THE ROYAL ENGINEERS JOURNAL

DECEMBER 1993 VOL 107 NO 3

Guidelines for Authors

The Editor is always glad to consider articles for publication in the *Journal*. Guidelines for prospective authors are:

Subject. Articles should have some military engineering connection but this can be fairly tenuous, specially if an article is well written and interesting.

Length. Normally approximately 4500 words (ten A4 pages **double line** space) + illustrations). Good blockbusters can be serialized.

Clearance. The author must clear his/her article with his/her CO where applicable.

Copy. Ideally text should be double space typed and include the author's pen picture and photo and captions for artwork.

Computers. Articles saved as Wordperfect 5.2, Microsoft 5, or ASCII files, on a 3.5in DOS floppy disc, are welcomed.

Photographs should be black and white if possible. Coloured photographs rarely reproduce well unless they are excellent quality with sharp definition. Slides are not acceptable at present.

Line Drawings, should be drawn in proportion with the page size (145mm x 205mm).

Rewards can be generous. The Publications Committee has about £250 in prize money to allot for each issue plus valuable annual prizes. All authors receive £10 to help cover costs.

Pseudonyms may be used. They will not be re-vealed by the Editor under any circumstances.

Contributions should reach the Editor by:

Early February for the April 1994 issue
Early June for the August 1994 issue
Early October for the December 1994 issue

Submissions before the deadline will be particularly welcome.

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Contents

Note: Correction to Contents page, August 1993 issue:
Please note that the article *Addu Atoll 1943*, by Lieut Colonel M D Maclagan, was inadvertently missed from the contents page. It should have been entered as item No 17 starting on page 190.

Editorial

As another year draws to a close, the Corps continues to spread its net wide. Over the last year, elements of the Corps have served in 38 different countries and, at the beginning of October, had units in 27 – truly ubiquitous!

For this edition of the *Journal* we have been blessed with receiving a good mix of articles covering both our yesteryears and current operations, see: *Vran – Sapper Mountain*, and *The "Daley" Container*, about Bosnia, and *Operation* Lecturer, *Cambodia*; it is particularly pleasing to record that the latter two articles are written by warrant officers. There are also two good submissions by younger officers, *The Road to Pak Nai* and *Tomorrow's Sapper Officer* – perhaps the article by Second Lieutenant Verity Orrell-Jones on *Europe's New Green Army*, has kindled the spirit of competition.

It would be remiss of me not to mention the excellent support we are continuing to get in our series of 50 years on articles. Next year is, of course, the 50th Anniversary of D-day. We plan to feature this event in the April edition prior to the Joint Professional Meeting at Chatham on 16 May 1994, which is to be linked to the opening of the special D-day exhibition in the Museum.

I am most grateful to Colonel E P F Rose and Colonel N F Hughes, for their series of articles recording the work of Sapper geologists, and to Michael Kitson for his dissertation on the Brennan torpedo, both of which are concluded in this *Journal*. It is only right and proper that both subjects are properly recorded for posterity.

Volume XI of the "History of the Corps of Royal Engineers", covering the period 1960-1980, is now available for sale. I would like to record in this editorial a deep debt of gratitude to all who have assisted in its production, and in particular to Colonel Hugh MacIntosh, the editor. Our Colonel in Chief was presented with a specially bound edition when she visited the Corps in Hameln at the beginning of November; this to sit alongside the previous volumes in the Royal Library at Windsor.

In conclusion may I first welcome, on your behalf, our new President Major General G W Field, CB OBE, and secondly wish you and your families a peaceful Christmas and Happy New Year.

Recollections of an Amateur Sapper – the Road to Tunis

COLONEL F H FOSTER, DSO OBE TD DL RIBA

The following is another short extract from the writer's complete book which recounts experiences throughout his peace and wartime service, and which is lodged in the Corps Library. The extract is published with the author's kind permission, and covers the period he spent in Tunisia when he took part in the campaign to drive the Germans from Tunis. It is not about the battle itself but about some of the tasks undertaken before and during the period.

IMMEDIATELY prior to active service in North Africa, 1st Division was training in Troon, Scotland.

A Combined Operations Planning HQ was set up in October 1942, in London near Marble Arch, and here the GOC, brigadiers, myself as CRE, CRSigs, other heads of services and their staffs were to plan Operation *Tunby*, the invasion and capture of Tangier. This operation was to take place immediately if Operation *Torch*, the huge operation for the capture of Algiers, failed. This was my first experience of planning, involving the three services. In a nutshell it involved, from my point of view, carefully studying the GOC's plan and then making an engineer plan to support it.

We were all issued with maps, air photographs, intelligence summaries, etc. Each Arm was allotted limited shipping space for stores and it was necessary to research and convert weights of stores into cubic feet; a conference was held each evening to receive bids from us all so that only essentials were loaded such as guns, ammunition, vehicles, food, engineer stores, and so on. We quickly learned about "shipping tons".

After about a fortnight of planning, the success of Operation *Torch* was announced. *Operation Tunby* was cancelled and our planning staff returned to Scotland.

King George VI came to inspect the Division before we left the UK. He lunched with us in "A" Mess. The GOC took me by surprise afterwards by saying, "I've had to be on my toes all the morning, so after lunch the monarch is all yours!"

Most of our RE stores were loaded for overseas but two Small Box Girder bridges were available and I had already arranged to put on a bridging race between field companies over a dry gap.

Imagine my surprise when, as soon as the race started, the King turned to me and said "Your men have to do a lot of heavy lifting. Do you get many ruptures?" I was rather taken aback by this unexpected question but replied by telling him that as the men were trained in lifting, there was little risk. He asked me to explain and then said "I must remember that. When I can, I like to do some gardening at home. I'm building a little rockery with rather heavy stones." He was very interested and after talking to a number of sappers, he wished us well, and moved on.

We embarked for North Africa immediately after Christmas, sailed down the Clyde, round the north coast of Ireland and then well out into the Atlantic on a very zigzag course. It was about ten days before we sailed through the Straits of Gibraltar. I was able to have a distant look at Tangier, about which I had recently learned so much.

We disembarked at Algiers during an air raid and marched to our first camp, situated on the racecourse. One of the first vehicles to arrive was my staff car. The GOC sent me, together with his G1, up to the front line, held by the 78 Division to find out the form generally. 1 Division was to take over from 78 Division in the general drive for the capture of Tunis.

Next morning we set off on a scenic trip of about 450 miles, through Bouira, and the mountainous area of Craine des Bibanes with a fine view of the snowcapped Atlas mountains. Thence Bj Bou Arreridj and Macdonald, putting up at an hotel in Setif. We then set off via Constantine, Guelma and through places whose names are familiar to all who served in North Africa – Souk Ahras – Ghardimaou – Souk el Arba – Souk el Khemis – Thibar (excellent wine in the Monastery) and then to Testour our final destination. The G1 reported to HQ 78 Division and I to the CRE, Bob Blake, who made me very welcome and, for a couple of days, showed me the work his Sappers were doing.

One item, his *pièce de résistance*, was a triple, triple, triple, Bailey, dubbed "The Forth Bridge".

78 Division had done a wonderful job in advancing from Algiers, until they met the stiff German opposition in the area known as the Medjez el Bab sector.

The G1 and I returned to HQ 1 Division which by then had moved up to Guelma. The command of the Medjez sector passed from 78 Division on 25 March. 1 Division was not complete as the brigades had landed in North Africa quite separately and took time to come up to the sector, so reliefs of 78 Division's battalions had to be gradually carried out. Meanwhile our troops were gaining valuable battle experience.

In order to facilitate the concentration of the Division by 21 April, we carried out the following engineer tasks:

- "Bedford Bridge" (248 Field Company) Bailey Class 70 to relieve the existing class 15 at Sloughia. The abutments were of Roman stone and over a mile of approach roads were constructed with metal surfaces.
- An entirely new road, 3 miles long dubbed "Didlington Drive" was constructed in three weeks to bypass three narrow bridges on the track Testour – "Tally Ho Corner". This involved the construction of two "Irish bridges" of reinforced concrete, 340ft long and 180ft long respectively for Class 70 loads.

A word about the "Irish bridge". The name, as implied, is for a "bridge" that goes under the river instead of over.

We found that the River Medjerda was very shallow in many places and also very wide. In selecting bridging sites, we watched Arabs wading across with their simple long clothing held up to the shoulders. They obviously selected the shallowest places. Having found one that was roughly on the line of our new road, we dammed half the river at a time and constructed our reinforced concrete road on the gravel bed. It is a ford of course, but a useful crossing place albeit rather a wet one!

- For access from Testour to Oued Zarga, a railway bridge at Mzoorah was converted to take Class 9, wheeled and tracked vehicles. The superstructure from Folding Boat Equipment being laid over the existing railway lines. Long approach roads were necessary. The whole project was completed in 36hrs.

Invaluable assistance was provided by 137 Mechanical Equipment Company, with their heavy mechanical equipment, to make the necessary cuttings and embankments on many of our projects.

6 Field Park Company carried out multitudinous tasks for the Division during this period including the provision of defence stores, and water points, prior to and during the concentration. After the first advance, water supply was provided to brigades by supporting field companies.

Prior to the final concentration, Chassart Teffaha was occupied by 2nd Forresters. On 20 April, all tracks likely to be used in the advance were swept clear of mines by combined RE and infantry patrols. Our own minefields east of Medjez and "Grenadier Hill" were lifted by our Sappers to allow free forward movement.

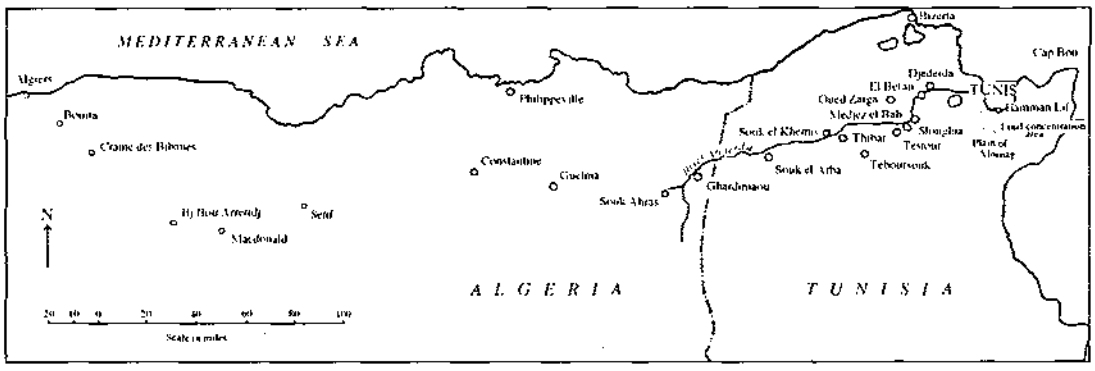
When the offensive started, 2 Infantry Brigade and 24th Guards Brigade crossed the start line, artillery support was by timed barrages and concentrations up to the capture of Gueriat El Atach and the left half of "Horseshoe Ridge". The whole of the Divisional artillery took part in the offensive on Tunis plus two army field regiments. Altogether 160 guns supported 2 Infantry Brigade and 80 guns 24 Guards Brigade.

Throughout the offensive the infantry brigades were supported by their affiliated field companies which carried out all minefield gapping. Scorpions accompanied 2 Infantry Brigade and were used with success to clear a minefield which was obscured in standing corn making detection by normal means impracticable. A captured minefield record proved invaluable.

Another task was the gutting of knocked out tanks by 248 Field Company. Some of the tanks were under fire and burning, rendering the placing of charges of explosives a difficult operation.

As part of the preparation for the final breakthrough, we constructed two routes known as "Harry" and "London" from Medjez el Bab to area Montarnand involving extensive use of mechanical equipment, explosives and small bridges. These routes were intersected by many narrow tracks, which necessitated the provision of innumerable illuminated direction signs.

During the general operations it was anticipated by HQRE that bridging equipment would be needed in the crossing of the River Medjerda. Preparations were necessary as all bridging stores were centralized under Corps control at Mzoorah some 30 miles away. The stores were



Map of general area covered in article.

released but held up at Medjez crossroads by heavy traffic.

Meanwhile 248 Field Company arrived at El Betan where it was necessary to reconstruct the crossing and lift the mines. The bridge consisted of 20 small masonry arches eight of which had been blown but leaving one sound pier at the far end. Two Bailey bridges were built, one 120ft double double and one 50ft single single (in tandem). The existing ford alongside the bridge was heavily mined. This was cleared, enabling many carriers and tanks to push on whilst the bridge was reconstructed.

I had been up at this bridge when the mines were being cleared with 248 Company's recce subaltern. After a short time I reckoned I had better get back to Divisional HQ but alas had not foreseen the very heavy traffic. I was not popular with my GOC. Upon arrival he said "I expect you always to be available for Sapper advice." Of course he was absolutely right and I learnt a valuable lesson. However it is sometimes difficult to appreciate what your forward field companies are up against unless you go and have a look-see sometimes. Moral: Don't get forward unless you can get back quickly.

238 Field Company built a 110ft, class 40 Bailey at Djedeida on a new alignment involving long approaches over soft clay and much metalling was necessary. Likewise 23 Field Company built a 100ft class 40 Bailey to replace a bridge blown on the main Tunis road about a mile east of Djedeida.

On 11 May, 1 Division came under command of 9 Corps and moved to a concentration area some four miles south of Hamman Lif in the Plain of Mornag. Brigades carried out mopping up operations in the hilly areas where some 5000 of the enemy were still at liberty.

At 1400hrs on 13 May the code word "Completion" was received from 9 Corps signifying that the Tunisian campaign had been brought to a close. It was an incredible sight to watch the German army driving into captivity, into PoW barbed wire cages in the general area, in their own transport! Many thousands of vehicles crammed to overflowing with very dejected looking troops. Soon 1 Division was concentrated in the areas alongside the Mediterranean enjoying a rest and the joys of swimming after weeks of thick road dust and water shortages.

Vran – Sapper Mountain

Operation Grapple November 1992 – May 1993

CAPTAIN A H HAY

After a short spell with a civilian construction company and trying his hand at instructing in Australia, Captain Alec Hay was commissioned into the Corps in 1989. A seemingly endless YO course later he joined 35 Engineer Regiment in Hameln, and whilst there was fortunate enough to serve in numerous appointments, one of which was as Combat Support Troop Commander with 44 Field Support Squadron in Bosnia. He is currently being re-educated on the Professional Engineer Training (Construction) Course which began in October 1993.

MOUNT Vran (2020m) lies to the east of Tomislavgrad (TSG), a Bosnian Croat town formerly called Duvno, in the southwest corner of Bosnia-Herzogovina. The mountain and immediate surrounding area were the preserve of foresters and transhumant hill farmers before the civil war in the former Yugoslavia, but when the British forces arrived in November 1992, it became home to the Sappers of 35 Engineer Regiment.

The task of the British Force (BRITFOR), working for the United Nations (UN) was that of a protection force (UNPROFOR) escorting humanitarian aid convoys. As a consequence, BRITFOR had an area of operations that reached from Split, on the Dalmatian Coast, to Vitez and on to Tuzla, a distance of 400kms. The centre-point of this long corridor was Mount Vran. UNPROFOR was in direct support to the United Nations High Commission for Refugees.

We were 44 Field Support Squadron of 35 Engineer Regiment, and our task was to open and maintain 220kms of track; Route Triangle, which wound precariously over the mountain towards the Catholic town of Prozor, and Route Square, the southern route, which runs from Lipa to the Muslim town of Jablanica, then along the metalled highway to Prozor. Both routes were quickly identified as being invaluable main supply routes (MSR) as an alternative to the unpredictable Mostar Road, which runs along the coast, through Mostar and then along the Bosnian Croat/Bosnian Serb front line south of Vran and so up to Vitez via Kiseljak. This road was favoured by convoys because it was metalled, though one could not rely on it staying open, due to occasional Bosnian Serb artillery or mortar fire and consequently, Triangle and Square carried much of the traffic both to support BRITFOR and for the delivery of humanitarian aid.

In order to construct these roads, we had to gain the tacit permission of all those who felt that they had jurisdiction over them. Initially we were given permission by Mr Papa Boban, who was the National Minister for Roads. However, the local warlords and councils did not feel that this was enough and could not agree on division of responsibility or ownership. A tongue in cheek gesture, by Lieutenant Colonel John Field, to buy Triangle for ten dinars was surprisingly accepted by all parties and we became the proud owners of 65kms of track.

Captain A H Hay
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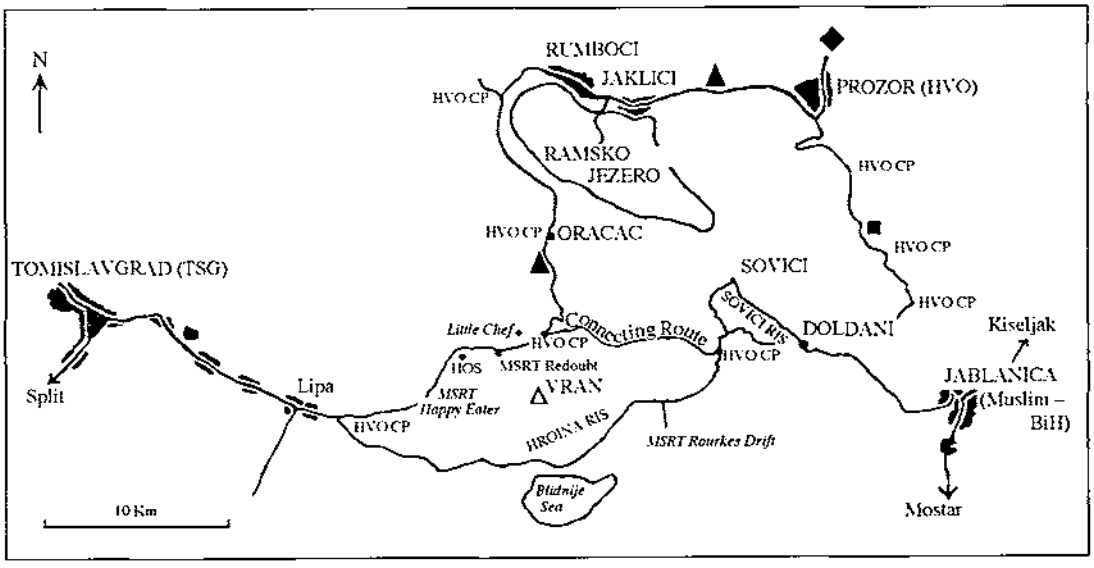


Map of area covered by article.

The climate was unforgiving. The day we arrived it was scorching at 30°C, but within a week blizzards and serious cold arrived to stay for the next six months. Snow was not permanent, though the temperature stayed doggedly below -10°C, dropping to a low of -65°C with wind chill. When it snowed, up to 2m would be deposited within 36hrs which would then just blow around for the next two weeks. Weather prediction was difficult and the local authorities probably thought the joke would be on us when they sold us the road.

Within a matter of days the first MSR base was established at Redoubt, in an old logger's cabin. This was shortly followed by a second base, Happy Eater, 10km towards TSG. There were no cabins at this second site and initially the team lived in a tented camp they had to establish in a blizzard. Drawing upon their childhood experiences of cowboys and indians, they drew all the equipments up in a circle around a lean-to and huddled over all sources of heat that could be made. Within 24hrs 12ft x 12ft tents had been erected complete with improvised insulation from cardboard and polythene. For a brief period a third camp, known as Little Chef, was set up as a construction base for building another road between Oracac and TSG but equipment serviceability and the weather suggested that we would possibly be overstretching ourselves and this project was therefore abandoned. An MSR Maintenance Base, part-tented and part-containerized, was established on Square, some 40km from TSG, called Rourkes Drift. We also had a mobile tented camp, Lost Tribe, which provided the construction teams' accommodation close to their work site. The day they first deployed the camp, they were snowed in and couldn't be found for 36hrs. A communications breakdown meant they couldn't talk to us either and so the next day's report simply read "construction tribe lost", hence the name.

Since the Bosnian-Croat army (HVO) were still working on Square, the priority was to be Triangle, and the teams set to work in mid-November widening what were pony and cart tracks to 4m and establishing passing places for Warrior armoured vehicles.

During the initial deployment of Warriors over Triangle to Vitez and Gornjy Vakuf, it began snowing and the drivers had great difficulty in maintaining their vehicles' grip on the road surface. The provision of crampons helped to an extent but when the ice was thick and particularly hard with compacted snow on top, the crampons became skates that encouraged the vehicles to slide sideways. If they were driven too close to the edge, their up-armoured weight would often cause the road edge to give way over a drop of anything up to 350m! The up-armouring gave the Warrior a much wider profile and on tighter corners skilled and courageous driving and commanding were required. Fortunately, there were few accidents.

Route Triangle, February 1993. Combat Support Troop Commander and Volvo 4400 returning from recovery task.

By 17 January both Triangle and Square were at least 4m wide and open to all military vehicles, less low-loaders, and the travelling time on Triangle had been cut from up to 1½ days to just 2½hrs. We had snow-marked 220km of road and track, constructed 13.5km of road across a peat plain with 2.3km of passing places. In all some 100,000m^3 of earth were moved and 42,660m^3 of stone won from quarries and borrow pits. We had further widened 20km of road to a minimum of 7.5m to allow two-way traffic by articulated lorries, and intended to continue this along the whole of Triangle. Work continued apace until March when the force was reduced which, for us on the mountain, meant losing one field section and consequently the speed at which the forest could be cleared was significantly reduced. (We tried experimenting with explosive tree clearance but this was not found to be economically viable.) Two weeks after this reduction, the weather took a turn for the worse, slowing construction to a crawl, and therefore no longer warranting the return of that field section.

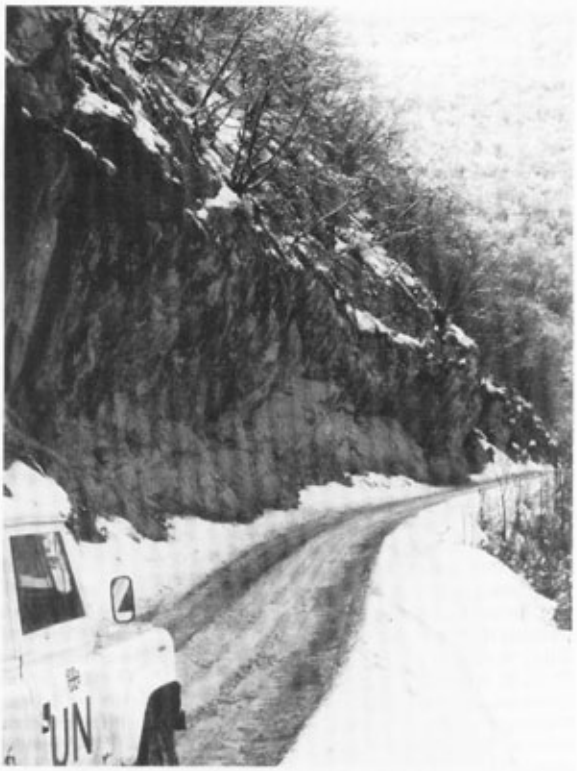
The stone in the area was of a limestone base, with residual soil. Apart from the borrow pits that we opened in former riband lakes in the valleys, which provided excellent fine grades of stones typically 5-15mm and sands, the bulk of the stone came from mountain quarries which, for ease of accessibility were sited close to the road in bowls and saddles. The high quantities of clay and organics in the bowls and saddles meant that quarries needed a lot of cleaning before stone could be won. Even the best stone still held a minimum of 15 per cent clays and organics. Consequently, when this stone was laid and compacted, we would wait until the rain/snow melt had leeched the layer of clays before introducing another course. The process was slow and frustrating but the end product was always successful. There were no rivers on this particular mountain but some 10km past TSG was a limited amount of excellent river bed gravel which was used for the bastion walling. The yield was however insufficient for use on the roads.

Since we had to build as fast as possible, we adopted the style of construction used by the locals which we found highly irregular because they made little provision for drainage. Of course the locals don't work in winter and we came horribly unstuck when the snow and ice melted, causing potholes and fords that damaged the wearing surface, in some cases destroying parts of the road altogether. Drainage ditches were cut where most necessary and culverts dug in five locations but sadly, three weeks later when we had to leave because of the roulementing work programme, we had not managed to make good the wearing surface. This was the only occasion where we felt let down by local advice.

Generally the plant used was a simple configuration of Terex 8230B Heavy Crawler Tractors (HCT), Volvo 4400 Medium Wheeled Tractors (MWT), Aveling Barford Medium Graders, Hamm Rollers, Hydrema Light Wheeled Tractors (LWT) and Iveco tippers (MDT). There were other equipments like the O&K Medium Wheeled

Vran - Sapper Mountain p250

Excavator, which didn't survive the first week and remained sick till the end of the tour; inappropriate to the conditions and not powerful or stable enough for working on slopes, they were soon limited to excavating borrow pits when they did work. The Fiat Allis Light Crawler Tractors were invaluable for some of the initial work, when cutting into the slopes, but their use was thereafter limited to camp construction. We found the MWT to be the most versatile and reliable workhorse in theatre. They made short work of quarrying, stone laying and earthworks as well as snow clearance. When the ground was frozen the LWT was too fragile for what was required of it though the back-acter was ideal for clearing top soil and tree stumps in the forest. The spares back up for the LWT was quite exceptional and their serviceability was rarely a problem as a result. The HCT, by contrast, was an excellent machine and formed the backbone of the main construction but problems arose when the cutting edges and toe pieces snapped against the frozen earth and took over a month to be replaced. The last equipment worth a mention is the MDT. It was quite excellent; robust, with a very good cross-country and snow-going capability. The S26 Self-Loading Dump Trucks which were supposed to share the work could not keep up and quickly rattled themselves to bits. Consequently the S26s were generally used as supply trucks on parts of the road already completed.



Blasted cut to west of Ramsko Jezero, Route Triangle, April 1993.

For large rock outcrops which could not be removed by plant, we received a Military Plant Foreman Shot Firer, SSgt R Garrett, and two drilling rigs from Long Marston (he was on a two-week loan, but once the extent of the blasting requirement became clear he stayed five months). One rig was an Atlas Copco and the other an Ingersoll Rand. Both were pneumatic and this became a problem in the cold, although we found the Killfrost 400 antifreeze seemed to keep air freezing to a minimum. The rigs were used on immovable rocks, for quarry facing and in the tight bends where a slewing HCT might go over the edge. In all some 12 bends were blasted, each requiring an average of one ton of explosive.

The Order of Battle (ORBAT) for this task, described above, consisted of the Combat Support Troop Commander, who commanded a grouping of approximately 120 men, comprising six of his nine sections plus a field troop, complete, and a section of signallers, medics, chefs and an administration NCO. Out of these were formed

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three maintenance/construction teams, the plant being the fluid entity. The main Vran HQ was located at Redoubt where the troop commanders lived, together with the field troop HQ. The administration NCO coordinated resupply of combat supplies for all maintenance camps from here. There were two cooks, two signallers, two medics and an ambulance driver. The maintenance team at Redoubt, itself, consisted of one plant section plus, one field section, mechanical transport (MT) section, REME workshop and RE flying fitter section. A plant section commander would command the working team of field section and plant section. The MT section drove tippers and support vehicles and would be located as and when required, usually between all three sites. Happy Eater was much smaller with a plant sergeant in residence in case of trouble, a plant section commander as team commander, a field section, plant section and one chef, medic and two signallers. Lost Tribe was hidden from all view and was simpler still with a plant section commander in charge and a field section, plant section and a chef. A further plant section with an MT section and the plant G1098 were at TSG to cover any works there and resupply of the troops on the mountain. As well as this, for the four weeks that Rourkes Drift was manned, there was a maintenance team of two field sections and a support section from 37 Field Squadron, which, though not under command, coordinated with Redoubt on concentration of effort. The remaining sections of Combat Support Troop were located at Split moving stores up country under the direction of the Combat Support Troop warrant officer.

