Southampton, before the days of the present new buildings—a very pleasant posting which all DDs enjoyed. From Crabwood David became Director of Field Surveys at the OS Headquarters, then still at Chessington, where I joined him later as Director of Map Publications (the old firm yet again).

"I greatly enjoyed serving alongside David but by no means always saw eye-to-eye with him, thinking that he spent far too much time fishing in my waters. But he was a charming man, always cheerful, apparently carefree but nevertheless caring, stumping about the place with his gammy leg. One thing we had in common was woodworking, wood-bashing he used to call it, something he was quite modest about, but he was really a good craftsman in this regard.

"Our families had been friends since our first gatherings at Newbury and after David's retirement my wife and I would drop in on them at Winchester whenever opportunity offered and we would always find a real welcome."

On retirement in 1968 he did not take up a second career and another full-time job, but took to sailing in a big way as a hobby, though he was never in a position to have a racing boat of his own. He was a first class navigator, as befitted a surveyor and also became a good sailing instructor for a firm offering Greek Island holidays.

HGHW remembers this time as having spent ten very happy summers sailing with David and his wife Naomi on borrowed or chartered yachts, during which he was a good skipper and good company.

His sudden death whilst mowing the lawn, from a massive heart attack, was a great shock to all of his friends as well as his family. He leaves his wife Naomi, a son and two daughters all three of whom are married, to whom go our especial sympathy.

HGHW, RMS, AW-W

LIEUT COLONEL A J WHEATCROFT B Sc MBIM

Born 3 March 1920, died 19 April 1981, aged 61

ANTONY JOHN WHEATCROFT was the grandson of Major General Sir Godfrey Williams KCIE, CB, who undoubtedly inspired him to join the Army Class at Rugby and encouraged him to go for the Corps when he went to the "Shop". He was commissioned in July 1939.

In 1941 he was posted to the Madras Sappers and Miners with whom he served in India, Persia, Iraq, Palestine, Italy and Yugoslavia. After the war he gained his B Sc at RMCS and later served in Hong Kong, Malaya, Nepal and West Germany where, in 23 Field Engineer Regiment, he commanded 2 Field Squadron, formed in Gibraltar in 1782, and of which he wrote a history. It was at this time in particular, that he showed himself to be a natural leader and when the high standards he set himself, which inspired similar standards from others, resulted in the Squadron being known as "Shiny Two".

In 1960 he became a Lieut Colonel and went to Nepal as CRE at Dharan, followed by two years in Singapore, from where he was responsible for the construction of an airfield in Thailand.

However it was in his last two postings, Defence Attaché for Morocco, with responsibilities to Gibraltar, at the time of the talks on HMS *Tiger* and then with BRIXMIS in Berlin, that his warmth of character and his personal charm really came to the fore. It was at BRIXMIS, above all, that his years of experience and his natural characteristics made him so popular in the international community. His keen interest in all that was going on, both in and out of the office, and his hospitality

Lieut Colonel A J Wheatcroft B Sc MBIM

combined with continuous good humour and cheerfulness helped to establish a healthy liaison with the other two Allied Missions. No one ever found out how he managed to transform his cellar into an international night-club!

On retirement from the Active List in 1970 he became a Careers Adviser for the University of London where he was much respected for his professional ability and where he gave invaluable guidance to young people. He took a real interest in the Modern Languages Association and was active in encouraging children to study languages. He was even seen on occasions to take notes in French! This still left time for his gardening and his annual visits to the Chelsea Flower Show where, accompanied by the rest of his family, he would invariably leave with his car overflowing with an exotic display of flora for his Hertfordshire garden.

All the contributors to this Memoir refer to his sincerity, his reliability, his charming relaxed almost debonair manner, his ability to judge character, his gift of imparting fun to any proceedings, his gentle teasing. Most notable of all was his kindness which ensured that he achieved results without creating any offence.

His marriage and family life were a model envied by all. His death on Easter Morning was a grievous loss not only to his wife Phyllida and his three children but also to his many friends and all those who served with him.

RFNA, AB, JREH-B, HRDH, RDF-K, JKS, JEW, DHY

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Engineer Support to Urban Operations

Sir,—I read with great interest the article written by Brigadier Bevan in the December 1981 issue of the *RE Journal*. I would like to comment on two points in particular.