As already stated, our responsibilities were for 220km of road and track construction and maintenance. In the winter this included snow clearance, for which we had snow blowers and snow ploughs. When the snow became very deep, Rourkes Drift was manned to clear route Square. This did not stop everyone working over sixteen hours a day for ten days, constantly clearing snow and rescuing those that had risked a crossing during the blizzards. The cold had a serious effect upon the construction work because the normally soft loam became like granite. Tungsten Alloy cutting edges and drill bits would break against it. Our vehicles and equipments had not been winterized before we arrived in theatre but within six weeks they all had rock wool, normally used for loft insulation, wrapped around fuel lines, batteries, air lines and various reservoirs. The situation was exacerbated by the delays in arrival of winter oils and lubricants, but more particularly by the locally purchased D1 diesel. This fuel had already the equivalents of 25 per cent kerosene in it and was certainly laced with Isopopenol but it was still freezing at a mere -20°C. Whilst running the machines, one could watch the wax and ice build up in the sediment bowls. Due to the quantity of ice in the fuel lines, we suspected that the local D1 had rather more water in it than normal. To solve this the plant was parked in some shelter, out of the wind, and run for one hour in three when not in use. One hour of plant exercises each morning got the actuators quite hot and the engines up to a good working temperature to allow the machines to travel to the work site without problems as long as they didn't stop – if they did, then the wind would cause the main rams to freeze in transit, and sometimes the fuel lines as well, rendering the machine useless and a severe problem to recover. The cold difficulties were not limited to the equipments. All our piped water had to be heated in a special reservoir tank, designed by WO2 Daley of 519 STRE, (see article this *Journal: The Daley Water Container*) which was kept at about +5°C. This would allow it to be pumped a few metres into the underground supply ring.

Overall, the plant worked many more battle hours per day than anyone expected they would, and no one knew of any civilian company that would work under these conditions. Consequently, an immense pride was felt by all concerned when a sector was completed. However, the toll that these conditions took on man and machine was enormous. The ratio of equipment maintenance time to work time was generally 1:1 in the worst conditions and 1:2 otherwise. Cold injuries were thankfully not a regular occurrence but when they did occur they were always due to the soldier being just too tired to dry and warm himself properly or wash, dry and powder his feet. Whilst we were digging a Land Rover out of a snow drift, my driver suffered a rather nasty rash where his shemagh had slipped revealing the lower face. In the five minutes before he had replaced it, patches of the outer skin had frozen causing him some distress afterwards when it thawed out.

Life was not all misery. Five kilometers from Redoubt and half way to Happy Eater was an

HOS company-sized barracks. These HOS, (well equipped, and politically motivated Bosnian Croat troops) were a particularly unpleasant group, though we heard that they always seemed to be in the forefront of the fiercest fighting so we held a grudging respect for them. When we first arrived in the area, it was this particular group that derived enjoyment from "drive by" shoots at Redoubt. About a month after we had established ourselves, their commander had an accident. When we found him, he wasn't hurt and it was made clear that since his men shot at us we didn't really want to help him. He was left to stew for a few hours and then we recovered and mended his vehicle, and fed him. He appeared grateful. After a few more similar incidents, one involving the local Bugojno Brigade commander, the local militia left us very much to our own devices. To our north was an HVO check point. This was manned by local farmers who spent one week in two being militia. The locals had benefited very well from our efforts and so were extremely friendly. They were always happy to see us. but not so all UNPROFOR, or for that matter all BRITFOR. We would be given access to areas that the Red Cross and European Community Monitor teams would not. These locals were in many ways quite protective of "our British Engineers"; and would warn us when "things" were going on such as an offensive in Jablanica, or a movement in the front line which was only a few kilometres away. When they were snowed in, their own brigade could not help them and so we recharged their communications batteries and donated a ten-man ration box. For the sake of such good relations the cost was very low indeed.

Triangle was the most direct route out of the interior to Split for refugees and so we had a constant stream to cope with. Generally, the HVO would deal with them before they got to us and on the occasions we had to help, the experience was never pleasant. That said, all of us felt some satisfaction as a result of helping them. The main problem was that through their own experiences or the media, the refugees believed that we had to help them regardless of the consequences to ourselves. In fact we helped them because that was the spirit of our humanitarian role and more often than not out of compassion. Our actual tasking did not allow for us to recover vehicles unless they were obstructing the road and then only to drag them to the verges. Sometimes those stuck on the road would mislead us by saying that an ambulance with a pregnant woman was stuck on the route and she had to get to TSG urgently. When we arrived at the scene there was occasionally an ambulance but very rarely the pregnant woman and sometimes weapons instead. We would help if appropriate but this would still mean two hours of lost sleep, and attitudes gradually hardened. We had, on various occasions, refugees, drivers, press and UN soldiers, who had been stuck on the road, staying with us overnight and, in one case, 40 people for five nights. This often led to frustration as Muslim refugees in particular had a different way of living to us and, in very cramped conditions, the two cultures didn't coexist very easily. It should be said though that we were known to help anyone that really needed help. Midway through the tour a bus of soldiers returning from the front suffered shrapnel injuries when a grenade exploded in the bus. One died but thanks to our RAMC medic, Sgt Hilton, and his band of plant operator volunteers, seven critically wounded survived and the other minor injuries were also seen to.

The work that we did on Mount Vran on the MSRs was very much a team effort. It is still hard to believe that we achieved so much, but that we did was all due to team spirit. The chefs kept us fed, the petroleum depot kept us fuelled, the REME fitters kept us operational and the stores sections kept us clothed and supplied. There can be no doubt that our presence and the fruits of our labours assisted the humanitarian efforts of the UN significantly, if only in the British areas. All are proud of that but each is also wiser for his experience, and that is to the benefit of the Corps.

Recollections of Operation Torch and North Africa 1942 and 1943

BRIGADIER H G W HAMILTON CBE DL

The Author, educated at Wellington College, RMA Woolwich, and Cambridge University, was commissioned into the Corps in 1938. During the War he served overseas with the British Expeditionary Force, British North African Force, and British Liberation Army. After various staff and regimental appointments, including being a DS at the Staff College, Camberley, he commanded 125 Engineer Regiment TA, attended the Imperial Defence College, and commanded 29 Engineer Brigade.

Retiring in 1968 he was General Manager of Corby New Town Development Corporation for twelve years. He is at present Vice-President of the Forces Help Society and Lord Roberts Workshop and a Vice-President of SSAFA.

THE Summer of 1942 saw 6th Armoured Division up in Scotland training for amphibious warfare. The Divisional Engineers, of which I was Adjutant under Basil Davey, was given the task of creating the Divisional Battle School and also of training elements of the Division in the art of disembarking from ships into landing craft using nets.

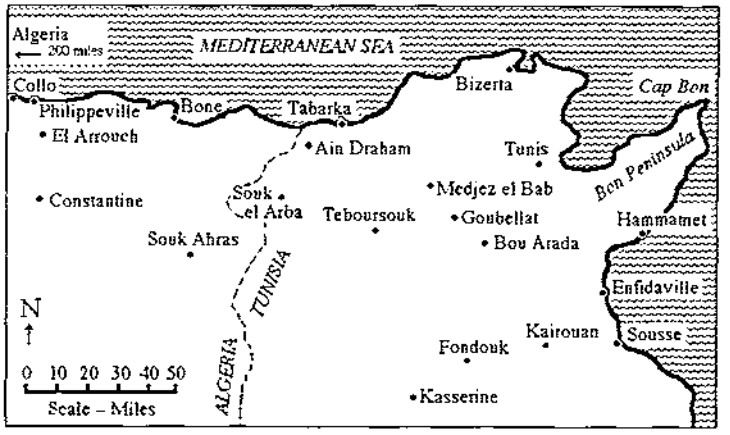
The Battle School was based on the "infamous" battle school at Barnard Castle, where battle drills were taught. "down, crawl, observe, fire" was the main cry, amongst a number of others. Live ammunition was used and fired very close above the heads of troops, and the NCO instructors seemed to vie with each other to see how close they could get; a number of casualties, fatal and otherwise, occurred and these were accepted as the cost of realistic training under war conditions. Troops sent to Barnard Castle were also taken to abattoirs and sprayed with blood, with the NCOs shouting appropriate blood-curdling encouragement! It was rumoured that the chief instructor was eventually taken away in a straight jacket!

We did not adopt all their methods but adapted them to our own situation and at the same time tried to work out battle drills appropriate to particular Engineer tasks such as bridging, minelaying, cratering roads etc. We built a mock-up of the side of a ship on the banks of the River Irvine near the racecourse, where the Divisional Engineers were camped, and troops had to climb down the nets into assault boats, cross the river (while small charges were detonated below the surface) and then crawl under wire with Bren guns firing on fixed lines above them. We had one fatal casualty when an instructor, not a Sapper I'm glad to say, threw a thunderflash too close to the face of a crawling man who raised his head too high and was shot by the fixed lines Bren gun fire. Another had a broken leg due to the shock wave from a guncotton primer being detonated under the assault boat.

After taking part in *Exercise Dryshod*, a simulated landing exercise across the southwest of Scotland, the whole division embarked from the Clyde for *Operation Torch*, the landing on the northwest African coast. Luckily we were not opposed and were able to land through the docks at Algiers and I remember writing to my parents, perhaps flouting security, that I felt like Rossini's Italian. 6th Armoured Division then sent a battle group, *Hull Force* based on the 17th/21st Lancers, forward to secure a base as far to the east

Brigadier H G W Hamilton CBE DL (Pg 254)

as possible but they were held up over the Tunisian border. The Division then moved up to the border through Souk Ahras and Souk el Arba, and took up a position to the west of Medjez el Bab with divisional HQ in the olive groves outside the village of Teboursouk. We remained there throughout a rather wet and cold winter subjected only to occasional air attacks, mostly on the cross-roads of Teboursouk. It was during one of these attacks that our Field Park Squadron Commander, Major Bill Jackson, later General Sir William, was wounded and evacuated to base hospital in Algiers, and Basil Davey then gave me the Squadron (144 Field Park). This appointment fulfilled a childhood declaration, made and recorded at the age of 12, that my ambition in life was to command a field squadron of Royal Engineers, a field squadron not a field company, as at that time (1930) field squadrons were still mounted and field companies were not, and I was a keen horseman even at that age.



Algeria-Tunisia 1942-1943.

With the two field squadrons supporting the forward brigades, the Field Park was given the additional task of maintaining the roads and tracks in the rear divisional area, but as we did not have the manpower or any plant, we employed local Algerian labour, with the promise of food as part remuneration. For supervision and interpretation we had two French and Arab speaking white Russian émigrés. They were hard taskmasters, and made sure that tasks they set and marked out, like ditches, were completed in the minimum time whether or not there was rock to be got through. The rations came in bulk in the form of sacks of lentils, sugar, powdered milk and so on with tins of bully and loaves of bread. I had warned the Algerians that they must bring some containers in which to take away their rations for the week, but of course they didn't – so the hems of their burnooses (loose outer garments) were lifted and filled with their individual allowances of loose lentils, sugar etc and their tarbooshes (hats) were taken off to be filled with tins of bully beef or bread loaves, and then put on again. They then staggered away, but I doubt if much reached their families as they ate most of it straight away.

Field park squadrons tended to be the Cinderellas of the Divisional Engineers compared to the more glamorous brigade field squadrons, and to uplift morale I arranged for a supply of the normal brass cap badges, which of course needed cleaning, to be silver-plated and sent out from home. These looked good on the dark blue berets we wore and had the desired effect, much to the annoyance of my fellow squadron commanders and the newly arrived CRE (Colin Browning), who had not been consulted.

The Spring of 1943 saw more action. In March the Division was sent south to the Fondouk Pass to help back up the American II Corps under Patton, in holding a German attack from the south and then to advance towards Kairouan. This involved a lot of minefield clearance, the Workshop Troop of the Squadron in particular was employed in assisting the field squadrons with mine detector repair and replacement.

We then returned to get ready for the 5 Corps *Operation Vulcan* offensive, which failed, and later took part in the push towards Tunis and the Bon Peninsula to cut across the German lines of communication and relieve the pressure on the 8th Army which was advancing along the coast from the southeast, but was held up at Enfidaville.

The Field Park Squadron was engaged on the usual tasks of setting up water points and engineer stores dumps, supporting the forward squadrons, maintaining a mine detector repair and replacement organization, running the divisional lighting set etc as well as carrying the bridging equipment.

Our CRE was hyperactive as far as the field squadrons were concerned having "O" groups at 6am and throughout the day, but was thankfully content to leave the Park to sort out its own tasks and problems, with me reporting to him once a day. This was awkward at times because he was so tired that he frequently fell asleep in the rear seat of the car whilst I was reporting to him. What does one do on these occasions – try and wake him up and continue, or quietly get out of the car and leave him to his well earned rest? I usually chose the latter!!

We lost our workshop officer to shellfire on the Goubellat Plain, whilst he was assisting field squadrons with mine clearance. Eventually 6th Armoured Division (in conjunction with 7th Division and 4th Indian Division) managed to take Tunis and clear the peninsula, and my Park Squadron finally finished at Hammamet on the southern coast, (now very much a tourist holiday resort). We took part in the victory parade in Tunis, and the whole Division was moved back into Algeria, centred on the coastal town of Philippeville.

There were many cases of malaria in the Division, including some in my Squadron, and they were all sent to the recently arrived 104 General Hospital which had been established in a large, dusty, hot and tented camp about ten miles from the coast near the village of El Arrouch, in order to take casualties from the Sicily campaign. One day I was visiting the hospital to see some of my men and had the idea of inviting some of the Sisters for a picnic and bathe with my other officers. I approached the Assistant Matron to give a general invitation to any Sister who was off duty to come, but she looked quizzically at me and said "Surely not any Sister, Major." I said "Yes anyone – they are all doing a wonderful job under such difficult conditions," to which she replied "You are 'green', what you want to do is to go into one of the wards and ask to see Sapper Smith or Jones and if you like the look of the Sister ask her out." I took her advice and in one of the wards found I actually had a Sapper Smith who was down with malaria but the very attractive and efficient Sister was a bit fed up with this line of approach from so many officers, was very busy with a ward of nearly 100 beds, and rather gave me the brush off! I returned the next day to see Sapper Smith, and this time she consented to come out and I fell for her in a very big way. The hospital had few if any amenities, so I soon became the blue-eyed boy of the Matron, by providing showers for her and her Sisters; lighting from the divisional lighting set; a bulldozed stage; and matting in the Sisters' Mess, Matron's tent and, of course, in my favourite Sister's tent! (What was otherwise the point in being OC of a Field Park Squadron?) This all paid off as after only a few weeks Matron gave "my" Sister leave to go with me to the Divisional Leave Centre on the coast at a delightful and romantic place called Collo.

On the way back we got engaged, only to find the very next day that I had been posted to Sicily and was to go immediately to rejoin Basil Davey, now Chief Engineer of 30 Corps, to replace his SORE II who had been evacuated sick. The reason for the urgency was that it was expected that 30 Corps was about to take part in the invasion of Italy, although I did not know that at the time.

On arrival at Tunis I only had a Priority III movement order to get to Catania in Sicily and had to wait. Eventually given a seat on a 'plane, I was taken off at the last minute and told that a special latrine bucket belonging to an American general had higher priority. Such was war!

I was then joined in my wait by Randolph Churchill, who also only had a priority III but tried to work the "I am the Prime Minister's son" approach; the US manifest clerk however told him, in no uncertain terms, that even if he were Jesus Christ's son he still could not get on! Eventually the pilot of a Dakota came in and called "Any one for Catania I'm leaving now," – we pushed our papers forward for inclusion on the manifest sheet, but the pilot said "Shucks I can't wait for all that crap," and, as we had our kit ready and Randolf still had a jeep, we followed the pilot and just managed to get on board as the plane started to roll. The only other passenger was an American general who strode up and down the plane biting his fingernails. On arrival at Catania, he was away in a staff car almost before the 'plane came to a halt – we heard that the allied attack across the Straight of Messina had started that day, and I always thought that the General must have forgotten something vital.

On arrival at 30 Corps I found that the Corps HQ was being run down and was to return to the UK in a few weeks' time to plan for the "second front". The CE, Basil Davey, was about to go to HQ 8th Army, to take over as CE on a temporary basis, but would be returning to 30 Corps

once we had started the planning at home. The GSO II RA and I found a German army amphibious jeep and spent our time bathing at the lovely resort of Taormina, as we had nothing else to do. I then got a message from Basil to bring his caravan up to 8th Army HQ at Bari and got his permission to visit the engineer school at Bone on the Algerian coast. This enabled me to get back to Philippeville and 6th Armoured Division where I persuaded the CRE to lend me his car, and asked the Matron to give my fiancée a week's leave, which she agreed to provided we had somewhere to go. This was easy as an old friend, Lornay Gayer, the CRE of a GHQ Troops Engineers, had his HQ in an hotel near Ain Draham in a cork forest to the east of Bone. I had arranged with my staff captain back in Sicily, that if sailing orders were received he was to send an urgent recall signal and we had only been at the hotel for a day when a car arrived with the message, so we sped back to the hospital and then to the airfield at Constantine so that I could get the next 'plane to Sicily. I was just about to board when I got a message saying that I was to report to the CE at Algiers. When I got there I was met by Bill Jackson, who had recovered and was on the CE's staff in some very boring appointment. He had had the bright idea that as I was engaged to a nursing Sister in Algeria, we should swap jobs, and he could return to England with 30 Corps, and I would be near to and able to see my fiancée. The fact that Algiers and Philippeville were about 200 miles apart, and that 104 General Hospital would shortly be moving over to Italy, did not come into his calculations! So of course I said NO and got the next 'plane direct to Sicily as I was concerned that the ship might go without me.

We returned to the UK in a ship called the *Leopoldville*, by coincidence the same ship in which I had sailed to Algiers nearly a year before. After a spot of home leave, 30 Corps established itself near Newmarket and was soon to set up a special HQ in London, near Victoria station, to undertake the planning of *Operation Overlord*, the invasion of France, but that is another story and will be told I hope in my next recollections for 1944.

Postscript

Soon after returning to the UK I called on the Matron in Chief (a Queen Alexandra's Royal Army Nursing Corps brigadier) in the War Office to put in a plea for my fiancée to be posted back to the UK so that we could get married. The Matron in Chief had been out to North Africa and remembered Claire well, because Claire had apparently given her a tough time with some strong questioning as to why there were no Voluntary Aid Detachments allowed abroad to help the QA Sisters in the General Hospitals. She did not give me much hope however, but as I left her office, having given a very smart salute, she suddenly said "Oh Major Hamilton, I do think you are wise" – "Why mam?" – "Our Sisters make the best wives!" was the answer! Within three months I was to agree wholeheartedly, as Claire did manage to get home and we were married.

Shortly after a brief honeymoon, we were staying in a small hotel in Newmarket when I suddenly found myself with a terrible headache and a very high temperature. We called out the doctor later that evening and he was at a loss to know what it was, provisionally diagnosing appendicitis. Claire had no doubt as to what it was and said very firmly – "A very bad attack of benign tertiary malaria", of which the young doctor rather naturally had no experience or even knowledge. She showed him how to take a blood slide from my ear (which proved positive) and got me into the small cottage hospital. Without her knowledge and care we would have had a very short marriage, instead of 49 years of happiness, since an appendix operation could have proved fatal in the circumstances! It was six months almost to the day since I'd left Algeria and Sicily, and I had been very careful always to take my mepacrine and other precautions, but one mosquito must have managed to get through the net.

The Officer Attachment – Tomorrow's Sapper Officer

SECOND LIEUTENANT J D HOLMAN BENG

The author, a bursar who studied mechanical engineering at Lancashire Polytechnic, graduated in 1991 with a sportsman's degree (2/2). Following officer training at Sandhurst, where he experienced the "Y "List, the graduate and the non-graduate courses (because of injury), he was lucky enough to be attached to 38 (Berlin) Field Squadron before returning to the classroom on his Troop Commanders' Course at the RSME.

QUESTION: A Young Officer leaves RMAS on 11 December and his Royal Engineers Troop Commanders' Course starts on 10 May. What do you do with him during the interim?

ANSWER: An Attachment.

THE two results that can come from an attachment are either 1. a frustrated young officer, or 2. a well motivated man or woman who has gained some qualifications and experience, and had some fun. The latter is easily achieved by planning for the YO's arrival and allowing him/her to use his/her imagination and resources; after all the attachment of today is tomorrow's Sapper officer. (For ease of reading the masculine form only of his/her etc is used from now on.) On arrival, people must realize that the officer won't have all the relevant engineering skills, although, having just completed a year at RMAS he is likely to be keen and glad to be with "the real army", in contact with other Sappers.

At present, smaller groups of officers are passing out through Sandhurst and therefore it is not always possible to run Troop Commanders' Courses which coincide with pass out dates; in my case only 11 passed out in December, but a minimum of 20 are required for a complete course complement.

There are two schools of thought about attachments. One is that an attachment is wasted time for the Corps and it is therefore best to keep production time from civvy to RE Troop Commander to a minimum. And the other is that the period between the year-long RMAS course and the seven months' course at Chatham will allow the young officer time to relax and settle into the Corps.

By now, you may have guessed that I'm in favour of the attachment. I have just started my Troop Commanders' Course after four months with 38 (Berlin) Field Squadron, and there will be those who say "What do you expect, I wouldn't mind four months in Berlin either." I agree, I had 37 days in that wondrous city but I spent more time at the Sennelager Training Centre and, even after surviving nearly seven weeks at the NATO Officers' Mess, I still hold my views on attachments.

"But for how long", the doubters may ask, "should an attachment last?" From a personal perspective, I would suggest four months. Long enough for those who wish to acquire and wear a dagger or wings to have a crack at those courses. Even if no interest lies in those options, he should still have enough time to settle and become known in a squadron. There must be

2Lt J D Holman
The Officer attachment p258

nothing more frustrating for an attachee than to turn up and then, just as he's beginning to shine, or at least emit a faint glow, have to leave: time should be given to allow an impression to be made, be it good or bad.

Four months is neither too short nor too long to make him view his Troop Commanders' Course as a burden, and an end to the fun he's having.

So, when the unit becomes aware that 2Lt Smoothly-Shaven/Rosy-Cheeked? is turning up for four months, what on earth is to be done with him?

In some situations he may be required to run a troop – an excellent opportunity (albeit "in at the deep end") to put newly-learnt man-management skills to work. If a troop is not available, he should "float", as I did; this gave me a chance to see all departments and broadened my knowledge and understanding of the day-to-day running of the squadron. Some days I was in the training wing organizing study days for junior NCOs, on others out with the plant troop, seeing what they did. I also spent a lot of time away on courses – five weeks to be precise. Had I gone straight from Sandhurst to Chatham I would probably have found it impossible to get away to acquire this excellent experience.

Within a day of arriving in Berlin, I was sent on a 3-week field firing (RMQ Stages 4 and 5) course – hard pork, but very good and I have a qualification (what?) I've already used and will no doubt use many times in my career. I then had a week at Hameln on a Medium Girder Bridge design course (something that I'll cover at Chatham but which gives me a head start), and this gave me a chance to see what the Combat Engineering Training Centre had to offer. So after four weeks I eventually got a chance to see the Squadron in Berlin – oh – and experience the best nightlife possible.

After a brief interlude came Exercise *Snow Queen*. I've always been a strong believer in adventure training, but to take the whole squadron away and occupy two lodges confirmed my belief that it is an invaluable form of training, and also a good change from routine.

By now I'd been with the Squadron for half my attachment and there was still more to do: a week in Sennelager working with the Gordon Highlanders' permanent range team (PRT) on the Operation *Grapple 2* field firing package. This experience was superb. Firstly I got to use my new field firing qualification and, most importantly, I saw how units train for active service.

ITINERARY DURING ATTACHMENT:

5 Jan	Arrived in Berlin
6-29 Jan	Field Firing Qualification, RMQ 4 and 5, Sennelager
1-5 Feb	MGB Design Course CETC, Hameln
18 Feb-3 Mar	Ex *Snow Queen*, Sapper Lodge, Bavaria
14-19 Mar	Op *Grapple 2* PRT, Sennelager
20-28 Mar	Ski Leaders/Instructors Course, Bavaria
7-12 Apr	Easter in UK
15-16 Apr	Parachute Course, Bad Lippespringe
17-30 Apr	Field Firing with 1 Gordons, Sennelager
1-6 May	Leave – Parachuting, Bad Lippespringe
10 May	Begin 109 RE TCC, Chatham

37	days in Berlin	9	days Parachuting
39	days on Course	14	days Field Firing
14	days Ex *Snow Queen*	6	days Op *Grapple* 2PRT

From there, back to Bavaria to complete a ski leader/instructor course. OK, so it was another week skiing but Exercise *Snow Queen* is an important part of BAOR soldiering and no doubt I'll be able to take people away to Bavaria at some future date.

As a grand finale to the attachment, the Squadron spent two weeks at Sennelager, field firing with the Gordons and putting 72 people through a one-jump parachute course. This was something the OC, Major Matthew Whitchurch, dreamt up. He would be first out the door with his squadron following him. Trepidation and fear beforehand, but now about half the squadron (including myself) are hooked and eager to do more.

The field firing was hard work, but very good training. Many people seem to forget that Royal Engineers have infantry skills. Exercise *Routes Drift*, as it was, produced some marked changes in personal skills, and we even managed to put the Gordons to shame once or twice. As the squadron packed up and headed back to Berlin, I stayed and got a few extra parachute jumps in, and then headed off to Troop Commanders' Course 109.

Having heard what I managed to do in four months, I hope readers understand why I believe attachments are important. I've met many people, seen many things and learnt more about real, practical soldiering than I did at Sandhurst. The experience has given me confidence. I have hundreds of ideas that I want to put into practice. I feel as if I've been accepted by the Corps and that I belong. I'm looking forward to Chatham and I have acquired some useful knowledge to help me whilst I'm there, and when I get a troop of my own.

Operation Lecturer – Cambodia

WO2 (QMSI) J FORAN MM

WO2 Foran, after completion of basic training, was posted to 39 Field Squadron in March 1977, during which tour he was able to spend some time in Canada.

In March 1981 he joined 9 Parachute Squadron and saw active service during Operation Corporate, *where he was awarded the Military Medal for his actions during a diversionary attack on Mount Tumbledown.*

Posted to 39 Field Squadron again, in December 1984, he rejoined 9 Parachute Squadron in April 1986, where he was Troop Sergeant and Troop Staff Sergeant.

He is currently Quartermaster Sergeant Instructor at 38 (Berlin) Field Squadron.

Introduction

As most people are aware, Cambodia has been at war for almost 20 years and during this time many millions of mines have been laid by the four warring fractions, plus the Vietnamese army.

The Paris Peace Agreement on Cambodia, signed in October 1991, has one small subparagraph which states that the United Nations Transitional Authority in Cambodia (UNTAC) will: "Assist with clearing mines, undertake a training programme in mine clearance, and also implement a mine awareness programme in Cambodia." A straightforward statement, but when considering the hundreds of thousands of refugees in neighbouring Thailand who were waiting to return, and the people already trying to survive in mined areas, the extent of the problem can be seen at once. Reports stated that up to 300 Cambodians a month were being injured by mines while carrying out day-to-day activities such as harvesting crops, collecting fruit from the jungle and collecting firewood. No figures were ever kept of those killed.

The aim of this article is to describe briefly how the mine problem was tackled, the types of mines used and methods of laying them, and to detail the mine awareness programme set out for both UNTAC personnel and the civilian population to use.

Mine Clearance Training Unit (MCTU)

When the first Royal Engineer detachment of 13 personnel, led by Lt Col M W M Warren, arrived in Phnom Penh in February 1992, it was part of a detachment from seven countries which, after weeks of information-gathering, conducted a number of courses, through the deployment of eight teams, located in eight different schools throughout Cambodia.

The first of these courses was a 4-week deminers' course, where students were taught the skills necessary for a platoon to plan and conduct mine clearance operations under supervision. The second was an instructors' course which consisted of a 5-week programme, followed by a 4-week period where the trainee instructors, instructed a deminers' course under UN supervision.

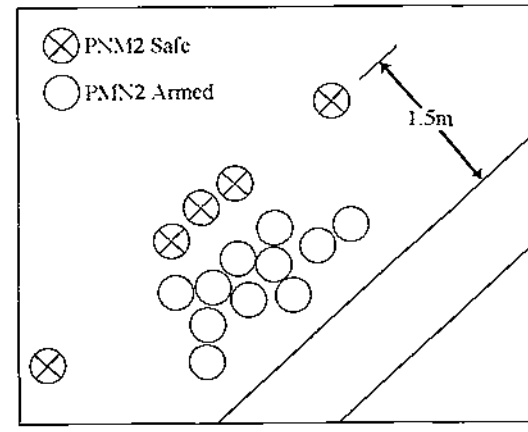
The more successful students on the deminers' course were selected for the 8-weeks long supervisors' course, the first five weeks being instructional and conducted by the New Zealand training team in Battambang, followed by three weeks supervision by a UNTAC supervisory team on a real minefield somewhere in the country. Other courses conducted were minefield marking and Explosive Ordnance Defence courses.

The first British training team was based in Pailin, the headquarter area of the Khmer Rouge, in Battambang province. Three members of the

Operation Lecturer - Cambodia, p260.

British contingent were in Phnom Penh as part of the HQ staff with Lt Col Warren as Commanding Officer of the Mine Clearance Training Unit (MCTU), and his successors were, Lt Col N F Roland-Price and Lt Col A Mulliner.

Initially relationships with the Khmer Rouge were good with much cooperation but, as time went on, the political atmosphere changed, threats were made towards the British contingent eventually leading to almost hostage-like conditions resulting in the second British team having to negotiate their way out of Battambang in mid-tour minus the Troop Commander and the Troop Sergeant. The team then assisted the New Zealand training team, conducting supervisory courses, until they were repatriated to BAOR and UK in February 1993, followed some weeks later by the Troop Commander and Troop Sergeant. The third and final team arrived and deployed to Kampong Thom, Kampot and Kampong Speu to supervise mine clearance operations and minefield marking.



Five PMN 2 mines are surface-laid 1.5m from a footpath, clearly visible and complete with arming keys (safe). Between the visible mines and the track a further 11 PMN 2 mines are buried, well camouflaged and in close proximity to each other, some even touching.
The safe mines act as a come-on. Any attempt to approach the safe mines without checking would almost certainly result in casualties.

Types of Mines

The majority of the mines laid were antipersonnel and covered the four groups, blast, fragmentation, bounding fragmentation and directional fragmentation. Most were of former Soviet Union or Warsaw Pact origin with some Chinese and Vietnamese mines added to the inventory. The most common mine found was the PMN 2 and the most feared was the Chinese type 72A and 72B. Both these mines look the same on the ground but only in a safe condition can they be identified by the shape of the arming pin, the 72A having a short round pin and the 72B a triangular pin. Obviously when the pins were removed and the mines armed, the mines looked identical. However that is where the similarity ended. It was known that one faction would arm the 72A and then arm the 72B (which, after pin removal, would take approximately 3 minutes 20 seconds to explode, but you could not reverse the arming procedure) then re-insert the shorter round pin into the 72B and lay it on the ground where, in appearance, it would resemble a 72A. Once lifted and tilted more than 10 degrees it would explode, resulting in a traumatic amputation of the hand, and possible stomach and eye injuries.

Antitank mines were used to destroy vehicles and bridges, the types most commonly used being the TM 46, 57 and 62M.

Methods of Laying

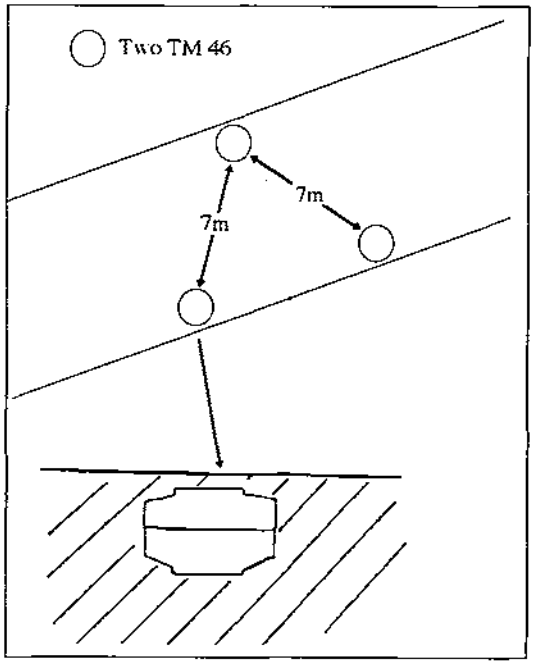
Mines were hand-laid, without pattern and without any form of record other than in the memory of the person laying them. They were either surface-laid or dug into the ground to a depth of about 5cm. In the case of fragmentation mines such as the POMZ 2, the sighting of one would normally mean the presence of up to three or four mines interlinked with tripwires.

Directional fragmentation mines were used to cover hides, patrol harbour areas etc and were normally used in the conventional way, being placed on the ground, but were also attached to trees and overhanging branches.

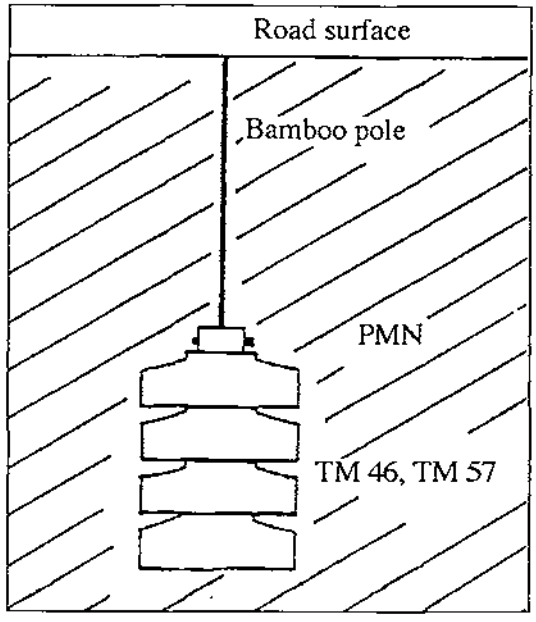
Antitank mines were dug in to a depth where the fuze was about 5cm below the level of the ground. One faction favoured laying six anti-tank mines in a group. They would lay them in three places with two mines laid back to back (the bottom mine was unfuzed) 7m apart in a triangular fashion and 50m between each group of six mines. On one occasion, four antitank mines were found at a depth of 1m with a PMN 2 mine placed on top of the mines and a bamboo stick placed on top of that, protruding from the surface of the road.

Areas most likely to be mined, apart from open arable land thus denying crops to the factions, were abandoned buildings, wells, river crossing points, shaded areas, track junctions and other likely defensive positions.

The village people, to protect their village and livestock, still lay mines at last light and recover them at first light. It is also known that the type 72A mine



Three groups of antitank mines are laid in a triangular pattern along a track. Each group is approximately 7m apart and buried. The group consists of 2 TM 46 antitank mines laid one on top of the other, the bottom mine being placed upside down. Only the top mine is fuzed.



A stack of antitank mines are buried on a road or track to a depth of 1m. The top antitank mine is fuzed.
A PMN is placed on top of the fuzed antitank mine and a bamboo pole rests on top of the PMN to the road surface. When pressure is applied to the pole, the PMN detonates which then causes the antitank mine to detonate. Several antitank mines are used because of the volume of earth.

was sometimes buried on its side so that the pressure plate was at 90 degrees to the prodder thus attempting to defeat discovery by prodding techniques.

Mine Awareness

As mentioned previously, a mine awareness programme had to be put together and Cambodians briefed on the mine problem. This was initially carried out in the refugee camps in Thailand by non-government organizations, (NGOs) and in Cambodia by the Mine Clearance Training Teams (MCTT). Likewise all incoming UNTAC personnel, including UN volunteers, were given a mandatory mine awareness brief, which included information on types of mines found in Cambodia, areas most likely to be mined, the Khmer traditional landmine marking system, Khmer advice on personnel protection from mines and the drill for withdrawal of people from a minefield.

In July 1993 the MCTU merged with the Cambodian Mine Action Centre (CMAC). This Cambodian organization is now responsible for all mine clearance operations, intelligence gathering and dissemination, minefield marking and finally, mine awareness.

Mine Awareness Survey

A survey was carried out in mid-July 1993 in conjunction with the Mines Advisory Group (MAG) and the Mines Advisory Training Team (MATT) which are sponsored by World Vision International. Both of these organizations have gained much experience in the field of mine awareness and how to pass critical messages to local villagers. The aim of the survey was to compile a list of comprehensive material already available within Cambodia, and to assess its effectiveness in the field, then to identify if there were any perceived gaps in the existing range of materials and finally to ascertain how best to fill those gaps. My task was to coordinate the ideas considered and to make recommendations to CMAC.

The materials used by MAG and MATT are silkscreens with drawings depicting messages such as "do not touch mines", signs indicating the presence of mines and how to mark mines.

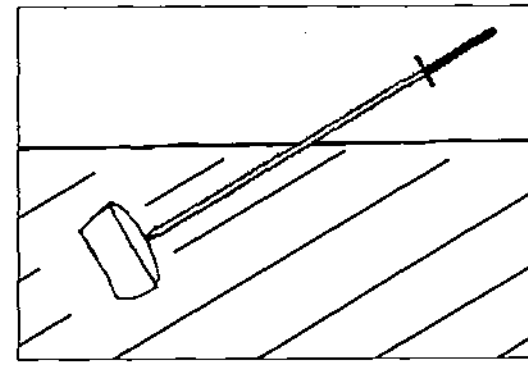
The target areas of this study were four villages in Battambang province where the presence of mines affected the people in their daily lives. The people spoken to were demobilized and serving

soldiers, farmers, woodcutters and amputees. After three days of intensive questioning with my interpreter, the following conclusions were noted:

- Mine Signs. The most common sign that people recognized was the skull and crossbones, and sticks in the shape of a cross laying on the ground, indicating to villagers the presence of mines. Few knew of any other signs such as arrows carved into the bark of a tree or a tree stump with a red arrow painted on it.
- Mine Clues. This was interesting as, during the first two days of questioning, most people said that they did not know of any mine clues such as disturbed earth or depressions or mounds in the ground, safety pins lying around or trampled vegetation. On the third day however, everybody seemed to know them all, and I then realized that the interpreter was telling the people the clues himself when questioning them. He rather sheepishly admitted he was, not realizing what he was doing.
- Prodding Exercises. Questioned whether if seeing their friend in a mined area they would attempt a rescue bid, the majority answered that they would like to but, knowing the correct drill, they would seek help from the nearest village. Some said that they would rush in without clearing a safe path to give assistance, while the soldiers said that they would prod using a short or long bladed implement. Everyone agreed that they wanted to know the correct drill and would be willing to attend practical lessons.
- First Aid. All villagers interviewed said that they would like to have some basic training in stopping the flow of blood or how to apply a tourniquet correctly. Most knew how to fit a cloth above the injured limb but did not realize that the tourniquet had to be released every 15-20 minutes to allow the blood to flow. One of the amputees spoken to had stood on a mine at 1000hrs, had a tourniquet applied and at 1700hrs was finally admitted to the hospital. During this period of time the tourniquet was only released once. His initial injury was the loss of the forward part of his foot but, because of the way the tourniquet had been managed, he had to have his leg amputated from above the knee. Would correct first aid training have avoided such an amputation? One only has to recall two recent mine incidents, involving NGOs and MCTU personnel with similar injuries which, with prompt and correct medical training, resulted in amputations which were not nearly as traumatic.

The people also wanted to know more about the types of areas that were likely to be mined.

I spoke to expatriates in Battambang about this and most were not in favour of giving practical assistance in demining training, stating that it should be left to the experts, but agreed that first aid training was essential. An example was given to us of an area in which in 1992 11 untrained local people were carrying out mine clearance activities but today only one survives.



This method of laying antipersonnel mines is used to defeat prodding. A type 72A is laid buried but on its side so that the pressure plate is 90° to the prodder.

It is well known that mine clearance is carried out by untrained personnel and, for families to survive, this will continue regardless of casualties. The question remains: "what if these people had been taught the correct drills in prodding and in first aid, would they still be alive today, or would the loss of a limb have been prevented?"

To illustrate how people are affected in Cambodia by the presence of mines, there is the example of the village of Doung Loeu, approximately 50km southwest of Battambang City. Here, in the last three years alone, 13 people have been killed and 12 have suffered amputations plus 75 cattle have been killed. These statistics are not caused by mine clearance activities but by the everyday work carried out to cover daily economic needs.

A number of proposals have been put forward in a report which we drew up; unfortunately it is beyond the scope of this article to detail them, but whatever action is taken can only benefit the Cambodian people.

As I write this article mines are still being laid, mainly on the main routes and in some areas that have previously been cleared of mines. Plans are under way now to integrate all factions into a united Cambodian Armed Force. Will the indiscriminate use of mines stop? Only time can tell.

A six-month tour passes very quickly, but there are many memories of Operation *Lecturer*. From my travels throughout the provinces it was a shock to see the difference between the Phnom Penh and village lifestyles. The village people live out their lives under the threat of attack, mines and in poverty. The most basic medical facilities are lacking, resulting in the most unnecessary suffering compared to the dollar-infested lifestyle of a great many people living in Phnom Penh where new Mercedes and Toyota landcruisers appear daily on the streets.

From a professional point of view, it was an operation I would not have missed. It has given me an insight into how other armies operate and I experienced much pleasure in seeing at first hand that most of the drills they use are an imitation or variant of those used by the British army. However, it was frustrating at times to see below-standard performances when I was powerless to do anything about them. Many people only "coast" and, as long as they do, things will never change.

If an opportunity should arise again I am sure there will be many volunteers. The tour has increased my knowledge of mines and their methods of use both by regular and irregular forces. This must be an advantage considering our apparent lack of mine intelligence on deployment on Operation *Corporate* (the Falklands campaign).

Memorial Window to Lieut General Sir John Bagot Glubb KCB CMG DSO OBE MC

THE peace and tranquillity normally associated with the town of Mayfield in Sussex, was severely disrupted on Friday 17 April 1993 as family, friends, associates and dignitaries attended a service in St Dunstan's parish church to dedicate a memorial window (*see right*) to Lieut General Sir John Bagot Glubb KCB CMG DSO OBE MC, who, as Glubb Pasha, commanded the Arab Legion and for 20 years was one of the most influential men in Middle East affairs.

Sir John was one of our most distinguished Sapper officers. He followed his father, Major General Sir Frederick Glubb, into the Corps in 1914 and served in the First World War in France where he was wounded three times and awarded the MC.

Bored with the prospect of barrack-square soldiering in Chatham after the war he volunteered for service in Iraq, and this was the start of a long and dedicated period of service in the Middle East, initially as a British officer but for the most part in the service of the Emir of Trans-Jordan as the controller of the Arab Legion. He was given the title Pasha, a title normally reserved for Turkish and Muslim senior officers, entitling them to fly a flag with one, two or three horses' tails to indicate seniority. He remained in Jordan until 1956, when political pressure to place the Arab Legion under the control of a Jordanian officer resulted in his premature return to Britain, where he settled with his family in Mayfield.

A portrait of Glubb Pasha hangs in the RE HQ Officers Mess and many of his medals and swords are on display in the RE Museum.

Over 250 people attended the service, including King Hussein of Jordan and Queen Noor, who took tea with the congregation in the picturesque Middle House Hotel. Lieutenant Colonel G W Dawson, CO Depot Regiment, represented the Corps.

King Hussein, Queen Noor and Lady Glubb.

Memorial Window to Lt Gen Sir John Bagot Glubb
p 264

The Royal Review 1860

GEORGE ROBINSON

This short piece was sent in by the author, who is interested in the history of Edinburgh and thought it might be of interest to our readers.

EARLY on the morning of 7 August 1860, the streets of Edinburgh began to be invaded by cavalrymen, artillerymen, engineers and riflemen from Scotland, Middlesex and the north of England's newly formed volunteer regiments, as they flooded into the Scottish capital by road and rail to take part in the Royal Review which was to be held in the Queen's park.

The city's shopkeepers and magistrates had made a special effort to decorate the capital for the royal occasion and Princes Street especially was bedecked with flags, floral displays and banners, while the bill-posters had fixed blue pennants to their ladders. Flags flew from the Scott and Nelson monuments and the Calton jail, housing the town's "hooks, crooks and comic singers", was festooned with bunting to disguise its grim appearance. Many of the banners and decorative shields carried the motto of the volunteer force "Defence not Defiance" which had been coined by a letter press printer and part-time volunteer in England.

Shortly after ten o'clock the main body of the volunteers began passing into the city's railway stations along with the hundreds of visitors who had travelled to see the event. Edinburgh's main station, the Waveley, had been reserved for passenger traffic and the volunteers travelling from the west and north of Scotland had disembarked at the previous stop, Haymarket, at the city's west end, where breakfast had been laid on for the hungry travellers in the railway company's goods sheds. The Inverness contingent had been travelling since seven o'clock the previous evening, taking 13 hours to reach the city, and some of the units had been on the move for two and three days. Many of the volunteers had arrived in cattle trucks and goods wagons covered by tarpaulin supported on struts, as the railway companies had exhausted their stock of carriages. Most of the units had regimental bands and, with sprigs of heather in their bonnets and shakoes and carrying hampers full of comestibles, they marched jauntily to the park in time with the music, via Princes Street and London Road, and to the cheers of the crowds who were delighted to see such a colourful and martial display.

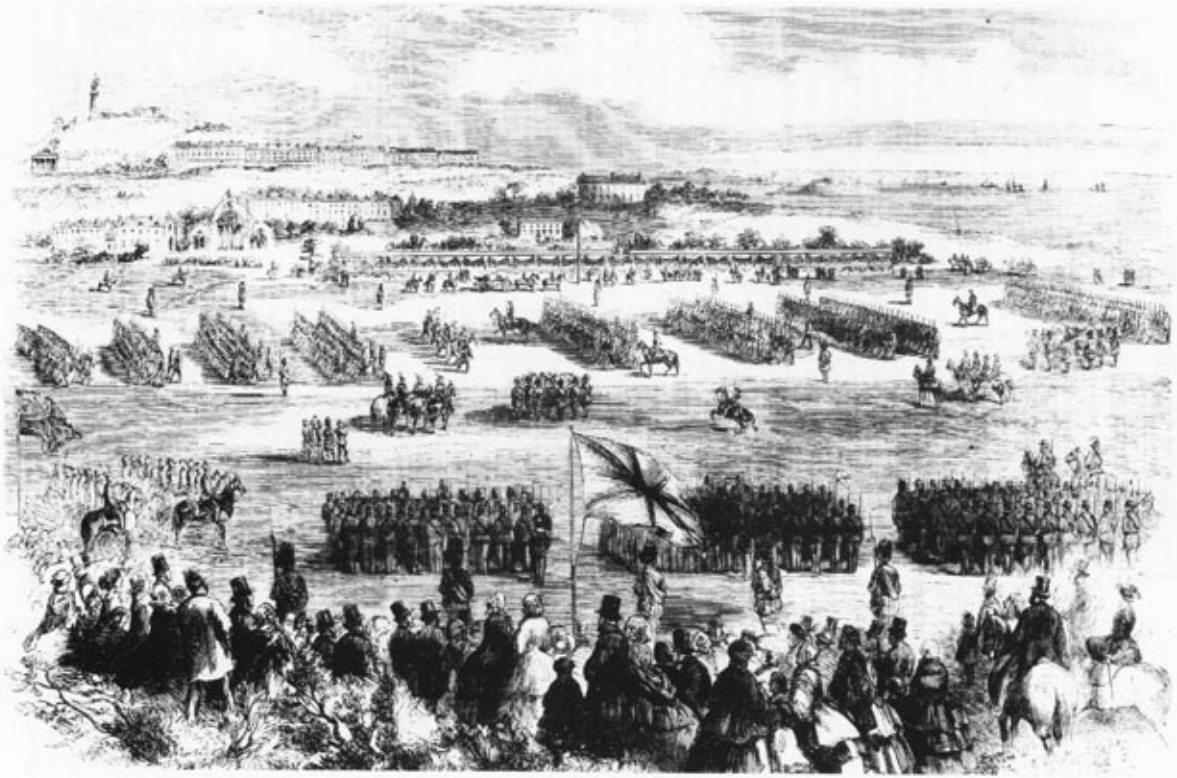
The Queen arrived in Edinburgh at 8am and after driving to Holyrood House, escorted by 13th Light Dragoons, the royal party drove along Princes Street, acknowledging the cheering crowds, to visit the Queen's mother, the Duchess of Kent, at Cramond, just outside the city. On returning to the palace, the royal carriage took the route back past Abbeyhill, to avoid the crowds packing the main streets of the city, before proceeding to the park for a place at the Review.

By 11 o'clock the park and the slopes at Arthur's Seat, over which flew the Royal Standard, were filling rapidly. The red and white striped grandstand had been designed to seat 4000 spectators and was almost 1000 feet long, with a central section decorated in the Royal Stuart tartan and festooned with evergreens and heather.

Before the Queen left Holyrood House with her cavalry escort it began to rain but as the royal party, consisting of the Duchess of Kent, princes Arthur and Leopold and the princesses Alice, Helena, and Louise, reached the review ground the sun began to shine, much to the relief of the volunteers and the crowd, many of whom had neglected to bring umbrellas. The Prince Consort rode on the right of the royal carriage, while the Duke of Buccleuch, Lord Lieutenant of Edinburgh and Captain of the Bodyguard of Scottish Archers, escorted her majesty on the left, the Lords Lieutenant of counties following on horseback.

The royal cortege proceeded slowly along the front of the 21,514 volunteers who were drawn up in a line of quarter-columns along the base of Arthur's Seat to the tumultuous cheers of the 300,000 spectators before stopping at the saluting base where 60 of the Queen's Bodyguard of Scottish Archers were formed up in front of the Royal Standard. When the Queen assumed her place with her bodyguard the bands of the 78th Regiment, the 29th Regiment and the 1st West York Rifle Militia marched forward to play the music for the march past.

At exactly four o'clock, the staff officers took their positions with their divisions and gave the order "Take ground to the right in fours" and the battalions, commanded by Lieut General Sir G A Weatherall, prepared to move forward. Led by the magnificently mounted Fife Mounted Rifle Volunteers in their scarlet tunics and black helmets the vast force consisting of two divisions, commanded by Major General Lord Rokeby and Major General Cameron, began to move, the



The review of rifle volunteers by the Queen at Edinburgh – the troops marching past Her Majesty.
London Illustrated News August 1860.

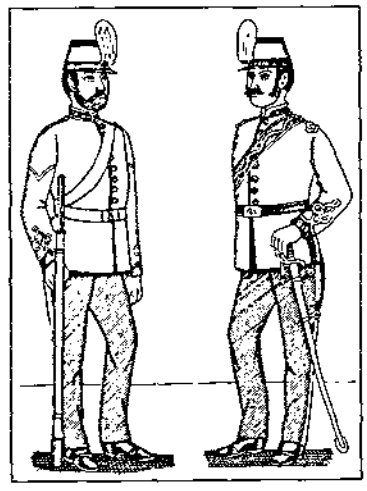
The Royal Review 1860, p265

Medallion issued for the Review. (Drawn by John Thomson.)

artillery following the cavalry, while behind the blue coated artillerymen marched the 198 volunteers of the 1st and 2nd Lanark and the 1st City of Edinburgh Engineer Volunteers commanded by Captain Johnstone of the 1st Lanark. Following the engineers, came the rifle regiments in their various uniforms, some in kilts, some in trews, while main units, the dark green of the regular rifle regiments, passed the Royal Standard. As the highland units of each regiment approached the saluting base, the brass bands stopped playing and the pipes of the 78th struck up, echoing off the Salisbury Crags, honouring each highland company in the vast force, including the exiled kilted Scots in the Northumberland Volunteers, as they paraded past the Queen.

The weather was hot and a huge dust haze began to rise and hover over the gigantic formation which took an hour and twenty minutes to march past the saluting base. After a pause, the General commanding gave the order and the army moved forward as one man until a bugle called the regiments to halt. The officers saluted with their swords and the battalions presented arms. The final command was given to the divisions for three cheers for the Queen and with the spectators joining in unison, the tremendous ovation lasted for several minutes, before the royal party began their journey back to Holyrood House at 5.45pm. Many of the volunteers stuck their caps on the end of their Enfield rifles and waved them in the air as the Queen made her way back to the palace and dozens of the younger soldiers stimulated by the events of the day broke rank and rushed forward cheering to surround the royal carriage.

The regiments marched from the Queen's park back through the streets of the city to their carriages and horse drawn transport waiting at the railway stations. Lieut General Weatherall expressed the Queen's admiration of the steadiness and precision which characterized the large body of volunteers whose movements she had witnessed, to the staff and battalion officers who had taken part in the review.



2nd Lanark Engineer Volunteers 1860. Drawn by John Thomson.

The newly formed volunteer movement had got off to an excellent start in Scotland and the regiments formed the basis for the units which were to serve against the Boers in South Africa and fourteen years later against the Kaiser's army in the First World War.

Some brief historical background notes about the engineer units mentioned *

1st Lanark Volunteer Engineers	Formed	11 Feb 1860	1 Company only
2nd Lanark Volunteer Engineers	Formed	May 1860	1 Company only
3rd Lanark Volunteer Engineers	Formed	April 1862	1 Company only
97th Lanark Rifle Volunteers	Formed	July 1861	

19 May 1863 all above amalgamated to become 1st Lanarkshire Engineer Volunteers – six companies.

1883 Eight companies
1885 A ninth, submarine mining company, was added, a second one being formed in 1888.

Both the submarine mining companies became separate units in 1885 and in their place a ninth railway company was added to 1st Lanarkshire Engineer Volunteers but this company was disbanded in 1889 and a new ninth company was formed.