Studies by both the Austrian and Swiss armies in this field have shown the importance of not moving the civilian population too far from their homes. Urban operations may be extremely violent, but as in a jungle, they are usually very localised. Within a city, a move of only a few blocks may be quite sufficient to give a reasonable degree of safety. In the case of villages, a move to the next hamlet may well suffice. Studies of civilian casualties in armed conflicts almost always show the vulnerability of rootless refugees who have been torn from their normal social environment. "Stay at home" is a recipe for survival, but it does impose an obligation on the authorities to maintain vital utilities such as water and sewage. Whilst the main responsibility for this must rest with the civil authorities, we, as military engineers, must certainly consider it as a factor when planning denial measures.

The second point is that almost the most important Engineer Support Measure in Urban Operations is sound engineering advice. This will range from a military engineering assessment of existing and damaged structures (ability to withstand weapon effects, ability to be strengthened and modified for defence, ability and methods of demolition etc) to a military engineering assessment of the public utilities (use of or denial of the sewage system, maintenance, repair or isolation of fuel, power and water supplies).

None of this information is easily available in RE manuals let alone specifically taught to RE Officers. There is an urgent requirement for text books on the subject —and a translation of existing manuals, issued to the German Army might be a first and speedy step in the right direction.—Yours sincerely, Roger Garnett

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ENGINEER SUPPORT TO URBAN OPERATIONS

Sir,—Brigadier Frank Bevan in his article *Engineer Support to Urban Operations* has given us a comprehensive record of R&D and operational studies. He is probably best placed to implement his own recommendations and many Sappers, including you Mr Editor, might be content to leave the matter in his capable hands. But could we have an opportunity to discuss this topical subject?

The paper is based on the theme of "fighting in" urban areas because the WP might outflank us if we do not use them. Will the WP really choose to fight in urban areas? The Brigadier argues that this is likely considering the influences of urban growth. A counter argument is that the WP preference for the speedy armoured advance influenced by consideration of the pattern of urban growth comprising of ribbons and nuclei, the obstacle potential of urban areas and the vulnerability of armour in urban terrain, will militate against such a choice. A deduction is that the defender must link urban areas into the obstacle plan and cover all the obstacles with fire. The WP would then concentrate on rural operations where he can use his armour, ploughs and plant to best effect.

A cursory map study of West Germany will show that routes outside major urban areas, such as Hanover, can be selected in rural areas and that they are seldom further than 2–3km distant from villages and towns. These distances match the current ranges of our anti tank weapons and an option is to "fight from" urban areas which afford good cover and protection. The direction of operations to the periphery of urban areas would obviate the need to recce and classify the components or urban terrain as suggested in the paper. Engineer effort would thus be saved by reducing the demand for recce of inner urban areas.

Whilst there could be a change in the reading of operational factors, I do not see any change in the recommendations of the paper. The intervisibility of targets and weapons on the edges of urban developments should not make any new demands for special anti tank and anti personnel weapons as would the demands of operations in "close packed areas". I certainly support the demand for continued R&D to procure better urban obstacles devices. Off-routes mines, area defence weapons and possibly the infantry mine (IMP) are particularly promising. Turning to building types, the multi-storey car park is an excellent site with good cover, protection and numerous fire positions for light armour and infantry anti tank weapons.

In summary I support the recommendations of Brigadier Bevan's paper, but question some of his operational deductions which could drive the formulation of tactical doctrine astray. For those planning urban training, could I recommend an excellent American publication *Military Operations on Urbanised Terrain* (MOUT) FM90-10. This pamphlet contains a detailed appreciation of tactics in urban operations and the preparation of obstacles.—Yours sincerely, F G E Grainger

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ENGINEER SUPPORT TO URBAN OPERATIONS

Sir,—I was most interested to read Brigadier Bevan's article on engineer support to urban operations. Publication of this article is timely since renewed attention is now being given to urban warfare throughout the Army, and Brigadier Bevan has given

us a great deal to think about.

However, as the whole subject is under discussion at present with little established doctrine, I wonder if I might be permitted a few observations?