Grierson gives no mention of 1st Lanarkshire Engineer Volunteers becoming a telegraph unit but in 1884, engineer volunteer units formed telegraph sections within their units.

The 1st Lanark still existed in 1908, but in April became split to form four different units:

1st Lowland Field Company RE
Scottish Wireless Telegraph Company RE TA
Scottish Airline Telegraph Company RE TA
Scottish Cable Telegraph Company RE TA

Probably, the Royal Signals connection came in later, but this would have been after 1920.

Later, in June 1903, 2nd Lanark Engineer Volunteers was formed.
In April 1908 it was split to form 4 different units:

2nd Highland Field Company RE TA
Lanarkshire (Fortress) RE TA – 1 company
2nd Lowland Field Company RE TA
Lowland Division Telegraph Company RE TA

124 Field Engineer Regiment TA was the descendant of the units in the 1950s.

*Provided by Mr J Thomson, from "Records of the Scottish Volunteer Force 1859-1908" by Maj Gen J M Grierson.

A 500kg Unexploded Bomb in Cleethorpes

LIEUT COLONEL E E WAKELING ERD MIMGT

WHILST I was in Grimsby, following the memorable raid of 13/14 June 1943, I received a report about a 500kg bomb dropped on a housing estate. One hundred houses had been evacuated and I was concerned that work could not begin at once – only Category "A" bombs could be started immediately. (Category "A" was given to bombs which, if they exploded, were likely to affect the war effort, ie damage factories producing war materials, railways and so on. Also Category "A" meant that the lives of bomb disposal (BD) personnel were less valuable than the resultant damage to the war effort.)

I decided to recce the area and was able to make a good assessment of what the subsoil consisted of, giving me a better idea of what equipment would be required. The soil appeared to be clayish, so I could use "open" timbering in the shaft which meant a considerable reduction in the amount of timber to be brought to the site. The men wouldn't like it, however, clay was the very devil to dig, it never seemed to want to leave the spade. The site was well above sea level and the area dry, so pumps wouldn't be needed – at least, not at first, water might be reached if the subsoil changed or if we had to dig deep, and 500kg bombs had a reputation for plumbing the depths.

Example of a 500kg bomb.

Having completed my recce, I went to advise the duty officer at the local police station that work would start in three days' time. This news would be passed on to the poor residents who were now existing in local halls: hopefully, it would provide some consolation to know that the length of time they would not have a home was limited.

On the day we arrived at the house behind which the bomb had dropped, the corporal, who would be in charge of the excavation, and I went down to the end of the back garden path where the remains of an Anderson shelter lay. The bomb had made a direct hit on the corrugated iron roof, dragging it down as it passed through. Fortunately it had been empty at the time, as the couple who normally used it had been elsewhere that night – the husband on firewatch and his wife, being on her own, invited to stay by her next door neighbours in their Anderson shelter, just 4ft away.

The first job was to remove the remains of the shelter to try and discover the direction in which the bomb had travelled after it entered the earth. The men were whistled up and while they got down to the job I went to my Pick Up (PU), got out my probe and made up an 8ft length. The hole would probably be about 20in in diameter, although probably full of earth which tends to fall back following the passage of the bomb.

When the shelter had been cleared, there in the floor was the outline of a hole. Using the probe, I eventually discovered that the hole of entry was angled towards the fence at the bottom of the garden, just behind the shelter – it was obvious that we would find the bomb in a shaft set in the field on the other side. This would be easier for the men, as the ground was flat there and no clearing or levelling of the site would be required before laying out the shaft template. The corporal was sent off to search for suitable access for the truck.

I added another 4ft length to the probe and hit something metallic at about 9ft. "Tail fin," I thought. It would not be attached to the bomb, so we would be digging much deeper. With the known angle of entry, and knowing the actual subsoil, I decided that the bomb was probably about 16-18ft down. I worked out the "offset", decided exactly where the shaft should be sited and, in view of the anticipated size of the bomb, I had previously made up my mind that the shaft would need to be 10ft x 8ft, so timber for that size had been brought to site on the truck, which was driven to within 200yds of where the shaft would be dug; it wouldn't do to have the truck blown up!

Soon the men had swung into action. Having worked together for so long, they knew what was

Lt Col E E Wakeling ERD
A 500kg UXB in Cleethorpes, p268.

required without being told what to do and two days later were down 9ft. It was hard going with that clay, but it was still dry and the shaft only needed "open" timber shoring which made things easier because only half the number of planks were needed in vertical support of the walls, the spaces being equal to the width of a plank.

In another two days, with the depth at 15ft, still no "trace". If my siting had been correct then there should have been some indication of the passage of the bomb. I told the corporal to carry on digging for another 2ft.

On the following day still no sign. I was so sure that my calculations had been correct, so "where was the bloody bomb?"

I sent all the men back to the safe point and began probing the vertical wall (up from the floor) nearest the hole of entry. After a quarter of an hour (and it was hard work), I called for my sergeant to come and take over. By this time I had well and truly probed the first 3ft of wall. Suddenly, at about 4ft up, the clank of metal on metal was heard. The bomb? We looked at one another. Could it be? At about 13ft? It didn't seem possible. Still, if it was, it was better to play safe. Get the electrical stethoscope out and put the magnetic microphone on the probe. If it was the bomb, then that contact could have started a clock if the bomb had been fitted with a 17 fuze and this type of bomb often was. The sergeant clambered up the ladder and told the corporal to start a "listening watch." Now that we were – or thought we were – in contact with the bomb, there would be a listening watch at all times.

The sergeant and I sat at the bottom of the shaft, deciding what to do next. We both agreed that if it was the bomb, then it was about 5ft in from the side of the shaft and the answer was a tunnel. We could agree on the vertical position of the tunnel, but where, horizontally, should we start? We had no knowledge of what part of the bomb the probe had touched nor in which position it was lying. "Right, for better or for worse, we will take the point of contact as the base/centre of the tunnel." Make it 4ft 6in high and 2ft 6in wide. That should be big enough to get the bugger out."

Now the "fun" would start. First we would have to retimber the wall, to allow a "breakout" into the tunnel. Progress was slow because of the height of the tunnel above the floor of the shaft.

When I got to the site later the next day, I found that work had progressed well and that the men were only about 2ft away from what proved to be the bomb. I urged them to take great care and to keep the number of men in the shaft at any one time to the minimum – work proceeded slowly.

The shaft.

The next day I visited the other sites as usual before going to the "tunnel" bomb. Soon after I arrived, the Sapper in the tunnel called out that he had made contact with the bomb. So everyone was sent off except for the sergeant. The microphone was transferred to the bomb itself – the time of real danger had arrived. From now on, any movement of earth from around the bomb meant the risk of starting the clock, if there was one. But more than that, a bomb of this size often had two fuzes. The usual combination was a clockwork fuze and a very sensitive anti-handling fuze, designed especially to kill the BD officer or at least to prevent the removal of the bomb so that it could explode where it was rather than in a bomb "cemetery".

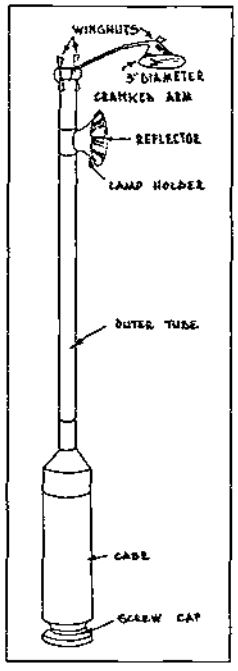
"Damn and blast!" Removal of more earth showed the bomb was vertical – with its nose uppermost! "How in hell did that happen?"

I did a spell of soil removing from around the bomb. It was difficult work, mainly because of the limited space and the fact that one had to kneel or lie down full length in the tunnel. Also, only a trowel could be used – picks and shovels were definitely out.

The sergeant and I took it in turns,

At last, one upside down 500kg UXB.

A 500kg UXB in Cleethorpes, p269.



Fuze mirror torch.

concentrating on the left-hand side of the bomb. Halfway round and still no sign of the fuze. By now we were sweating profusely, both from our exertions and from nervous tension. It was time for a rest; we had been working for two hours without a break. Fortunately there was a brew of tea – when wasn't there? We sat down to steaming mugs.

Sitting there, without relaxing, but with my mind on the job in hand, I asked Maggs, my batman/driver, "Do we have the fuze mirror torch in the PU?" This was a piece of equipment designed to "see round corners." It consisted of a normal torch body with a metal tube about 18in long fitted at one end in place of the bulb and lens. At the other end was a bulb set in a reflector and at right angles to this, a round mirror on an arm which could be adjusted to any angle – see diagram, above.

Back in the tunnel, I slowly but surely removed the earth, concentrating only on the area where I thought a fuze pocket would be. I couldn't remove all the earth – something had to hold the bomb in position. After 20 minutes, I stopped and began to feel round the bomb, removing some more earth with my hand, and I felt a fuze head. With the trowel, I cleared sufficient earth to allow access for the fuze mirror. I raised it carefully, pushed it horizontally past the bomb until the light was shining on the fuze head. "Bugger!" I hadn't cleaned the fuze head, I had forgotten to put some rag in my pocket for just that purpose. "Ah well, bang goes another decent handkerchief – and they still required clothing coupons too!" Handkerchief in hand, I reached round the bomb again, felt for the fuze head and cleaned it. As an afterthought, I felt the fuze head with my fingers. "Were there two plungers, or only one plunger; only one would mean a long delay fuze – a 17B had one – two plungers! I'm in luck so far. Still, it might be a 50 fuze with a 17 in the other pocket, if there is one.

Right, now where's that fuze mirror? Switch on. Get that light round again. Now what's that? A 52? Can't be, there's no such animal. Of course, it's a mirror image – clot! A 25. Cushy. Just another ordinary impact fuze, probably isn't another fuze pocket anyway. But, let's have a look. Where's that trowel? Now to clear round the bomb about 15in lower. (Higher really, I'm working towards the nose!) Good! No other fuze pocket. So, only one fuze, and it's an impact."

Crawling backwards out of the tunnel into the shaft, I climbed up the ladder, and yelled: "BD discharger" to no one in particular. The sergeant came up with the BD discharger all ready for use and, back down the shaft, I opened its box and took out a bronze collet, connecting this to a flexible hose on the other end of which was fitted the cylinder of the discharger. Pouring the required amount of fluid into the cylinder, I screwed the cap on and attached a bicycle pump lead to the connector on top of the cap. Back down the tunnel, I screwed the collet onto the boss of the fuze head tightly, to ensure a fluid tight connection, and hung the body of the discharger from a hook I had put in earlier. Using the pump to build up pressure to the correct level, I turned the lever on the collet allowing the liquid to be forced down the side of the plungers into the fuze, and tried to remember how much of the fluid should now flow into the fuze before it became immunized.

One of the dangers was that, if too much pressure was built up, the plungers would be depressed and the bomb would explode! Somehow the Germans had found out that we were immunizing number 15 fuzes by depressing the plungers several times, so they brought out another impact fuze, a 25, which exploded if the plungers were depressed. Fortunately the boffins had come up with the Discharger system which forced fluid into the fuze without depressing the plungers (providing you were careful).

Giving a couple more pumps to maintain pressure, I could see that the fluid level was dropping nicely and knew I would have to wait about half an hour for the necessary amount of fluid to enter the fuze and so left it to go and collect the Merrilees extractor, (similar to the one depicted on the opposite page) ready for the next part of the job.

Once the fuze was immunized, I removed the Discharger equipment and said "Right corporal,

get the chaps to move that hunk of metal out of the tunnel and into the shaft, with the fuze uppermost, and we'll get the fuze out."

Back at the safe point, with another cup of tea, we relaxed and smoked cigarettes. I said, "Well, we should get this cleared up today, and those poor people can get back to their homes for a good and comfortable night's sleep."

Interrupting our welcome rest, the corporal came back to report that the bomb was ready. "Right, lay out the Merrilees kit. The cord from here to the shaft; screw in pulleys at both the top and bottom of the shaft and anywhere else where we might have to change the direction of the pull and let me know when it's done."

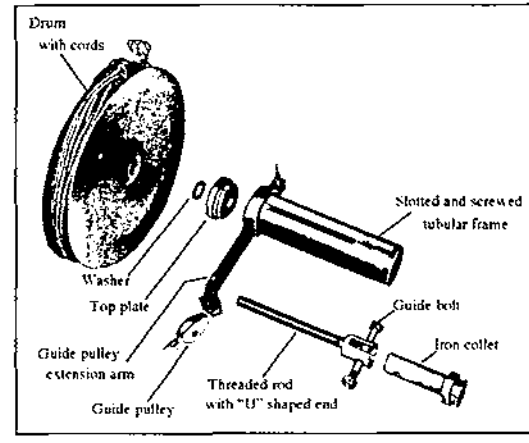
The danger wasn't over yet. Although it was only an impact fuze, there was still a possibility that the Germans had put an anti-withdrawal device under the fuze. I had always been surprised that there weren't anti-withdrawal devices under every fuze, after all they didn't cost much and the Germans must surely have known that at least ten per cent of their bombs failed to explode.

When the corporal reported that all was ready, I told everyone to remain at the safe point and returned to the shaft. Taking a fuze key out of my pocket, I applied it to the locking ring which circumvented the fuze. There were two slots in the ring, into which the key fitted perfectly – thank God for boffins! It took a lot of effort before I was able to unscrew the ring then, laying the fuze key on one side, I unscrewed it by hand and lifted it out, followed by the locating ring which was there to ensure that the German armourer put the fuze in the right way round. The next job was to put the collet on the head of the fuze. Once that was done I picked up the extractor tube of the Merrilees, placed it over the collet and screwed it onto the threads recently vacated by the locking ring. Picking up the long-threaded rod with th "U" shaped end, and inserting this down the Merrilees tube, I then connected the "U" shaped end to the tail of the collet by fitting the bolt through the slide holes in the tube, through the lined up holes of the "U" shaped end and the tail of the collet. Next, I put on the top plate, a washer and then the drum of cord, which I spun round until it was seated on top of the cylinder. I pulled some of the cord off the drum and ran it through all the pulleys in the shaft and above. I returned to the bomb, checked that the drum would rotate freely and that the cord was clear through all the pulleys, then walked back to the safe point.

Sitting down, I started pulling – slowly rotating the drum which in turn lifted the fuze by pulling the rod up through the centre of the drum as the drum travelled down the thread on the outside of the rod. All went well for a short time but soon I noticed increasing resistance. "I'll just go and check the line, it must be caught somewhere." Every line and pulley was clear, no snags or anything else which could account for the resistance felt. I started to turn the drum by hand: it moved but with difficulty. I climbed up the ladder, called out to the sergeant that I was going to have a go at extracting the fuze and returned to straddle the bomb – it was a bit cold! Grasping the drum with both hands, I started to rotate it again. Through my mind went the thought that this was the only way, for me. Technically, I should have left it, 'phoned HQ and asked for the steam sterilizer. That way would have been safer but might have taken two or three days longer and I was mindful of the people waiting to go home.

Having made up my mind, I set to work with all my strength. I managed about a quarter of a turn with each application. This went on for a few minutes, when there was a sudden snap! I nearly fell off the bomb as the drum started revolving rapidly.

"What now?" I thought. Very carefully I undid the bolt holding the threaded spindle to the collet. I was then able to lift off the drum with the threaded rod still in it. This revealed the collet with the top third of the fuze attached – the remainder, the worst part, being still in the bomb and containing the detonator and the gaine, which itself contained a very sensitive high explosive. This was a situation for which I was



Merrilees Fuze Extractor.

not prepared. There was nothing in the manual about fuzes breaking in half. I realized that the shock of the bomb hitting something and going through 180 degrees, must have moved the filling thus damaging the fuze in its pocket enough to cause the jamming.

Once again, I thought I ought to ring HQ and ask for the steam sterilizer. Back to square one! My mind was still on the poor residents existing in local schools and church halls however. "Bugger it. Never mind the rules, let's get rid of this bloody lump of metal." I went back to the safe point, told those waiting what had happened, and what I was going to do. (If the sergeant had any thoughts about my proposed action, he decided to keep them to himself.)

"Rig up the sheer legs and get that bomb up on the deck. I'll have a word with the local police." Leaving the men to get on with the job, I jumped into my PU and made for the nearest police 'phone box – one of those "Tardis" looking affairs. I had a key and was able to speak to the local police station on their own internal telephone system to enlist the help and cooperation of the superintendent. A police car and two motor cyclists were detailed to go to the site.

Returning to the site myself, I found the bomb already on the surface and it was soon loaded onto the 15cwt truck. To reduce the number of possible deaths, I decided to drive the truck myself. Telling the sergeant to organize the backfilling of the shaft and withdrawal of timber, and to 'phone the police station to announce that the residents could return home, I went over to the police car and motorcycle outriders to explain what I wanted them to do. There was a look of amazement on their faces, tinged with a little fear.

The idea was that the two motorcyclists would go on ahead, one stopping at the first road junction to ensure that we were not held up, the other proceeding to the next junction. When I had passed the first junction, the outrider would then have to overtake the truck and the police car in order to be at the next but one junction – leap-frogging all the way. The police car would precede my truck with lights on, flashing blue lights, and siren going – there was to be no stopping on this journey.

With the police car in front we set off, following the two motorcyclists. Once on the road I had difficulty in keeping up with the police car. The driver was obviously trying to keep the maximum distance between himself and the bomb.

After a hectic and fortunately uneventful five-mile journey, we reached the marshes where the bomb was to be dumped, prior to being blown up. I tooted the truck's horn, to indicate that I was going to turn off the road. The police didn't stop but turned in a tight circle, the driver tooted a "farewell".

Driving into the dump I pulled up at a suitable site and undid the tailboard. The forethought of the sergeant was obvious, the bomb had been loaded right up against the edge, wedged with sandbags to hold it in position. Once these were removed, I crossed my fingers and pushed it with my foot. "This is it," I thought, but yet again fate was kind and there was just a thump when it hit the ground – it was exploded later at our pleasure.

Of course, the report to company HQ merely said that the bomb had been defuzed and taken to the bomb cemetery for disposal.

The Brennan Torpedo: Part III
Installation, Employment and Withdrawal From Service, 1887-1906

MICHAEL KITSON MCSD NDD FSG

Other Options in 1887

At the time of the Brennan torpedo's purchase, the Inspector General of Fortifications (IGF) maintained it was superior in its performance to all other torpedoes, and his claim was well founded even though there were by then several other guided torpedoes and, within a decade, a legion of them; of these only two were purchased and taken into service – the Brennan, and the Lay, which was bought in small numbers by Peru, Russia and Turkey. In 1887 none achieved the speed of the Brennan, and only the Lay could be steered to its target and also match the Brennan's range.

The Lay torpedo could have been employed for the purpose the Royal Engineers had in mind; the interception of armoured vessels in narrow waters. It carried a charge of 150lb of dynamite, was powered by an electrically controlled gas engine, and ran partially submerged at 16 knots out to a theoretical range of 2600yds. But it was slow, vulnerable to gunfire, and as it ran on the surface could not strike the target at a sufficient depth to maximize the explosive force of its charge.(1) Moreover in trials on the River Thames at Erith in March 1887 its steering proved erratic.(2)

During the development of the Brennan torpedo and throughout its service, the potential of other torpedoes and weapons which might serve the same purpose for harbour defence, including the advent of the (Nordenfeldt) submarine,(3) were kept under review by the War Office. For example in the mid-1880s fixed shore-based batteries of Whitehead torpedoes were considered by the War Office for coastal defence, and a number was installed by other countries (at Spezzia, Kiel and Antwerp), but as they could not be directed, provided no advantage over gunnery, and also, though the Whitehead could achieve 24 knots in 1887 the range claimed for it was only 600yds,(4) and pessimistic estimates placed its maximum range even lower – at 350yds.(5)

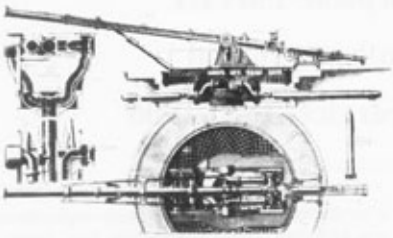
Another guided torpedo tried by the Royal Engineers in Stokes Bay during the early 1890s, when the threat from larger and faster torpedo boats was addressed, was the American Sims-Edison. There were two main components of this weapon; the body of the torpedo and a copper float beneath which it was suspended. The Sims-Edison was driven by electric power from a generator on shipboard, or ashore, and the cable by which it was electrically powered and directed unwound from a reel in the torpedo as it moved forward. The range of the torpedo was 4500yds, the full length of the electric cable, and from a standing start it gradually achieved a maximum speed of 25 knots. Doubt was expressed about the vulnerability of its electric cable to snagging and being cut, and the effect gunfire might have on the float.(6)

The Dynamite Gun

While the final negotiations for the purchase of the Brennan torpedo were still under consideration, another American invention, the "Aerial torpedo thrower" or "Pneumatic dynamite gun", was seriously considered as an alternative. The first gun of this type had been invented in 1883 by D M Mefford, an Ohio school teacher, but was developed and promoted by an artillery officer, Lieutenant Edmund Zalinski, an expert in the use of high explosives.(7)

The propellant for this gun was compressed air provided by a steam-powered compressor, and the 8in model of 1885 was able to throw a dynamite submarine mine to a range of 2000yds. Air pressure was used because the sensitivity of dynamite prohibited a powder propellant.

The trials in 1886 and 1887, which were held in public and attracted wide interest, demonstrated its rapidity of fire and the destructive power of such charges falling within 20ft of the target. They were aimed, and fell, accurately to explode on, or close to, or below, the target. As a result of these trials, in 1888 the United States Navy launched a "dynamite cruiser" (*USS Vesuvius*) armed with three fixed 15in tubes for coastal defence and countermining purposes, though the US Board of Ordnance did not



Cutaway section showing the 15in Pneumatic Dynamite Gun installed at
Dale Point Fort, Milford Haven.

adopt the gun for coastal fortification until much later, in 1895. Within three years of the trials, Italy and Britain had placed orders for single guns, and Austria, Brazil, Denmark, France, and Spain were reported to be interested in making purchases.(8)

Apart from the gun's destructive power (15in tubes could throw charges of a half-ton(9)), there were other advantages; the weapon was cheap to produce, the air pressure could be finely regulated to give great accuracy, and the gun was laid and fired by only one man. Furthermore, it had the merit of being virtually soundless – there was no report from the gun, and it produced no smoke, or flash, attributes compatible with the new emphasis placed by the Fortifications branch of the War Office on "invisibility", or camouflage, and the Director of Artillery became interested enough to negotiate the purchase of one gun for trial. He was supported in this by the Duke of Cambridge (the Commander in Chief). More surprisingly it also attracted interest and support from Royal Naval officers at the Admiralty, perhaps partly because the example of the *USS Vesuvius* enabled the weapon to match the Royal Navy's concept of their role – one of mobile attack and fleet action, – and because the lightness of the tubes suggested they might be employed by small craft such as torpedo boats. Its simplicity of manufacture made it attractive to both the Admiralty and War Office because of the chronic shortfall between the number of new-type, powerful, breechloading guns required for the Navy and Imperial defence, and the number which could be produced annually.(10) When the War Office discussed purchasing a single gun however, the Pneumatic Dynamite Gun Company, with possible purchases by other nations in mind, was confident enough to insist on a minimum order of 25, costing £200,000. The War Office's solution to this problem was to ask the Government of Victoria to purchase a single weapon to be tried and tested in Britain, at War Office expense, before its dispatch to Melbourne.

As a self-funding colony, Victoria bought weapons directly from armament manufacturers to such an extent that it was occasionally held up as a model for other less progressive, and less prosperous, colonies. Some of Victoria's purchases had been innovative weapons, for example the prototype "disappearing guns" obtained three years previously; a purchase which had provided the first trials and used by Armstrong and some officers to push the War Office towards their eventual adoption for Imperial coastal defence.(11) The Colony had repeatedly pressed the War Office for a supply of Brennan torpedoes, but was advised in 1887 there were none available and, even by 1890, the reply was only slightly more encouraging, as the War Office was prepared to supply them "...after meeting the most pressing wants of the Imperial defences..."(12) As a result of these delays, in May 1888 Victoria ordered a 15in Zalinski gun, which threw dynamite projectiles weighing 500lb up to about one mile, and construction plans were prepared for its installation in Victoria on Point Nepean at the Heads. But suddenly, the following December when the gun was still under construction, the Victorian Government cabled its Agent General in London to sell it "...to her Majesty's Govt or any other."(13) This dramatic change of mind may have been caused by the first cold wind of economic depression in Victoria, heralding the catastrophic bank crash of 1893, and an end to the boom years. Cuts in Victorian defence spending followed in 1891 when two metropolitan (volunteer) infantry battalions were disbanded and rates of pay were reduced.(14) But certainly the catalyst in the cancellation of the order for the dynamite gun was the new commandant of Local Forces, Major General Alexander Tulloch RA, who, on his arrival from Britain "...was just in time to stop the purchase of a dynamite gun which would have cost a large amount and been very expensive to keep up."(15)

The Pneumatic Dynamite Gun Company eventually agreed to the War Office purchasing a single gun and extremely successful trials followed in England at Shoeburyness during February 1891. The trials were conducted in great secrecy at the request of the company, which feared that if the purchase of a single gun became public knowledge it would jeopardize multiple orders placed by other European countries.(16) In 1892 the "Victoria Dynamite Gun" was

emplaced permanently for defence and further trials at Dale Point Fort in Milford Haven, (paradoxically in a position planned for a Brennan Torpedo Station) where it remained until 1897 when the installation was dismantled and the gun removed.(17)

Several batteries were built in the United States for coastal defence. The first ones, each containing three dynamite guns, were completed at Fort Hancock on Sandy Hook in New Jersey in 1893, and the next followed two years later on a bluff above San Francisco's Golden Gate.(18) Others were under construction in 1900 at Fisher's Island, New York, and at Port Royal, Carolina, in 1900, but whether they were completed is uncertain as pneumatic dynamite batteries were declared obsolete in 1901.(19) The experimental cruiser(20) which carried three, fixed-elevation, 15in tubes in the bow, was never developed further, but did see action in the Spanish-American war when the invisibility and silence of her guns were put to use in a night-time bombardment of Fort Morro in Santiago Bay, Cuba.(21)

Brennan Torpedo Stations

The torpedo stations, from which the torpedoes were powered, launched and guided, comprised a number of compact, very functional, specialized buildings and rooms. Each one designed for a specific purpose and containing equally carefully designed, specialized equipment to carry that purpose out.

In this they were not unlike a battery of guns of the same period. For instance, their architecture ensured the separation of one activity from another, such as routing torpedo retrieval (entrance) passageways separately from launching (exit) ways. A similar concept to the one which required cartridges and projectiles to take different routes from their separate magazines to the guns, if possible by separate lifts, so as to meet only at the gun's breech for loading.

We may not, now, be able to come to a full understanding of the complex industrial archaeology of Brennan Torpedo Stations (and certainly not in a short article such as this), mainly because the architecture and fitments of Brennan torpedo stations evolved over time, and in consequence were updated and altered whilst the torpedo was in service and also because the torpedo stations were dismantled and put to other uses after the torpedo was withdrawn from service.

This article will attempt first to set out the sequence in which the design of the torpedo stations was undertaken, and second to address in more detail some questions concerning the function and fitments of one particular torpedo station, the station at Lyemun Pass in Hong Kong.

Plans and Drawings

The major source of information for the design of Brennan torpedo stations, is the abundant (but incomplete) collection of plans and drawings held by the Public Record Office in London, many of them signed by Louis Brennan and his partner John Temperley.(22)

The collection begins in 1884 with initial sketches for the testing station at Garrison Point Fort, Sheerness, and continues almost without a break until 1907. But as the bulk of these drawings detail successive, as well as alternative, proposals for architectural alterations and installation of the fitments, care must be taken in their interpretation, because without supporting descriptive, or archaeological, evidence there is often no absolute certainty that the plans were carried out. For this reason the interpretation I have attempted must be considered to be conjectural. Nevertheless amongst the collection are a few Record Plans (surveys for record purposes), which can be relied on to show the architecture of an installation as it was at a particular date, but sadly these rarely give details of fitments.

It is interesting that torpedo stations differ markedly from each other and whilst plans and drawings do not, by themselves, supply enough information to account for it, perhaps further research and thorough archaeological surveys will do so. For example, there is an essential dissimilarity between torpedo stations built, with obvious constraints, into casemated forts and others which were not. Some differ because they underwent a major phase of redesign, from others which, although the drawings had been prepared, did not. It is also necessary to bear in mind that although the process of design, discussion and drawing, continued until 1907, the actual implementation of major improvements took place in quite short bursts. Two factors must have contributed to this: the necessity of obtaining finance through Parliamentary Estimates, and the undesirability of placing torpedo stations out of commission whilst alterations were in hand.

Between 1887 and 1893, from plans of installations for Garrison Point (Sheerness), Fort Albert (Isle of Wight), Fort Camden (Cork), Cawsand Bay (Plymouth), Forts Tigne and Ricasoli (Malta), and Dale Point Fort (Milford Haven), we can see a layout evolving which culminates in the cut and cover installation at Lyemun, Hong Kong.(23)

The evolution of a simple and functional design is arrived at through a process in which Louis Brennan, John Temperley and officers of the Royal Engineers,

suggest, discuss and discard numerous alternatives to the layout of the component rooms and fitments. A process which continued until 1906(24) creating torpedo stations which were amazingly complex (and precisely detailed) feats of mechanical engineering.

Torpedo Stations: The First Design Phase

Almost all the installations built were sited within the defensive capabilities of forts, but only four are built into the structure of the forts themselves. At two of these, Garrison Point and Cliffe, the existing gun casemates were adapted to accommodate the installation, and at Fort Albert and Ricasoli, although the installations were built alongside and within part of them, various components of the plan, such as the torpedo store, or the engine room, were built specifically for the torpedo, with the minimal adaptation of existing rooms which had been designed for other purposes.

During discussion, it is convenient to divide the process of the planning and construction of Brennan torpedo stations into a number of phases, the first of which, the development of a testing station at Garrison Point Fort, took place prior to the purchase of the torpedo, and was begun in 1884. At that time the guns of the Fort, a product of the Royal Commission of 1859, were mounted in two tiers of granite casemates, each with an iron armour shield.(25) The Fort, situated on the tip of the Isle of Sheppey, where the River Medway enters the Thames, was formed in the shape of a capital letter D. Thus its 44 guns, mounted along the curved front face, covered the River Thames on the right flank and the River Medway on the left.

In October 1884 *The Times* reported that War Office experiments were to be undertaken with the Brennan at Garrison Point Fort, and in May, the following year, that an upper casemate had been made available.(26) From an undated plan (which other evidence suggests was drawn in 1884) we know that this was casemate number XIV, on the western, left flank of the fort, facing the Medway.(27)

A steam winding engine powered by a single boiler was installed in the upper level casemate, and the launching way constructed so that the twin rails on which the torpedo ran down to the River Medway exited from the embrasure of the casemate below." Despite several months of delay caused by winter gales covering the launching way with shingle, building groins to protect them and also, inspite of difficulties, getting the boiler and engine to run successfully, by the last two weeks of December Garrison Point Fort Testing Station was operational and trials of the torpedo running out to its full range had begun.(28)

The following June one of these trials was the subject of a report to the Ordnance Committee by Major D O'Callaghan RA, whose account provides a reliable dated description of the design and operation of an early torpedo station, and therefore also provides a measure of how greatly they were subsequently improved. "The carriage", he writes, "from which the torpedo is launched is mounted on trucks (small strong wheels) resting on rails on a lower carriage, or trolley, on which it is brought round from the store to the launching way."

As Garrison Point Fort had long been a submarine mining establishment the use of narrow gauge tramways for moving heavy mine cases and cable etc was already established there. The gauge of submarine mining tramways (18in) and the torpedo launching ways (7in) differed, being determined, in the case of the launching ways, by the width of the torpedo.

The necessity for transferring the torpedo top carriage from the lower trolley to the launching way was described by Major O'Callaghan in his report: "These ways are of such a height as to form a continuation of the rails on the trolley and the trucks (small wheels) of the top carriage will, therefore, run on them when the latter is detached from the trolley." In this account the torpedo is described as being held on the ways outside the fort, whilst final preparations were made, such as the mast being raised. "When everything is ready for the run, the engine is started at slow speed, and the screw propellers commence to revolve. The steering wheel (which governed the difference in speed of the two winding drums and hence depth and steering control) at the top of the Fort is turned, the rudder deflected, and the starting trigger released. The top carriage at once starts down the incline and the torpedo leaves it as soon as it is waterborne."(29)

The design of this first primitive installation suffered from a number of distinct disadvantages. For example, during launching the method of coupling up the wire from the torpedo to the intake drums of the winding engine in the upper casemate was clumsy, and must have been a time-consuming process. It was done by leading a short length of wire from the winding engine, over a universal pulley at the embrasure of the upper casemate so as to hang down the outer wall. A soldier, outside the fort and protected from fire only by the glacis which hid the launching way from the River Thames, raised the mast, coupled the two ends of wire and, presumably, stood well back as the winding engine was started and the torpedo wire taken onto the winding drums.

Another difficulty was caused by the use of the detachable top carriage, as a second torpedo could not be run until it was cleared from somewhere in the sea at the end of the slipway. Also, the boiler and steam winding engine in the upper casemate were dangerously cramped, with little protection if a wire snapped; so cramped that the governor of the vertical engine rotated only a few inches from the roof.(30) The casemate below could only hold five torpedoes even when packed closely side-by-side. Initially such considerations were of minor importance indeed, irrespective of the problems shown on paper, it is probable that the torpedo brought round from the Brennan Torpedo Factory behind the Fort was the only one completed at this date. It seems, therefore, that the purpose of fitting out Garrison Point Testing Station during this first phase was essentially experimental, with the prime intention of testing the design of the torpedo as well as the installation. Thus some of the problems encountered here were not finally corrected at this site until the 1890s, in particular those which derived from the difficulty of adapting casemates to the uses of a torpedo station. Conversely, minor improvements which could be made economically were put in hand quickly, and lessons learned from Garrison Point Testing Station were applied promptly to the design of other torpedo stations, in particular to the first of the seven torpedo stations begun in 1887.

Torpedo Stations: The Second Design Phase

The first Torpedo Station to be completed (as far as the general public was aware) was situated at Fort Albert, where the Solent narrows opposite Hurst Castle. In this case design began shortly after the torpedo was purchased, and the installation was operational in a remarkably short time, – just before the celebrated demonstration of the Brennan torpedo's destructive power from Fort Albert on 26 June 1889. There is no doubt that the object of this demonstration was to obtain parliamentary support to finance the next phase of design and construction through Supplementary Estimates; the urgency applied to design and construction at Fort Albert torpedo station may have been a product of it. The installation introduced the "classic" torpedo station design. Here the problem of using cramped casemates was avoided because they were thought to be of less value as protection anyway, being of brick and long considered useless against rifled gunfire.(31) The bulk of the Fort was, therefore, filled with sea sand and the torpedo station added in bomb proof concrete buildings outside the fort and set against its protected, rear and (upstream) northern walls.

Although the first drawings for the remaining six installations were begun shortly after those for Fort Albert, they remained on the drawing board long after Fort Albert was operational and consequently contained some features of more advanced design.

The first surviving drawings for Fort Camden (Cork Harbour) were made in 1887; followed in 1888 by Forts Tigne and Ricasoli, Cawsand Bay, Lyemun Pass, and Dale Point Fort. Also during 1888 plans were made by the colony of Victoria to provide an installation at Observatory Point for the defence of Port Phillip. With the exception of Observatory Point and Dale Point Fort, which were never built, these were completed between 1893 and 1894.

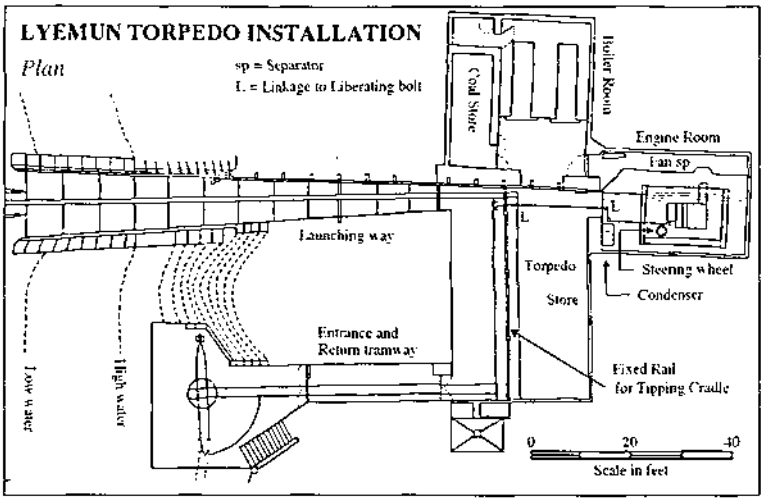
For one installation, Cliffe Fort in the Thames Defences, no plans have yet been found, nor any accurate records from which to date its commencement and completion. But we do know that it existed in March 1891, when the Inspector General of Fortifications reported that seven torpedo stations were either completed, or in progress (Cliffe Fort, Garrison Point Fort, Fort Albert, Cawsand Bay, Fort Camden, Fort Tigne and Fort Ricasoli). He also listed a further eight sites for installations, which were to be undertaken as funds became available, amongst them are Milford Haven, Hong Kong, and a second installation to close the eastern entrance to Plymouth Sound at Fort Bovisand.(32)

In 1891 the problem of space at Garrison Point Fort was addressed by building a torpedo store (the room usually next to the head of the launching way, where torpedoes stood ready for launching) outside the eastern, River Medway, side of the fort. This torpedo store was unusually large as it held 12 torpedoes. It is possible, but by no means certain that a similar update took place at Cliffe Fort.

Lyemun Torpedo Installation

This Brennan torpedo station is located on the (southern) Hong Kong Island side of Lyemun Pass; the narrow eastern entrance to Hong Kong harbour. It is a typical second phase development, and serves to demonstrate the great extent to which fittings and machinery had been developed since 1884. When the first plans were drawn in 1888, the colony comprised Hong Kong Island, Stonecutters Island and Kowloon Peninsula (the adjacent mainland as far north as what is now Boundary Street).(33) It was by then a vital coaling, supply and refit base for the Fleet on the China Station, and Hong Kong's strategic importance increased with the growth of the Naval presence until, by 1898, it was second only to the Mediterranean Fleet's base at Malta.

The tactical role of Brennan torpedo installations altered over the period of their use, but in addition to



their deterrent value they were employed to carry out two main tasks. Initially in the mid-1880s, they were thought useful as supplementary weapons to submarine minefields at a time when Defence Electric Lighting was still undeveloped and the night-time defence of minefields posed problems. The method of attack was to send ship's boats into the minefield at night to clear a way through by countermining – previously, by daylight, the attacking warships positioned outside the minefield would have attempted to silence the guns of the defence. Thus Brennan installations were sited so their torpedoes ranged in front of the minefield. Although the technique of rapidly laying, maintaining and defending submarine mines was perfected between 1883 and 1892(34) it took time (and money) to actually implement these defences; practice, at some ports, lagged well behind the theory and so a good case could be made for the use of Brennan torpedoes in addition to minefields.

The second task for Brennan torpedoes was to prevent enemy vessels rushing, or running past artillery defences at speed, and because by 1894 torpedo boats and destroyers were capable of 27 knots, the defence of ports within their range was reviewed. This resulted in a report by the Joint Naval and Military Committee of Defence, which listed Malta and Gibraltar and the whole south coast of Britain from Harwich to the Scillies as being vulnerable. Hong Kong was to be given special consideration because of the presence of a Chinese torpedo boat station at Whampoa, as well as the proximity of bases of other European powers on the China coast. The Committee recommended an urgent provision of means for closing the entrances to ports rapidly, as well as quick-firing guns and Defence Electric Lights. The decision to increase the speed of the Brennan torpedo and the third phase of the development of torpedo stations which followed must also be seen as a product of these concerns.(35)

Defence posed a particularly difficult problem for Hong Kong, the complex topography of its harbour needed a large number of guns (17 batteries extant or approved in 1887). The distance between Hong Kong Island and Stonecutters Island required a submarine minefield 4000yds across to close the main western entrance, an area of water the Officer Commanding considered to be "... much too great (in extent) to be efficiently defended by submarine mines, and," he added "an increase to the armament would not afford any satisfactory solution to the problem."(36)

The eastern entrance through Lyemun Pass, although sufficiently narrow, proved at that date too deep, being 25 fathoms at low water, and the bottom too crevassed, for submarine minefields to be established.

Even as early as its first trials in Australia the Royal Engineers had recognized the Brennan torpedo's suitability for closing narrow channels where submarine mines could not be employed. In 1893 when writing critically of the employment of Brennan torpedoes and of the catchphrase "running past", Captain G S Clarke ceded that there were nevertheless two ports in the Empire where enemy warships could run past to good effect into deep water with plenty of room to manoeuvre; the Heads to Sydney Harbour and through Lyemun Pass into Hong Kong Harbour.(37)

Lyemun Pass is roughly rectangular, 400yds wide at its narrowest and 900yds long. The torpedo station was installed on the (southern) Hong Kong Island shore at the inner (western) end of the entrance channel. The high ground behind the torpedo station held the batteries of the eastern defences which were enclosed by a series of deep ditches and caponieres, thus, the torpedo station was also included within the landward fortifications of the Lyemun Redoubt and served by the same Defence Electric Lights of which, by 1906, there were five.

Architectural Layout and Structure

It is useful to visualize the ground plan of Lyemun torpedo station as taking the shape of a cross. Thus the main upright of the cross represents the launching way, which enters the sea at its foot, with an engine room at the head of the cross, the coal store, boiler room and

water tank room to the left of the cross bar and the torpedo store to the right. One feature impairs this simile as, from the side of the torpedo store farthest from the launching way (the outer end of our cross bar) an entrance passage runs parallel to the launching way from the torpedo store to the shore. The rooms were cut from the rock of the steep hillside, and then, by the process we know today as cut and cover, the walls were lined and the roof arched in brick. When the hillside above was made good with earth and rubble all that could be seen of its structure were the air vents above the torpedo store, a narrow slot cut into the rock for the launching way and the opening to the entrance passage.

In addition to these components a wire and general store was built beside the narrow gauge track, which connected the jetty for retrieval with the installation. The wire store contained tanks of lime water in which "used" wire was stored to prevent rusting, and also a wooden chest for storing new wire in quicklime. In the wire store at Lyemun, torpedo drums were coiled, and engine winding drums uncoiled, on hand winches, and the hut also contained handling machinery in the form of an overhead traveller, hoist and turntable. The tracks (their course can still be followed easily) continued along a causeway at the sea's edge to the retrieval jetty on which stood a 30cwt crane.

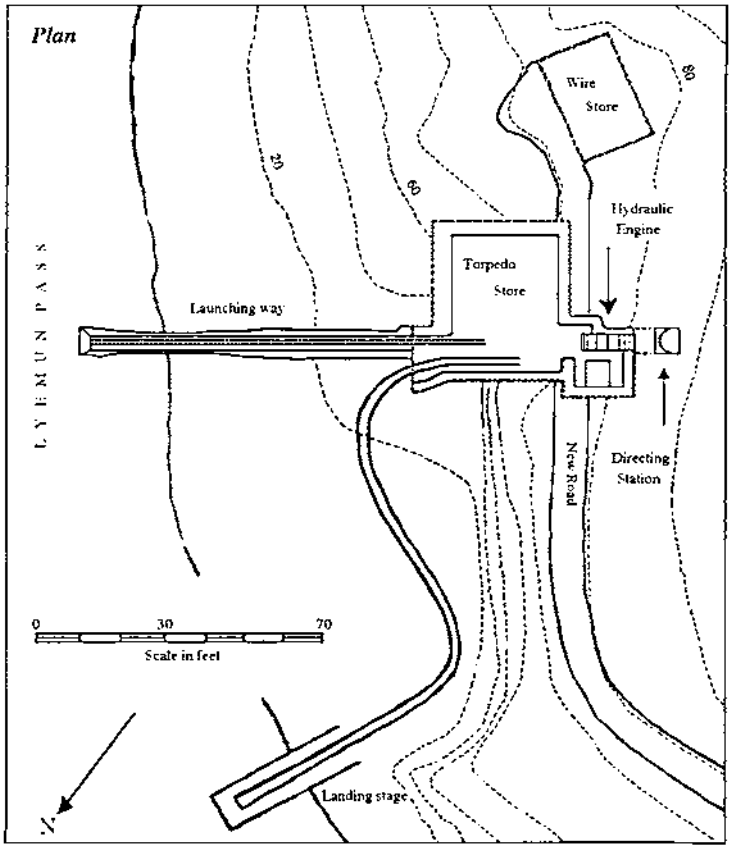
Coal Store, Boiler and Engine Room

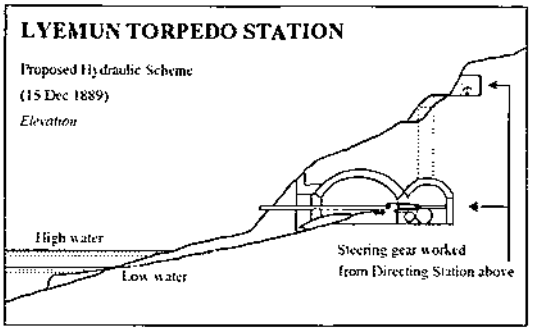
The winding engine, situated immediately behind the head of the launching way, was driven by a pair of horizontal cylinders, with the cranks placed at right angles to each other. Steam was raised by two coal-fired, single-flue, Cornish boilers. Cornish boilers were one of the most common type available and, although by the 1890s less efficient than others, their simplicity made them easy to clean; a distinct advantage if they were to be used where feed water was impure. The boiler room was placed between the coal store and engine room and as the coal store was filled by way of a chute from the road above, there was no need for coal to pass beyond the boiler room. The activities of engine and boiler room (as well as the coal dust), were further separated by a door.

Both boiler and engine rooms had little space to spare as the steam plant included a labyrinth of steam and water pipes as well as an impressive array of auxiliary gear, such as condenser, separator, pumps, stop valves, safety valves, injector and settling tank; the largest item amongst the auxiliary equipment being the condenser.

Condenser and Auxiliary Steam Plant

Initially condensers were installed in Brennan torpedo stations to limit the great amount of steam exhausted above the installation – enough to signal its exact position for a considerable distance and, worse, to signal the precise moment a torpedo was launched. It was also thought that steam might obscure the view when directing a torpedo to its target. The first attempt to solve this problem was directed towards finding a method of delivering the hot waste steam directly into the sea but this idea was given up when the delivery pipe was shattered by a back rush of sea water caused by the formation of a vacuum. Another entirely original solution to the problem proposed altering the power source of the winding engine from steam to a water turbine, and in 1889 plans were prepared for the torpedo station at





Lyemun to be powered by an hydraulic engine. To obtain sufficiently high water pressure for a turbine it was planned to pump water up to a reservoir on the top of Mount Parker, over a mile from the torpedo station, and 1700ft above the engine.(38)

As well as entirely removing steam and smoke this scheme dispensed with the necessity of raising steam before becoming operational, and the need to maintain it continuously when standing to. The hydraulic engine had two other advantages: first the torpedo station, as well as its machinery, could be simplified down to only three components, a torpedo store, engine room(39) and a directing station on the hill above. And the simplicity of its operation enabled the steering gear to be controlled from this cell by one man. Second, as the speed of water turbines can be regulated very precisely by adjusting the flow of water, this advantage could be applied to obtain exact control of the difference in speed between the incoming wires from torpedo to winding engine; the method of steering the torpedo described in the early patents.

In 1889 hydraulic engines such as the French Girard Turbines were attracting attention because of their simplicity and economy. In 1881 a Girard with a head of water of 594ft was capable of 210rpm, and a Pelton wheel used at an Alaskan goldmine in 1890, with a head of water of 400ft, developed 500hp; it was claimed to have driven 240 stamps, 96 ore mills and 13 ore crushers.(40) The hydraulic engine's practical use was, therefore, well established, and it seems that enough power could have been generated for the torpedo to achieve the high speeds demanded of it.

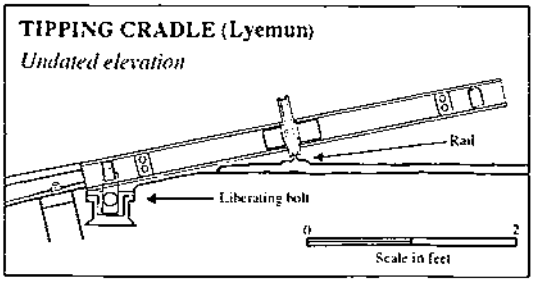
However, this proposal was also abandoned and an ejector condenser adopted which, although a lot of water was required, removed the steam economically. Condensers had long been used to improve an engine's performance by creating a partial vacuum on the exhaust side of the piston; ejector condensers achieved this by combining exhaust steam, travelling at high velocity, with a stream of cold water through one, or more, combining cones.(41) It seems probable (from the incomplete evidence of partial plans) that at some torpedo stations (Forts Albert, Camden, Ricasoli and Tigne) the waste water was lost by being discharged into the sea, and therefore a very considerable quantity of water was required. This need was met by storing about 12,000 gallons of saltwater, and 12,000 gallons of fresh water in separate header tanks located just behind and above the boilers. The height of the tanks was sufficient to provide more than the 20ft of head required for the ejector condenser, and as the saltwater was raised from the sea by a pump driven by the engine, the supply was unlimited.(42) It can be safely assumed that fresh water was reserved for the boilers, as salt water would have produced excessive corrosion and scaling.

At Lyemun (and possibly at Piers Cellars) the arrangement was different as only fresh water, taken from a large reserve tank on the hill above the installation, was fed to a single header tank. It is possible, therefore, that condensate (condensed steam) was recycled to the boiler, with, perhaps, the condensing water as well. On plans for the engine rooms of these two stations additional equipment is shown which does not appear on plans for others. For instance, a separator, used to remove impurities such as oil from the steam, and water produced by heat loss during the passage of steam from the boiler to the engine. Also a rotary air pump was installed, probably with the object of drawing off air and gases which leaked into the condenser, or were carried into the condenser by the steam and, as they were noncondensible, air pumps were used to prevent them building up and eventually destroying the vacuum.

Torpedo Store

A SERVICE torpedo, when fully loaded with wire, weighed over a ton(43), and this was a prime consideration in the design of installations to provide for handling torpedoes quickly and without damage. This was vital when they were run in succession, and needed to be moved sideways from the torpedo store onto the launching way as efficiently and quickly as possible.

For this Brennan devised the Tipping Cradle, which was a trolley formed as an extension of the launching way and on which the four small wheels of the torpedo

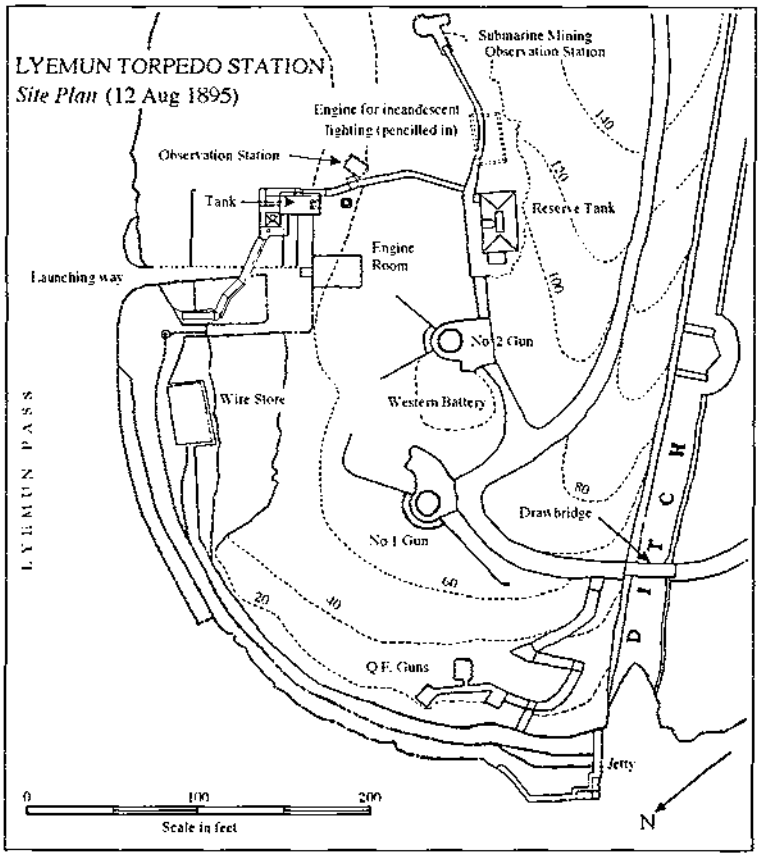


rested. The cradle was itself fitted with two larger wheels placed at right angles to the line of the launching way, and the rims of these wheels were recessed to engage with a single rail which crossed the floor of the torpedo store, from the back of the store to the head of the launching way. The ten torpedoes in the store(44) lay side by side, each on a tipping cradle, so the first torpedo for launching was moved sideways along the transverse rail, until the cradle lined up with the extension of the launching way. It was then tipped forwards (its cupped wheel rims pivoting on the transverse floor rail) so that the rails on the cradle formed an extension of the rails of the launching way. In this position the torpedo rested on its wheels at the head of the launching way, ready for launching, and pointing downward at an angle of 12° to the horizontal. It was held from moving down the ways by a bolt (liberating rod), which engaged with two small lugs, or stops, set on the underside of the torpedo next to its forward wheels, and another pair of stops, set next to the torpedo's rear wheels, prevented it from rolling backwards off the cradle during handling. The liberating rod was connected through a linkage to a lever beside the winding engine and so could be withdrawn by the engine driver to start the torpedo down the ways.

Handling in the store was simplified by an overhead traveller used to lift the torpedoes, either to change their order, or to move them from the narrow gauge truck on which they were brought into the back of the store.

Torpedo stores usually included a recess for a safe in which the depth mechanisms of the torpedoes were kept when not in use, and also the record books for each torpedo. However, these do not appear on plans for Lyemun, nor does the fireplace for heating.