My first point concerns Soviet political aims. If the Soviets ever attack the West with conventional forces I believe they will want to minimise the damage to their own country and will strive to avoid a nuclear exchange. Their best chance of success lies in a rapid thrust into the heart of West Germany, aiming at the demoralisation of the population, the collapse of government and the creation of discord within NATO, leading to an acceptance of new boundaries and a new balance of power. Long drawn out battles in well known German cities would stiffen civilian resolution and give NATO time to react. It is therefore not only Soviet tactical doctrine but their political perception which would lead them to avoid cities and population centres other than those few which might have political or strategic significance.

My second point, which follows from the first, is a tactical one. Although urbanisation is increasing, such areas remain a comparatively small proportion of the total land area. If the Soviets are only going to enter built up areas where they cannot avoid them, an analysis of the ground should be able to identify the most likely routes, and the problem becomes the straightforward one of making the best use of a form of close country, with, as Brigadier Bevan suggests, a close tactical similarity to forest. Although it is dangerous to generalise I suggest that it will rarely be advisable to defend a town from within, necessarily using large numbers of infantry; better to cover the interior with patrols and ambush parties supported by obstacles and to contrive the main engagement on the exits from the town where heavy fire can be brought to bear on a canalised enemy while his supporting elements are unsighted.

Finally the techniques for creating urban obstacles need careful thought. As Brigadier Bevan has pointed out humanitarian and political constraints will apply; in the early stages they will predominate and in a preparatory period they will be paramount. No preparation which causes serious damage is likely to be permitted before the first shot is fired, and the wholesale destruction of cities will only be authorised when the tactical situation is desperate. Non destructive obstacles like those touched on in the article will be important since they may be the only sort we can emplace in time. Our countermobility systems have been developed for use in open country and do not easily transpose to the urban situation. In particular we need an urban mine, light enough for several to be carried by an infantryman and possibly disguised as a brick, tile or other piece of urban debris. The rooting of roads in urban areas is likely to be a waste of time. Not only is the process slow and laborious but the result is no hindrance to modern vehicles. Contrary to popular belief a rooted road is not very suitable for mining. Much handwork is still needed to emplace mines, and the large slabs of unfractured pavement tend to form bridges over the mines as a recent RSME trial has shown. It is better to surface lay mines and cover them with easily available rubble whether or not the mines look like bricks.

None of this detracts from the conclusions of the paper. We have neglected urban warfare for too long and we must now give the subject more attention, both in training and in weapon design. However, I believe we should take care to keep the problem in perspective. For the present and foreseeable future the main battles are going to be fought outside built up areas, and we must not allow ourselves to be deflected from our main task of defeating the armoured onslaught in the field.—Yours faithfully, J R M Hill

Captain J D C Dix MA
17 Clos De Patier
St Saviour, Jersey CI

Solar Preheat for Domestic Hot Water

Sir,—Having read Colonel Guyon's excellent article on Solar Preheat for Domestic Hot Water in the September 1981 *RE Journal*, I felt compelled to write to you lest his technical approach should be off-putting to prospective indulgers in solar heating.

I live in a three-bedroom semi-detached house, with a coal open-fire/back boiler for hot water and central heating during the winter, and an electric immersion heater for hot water in the summer. As a believer in conservation, preservation of natural resources, and being enamoured of the principle of something for nothing, I decided after a cursory study of the market, to install solar panels for heating our domestic hot water.

The system consists of two solar panels (total 3·2m^2) mounted on a SSW facing roof at 35° to the horizontal, feeding an "Econozone" heat exchanger (on a closed circuit) in the hot water tank. The system is controlled automatically by a control unit which turns on a circulation pump whenever the water temperature in the panels is 3°C greater than the temperature in the hot water tank. The whole system, classed as a "retrofit" by Colonel Guyon, cost £630 for materials only: it is not necessary to install a separate tank, as the "Econozone" heat exchanger can be fitted into the standard domestic copper hot water cylinder, using an Essex flange.

To test the *financial* efficiency of the system does not require detailed temperature measurement and thermodynamic calculations. I merely read the electricity meter for four weeks, using the immersion heater for all our hot water requirements. Then having commissioned the solar heating system, and using the electric immersion heater on a time switch as a boost, I continued to read the electricity meter daily for five weeks. Bearing in mind the high electricity tariffs here in the deep south, I calculated that with current interest charges of 15%pa, the system will pay for itself in six years. If interest or electricity charges rise, the pay back period decreases dramatically.

To summarise, solar heating for hot water is a viable proposition for any house with a pitched roof which faces in a Southerly direction. Based on my experience I would recommend it to anyone who is prepared to install the system themselves. If I can be of assistance to anyone thinking of installing solar heating, I will be only too glad to offer advice and answer correspondence, based upon my own, admittedly limited experience.—J D C Dix

Lieut Colonel J M Guyon MA
52 The Row
Sutton, Ely
Cambs CB6 2PD

Solar Preheat for Domestic Hot Water

Sir,—As an old solar hand (1956) I am delighted to welcome Captain Dix (see preceding "Letter") into membership of the small club of actual practitioners, following Major Christmas in Jamaica and Brigadier Stewart in Egypt and Cyprus.

No ordinary lazy Englishman seeks complication for its own sake nor technicalities if they can be avoided. Unfortunately solar energy collection is unavoidably complicated because of the huge and unmanageable number of variables, most of them changing all the time, and never the same two days running.

It is only fair to point out that Captain Dix lives in a fortunate island which receives 21% more radiation than Cambridge while Aberdeen receives 15% less than Cam-

bridge. I also understand that his test was done during the month of May. May in Jersey gets twice as much radiation as the monthly average figure year-round.

Electricity for summer boost in Jersey costs 5·2p against 4·44p—17% more. Solid fuel prices are comparable @ £100 per tonne. Winter boost, using an open fire with back boiler in the island and a hopper fed anthracite central heating boiler on the mainland, probably costs about half as much as full rate electricity for water heating alone. The island heating season lasts about four months, Cambridge nearer eight. So the island is on electrical boost for eight months, Cambridge nearer four. Hence the annual average boost cost is about 4·3p a unit (kWh) in the island against 2·9 in Cambridge.

Captain Dix was lucky to find an installed domestic hot water cylinder large enough to hold a full day's supply. Most people, when they rent or buy, find that they either need a bigger cylinder or a second solar preheat tank.

Cambridge installed cost, including a new cylinder (updated from 1979 to 1981 prices) was £391 per square metre of collector, Jersey £197 without labour; doubling Jersey for labour gives £394 without a new cylinder, reflecting the probably higher cost of materials on the island.

The simple payback period for Cambridge (capital cost £1500, annual taxfree savings £107) was about fourteen years, reducing as fuel prices rise. This is equivalent to about seven years without labour cost of installation, and compares well with Captain Dix's figure of six years including an interest charge—probably less without. The conclusion must be that with more free solar fuel and higher cost of other ways of heating water, the island should do better than the mainland—as in fact it does.

I should be very pleased to hear of any other measured results from installations in the UK.—Yours faithfully, J M Guyon.

Major B F Gerhard RE
Senior Instructor Lithography
School of Military Survey
Hermitage, Newbury, Berks

Development of Map Printing in the British Army

Sir,—It is intended to compile a brief illustrated history on the development of map printing in the British Army covering the period from the 18th Century to the present time.

Development Of Map Painting In The British Army

The history will cover in broad detail such aspects as, equipments and techniques, development of printing techniques, ingenuity in war time, locations of map printing establishments etc, and in particular the mobile/transportable role of map printing.

Photographs, documents, letters, examples of early maps and amusing incidents etc, covering the period would be appreciated. Copying facilities for all material received are available and suitable acknowledgements would be made for all contributions received. All contributions should be addressed to me at the above address.

The enclosed photograph is of an old (pre 1880) English lithographic press issued to the American Engineers and used by them in Archangel, Russia, in 1918–19. An electric motor was attached to the press by the Americans to power it. It is possible that a reader might be able to identify the press.—Yours sincerely, B F Gerhard

Lieut Colonel P H Brazier
Nash Court Farmhouse
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Sturminster Newton
Dorset DT10 1JZ

THE ROYAL ENGINEERS HISTORICAL SOCIETY

Sir,—I read with great interest Colonel Sandes' article on the embryo Royal Engineer Historical Society.

The list of equipment and tools used by the Royal Engineers especially during previous wars is immense. Even if much of it could be located today producing sufficient display space will be a major problem.