Maintenance work on the torpedoes was difficult in the poor lighting conditions of the installations, which must have made running them at night a hazardous operation. Replacing the oil (hand) lamps by electric (incandescent) lighting was tried out at some home stations in 1894; and at Lyemun, on a plan dated 1895, a building for an oil engine to power the dynamo for them is shown close to the reservoir.(45)

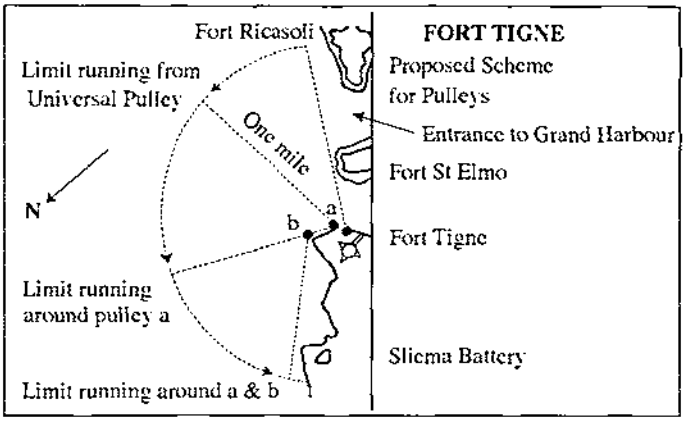


The Launching Way

At Lyemun the rails on which the torpedo ran into the water were 90ft long from the tipping cradle to the end of the launching way. They began 5½ft above high water, at an angle of 1in5 and levelling gradually to an angle of 1in7, ended 3½ft below low water. At Lyemun the total descent (measured vertically) was 15½ft.

The length and slope of the ways varied considerably between stations(46), the longest were those proposed for Dale Point where there was a very considerable tide of 18ft between springs. This required a launching way over 250ft in length and entailed a 40ft vertical fall from top to bottom.

Dale Point Fort was the first station for which it was proposed to cast the 84 pylons to support the ways in iron. Doubtless the cost and length of these ways were, in part, the cause of the plans for this installation being dropped. Also, unusually for a Brennan torpedo station, they were remarkably exposed, and perhaps their vulnerability to gunfire at low tide was unacceptable.



Certainly to a fast torpedo boat armed with a quick-firing Nordenfeldt, and running in through the heads, a Brennan torpedo travelling down the long ways at low water, would have presented an irresistible target – one not unlike a modern arcade game.

At Lyemun the launching way ran through a narrow cut to the sea, which both hid and protected it. Other installations employed similar methods; a large traverse, or the wall of the fort providing protection, with the addition, in two instances, of a lean-to wooden roof to hide the launch from the rear. The outer ends of the cut at Lyemun were faced with brass sheathing, most probably intended to prevent the incoming wire from snagging and damage. Earlier plans for the installation at Fort Tigne (1888) show quite clearly that serious consideration was given to using pulleys, mounted on bollards, on Point Dragut, against which the wires might run so as to increase the arc of the torpedo's lateral range. By arranging the incoming wires to run against two bollards Brennan proposed to turn the torpedo through an angle of 160^{o} and so enable it to round the point and run close along the coast off Sliema.(47)

Transmitting power between the winding engine and the torpedo by the use of wires allowed great flexibility in the architectural layout of the installations, for instance if it was necessary to place the engine room to one side of the head of the launching way, with the engine working at right angles to the head of the slip, this could easily be achieved by running the wire round a pulley, as was the case at Ricasoli. However, since the wires were drawn in at about 64ft per second it was essential that they ran from torpedo to engine without rubbing or snagging, or endangering personnel.

Launching posed a problem because although a torpedo ran in a straight line through the cut into the sea, if it was then to be turned to the left, or right, the wires would probably be fouled at the end of the ways.

Brennan devised a way to keep the first pulley, that is to say, the first over which the incoming wires passed, close behind the torpedo as it ran down the slip, and then lock into position above the end of the cut as a universal pulley. The equipment he devised for this was known as the Travelling Carriage and Girder.

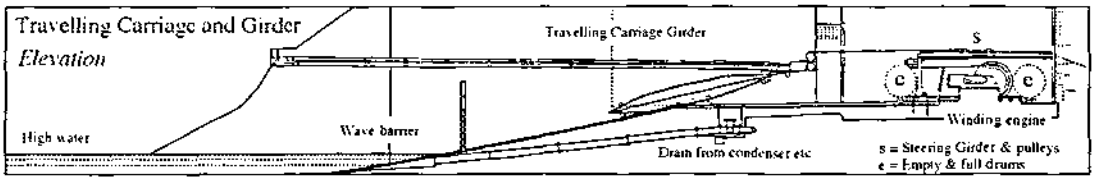
As its name suggests a girder fixed to one wall of the installation above the launching ways, carried a sliding carriage on which two pulleys were mounted, the driving and universal pulley, and over which the wires ran. The axle of the driving pulley was formed as a pinion, which engaged with a rack on the girder, so that, in simple terms, it operated as follows: as the wire was taken in it revolved the driving pulley and consequently drove the travelling carriage to the outer end of the girder where it was locked into position by a retaining catch and the driving pulley disengaged to allow the wires to run over only the universal pulley.(48)

In this position the universal pulley provided the best lead to the wires, well clear of the installation. The girder at Lyemun was 74ft long and sloped slightly upward to its outer end, which might have aided the travelling carriage's return to its original position after a run.

At the inner end of the girder was a fixed pulley and from it, at Lyemun, the incoming wires ran back only a distance of about 18ft to the steering pulleys above the winding engine. From the steering pulleys (one for each incoming wire) the wire was led over a dynamometer to the winding drum. This measured the stress on the wires, and was also used to provide records of stress during a run.

Steering Mechanism

An explanation of the method of steering the Brennan torpedo published in June 1887 by the magazine *Engineer*, described the winding engine at Garrison



Point Fort in detail, and this account has been accepted as the correct one since then. Its assertion that two drums were used, and their speed was differed to steer the torpedo, restates the description given in Brennan's second patent and there is no doubt that, originally, this was correct. Furthermore, this method was probably used at Garrison Point Fort until about 1892,(49) as an undated plan and elevation show details for the installation of a vertical engine exactly corresponding to the engine illustrated in the *Engineer*. But at other torpedo stations this method of steering was not proposed during the second phase of torpedo station development after 1888, nor were two separate drums used.(50)

The type of winding engine shown on the plans for all stations during the second design phase (c1888 to 1902) was a twin cylinder horizontal engine and this type was installed at Lyemun. Above the winding drum of the engine and placed in a direct line behind the travelling carriage girder was a second girder (steering girder) upon which the steering pulleys were mounted.(51)

In the case of this type of engine both wires were attached to the same drum, but separated by a flange as they were wound on. Therefore, as the drum was constructed in one piece there is no doubt that the wires were wound onto the drum at exactly the same speed. The difference in speed which worked the steering and depth mechanism of the torpedo was obtained by drawing back one steering pulley along the girder and simultaneously moving the other forwards by exactly the same amount. The maximum amount of travel which could be obtained between them in this way was perhaps 14ft, at the most, which would have produced a difference of about five revolutions between the torpedo drums.

The steering wheel which set the position of the pulleys on the steering girder was set on a pillar at the opposite side of the engine from them. Drive from the winding drum shaft was transmitted via a belt drive to a "jack in the box" differential mounted above the central shaft of the driving wheel. From here by turning the steering wheel left, or right, it was transferred by geared drive shafts to the front end of the steering girder where a chain drive moved the driving pulleys backwards, or forwards.(52)

Directing Equipment

The man at the steering wheel in the engine room could not see to direct the torpedo and relied on instructions from the officer in the directing station above. It was extremely difficult to judge the course of a torpedo running in a curve except at a considerable height above sea level, in fact 40ft was thought to be the absolute minimum needed to follow the torpedo and direct it to its target, and as most directing stations were placed some distance from the engine room the method of communication adopted was similar to a ship's telegraph, and based on the position of a pointer on a dial supplemented by bell signals.

For this reason the signals from the directing station were simple, and those from the engine room to the directing station were even more limited – to pressing a buzzer, which acknowledged the order and confirmed it could be carried out. When telephone communication was added is unknown, but it was standard equipment at all installations by 1903.

There were two dials in the engine room, one, for steering, was mounted on the same pillar as the steering wheel, a second was reserved to convey preliminary orders to the personnel in the torpedo store and engine room, and orders for engine driving. Engine driving and steering were regarded as different functions and undertaken by different personnel.

The directing station at Lyemun was positioned on the hillside southeast of the installation, on the 65ft contour with a clear view of the whole of Lyemun Pass. From the archaeological remains(53) it appears to have been 5ft 2in wide and 9ft from the front curved bay to the back wall. It was similar to one which still exists at Fort Ricasoli, "...small and inconspicuous,"(54) protected by a sloping steel armour roof, and having an observation slit set in the full width of the front wall. The sending instrument was placed on a ledge below the observation slit and held a detachable pair of powerful Zeiss binoculars. The instrument was simplicity itself, was probably movable, and was operated by pressing one pair of keys to work the steering dial, and a second pair of keys for the engine dial. The dials in the engine room were duplicated on the back wall of the directing station.(55)

Only sparse information has been found to show the way messages were conveyed, but it seems likely that on the dials the pointer could be moved to 23 positions. Zero was at the top, with 11 positions to the left and 11 to the right. Thus if the Directing Officer pressed once on the left key of one set, the pointer on its corresponding dial would move one position to the left. And the right key pressed five times would move it five positions round the dial to the right. If both keys of one set were pressed simultaneously the pointer returned to zero. In this way the amount of steering needed, to left or right, could be signalled to the man at the wheel, which would explain the recommendation in the "Memoranda for Torpedo Station Officer" which states "the steering should be put on gradually, if possible, two, or three at a time."(56) And although there is no definite evidence for it, presumably, positions on the engine dial were used to signal general commands such as "are you ready" and "connect up" as

well as commands to the engine driver such as "half-speed," "full-speed" etc.(57)

With the torpedo wires connected up to the winding drums and the torpedo on the cradle at the head of the ways ready for launching, and with the target in view, the directing officer would first signal "Are you ready", which the NCO-in-charge acknowledged. This was followed by "Stand by" – a warning to all personnel to be prepared to act immediately on the order to launch the torpedo. Then when he judged the target to be within range, the directing officer would attempt to get the first shot in as quickly as possible; while the installation was still well under cover, and early enough to get in a second shot if necessary.

The command "Full speed" fulfilled a dual purpose and on it being signalled the engine driver released the liberating rod, and at the same time opened the throttle of the winding engine to drive the propellers at the maximum launching speed. The moment the liberating rod was withdrawn, the torpedo began to run down the ways and took its preset depth. Then, as it travelled underwater, the course of its mast was followed by the officer who signalled steering directions to the engine driver.

In fact, there was little time for fancy steering, as can be seen if we estimate how long it would take a torpedo to reach a target entering Lyemun Pass close to Lyemun Head on the opposite shore, a distance (allowing for running in a curve) of about 1000yds. From the command to launch being given until the torpedo struck the target would have taken just under two minutes.(57)

The Introduction of Mark II Brennan Torpedoes

The second phase of design and construction was followed between 1894 and 1898 by the redesign of the Brennan torpedo prompted by the emergence of faster and larger torpedo boats and torpedo boat destroyers during the 1890s. The object was to increase the torpedo's speed from 20 to 30 knots, which required a higher breaking strain for the wire and an increase in its diameter from 0.4in to 0.7in. This entailed a comprehensive redesign of the mechanism to accommodate larger and stronger components within the same internal space as it was impossible to increase the size of the torpedo itself. Eight torpedo stations had already been completed(58) and their architecture and fitments prohibited any increase to the external dimensions of the torpedo. The difficult task was accomplished and the "improved" Brennan (Mk II) was in production by 1898, when the Brennan Torpedo Factory was reported to be "...in full swing"(59) manufacturing it.

The Floating-Station Experiment

At the same time as its speed was increased, successful experiments were made in launching the Brennan torpedo from a ship at sea, and a converted trawler, renamed *Sir Howard Elphinstone* became the first seagoing installation. The method of launching, described as using davits was probably similar to the dropping gear adopted for Whiteheads on small torpedo launches. But whatever the method was it proved effective enough in trials in 1901 for the trawler, stationed in the Thames Estuary at the Nore, to prevent several attempts to enter the Medway and Thames by a torpedo boat towing a target, as "... the attack failed completely the torpedo getting home on the target in every run."(60)

The *Sir Howard Elphinstone* was retained as an effective mobile installation and one which could be called on if any of the Brennan torpedo stations was out of commission for repair, or alteration.

Torpedo Stations: The Third Design Phase

Plans and drawings made during the last phase of development of the torpedo stations are concerned with alterations to the architecture as well as changes to fittings by: the adoption of vertical engines in addition to the horizontal engines already installed; the addition of a second launching way and torpedo store, which enabled two torpedoes to be launched in rapid succession and doubled the number of shots possible; the phasing out of ejector condensers and their replacement by surface condensers; the addition of armour which enclosed the universal pulley at the end of the travelling carriage girder.

Although plans were drawn up for these improvements at most installations, including Lyemun, only at Cliffe Fort is there any clear archaeological evidence of a second launching way, and it is assumed, with this one exception, that the torpedo was taken out of commission before the changes were carried out.

At Cliffe Fort a partially dismantled large cylindrical iron drum, set in the roof of a casemate of the installation, has attracted interest as it is thought to be the remains of one of the directing stations. This idea derives from an account of Louis Brennan's inventions, which mentions that direction stations were "... 40ft high telescopic steel tower(s) hydraulically extended."(61)

As this would seem to have been an expensive option, a more plausible (but still uncertain) explanation for the drum is that it is part of a water-cooling tower, used to cool the discharge water of the condenser for reuse. One to which the remains at Cliffe Fort bear a resemblance is the Worthington Cooling Tower, and in this system, hot water, after passing through the condenser, was pumped to the top of the 30ft tower, where it was distributed by a revolving spray over surfaces of wire mesh, or pottery pipes, packed into the tower. A fan blew cold air upwards and the water was cooled as it fell, in thin films and droplets, by contact with the surfaces, and by evaporation.

It was then collected in a tank at the bottom of the tower and carried back to the head of the condenser.(62)

Below the cylindrical drum at Cliffe there appears to be the remains of a suction tank for cooled water, and although the room in which they are situated is labelled "Disused Rising Tower" on a plan dated 1916,(63) until further drawings are found, or extensive archaeological research completed, its use remains undecided.

Withdrawal from service

In the aftermath of the Boer War when the standing of the Army was singularly low and during a period in which the economy left little to spare, the massive Naval building programme, in competition with Germany, set the scene for a bitter competition for funds between the Services, and in it the Blue Water Naval theorists had the upper hand. Quite simply, for many politicians, this theory had come to mean that the Navy should take sole responsibility for home and Imperial defence. It was also a time of reorganization for the Army and the War Office, which brought with it the disruption of committees to which defence questions were normally referred and devolved decision making onto only two, or three, persons.

In May 1904 Admiral "Jacky" Fisher became First Sea Lord. He was energetic, charismatic, had excellent political connections, was as utterly determined to rebuild and reform the Navy as he was convinced of the inevitability of war with Germany. He also foresaw that submarines would become powerful weapons and used his influential connections to further their adoption, which, characteristically, included demonstrating them to King Edward VII at Portsmouth.(64) And it was their development which reopened the question of whether the Navy, or the Army, should be charged with responsibility for coastal defences. Consequently in 1903 the Admiralty suggested that all submarine mine defences could be withdrawn and the facilities put to better use for coastal defence submarines.

In 1904 this was accepted by the Army Council. However, the seriousness of such a move was immediately apparent, in particular at places such as Australia, Hong Kong and India, where there were extensive submarine mining installations, no submarines, and little chance of obtaining them in the foreseeable future. As a result, in 1905 the Owen Committee was formed to report on all defences abroad. Their first report in July 1906, produced the scheme, which was put into effect, for a rationalization of guns to four types only, 9.2in, 6in, 4.7in and 12pdr, and in addition to this all Defence Electric Lights became fighting lights (not fixed-beam), and submarine mines were abandoned, as was the Brennan torpedo, which was considered no longer necessary to the defence.(65)

If we consider that when the new 6in guns were installed throughout the imperial coastal defences their gunners were instructed to open fire at 10,000yds, with a fair chance of scoring hits immediately, then the decision to disband submarine mining seems at face value a progressive step.

But submarines, of which there were then very few, barely seaworthy, vessels in Royal Naval service, were not, as was proposed, used for either harbour, or coastal defence. And such vessels could not keep station underwater for any length of time, even if stations could be found to place them where they could intercept raiding cruisers. However, the mines were altered to naval pattern, the electrical submarine mining gear destroyed and submarine mining boats and Brennan torpedo stations put to naval use.(66)

Mines were used on an unprecedented scale in the First World War, and submarine minefields of "controlled" as well as "automatic", or "offensive", mines were employed by both sides. The suddenness and finality of the decision was certainly regretted when in July 1911 the Navy began to look for a safe defended base in Scotland, where amongst other sites the Firth of Forth was considered, but its defences were found "... to be practically nil," as previously submarine mines and a volunteer mining service had provided the core of the defence;(67) as great a loss as that of the equipment must have been the dispersion of trained personnel and irreplaceable expertise. Nevertheless controlled minefields were laid for the defence of Scapa Flow in 1915, as well as the River Thames at Coalhouse Fort on the opposite bank to Cliffe Fort.(68)

That minefields provided an effective defence was demonstrated by the Turks during 1915 in the Dardanelles, where automatic and controlled minefields covered by guns, and supplemented by drifting mines carried down by the current, closed the Dardanelles and inflicted heavy losses on the Entente Naval forces before they were forced to give up the month-long attempt to break through.(69)

The allies also made an extensive use of minefields, such as those placed in the North Sea, Otranto, Cape Bon, and Aegean Barrages. The North Sea Barrage, constructed in 1918 with the intention of closing off the Atlantic to U-boats, stretched from Norway to the Orkneys. Its inception and construction were due mainly to the initiatives and expertise of the US Navy Department, which had maintained an interest in submarine mining since the Civil War. A gigantic undertaking, it had an average width of 25 miles and consisted of 70,100 mines, of a type specially developed by the US Bureau of Ordnance to be laid in depths of water up to 70 fathoms, and in the five months of its use the barrage accounted for 17 U-boats.(70)

Conclusion

Guided naval torpedoes were not taken up again until the 1960s when experiments began with submarine-launched, electrical, wire-guidance weapons; the Mk 23 in Britain by Vickers Armstrong developed concurrently with the Mk 39

in the United States.(71) And for this reason alone the Brennan torpedo is uniquely interesting. The three parts of this article have sought to draw attention to a weapon which was an outstanding feat of innovative mechanical engineering and which successfully broke new ground. In addition the purpose has been to encourage further archaeological research at the sites of Brennan torpedo stations, and research which will resolve the question of the torpedo's depth and steering mechanism.

It is clear that Louis Brennan was well aware of the action of gyroscopes, and from accounts of trials, and other records, the Brennan torpedo frequently behaved in a manner to suggest the application of a strong gyroscopic force. But whether this action was produced by the revolving drums of wire and was, out of necessity, controlled, poses a question which remains unresolved. As do the two questions which must follow it. If the gyroscopic action was sufficiently understood to be controlled, was it employed as a directional stabilizing force or employed as a means of obtaining guidance?

These questions can only be addressed after a carefully recorded examination has been made of the sealed depth and guidance mechanisms, which are identifiable and are still *in situ* in the torpedo at the Museum of the Corps of Royal Engineers at Chatham.

ACKNOWLEDGMENTS

THE section describing Brennan torpedo stations owes much to two members of the Fortress Study Group, to David Barnes who accompanied me on a stormy and wet first visit to Garrison Point Fort in 1980, and encouraged me to write a thorough account of the Brennan Torpedo. And to Alec Beanse who at a chance meeting in the map room of the PRO in London suggested that importance should be attached to the words Steering Girder appearing on plans of winding engines, and whose interpretation of the function of the girder and the steering pulleys I have adopted.

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48. Tracing No 321, Louis Brennan 19.3.89, WO 78/4468.
49. The first drawing showing a horizontal engine, steering girder and travelling carriage at Garrison Point is Brennan's "2nd Design" dated 18.7.1889, Neither his "1st Design" or "3rd Design" show these features, or are dated. The vertical engine may have continued in use, as drawings for its connection to a steering girder were made in 1890 – see WO 78/4430.
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57. The commands that are known were: "Zero", "Are you ready", "Stand by", "Connect up", "Stop", "Half-speed", "Full-Speed" – see Memoranda for Torpedo Station Officer, 19 June 1903, pp11-12, WO 32/6065. The order given to launch (at launching speed) was either "Full-Speed", or "Half-Speed", depending on the particular Torpedo Station.
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The Road at Pak Nai

LIEUTENANT E W JUDGE

Lieutenant William Judge was commissioned in April 1992 and attended No 105 Young Officers' course. He was posted to the Queen's Gurkha Engineers in November 1992, where he took command of "F" Troop, 68 Gurkha Field Squadron, after completing his Nepali Language Qualification Course.

He is currently deployed with the Squadron in Nepal to provide assistance in flood relief in the aftermath of torrential rains.

CASTLE Peak Range Complex is the most important live-firing area in the Colony of Hong Kong and the only area with a large enough uninhabited space to allow the use of modern antitank weapons by the units of 48 Gurkha Infantry Brigade. Access to the area is provided by a network of roads, mostly constructed by the Queen's Gurkha Engineers (QGE). Without these roads, access would only be possible by foot, which tends to affect both time and enthusiasm on the range somewhat adversely. The road which enters the ranges from the north, near Pak Nai Training Camp, allows access to both high explosive antitank (HEAT) ranges in the complex and is known, predictably enough, as the Pak Nai Range Road (PNRR).

Spring and summer weather in Hong Kong usually involves thunder and lightning and invariably results in bathsfull of water crashing down in sheets at a staggering rate. It is a well-known rule that states: "dropping large quantities of water on roads built on hillsides is a recipe for disaster," and sure enough a 40m section of PNRR subsided badly after a prolonged soaking during the storms in June and July 1992, making it impossible to drive to one of the HEAT ranges. Mr Patten was doing his best to ruffle feathers in Beijing at the time, so chaps who knew their way around a 94mm launcher were considered quite a valuable commodity. Clearly the infantry-wallahs had to be let back onto the ranges fast, to keep their "eye in", so it fell to the QGE to solve the problem.

Predictably enough, for such a famously sharp and professional Regiment, things happened chillingly quickly. A recce was carried out by Design Troop under the dynamic leadership of Captain Mike Suttill, and, seemingly in a flash, plans were prepared for the construction of a new road to bypass the damaged section. Plant Troop, under the inspirational leadership of QMSI Moore, our Military Plant Foreman, launched itself into the task in September 1992 and, with some help from "F" Troop, succeeded in carving out a new cutting from the hillside and laying therein a surface of coarse aggregate and some rudimentary drains. The new cutting was some 100m long and its construction involved the removal of over 7500m^3 of material. Despite being only a temporary repair, this new road was perfectly adequate to carry 4-ton trucks and their cargoes of enthusiastic infantrymen to the ranges during the really quite delightful weather which lasted until January 1993.

Well-known rules are becoming a bit of a theme in this article, so it should come as no surprise to find another; this time its the old chestnut about weather repeating itself every 12 months or so. I am confident that everyone will

Lt E W Judge
The road at Pak Nai, p288.

have twigged that a coarse aggregate road is even less likely to stand up to a 4-month shower than an ageing concrete one. The Regiment had about four months to plan and construct a permanent repair to the road, to be finished by the end of April.

Once more Design Troop rushed to the scene, and quickly passed the buck down the line to SSgt Bhalabahadur Rai who, being at the end of the line, became responsible for the Detailed Reconnaissance and Planning Report (DR&PR). Following in the finest traditions of RE Clerks of Work, his plan was quickly completed. The new repair would consist of a 150mm thick reinforced concrete pavement 4m wide, with a 3m wide passing place (in the vain hope that the road would be massively overused).

The side walls of the cuttings were bare earth at this stage, so catchwater drains had to be dug and concreted along their length to minimize erosion of the slopes. Following this, all the side walls were to be hydroseeded (by a civilian contractor – landscaping sadly is not yet part of the B3 Combat Engineer syllabus) to establish a growth of vegetation on the slopes, further increasing their resistance to rainwater erosion. The DR&PR also involved a lot of work on a culvert and spillway, taking run off underneath the road and discharging it further down the hill. The original channel was made from unreinforced concrete and, having been undercut by erosive floodwaters, the bottom half of the channel had been left cantilevered into space. As was to be expected, the suspended portion had dropped off. I think we could have got a well-known rule in there somewhere.

The plan involved the excavation of a large area, below the tip of what remained of the spillway, in which was to be constructed a very strongly reinforced concrete retaining wall, through an opening in which the spillway would discharge. The base slab of the wall was to be extended forward from the toe to form a reinforced concrete apron below the mouth of the spillway. The aim was for the floodwater discharging from the channel at high speed (the channel gradient was definitely the wrong side of 45 degrees) to strike the apron and lose much of its energy. Having moved from the supercritical to the subcritical state it would then flow sedately down the valley without taking too much of the valley with it. The retaining wall slab, laid behind the actual line of the wall, was to be covered with backfilled earth to a depth of at least 1.2m. It was hoped that this mass of soil would be large enough to hold the structure in place throughout five or more years of atrocious weather, and thus allow the base slab to act as a solid foundation for the whole wall/spillway structure. This part of the works was on a hillside sloped at 60 degrees, which made the use of plant inconceivable and the use of ready-mix concrete extremely difficult. Indeed I am indebted to LCpl Subashir Rai for a most excellent CGI (corrugated galvanised iron) chute without which completion of the project simply would not have been possible.

A mighty tome containing this plan in fabulous detail landed on my desk in February. I must admit to being momentarily taken aback, and also to suffering regret at doodling away so much time during my YO course lectures: This was clearly my First Big Project!

There is a well-known rule that says don't put unnecessary information in articles. The inclusion of Pak Nai Training Camp in an earlier paragraph may have seemed superfluous at the time, but now all will become clear: "F" Troop was swiftly booked into said camp for a six-week period in March and April to tackle the project, and I set about the planning like a very quick-planning person. After paternal chats from my OC, the QM, the MTO, the SSM (and many others) I knew a lot more about writing administration instructions and also found that my life had been sorted out for me. A night on the word processor put all the arrangements onto one piece of paper, construction and safety orders were rattled off and before I knew it the "O" Group was over and we were on our way.

On 22 March 1993, "F" Troop occupied Pak Nai Training Camp and I took over as Camp Commandant. I would have liked to have had an enormous parade to mark the occasion but the Troop Sergeant, Corporal Uttamsing Gurung, very sensibly got on with the task in hand. Instead I had the Squadron flag run up the flagpole and left it at that. The camp was excellently equipped with a large kitchen, full bathroom facilities and a secure storeroom and telephone communications. Best of all, it was a mere 400m away from the site, which meant there was no need to get up unhealthily early nor to partake in Hong Kong's favourite sport of traffic-jam sitting.

With us we had a small vehicle fleet; the MTO (Motor Transport Officer) wouldn't trust me

with more than a LR and a 4-ton TCV (troop carrying vehicle), but I also received a LWT (light wheeled tractor) to do the cut and fill required on the road, from the MPF, who was "a very nice man." The Troop had been beefed up by attachments from other troops in the Regiment, to bring us up to strength as far as necessary tradesmen were concerned, and we were 28 strong on deployment. There were no cooks available, so I let two of my most experienced sappers loose in the kitchen and prepared for the worst. I shouldn't have worried; tea and *bhat* were produced every day, on time, piping hot and absolutely delicious. Thus we proved that even in this day and age, the B3 Combat Engineer Course prepares a man for anything.