However there is one item of equipment which in my view is of outstanding historical importance to a Corps of skilled artisans and that is a "Tool Cart". One of these really must be procured or, if necessary, an authentic copy constructed. Many Sappers still talk about their Troop Tool Carts; yet no serving, and sadly a rapidly decreasing number of retired Sappers, have any memory of what a horse-drawn Section Tool Cart looked like. I feel this is a matter of some urgency before the necessary information is lost forever.—Yours sincerely, P H Brazier

Book Reviews

SOME DESPEPATE GLORY

THE DIARY OF EDWIN CAMPION VAUGHAN

(Published by Frederick Warne. Price £9·95)

EDWIN VAUGHAN was a nineteen year old Lieutenant in the 1/8th Battalion of the Royal Warwickshire Regiment. His diary covers his service in France, in the 48 (South Midland) Division, from 4 January to 28 August 1917.

In those eight months, Vaughan develops from an inexperienced, rather pompous youth, who is considered a failure by his brother Officers, into a competent but war-worn young Officer. The diary is unusual in its candour and honesty, since he records his own failings and frequently admits that he was "windy". It is this candour and his gift for putting into words his own feelings and his relationship with those around him, while recording mundane day to day events, that makes this book so readable and gives it a charm that overrides the horrors of the mud, blood and noise of life in the trenches.

He had no apparent conception of the overall conduct of the war and does not even

record the part played by his own Division. His world is strictly confined to his own Battalion and those around him, so that the reader will not learn a single historical fact from this book, but he will learn a great deal about human nature and its ability to survive the horrors of a war in which a Company of ninety men was reduced to fifteen.

A "must" for every young Officer since it effectively describes the actualities of war that are so different from those of training and recent peace-keeping operations.

JTH

ADVENTURES IN THE RIFLE BRIGADE AND RANDOM SHOTS FROM A RIFLEMAN

CAPTAIN SIR JOHN KINCAID

(Published by Richard Drew Publishing Ltd. Price £9·50)

THIS is a facsimile reprint of the 1909 combined edition of these two military dossiers by Johnny Kincaid. He joined the Rifle Brigade in early 1809 and *Adventures in the Rifle Brigade* covers the Walcheren Expedition, the Peninsula War and the Waterloo campaign. It tells of regimental life, battles and social interludes.

Kincaid was a young Officer, full of life and bubbling with enthusiasm. He writes about everything and anything that takes his fancy, in a humorous and robust style that entertains while it informs. *Adventures in the Rifle Brigade* was first published in 1830 and was followed by *Random Shots of a Rifleman* in 1835. As so often happens, the second book by no means lived up to the promise of the first and in the combined edition it was abridged, and rightly so.

Random Shots is an apt title since there is no central thread to hold the reminiscences together, but the abridged form leaves the best of his anecdotes intact.

As an insight into life in the Peninsula War, it ranks alongside *The Recollections of Rifleman Harris*.

JTH

ST HELENA

INCLUDING ASCENSION ISLAND AND TRISTAN DA CUNHA

TONY CROSS

(Published by David & Charles. Price £4·95)

THE British Colony of St Helena is probably the best known of the few really remote Islands in the world, mainly because it was there on this "speck in the South Atlantic", that the defeated Emperor Napoleon died after six years of exile. In spite of this claim to fame, there is little in the way of recent published information about this delightful Island—certainly not of a general nature. This book admirably fills the gap, both for the potential tourist and as a nostalgic reference book for those lucky few who have been the guests of the Island people.

Tony was on the Island for some time as is reflected in his attention to detail. All the basic historical facts have been researched thoroughly, but have been presented in a very readable fashion and he has captured the unique flavour of the Island in his more descriptive chapters.

The chapter on the Dependency, Ascension Island, makes this apparently inhospitable Island a place of considerable interest, particularly to ornithologists and oceanic biologists, and is of interest to all those interested in isolated places.

The Appendix covering the even more isolated Tristan da Cunha fails to stress the fact that these ruggedly independent Islanders, having savoured—and rejected—the Western way of life, are more independent than prior to their evacuation due to the volcanic eruption. A proud and self-sufficient people.

GDKB

OPERATION DRAKE—VOYAGE OF DISCOVERY

ANDREW W MITCHELL

(Published by Severn House Publishers Ltd, London. UK Price £12·95)

THIS book is about the largest and most complicated expedition ever to leave Britain. In it the Author, who was the Scientific Co-ordinator of Op Drake, paints a picture of some of the remarkable discoveries made and the unique wild life encountered. For the 414 Young Explorers (YEs) who actually took part in the expedition (out of some 58,000 applicants!) it was the adventure of a life time.