The Troop quickly settled down in camp and began work on the project. Cpl Uttam arranged a sensible daily routine and issued detailed tasks to the various teams each morning on parade. I spent my days supervising the safety and quality control aspects of the work, and planning for the next few days as far as stores deliveries and administration were concerned. This mainly involved booking ready-mix concrete (about 20 lorry loads in all) and beating off pleas from the Regiment for manpower. Life away from the Squadron Orderly Room and the Adjutant took on a new simpler format: for the first time in ages I was able to concentrate on the task in hand without distraction. This is, however, the real world and I found all the distractions waiting for me when we returned to barracks at Perowne each weekend.

The initial work on the road involved cutting and filling to adjust the road profile to the specified levels. The LWT, the surveyor, and two Bomag rollers (with ferocious combat engineer crews), set about this work with gusto and had parts of the road ready within three days. The main effort was filling in the area of the parking place where the level had to be raised by over 1m. Once this work was complete the Bomags were exchanged for Cobra pneumatic drills to set about the task of breaking up a portion of the old road which required filling and then relaying. It didn't take long to realize that the G1098 Cobra is adequate for breaking thick slabs of toffee but is useless for reinforced concrete. This naturally dulled a bit of the combat engineer's enthusiasm, but when I laid on a Bristol compressor and two heavy breakers at short notice, they took heart and removed the remaining road in an afternoon. As I've said before, the MPF was a very nice man.

The road was split into six bays, which were to be poured individually, with sealed joints separating them. All the bays were reinforced with steel mesh 50mm below the surface (supported by "F" Troop patent mesh supporters). Once all the levelling work was complete in a particular bay we poured it as soon as practicable. Each bay generally took three lorry-loads of ready-mix to complete and could be poured, brush finished and sealed in two hours. I occasionally got my volume calculations wrong at which stage the 100ltr mixers came in handy and the process took a little longer.

The work on the spillway and wall was carried out at the same time as the road. Initially a large area was dug out of the hillside by hand and the formwork and reinforcement for the base slab were set up therein. It was at this stage that we found those men in the Troop who could really read reinforcement drawings! With the help of LCpl Subashir's chute, we poured the slab and the wall kicker using ready-mix. This operation was tricky to control, especially as the vertical height difference between the lowest and highest men on the job was approaching 10m. The first lift of the wall (the first metre) quickly followed, after which the general duty men began backfilling behind the wall to the line of the new spillway. Once this earth ramp had been compacted we quickly poured the base of the spillway onto it, from the end of the old channel to a special gap in the retaining wall. Once this had cured for three days, I relaxed considerably as we had passed a period fraught with awful possibilities: despite blocking the culvert which fed the spillway as best we could, it still carried a small but fast flow when it rained. Had we had bad weather during the backfilling or concreting stages much work would have been lost and we would have been seriously delayed. Thankfully all I got was a pronounced military suntan! The side walls for the spillway and the top (0.6m) lift of the retaining wall were soon done and it was all over bar the backfilling.

The Troop has been allocated a five-week period for the task, and we managed to keep to the Cascade diagram timings successfully up until the final week. The Troop was split into a formwork team, and two GD/concreting teams which moved from task to task as required. Most days the teams were split to do the myriad of small tasks on the

road itself and on the retaining wall, but when concreting was required it was a case of all hands to the vibrators to get the pours completed quickly because of the heat. The well-known rule about Chinese ready-mix lorry drivers was once again shown to be true.

Most of the world seemed to ignore one particular well-known rule throughout the project. This time it's the one about arranging visits to Troop projects just when the Troop Commander is at his most frantic. For most of the time we existed in a state of blissful isolation, but we did have one entertaining afternoon hosting a party of Malaysian Officers, all of whom had an impressive array of gold on their uniforms.

Working on the retaining wall – note the formwork on the line of the new spillway, and the gap through which it discharges.

Our final week was one of intermittent but very heavy rain, and steady attrition of my manpower by the Squadron 2IC and SSM. At this stage my Troop strength was below ten men. Thankfully the OC proved himself to be an understanding and sympathetic man and gave us an extension. "F" Troop completed all the works on time and declared the PNRR open on 30 April 1993. We installed a smart brass plaque by the road, with '"F" Troop' on it in particularly large letters, in the hope of publicizing our work to the Brigade of Gurkhas until 1997 and thereafter annoying the PLA. We packed up the site and cleaned up the camp. All that remained for me was to brief the hydroseeding contractor and go home to complain about my mobile telephone – it was certainly mobile, but sadly not much use as a telephone. All I got as a reply was the comment that one out of two wasn't bad.

The HEAT ranges at Castle Park are now accessible by road at all times of the year and in all weather, and it is fervently hoped that the Infantry will use them. The soldiers of "F" Troop enjoyed six weeks without doing barrack guards and demonstrated their outstanding trade skills in a project which stretched them to the full. The Troop Commander got a nasty suntan, spent a lot of time on an intractable mobile 'phone and discovered that San Miguel beer does wonders for a man's Gurkhali – *Jai* QGE!

Sapper Training at No 1 TBRE Clitheroe

JOHN IRWIN CEng FIMechE FIEE FIMgt

John Irwin was commissioned into the Royal Engineers in January 1945 and joined Queen Victoria's Own Madras Sappers & Miners Group (QVOM), Indian Engineers, as 2IC Training Workshops at Bangalore. After some months he was posted to a Sapper unit in Burma, joining en route 330 (QVOM) Indian Field Park Company, engaged in the repair of Chittagong airfield, the base for the over-the-Hump-to-China flights. Subsequently he caught up with 21 (QVOM) Indian Engineer Battalion, and sailed with them on Operation Zipper, *the invasion of Malaya. He served with that unit of 459 Indian Forward Airfield Engineers, engaged in the repair of Port Swettenham and Singapore's Kallang airfields and on the construction of the postwar garrison camp at Kluang, Johore State, first as transport & workshop officer and then as a company commander.*

He returned to the UK in 1947 and spent the rest of his career in manufacturing industry.

Sergeant Gunn RE, and a corps band, met us at the station, in late summer 1943. We had just arrived after four weeks at 4 Primary Training Centre at Fulwood Barracks, Preston, and it was very satisfying to see that our new Corps did things in style, making the men of 99 War Party feel good that they had joined a Corps which observed such traditions. So, in full marching order, pack on back, respirator on top, ammo pouches in front, haversack at the side, straps galore and rifle at the shoulder, we marched out of the peaceful little Lancastrian town of Clitheroe to the strains of martial music.

After a short time, a gaunt six-storey mill was sighted – the wartime location of No 1 Training Battalion RE (TBRE). As we marched through the main gateway into the walled parade ground, the army-commandeered, L-shaped barracks looked even more daunting. Low Moor Mill was to be "home" for nearly four months.

Our War Party (named after the irregular Boer fighting units which caused British troops so much trouble in the Transvaal and the Orange Free State some forty years earlier) of 130 men was allocated the barrack room on the top floor with the RE battle honour "Albuera" above the door. In this terrible battle, fought on 16 May 1811 during the Peninsular War, two RE officers were killed and two RE officers and three sappers wounded. One account of the battle states, "General Beresford had allowed Marechal Soult and his French army to manoeuvre him into the worst possible position astride the road to the town of Badajoz, to which he was laying siege, when strategically he did not need to fight at all. Tactically, Beresford was ill-prepared for an attack on his flanks and when, because of this, the battle was all but lost, the initiative of one officer, Colonel Henry Hardinge, re-established the vital flank. However the day was really won by the outstanding discipline of the British troops, who maintained continuous fire from a diminished 'thin red line' of 1800 muskets in the face of a furious onslaught, thus demoralizing and causing the final rout of the French."

It is fair to say that the officers and NCOs of 99 War Party were determined to ingrain the same sort of discipline into the Sappers under their charge. This objective was not confined to drill parades, nor fieldcraft, nor Sapper training. It encroached into every hour of the day between reveille and "lights out". The innumerable tasks imposed on us meant that we were rarely free to leave the barracks on our off-duty hours during the week. The tasks included: fire piquet, mobile and barracks defence duties, evening medical inspections and kit inspections, overall changing,

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parades, duty haircuts and of course the frequent call to cookhouse fatigues. When our section was detailed for daily barrack room cleaning duty, we had to be up and dressed before reveille at 0600hrs so as to wash and polish the enormous mill room floor to the standard of the Manchester Cotton Exchange, and be on time for first parade at 0750hrs.

At weekends, there were other restrictions ranging from telephone orderly duty to guardroom and fire watching duties. It was particularly satisfying to find that occasionally our superiors got their rotas confused, enabling us to fulfil mobile defence duty, fire piquet, night work and cookhouse fatigue all on the same night.

Low Moor Mill, Clitheroe, the wartime location of No 1 TBRE.
(Courtesy of John L Wilkinson, Clitheroe.)

Dominating the field park and fieldworks areas behind Low Moor Mill, were two large steel bridges spanning the River Ribble. This scene gave us an instant flavour of military engineering. But we soon learned that the huge Inglis tubular truss bridge and the Hamilton unit construction bridge were developments stemming from the First World War and were now seldom used by Sappers even for lines-of-communication. Nevertheless, bridging equipment was still the most obvious tangible evidence of military engineering in the field. Concertina-wire roadblocks and field defences had their place in the scheme of things, but for me bridging was undeniably the *pièce de résistance* of the sapper training course.

We cut our teeth on both the Small and Large Box Girder bridges and got our feet wet on Folding Boat Equipment. Watermanship added a further dimension to soldiering and an agreeable one to a Sapper who, in earlier years, had spent his summers on small boats on the Clyde. Our days on wet bridging were brightened by the welcome arrival on site of a YMCA canteen van at mid-morning. Cream cookies at two for threepence, together with well-sugared tea, helped to provide the extra energy needed for the heavy manual work.

Finally we graduated to Bailey Bridging Equipment. To an engineer with a background in aircraft, it was beautiful in concept and delightful in its simplicity. But its beauty tended to fade after eight hours' work as a member of panel and transom parties. After three days erecting and dismantling Bailey bridges, some of us had to have medical attention for septic sores in the crooks of our arms. However, no doubt to a Sapper of the nineteen twenties, building a triple truss Bailey would have seemed exceedingly simple compared to a triple truss Inglis.

As I carried one panel after another into position on the growing bridge, I ruminated on the strong similarity between aircraft structures and military bridge structures. On balance, the similarities were greater than one might expect, considering the more obvious differences between the two. The fabricated aluminium spars of an aeroplane's wings continuously take the moving upward thrust of the air supporting the underneath surface of the wings, while bridge trusses take the downthrust of rolling loads. Even the Bailey panel pins had their counterpart in the wing-root bolts – actually precision machined tapered pins – which lock the front wing spars when the folding wings of naval aircraft such as the Fairey Fulmar or Fairey Barracuda, are swung forward into the flying position before taking off from an aircraft carrier. In both cases, economy of weight, consistent with maximum safe deflection, is a prime consideration in the design so that the maximum load can be carried at minimum operating cost. For military bridging this cost can be represented by the number of man-hours required to build a bridge of a given load classification over a specified gap while the payload of the military aircraft is the weight of the crew, torpedo or bombs and fuel it can carry

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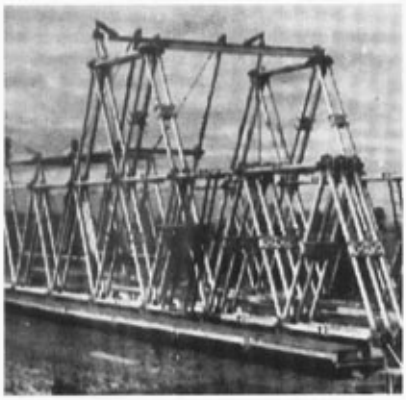
Inglis tubular truss bridge (1940 version) designed by Professor Charles Inglis of Cambridge University.

for a given range from its floating base. Mental comparisons came to a speedy end when I had to carry a pair of shackles across the skeleton launching section, concentration being needed to keep my balance twenty-five feet above the fast flowing flooded Ribble.

Rain saturated the Ribble Valley during our months at No 1 TBRE, reinforcing a geography master's explanation in my schooldays that the humidity of Lancashire met the requirements of the cotton industry so well that the county became the centre of that industry in England. Rain all but flooded us out of our bivouac camp on Pendle Hill during a 48-hour fieldcraft exercise over one weekend. Worst of all was the night scheme to lay a minefield, when torrential rain brought home to us how weather can make such a task an even greater hazard than usual. We crawled about in squelchy mud in the dark, laying dummy mines in the prescribed pattern at the correct depth and finding it virtually impossible



Large Box Girder Bridge, also known as the Martel Girder, first adopted in 1925.

to muster any enthusiasm for the task in hand. I formed the impression that regardless of weather conditions, the laying and breaching of minefields was one of the nastiest jobs field Sappers had to undertake as part of their normal duties.

Fieldworks training provided a variety of interests. With heavy wooden spars we built a gyn which could have lifted a 330bhp six-cylinder Mirrlees stationary diesel power plant and constructed sheers which could have swung a 1565hp Rolls Royce Merlin engine from a Spitfire on a jungle airstrip; needless to say, the latter possibility was remote from the minds of both our instructors and ourselves.

We embedded holdfast anchorages, which could have been prototypes for the Severn suspension bridge, and we learned why troops had to break step to prevent harmonics when marching over the suspension footbridge which crossed the Ribble in the fieldworks area. The mysteries of the Morris Commercial compressor truck, with its two-cylinder two-stage air-cooled compressor, were revealed to us. And, using portable Pulsometer pumps, we assimilated the rudiments of potable water purification and supply.

In all these activities, the three young subalterns training 99 War Party showed an appropriate sense of leadership by participating personally in many of the training projects. Our Section Officer, Second Lieutenant T S Lucas, established an excellent esprit de corps by mucking in and wielding a pick and shovel when necessary to help the Section complete a difficult assignment on time. Throughout the course, Sergeant Gunn displayed an imperturbable unflappability, appearing, to the Sappers of 99 War Party, to be the personification of a Corps which had existed for over 160 years.

Operation *Avalanche*, the invasion of continental Europe through the Gulf of Salerno, south of Naples, began in the early hours of 9 September 1943, and we were able to follow it in some detail in the Information Room at No 1 TBRE. Sicily had been won, and the Army Bureau of Current Affairs (colloquially known as ABCA) did a first class job of keeping us informed on how the War was progressing.

Although General Eisenhower, Commander-in-Chief of the Allied Forces in the Mediterranean, had broadcast the news of the Italian surrender the previous evening, the Germans there put up a determined defence and for several days the result of the battle was touch and go. Only the support

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of units of both the Royal Navy and the US Navy, which bombarded the enemy, enabled the beach-head to be held. It was 11 days after D-day before the battle was won and British X Corps and US VI Corps, under the overall control of US General Mark Clarke, forced the German army to retreat.

This was encouraging news but at this stage in our training it was difficult for us to imagine the role that we might have to play in the war against Hitler. It is probably true to say that the furthest most of us could see was the completion of the sapper training course and the ten days' leave which we would then be due. In a confidential discussion, one of our young officers confided to me that he was not at all sure how he would react under the stress of battle and that he had doubts as to his ability to protect the lives of his men in battle. This was something I did not yet have to think of.

The intricacies of fuze ring-mains with parallel electric circuits were imparted to us and we learned the difference between safety fuze, IF (instantaneous fuze), the three types of Cordtex and FID (fuze instantaneous demolition), filled with TNT to detonate at 5800fps. Offensive and defensive demolitions were demonstrated, using guncotton slabs, Nobel's 808 plastic explosive and ammonal; we were also shown how to detect and deal with booby traps.

I can still recall the uneasy feeling I had as, for the first time I walked slowly back to cover, as instructed, having lit a fuze on a guncotton charge positioned on a length of 12in x 7in RSJ. Seconds later, I had a clear demonstration of the power of guncotton because the RSJ section was no longer there. The importance of carrying out safety drills was dinned into us to such an extent that fifty years later, whenever I see an electric detonator, I still feel an instinctive urge to put the detachable handle in my trouser pocket – even when it happens to be in a military museum!

Gas training, whereby we were exposed to a variety of gases, including mustard gas, was a necessary but particularly unpleasant part of the course. Late one evening a simulated gas attack brought home to 99 War Party just what a real attack would be like; over-zealous NCO instructors released a canister of DM (diphenylaminechlorarsine) gas in the ablutions and the cry of "Gas!" caught most off-duty Sappers without respirators. Choking and spluttering to the point of sickness, we had to move our bedding to the unpolluted atmosphere of the gymnasium in order to obtain an undisturbed night's rest.

Folding Boat Equipment, known as FBE. Introduced in 1928 and developed to 9-ton capacity.

"Would you serve in the infantry if you were unsuccessful in obtaining a Sapper commission?" asked the Chairman of the Unit Selection Board. I replied that I should be happy to follow in my father's footsteps in the Seaforth Highlanders. As a young volunteer in the First World War, my father had been commissioned in the Seaforths after having been awarded the Military Medal as a sergeant in the Black Watch in the Battle of the Somme in 1916. However, I had no thoughts of emulating my father's deeds. Although he had never mentioned his war experiences to me, I had learned that as the sole survivor in his sector of the line, he had maintained fire from all parts of his Company's section of the trench for a prolonged period of time, thus deluding the enemy into thinking that the line was still fully manned.

The day following my interview with the Unit Selection Board, I was scrutinized by the Colonel and some three weeks' later I reported to Moreton Hall, a rambling country mansion in Whalley, a village near Clitheroe, for the three-day War

The ubiquitous Morris Commercial compressor truck with its two-cylinder, two-stage air-cooled compressor.

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Office Selection Board. This was a pleasant change from our strenuous Sapper training. True, there were tests, of physical prowess and leadership, in overcoming ingenious obstacles set up in the grounds of Moreton Hall, as well as intelligence, aptitude and practical situation tests and interviews. But we had spring mattresses and linen sheets on the beds and we enjoyed well-cooked meals in surroundings more like home; for this we gladly paid the voluntary mess fee of two shillings per day.

In retrospect, I felt sorry for the Sapper candidate who, when carrying out a platoon officer role assignment, was instructed to convey the news to me – one of his platoon – that my parents had been killed in a recent air raid on Greenock, my birthplace. Unperturbed, I explained there must be some mistake as my parents now lived in Cheshire. Unfortunately, he was not sufficiently quick-witted to extricate himself from the situation and this may have been one of the factors which caused his name not to be among those of the successful candidates.

Clearly initiative was considered to be one of the key characteristics which the selecting officers were seeking. Had they been aware of the devious means to which I had resorted on off-duty Sundays in order to see my lady-wife-to-be in Cheshire, some 60 miles from Clitheroe – without having the necessary Day Pass – involving as it did an outward journey on an early milk trunker to Manchester and returning on two buses and two trains on knife edge connections at Bolton and Blackburn, I feel sure that I should have been excused all further tests for initiative.

It might be thought that the Corps of Royal Engineers was an unusual arm of the Service for a mechanical engineer, trained in the design and manufacture of naval aircraft, to aspire to. Suffice to say that although an opportunity to join the newly formed Corps of Royal Electrical and Mechanical Engineers was offered me by the War Office Selection Board, the wider scope of military engineering combined with the long-standing traditions of the older Corps, confirmed my resolve to become a Sapper officer.

The walled parade ground at the rear of Low Moor Mill resounded with the music of a Corps band and the staccato beat of marching boots on a Pass Out Parade. Proud as peacocks, chests expanded to fill out battledress jackets, 99 War Party gave the "Eyes Right" to the Colonel at the saluting base. We felt that we had every right to be proud! Had we not survived probably the most gruelling 12 weeks of our young lives? And were we not Sappers to boot! Forgotten were the nights on guard duty when the wind howled and the flooded Ribble gushed thunderously past the wartime location of No 1 TBRE, and forgotten was the 48-hour scheme on Pendle Hill with only groundsheet bivouacs to keep out the blinding rain. We had begun to get the flavour of what it meant to be a Sapper; had learnt the rudiments of fieldworks, bridging and watermanship; and we liked it!

After ten days' leave I returned to Low Moor Mill to find myself – with others of the now extinct 99 War Party – in Depot Company, awaiting posting. However, no comfortable mill room or weaving shed was waiting for us this time. Instead, we were billeted in Hut No 22 with a stove to clean and blacklead before breakfast and a hearth kerb to whitewash with a shaving brush.

A spell in the blacksmith's shop gave me the opportunity to acquire a new skill – one which I had not encountered in the aircraft industry – and I was able to fashion a complete set of fire-irons for the hut. The warmth of the blacksmith's shop made this temporary duty a prized one in the extremely cold wet winter days in Lancashire.

It was another four weeks before the five cadets of 99 War Party were posted to Pre-OCTU at Wrotham. I did not realize till later, how attached I had become to the sleepy little Lancastrian market town of Clitheroe, where entertainment was limited to the local cinema, concerts at the YMCA, and low-cost snacks and meals generously provided by lady volunteers at several church halls. Nor was it until years later, when I was responsible for 5000 employees in a large engineering manufacturing company, that I recognized the tremendous organization required to train Sappers in such large numbers and to concentrate so much knowledge and experience into only 12 weeks.

To the officers and NCOs who had to start training a new intake of Sappers every three months or so, it must have seemed a mundane and perhaps even boring task to have to endure during wartime. Nevertheless, in the autumn of 1943 Sergeant Gunn, the other NCOs and the platoon officers training 99 War Party, displayed a degree of dedication which might easily have been mistaken for enthusiasm.

The Sommerfeld Bed

MAJOR R C S (MICHAEL) LOW MC

Before the 1939-45 War Major Michael Low MC worked for the London Midland and Scottish Railway. He gained a rugger blue at Oxford and on the outbreak of war joined the Sappers. He was OC of 7 Field Company at the Rapido Crossing in May 1944. After the War he became Deputy Chief Mechanical Engineer of British Rail. The "2IC Pat" mentioned in the article is Lieutenant Colonel Pat Huyshe and it was he who sent in the story. Ian (Innes) and Malcolm (Sharland) were both killed in action in Italy. Michael Low died in 1990.

As it is now well over 40 years since the event, it is safe to release another secret of World War Two which took place in North Africa in late autumn 1943.

When everyone had been issued with khaki drill and all vehicles had been fitted with radiator condensers, we had formed the impression that we were about to be sent to a hot and dusty country – not so – we arrived shortly after Christmas 1942 in a snowstorm and quickly realized that the North African winter could be cold and wet. It was therefore no great surprise when in October 1943 our CRE, Colonel "Tiny" Moberley, burst into the 18 Field Park Company office tent as we were having a cup of tea on a wet Sunday afternoon, and announced that the General was concerned that men were sleeping on wet ground or cold concrete floors and he wanted 10,000 beds made at once. "Here's an interesting job for you Michael, get on with it. I want them completed by next Sunday." As he departed he turned and added: "By the way you must not use any timber."

Working under "Tiny" was always entertaining and we were used to surprises, had we not been asked to produce 100 dartboards, 150 pipes, from the local bruyère and some shotgun cartridges so "Tiny" could go duck shooting? The last mentioned involved making lead shot and with no shot tower available, a Sapper up a tree dropping blobs of lead into a bath was tried without success. In the end fine round shot was produced by dropping molten drops of lead on to a sloping steel plate, dusted with dry cement.

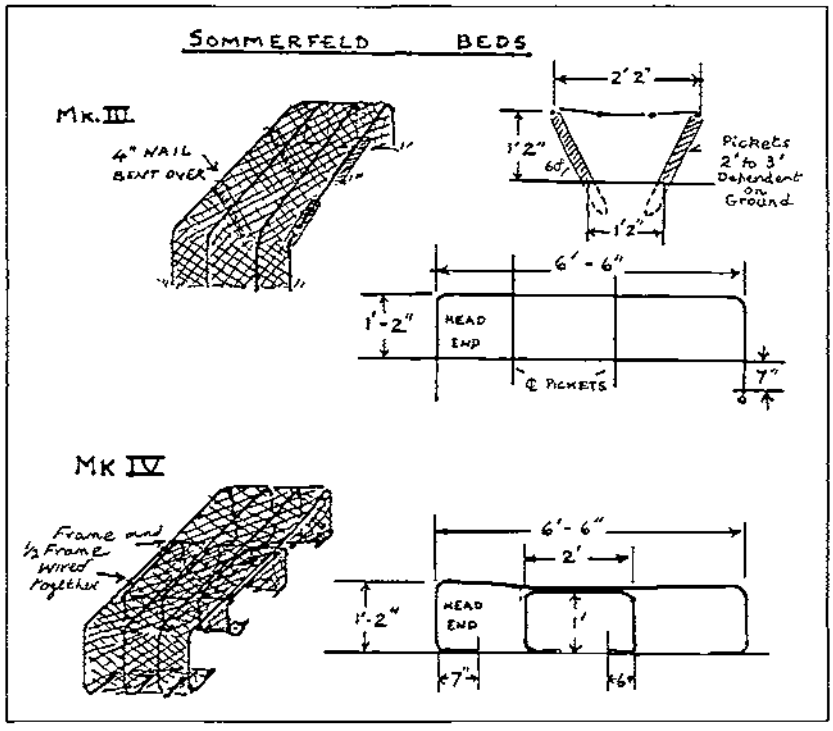
However back to beds. Having discussed the problem with 2IC Pat, Workshop Officer Ian, Stores Officer Malcolm and Workshop Sergeant Lunn, we spent about a quarter of an hour enumerating the reasons why it was impossible and then, of course, in true Sapper tradition, started to work out how it was going to be achieved. Many of the best inventions are stolen and so it was in this case. Someone had seen a Sapper in 59 Field Company asleep in a crude bed made from Sommerfeld track. A spy was sent out to have a look and Malcolm went off to find out how much Sommerfeld was available. A couple of rolls were found and we tried out a few ideas. Mks I and II beds were turned down after the test load, Corporal Bailey, collapsed them. Mk III, for use on soft ground and partly supported by four wood pickets and Mk IV, for hard standing, stood the test and were passed for production. Having found that there was an adequate supply of Sommerfeld track available, the next requirement was to design a production line and work out where the men were coming from to do the production.

The tools required were wire cutters, long handle cutters and a bending machine. The bending machine was a simple arrangement of two boards hinged together, one with an operating lever and the other secured to the ground on which was mounted a bar to hold down a panel for bending. Lines were marked on the ground to position the panel, cut from the roll of track to align it for each bend position.

Each unit wanting beds would have to provide its own transport and production team. For Mk III beds 1 NCO IC, 28 ORs and 5 ORs loading, and for Mk IV 1, 24 and 3. Pat went off to Division to work out a programme for units to report with their teams.