Operation Drake was about science and research, medicine, archaeology and geography; it was about international co-operation; it was about exploration, adventure, challenge and discovery; it was also about people, young people with a purpose led by not so "young people" with so much to give. What a marvellous combination it turned out to be.

Aided by some 40 colour and over 100 black and white photographs and illustrations your reviewer (who is not very scientifically minded!) found it difficult to put the book down. Informative, thought-provoking, exciting—in short, a very good read.

BP

TUNNELLING HISTORY AND MY OWN INVOLVEMENT

SIR HAROLD HARDING D Sc. B Sc. FCGI. DIC. F Eng. FICE

(Published by Golder Associates, Toronto. Price £11·00 obtainable from Golder Associates, 54–70 Moorbridge Rd, Maidenhead, Berks)

THE Author's experience in tunnelling, particularly soft ground tunnelling, is not unique, but it is rare. What is unique is the combination of his experience, his historical memory, his sense of humour and his simplicity of expression and complete lack of pomposity.

In his view the history of tunnelling resembles the path of a firework rocket. A long thin trail gradually accelerates the rocket until there is a sudden burst which throws out separate trails which themselves explode in a countless shower. To disentangle the history of so many types of tunnel the Author has followed main types and trends separately, although they run parallel with each other.

Sir Harold, an Honorary Member of this Institution, refers to the very real contribution of Military Engineers in the development of tunnelling and to his experiences as an adviser on Bomb Disposal tunnelling.

This very readable, well illustrated and referenced book will be of interest to all engineers as an instructive, interesting and amusing account of the experiences and thoughts of a much respected and admired fellow engineer.

EEP

BOOK NEWS FROM INSTITUTION OF CIVIL ENGINEERS

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

PRECAST PILING PRACTICE

Bengt B Broms: Price £6·00

THIS book was originally written as a text book for the undergraduate students at the Royal Institute of Technology in Stockholm. Others involved in piling showed an interest since it summarised current methods and it was translated into English. It contains detailed information on the design of piles, piling equipment and methods, bearing capacity of axially and laterally loaded piles and pile groups, problems and control methods. Although written for students it is of considerable interest to practising engineers.

REVISED PRICE LIST FOR HISTORY OF CORPS

BECAUSE of reprinting the prices of Individual Volumes and Sets of *The History of the Corps of Royal Engineers* have been revised. The policy of the Institution is still to recover costs only from Members.

PRICE LIST 1982

		MEMBERS	NON-MEMBERS
Volume I	Norman Times–1860	£ 4·50	£ 9·00
Volume II	1860–1885	£ 4·50	£ 9·00
Volume III	1885–1914	£ 4·50	£ 9·00
Volume IV		£ 3·50	£ 7·00
Volume V	1914–1939	£ 5·50	£11·00
Volume VI		£ 4·00	£ 8·00
Volume VII		£ 3·50	£ 7·00
Volume VIII	1939–1948	£ 4·00	£ 8·00
Volume IX		£ 5·00	£10·00
COMPLETE SET		£29·50	£59·00

Postage & Packing, Surface Mail UK: £1·43 per volume up to £2·65 per set
Post & Packing, Surface Mail Overseas: £6·00 per volume up to £15·00 per set

Sets for Members may be purchased:

1. By single payment of £29·50, *plus p&p if applicable*
2. By Bankers Order of:
   (a) 9 monthly payments of £3·70
   (b) 4 quarterly payments of £8·30

The set will be despatched on receipt of Bankers Order, *plus cheque to cover p&p.*
Sets for non-Members can only be purchased by a single payment of £59·00, *plus p&p.*

ARTICLES AND CORRESPONDENCE FOR THE JOURNAL

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

ARTICLES

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

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

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

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

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

Three further awards are made each year:—

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

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

The Arthur ffolliott Garrett Prize (to purchase or help purchase a piece of silver, value £20) for the best article on the technical aspects of logistic engineering or survey by a Serving Regular RE Officer not above rank of Lieut Colonel.

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

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

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

CORRESPONDENCE

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

The submission dates for Correspondence on published articles are therefore:

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