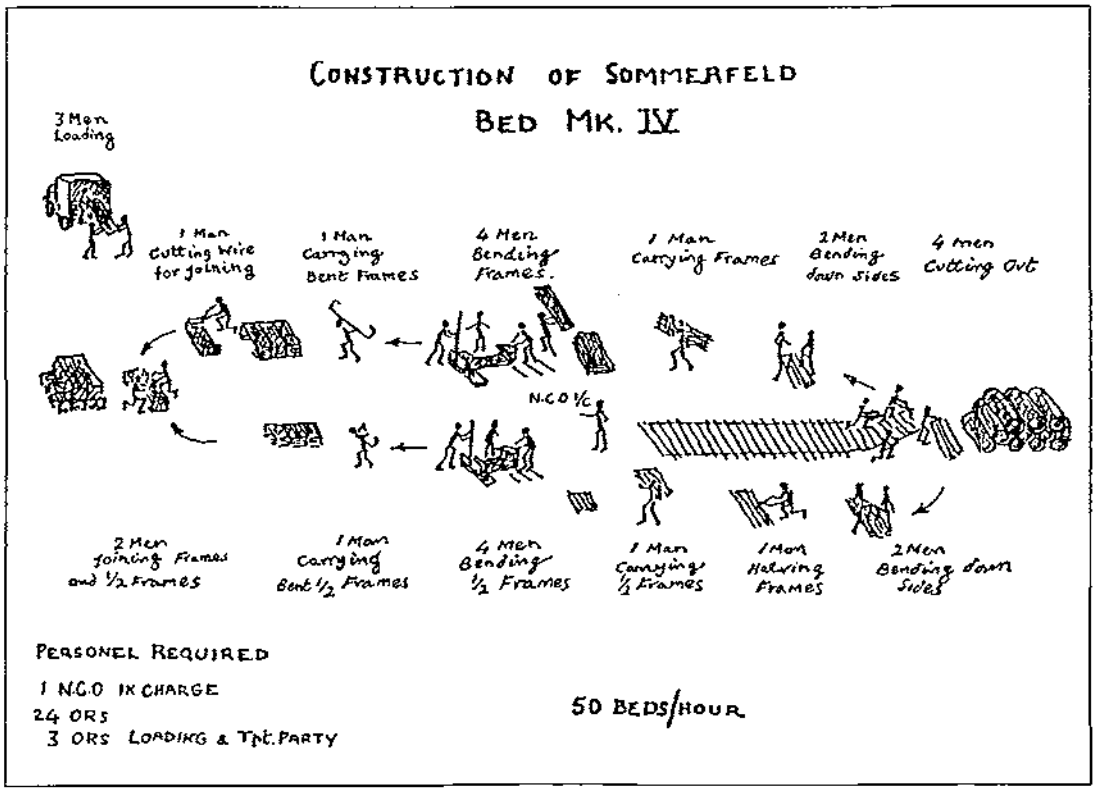
By 8am on Monday two production units, one for Mk III and one for Mk IV were set up and shortly after, members of 18 Field Park were proving the system by making their own beds.

The production rate for Mk III had been estimated at 70 beds an hour and 50 for Mk IV. In fact once a team had got the hang of the job these rates were often exceeded. For Mk III there were four men cutting panels from each end of an unrolled Sommerfeld roll and from then on two parallel production lines with bending machines.



A small team from 18 Field Park showed the unit production teams a pin-man diagram and positioned the members of the team, a whistle was blown and the whole operation rolled into action.

I cannot remember exactly how many beds were finally required by Division but I think it was well over 8000 and the last bed to come off the production line was late on Friday evening. I was able to report to "Tiny" that the operation was complete and I am glad to say that he was duly impressed.



With Eighth Army on the Adriatic Sector in 1943.

"The best laid plans o' mice and men gang aft aglae."

MAJOR G V J M SMITH MBE CEng DipBIA

Introduction

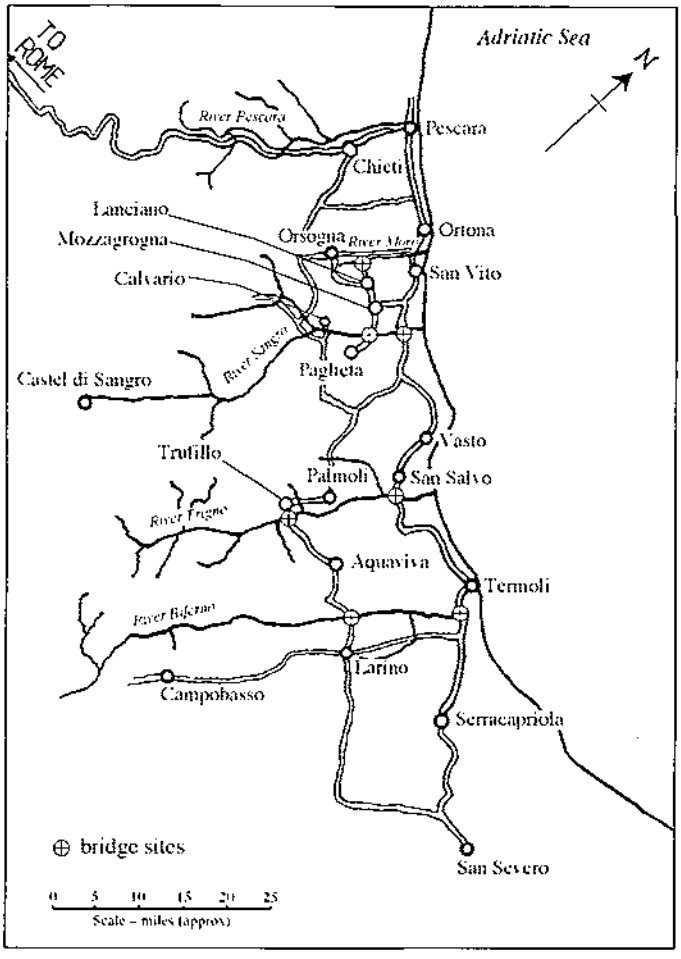
This is the story of my introduction to Bailey bridging and mine warfare when serving with 8 Indian Division and 5 Corps in Eighth Army during the last three months of 1943. The story of 8 Indian's Adriatic Campaign is told well in "The Tiger Triumphs" published by HMSO in 1946. This praises their Sappers but only occasionally details their efforts. The story of bridging in Italy is given in more detail in the GHQ Middle East publication "Engineers in the Italian Campaign" of December 1945. I have used these to confirm some details but this story is based on my personal notes and copies of reports to Chief Engineer 5 Corps.

On 2 August 1943 GHQ India posted me to take command of 7 Indian Field Company (King George V's Own Bengal Sappers & Miners (KGV's O Bengal S&M)) in 8 Indian Division. I handed over Faridkot Field Company in Assam, flew into Calcutta and took a three-day flight in a Sunderland flying boat to land on the Nile at Cairo, reaching 7 Company on 14 August. The change from humid heat and perspiration, on the Assam-Burma border, to dry sunshine was a bonus. The Division was to go to Italy and I found them in the Jebel Mazar area, behind Beirut, engaged in mountain warfare training. After celebrating my 26th birthday with a quick visit to Damascus, I moved south with the Division to do some Bailey bridge training. 7 Field Company built only one 110ft triple-single (TS) before loading at Haifa for Italy. On 3 September Eighth Army crossed the Strait of Messina from Sicily. The Italians surrendered. 1 Airborne Division took Taranto unopposed on 9 September and moved on to take Bari, where 78 British Division landed. On Sunday 19 September, 8 Indian Division sailed into Taranto in a convoy of six ships. I remember a steady confident approach as we glided slowly past the many Italian warships at anchor and docked; no cheering, only the deathly quiet expectation of action. It was a thrilling experience that made me feel confident of a successful campaign. That confidence had been boosted by a letter, dated 12 August, from the Commandant, KGV's O Bengal S&M Group. In it, Colonel Obbard advised that 7 Company had had trouble amongst Sikhs (two murders) and that he had selected me for the command because I had done really well with the Faridkot Company.

The Biferno River

78 British had advanced quickly up Highway 16 from Bari and forced a German withdrawal from the Biferno on 6 October. 8 Indian joined them in 5 Corps on Eighth Army's Adriatic coastal sector and moved forward between 1 Canadian of 13 Corps to their left and 78 British on the coast. Ahead of 5 Corps, starting about 150 miles north of Taranto, was a series of rivers that I came to know as the Adriatic obstacle course. In dry weather these rivers were mere paddling pools between shingle beds; easily crossed in places by tanks. Rain in the mountains changed them into deep rivers. The Biferno was the first of these. Beyond it, Highway 16 was narrow, winding and water-bound, but the inland road for 8 Indian was narrower, heavily demolished and less stable. 8 Indian moved to Larino, where our 17 Brigade relieved a British brigade on 18 October. 7 Field Company was to bridge the Biferno four miles to the north. Our divisional artillery fired its first rounds in Italy on the night of 20 October. That night two companies of infantry crossed the river and I sent a party forward to measure up and set out for bridging. It was raining heavily.

The amount of Bailey required, estimated from aerial photos, was sent up that night. The German demolition had left a central pier too narrow for two simply-supported spans. A 220ft Class 30 TS Bailey was required for tanks to support the advance on the Trigno about 12 miles ahead. I decided to provide a support that permitted rotation without overloading the bottom chords over the pier. This was made in our 47 Field Park workshops by welding two layers of bottom chord (a 6½ft length over a 3½ft) on cut off bases of end posts. Six were required to fit under the bottom chords of the two 3-panel trusses. Later, we found that the task of



The Adriatic obstacle course.

jacking the sag out over the 220ft length and fitting the units, was very time-consuming – but that was the least of our problems. Early on that first night, the work party was fired on, the reconnaissance officer was shot in the hand, site work stopped, the bridging material was unloaded off site (reason not known) and the rain did not stop. Assembly of the Bailey started on the next evening after the components were taken to the site on company trucks. It was another dark wet night, a compressor truck knocked over setting-out pins and assembly was started late. Work resumed in the evening of 22 October. I had given a completion time of 36hrs based on two nights work, but this night the central supports arrived late and their height was greater than notified. After two nights' of construction, unhindered by any remembered enemy action, we failed to complete the bridge by first light on 23 October. It was the anniversary of the Eighth Army's attack at Alamein. My CRE, the late Colonel C M MacLachlan, OBE, relieved me of my command in a signal timed at 0735hrs that morning. I believe the bridge was completed that night as 17 Brigade advanced on the night of 24 October. By that date, 78 Division had crossed the Trigno River.

After absorbing the shock, my reaction was one of anger at unfair treatment. The anger increased when I protested to my Division's Commander and found that I was reported to lack battle experience, organizing ability and determination. The first was true, but the commendation dated 3 September by the GOC American Air Command, expressed a contra opinion, as had Colonel Obbard on 12 August. I took my case to 5 Corps Commander arguing that my CRE had known me only a short time, that my previous four commanders all commended my performance during the past three years, and that too much had been demanded of a unit with little experience of Bailey bridging. Lieut General Alfrey explained that as my CRE had lost confidence in me, I had to go. I have always believed that a team leader should accept responsibility for the performance of his team, so I had to accept my sacking. At that time I had to get on with my life and went to work for the Chief Engineer 5 Corps.

Now 50 years on, when reviewing that event, I ask myself "where did I go wrong and what should have been done?" To find answers, I read the story of the Biferno Crossing as recorded by others. In "Engineers in the Italian Campaign" published by GHQ Central Mediterranean Forces in December 1945, I read that on 3 October a brigade landed at Termoli (beyond the Biferno) and linked up with 78 Division but the Germans counterattacked forcing withdrawal. Then the river rose and tanks could not recross the Biferno till a Class 30 bridge was provided. 214 Field Company (78 Division) hastened construction of a 100ft Bailey across two demolished spans of the Highway 16 bridge and repaired a third damaged span. The bridge was

built under fire, in incessant rain, four bricklayers laying 5000 bricks in 9hrs. The bridge was completed in about 30hrs and tanks crossed to redress the battle. From the story of 8 Indian Division in Italy, "The Tiger Triumphs," I read that it was not until 2 November that 8 Indian was committed to its first action in Europe, in their attack across the River Trigno – significant in that this implies no real fighting during October.

While it may have helped me to a different decision had I known of the early October withdrawal and the little opposition encountered, I realized that my first and big mistake was to assume that the bridge had to be built at night. It is highly likely that assembly could have started on the morning of the 21st and we should have been able to work by day on the 22nd without any real hindrance from enemy action. Rain, cloud and advanced patrolling would have stopped enemy observation. Wireless contact with infantry patrols ahead could have helped an earlier appreciation of the situation. When compared with the determined effort of 214 Field Company, my lack of determination seems fair criticism. My other mistake was the choice of central support. In the light of later experience, I should have used a simple timber baulk as the central support, at least until tanks and artillery had crossed. The rotating support could have been fitted in a second phase, as was used by field companies under CRE 8 Army troops when building a 340ft continuous Bailey on Highway 16 over the Trigno.There temporary piers were replaced in a 2nd phase. One question remained: "Was it enemy fire that wounded my recce officer or that of our infantry on hearing sounds from our work party also across the river?"

The bridge was completed on 24 October, 17 Brigade passed over that night and 8 Indian Division advanced to the Trigno hindered mainly by demolitions, mines and mud. On the way nine bridges were built by their 66 and 69 Field Companies ranging from 40ft single single (SS) to 150ft double double (DD) at Aquaviva and a 170ft DD at Montefalcone. The Trigno was in flood with all bridges blown and approaches mined. 8 Indian was committed to its first battle on 2 November when it forded the river to attack Trufillo. 66 Field Company cleared the approaches of mines and built a FBE (folding boat equipment) trestle bridge over the river. The other Sapper companies joined in the task of keeping 8 Indian on the move by clearing mines and repairing or by-passing demolitions. The momentum was maintained. Infantry captured a bridge over the Senello ravine with charges intact on 7 November, advanced to take Atessa village and, after repelling counterattacks, found that the way to the Sangro was open.

On 23 October a battalion of 78 Division crossed the Trigno near Highway 16. On the 27th a crossing was made near the sea, San Salvo was taken on 3 November and a 340ft Bailey bridge was built over the river by 561 and 586 Army Troops Field Companies (on temporary piers in 36hrs). One of 5 Corps' troop companies also built a Bailey bridge at 8 Indian's Trigno crossing. By 10 November, 78 Division had reached the Sangro. This was the third water jump. I also arrived on the scene in time for the engineer battle with the river.

Crossing the Sangro River

Early in November, 5 Corps faced the *Gustav Line*. It is described in "The Tiger Strikes" as a string of villages on knolls, transformed into self-contained interlocking fortresses with deep shelters and escape tunnels connecting reinforced houses. Eighth Army gave 5 Corps the task of advancing to take Chieti on Highway 5 from Pescara to Rome. At the same time they gave 2 New Zealand Division the task of advancing on the more tortuous inland way to Highway 5 west of Chieti. 5 Corps' attack plan required 78 Division to establish a bridgehead over the Sangro, 8 Indian to breach the *Gustav Line* at Mozzagrogna and later 1 Canadian to advance to Pescara. To conceal the New Zealand Division and the concentration at the point of attack, 19 Indian Brigade remained at Archi 12 miles inland and explored the Sangro before the 26 Panzers. Later they crossed to provide the bridgehead for 2 New Zealand Division 8 miles inland from Mozzagrogna, at Calvario.

The demolished bridge over the river on Highway 16, known as the Sangro bridge, was about 2½ miles inland. From there the river ran between 8ft high flood banks, some 400yds apart. The Paglieta bridge leading to Mozzagrogna was a further 2½ miles upstream. Between the bridges, the river ran between lateral raised roads, over one mile apart. The normal waterway was about 120ft wide, meandering and shallow at normal flows with several fords showing on air photos. From these photos it was planned initially to use a ford 1¼ mile in from the coast for 78 Division's bridgehead forces and later called "Piano." The main assault crossings were to be "Freddy" for wheels east of the Sangro bridge plus "Harry,

Paglieta bridge. Remains of original No 3 (north) pier with replacements.

Nuts, Toc" and "Vic" in that order upstream to Paglieta bridge, for tanks, carriers and wheels.

The Sapper battle on the Sangro was in two parts, first the preparation for the assault on the *Gustav Line* and then the support to the assault and the advance including replacement of those temporary crossings with more permanent bridges. Most of the early work was done by 78 Division's Field Companies 214, 236 and 237 with 626 Field Squadron assistance. To conceal 8 Indian's presence, their Field Companies, 7, 66 and 69 worked only on the near bank until D-day. 5 Corps Field Companies, 564, 565 and 751 were to replace Paglieta bridge. All ten units were required on construction and maintenance of crossings from 19 November and into December. On 11 November 78 Division's infantry began eight nights of aggressive patrolling, up to 2 miles beyond the river, to Foccacia and the road behind the crest. Behind this screen, their Sappers searched for mines and crossing routes. The enemy interfered once when 256 were lifting mines on "Freddy" track. The recce officer and six sappers were taken prisoner but a corporal escaped to report 47 mines lifted. The enemy mines caused many casualties during the whole campaign. 237's recce parties spent nights locating mines on that far bank between the two bridges, with infantry protection. On the first night booby traps were found, at first with single-pull igniters screwed into Italian box mines. Then a series of interconnected mines, caught the lifters. Five men were killed and two wounded. Fifty mines were lifted, some with double-pull strings on one igniter, some with 2-pull igniters and some interconnected. On the night 12/13th 626 Field Squadron found fords for tanks, known as "Nuts" and "Harry".

From the 15th the river interfered, rising rapidly and making fording difficult even for tall men. 564 could not cross on the 18th to inspect the far approach on "Vic" crossing. They tried again the next night with ropes, but had to use dragging methods to recover an officer. Later that night two officers got across a mile further down and examined the far approach, that third try being successful. On 19 November 214, 237, 564 and 751 moved their work parties forward to the river for work on "Piano" and "Freddy" assault crossing routes after dusk. 7 and 69 also moved in that night put 30ft Baileys over a mill-race paralleling the river for "Nuts, Toc" and "Vic" routes. By dawn, a brigade of 78 Division had forded the river and established the bridgehead on the escarpment. Fording supporting arms with certainty became impossible on the 20th. That night a flying ferry was built and a Bailey set unloaded on the "Piano" approach. Shelling hampered work on "Freddy" and killed one, wounded three and shell shocked five others. By 2300hrs the river had risen but another brigade crossed to reinforce 78's bridgehead. Mine detectors failed to detect – after being soaked. Orders were issued on 21 November first to build three assault bridges and then two maintenance ones. Recces were made quickly. That day five tanks crossed at the ford on "Harry" but found the soft going difficult on the far bank.

That night 78 Division (214 and 237) built a 140ft DS Bailey at "Piano" opening it for light traffic only on account of the poor approach. 8 Indian (7 and 69) built a 100ft DS Bailey between "Nuts" and "Harry" fords. This was named "Harry" bridge. A smoke screen was laid by the artillery to cover the completion of "Harry" bridge in daylight. Corps Troops (751 and 564) commenced 140ft DS on "Vic" route but did not complete because bridging lorries arrived late. Two more ferries were provided that night and mine-sweeping carried out on "Vic" and "Piano" tracks. Two Sappers were wounded, one badly; the long trek back combined with difficulty in fording the river caused too much loss of blood to one and he died on reaching the aid post. During

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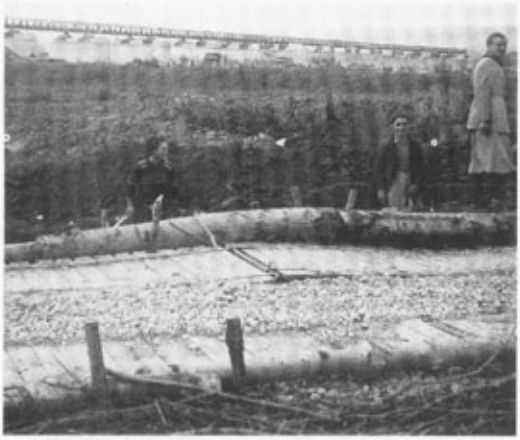
daylight of the 22nd, six tanks crossed by "Harry" bridge. The bottleneck now became the Osento diversion 2 miles in rear which became a sea of mud. Two tanks tried to ford near "Piano" bridge and ruined the approaches. This tank activity brought intermittent shelling and mortaring on "Freddy" chasing small parties back. When shelling stopped at dusk on the 22nd, "Vic" bridge was completed. The first customers were ration-carrying mules. They refused to cross. The building crew were not amused. One consolation was the rescue of a L/Sgt who floated downstream and grabbed the bridge. During the night, great efforts were made to open "Piano" and "Vic" for wheeled traffic by improving approaches and clearing mines over the river (on "Vic" and on the lateral road east and west from Highway 16). "S" mines killed one officer and wounded two Sappers. By dawn on the 23rd, two troops of anti-tank guns had crossed on "Piano" to support the brigades together with tanks which had crossed previously. 8 Indian took over the maintenance of "Vic" (66 Coy) as their main axis and were to construct their "B" maintenance route upstream of "Vic" (7 and 69). Corps Troops (751) had started the "A" Maintenance on "Freddy".

Advance from the Sangro

At 0300hrs on 23 November, 19 Indian Brigade sent two battalions across to attack the village of Calvario 8 miles west of Mozzagrogna. About 100 fighter bombers plastered that village and others on the ridge early in the day. Later the river counterattacked and by evening the river level was up 4ft. The approaches to "Piano, Freddy, Harry" and "Vic" bridges were under water with the river gap now 1000ft. Only one ferry survived and "Piano's" home ramp was swept away. Despite the current, parties crossed to complete mine-sweeping. Work on the far side of "Vic" was stopped by shelling which wounded the officer in charge. The immediate problem of maintaining the bridgehead brigades was solved by two detachments of amphibious vehicles (DUKWS) which ferried supplies by sea from a southern to a northern beach at the river mouth. They are reported to have moved 2000 tons in two nights. One of their "ducks" took emergency rations by swimming out to "Vic" bridge and on to the lateral road. It brought back wounded at 0300hrs on the 24th. Inland at Calvario, mules were swept away in the flood but on 24th, the village was taken. Over the next three nights flood damage was repaired, work continued on both "A" and "B" maintenance routes, and two Indian brigades moved into the bridgehead.

On the morning of the 27th, tanks and supporting arms began crossing on "Harry" and "Vic" bridges to get into position with 8 Indian on the escarpment. "Piano" was little used that day as the essential weapons for 78 had crossed before daylight. Some tanks chose the alternative ford, as "Harry" bridge was shelled on the afternoon of the 27th and knocked out. Fortunately fording was possible. Corps troops were ordered to strengthen "A" Maintenance to take Class 30 in an emergency. At the end of the day, "Vic" route had taken 50 carriers and 25 antitank guns, and 100 tanks were taken over in support. That night the Gurkhas entered Mozzagrogna, but had to retire in the face of flame-throwing tanks at dawn, because a large crater stopped supporting tanks. That same night a 100ft Bailey was built by Corps troops over a demolition on the exit from "A" Maintenance, and mines were lifted. 8 Indian built an FBE 300yds downstream of Paglieta bridge to take ambulances and staff cars pending the opening of the maintenance routes. "Piano" passed three infantry battalions and 170 vehicles moving up in readiness. On 28 November, two enemy aircraft tried and failed to bomb "Vic" bridge. Shelling delayed work on "A" Maintenance but a 140ft DS Bailey was built and completed early on the 29th. The clearing of bases for Paglieta bridge went ahead. That morning 8 Indian took Mozzagrogna, 78 British captured San Maria, they linked up on 30 November and had breached the *Gustav Line*.

"Vic" and "Piano" routes had carried the traffic as a result of untiring maintenance carried out on them. The FBE did its job of carrying ambulances but a tank ruined one approach early on the 30th. "A" Maintenance was open ready to take more tanks that day. "Vic" bridge was hit by shellfire on the 29th but repaired and opened for traffic on the 30th at 1000hrs. Bridges were renamed on 1 December, "Piano" becoming No 1, Maintenance "A" No 2, "Vic" bridge No 3, the FBE No 4 and Maintenance "B" No 5. The latter was a 350ft composite Bailey and FBE trestle completed early on 3 December. That day, 1 and 3 (the old "Piano" and "Vic") were almost worn out and it was time for 78 Division to rest. 1 Canadian Infantry Division took over. Chief Engineer, 5 Corps, ordered Corps troops to take over maintenance of the



The longest Bailey in Italy, during launching, with Piano's vehicle track in the foreground.

roads forward of No 2 and 5 crossings and to develop Highway 16 from Rocca to San Vito (6 miles up the coast from the River Sangro). They were due to complete the 350ft Bailey Paglieta bridge on 4 December.

The battle with the river seemed over, but it attacked again that evening just after the bridge was completed at 1900hrs. One hour later, the third pier was washed away to leave the bridge sagging from the centre pier to the north bank. No 5 stood up well but dropped the end of the 120ft Bailey into the flood. The FBE at No 4 did not stand a chance. The old "Vic" bridge as No 3, already battered by shellfire, was soon alone in its glory but when the flood eventually subsided only minor damage to bank seats had resulted. No 2 bridge suffered with the far span of 140ft dropped and swept downstream about 15ft; No 1, which was the oldest member, gave up the ghost and finished up almost parallel to the bank. The next morning, 8 Indian in Lanciano and 1 Canadian in San Vito were left with the sagging Paglieta bridge fit only for jeeps. It was jacked up on a new third pier and opened at 1000hrs on the 7th. No 2 bridge was replaced by a composite trestle and floating FBE bridge at 1115hrs that day. The FBE replacement was anchored with wire rope to piers of the blown Sangro bridge and was not troubled by the river. It was dismantled later after carrying almost 8000 vehicles and was replaced by a 1126ft Bailey over 18 piers. 8 Army Troops worked by day and night with floodlights from 4 December to complete it in ten days on the demolished Highway 16 Sangro bridge.

On 9 and 10 December, 8 Indian (69 and 7 Companies) built and strengthened a 120ft Bailey on the River Moro. It was built from the enemy side with covering fire from tanks, and known as "Impossible Bridge." At the same time 2 New Zealand battled at Orsogna and 1 Canadian attacked Ortona. On Christmas Day the Canadians were cleaning up there and probing to Pescara but the enemy still held Orsogna. On the 31st snow stopped all progress by Eighth Army. General Montgomery said farewell to them and I left to join 4 Indian Division.

Post Scripts

Commendation and Chore. On 29 November, 1/5 Gurkhas shared in the Army Commander's congratulations on the capture of Mozzagrogna. When cleaning up later, some were detailed to remove and bury a few German dead. After being carried outside, one of the presumed dead showed signs of life and a kukri was drawn. When a looker-on argued that you must not kill a prisoner, he was told "Surely sahib, you cannot bury him alive and the order is (*hukm hai*) to bury them." This was simple logic to a Gurkha, trained and famous for obedience to orders at all cost. After the alternative was explained, the German was added to the thousand prisoners taken in the Sangro battle. The high reputation of the 1/5th is reported to have cost them over 1000 casualties during their 20 months in Italy – this figure being more than their battalion strength.

The Basutos. Many of the river bridges required Bailey parts to be carried over 500yds from road to site. Pioneers helped Corps troops greatly. I asked a serjeant of 564 Company for his opinion of the African pioneers who assisted him. He replied "No one told the Basutos that a Bailey panel was a six-man load. They tried with two men then settled on four as a carrying party – they were marvellous."

Friend or Foe. A Canadian infantry officer told me that he was lying on patrol overlooking the

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Moro river, when he felt a hand first on his helmet, then on his shoulder. When he turned his head, he found a smiling Gurkha lying alongside, with kukri poised. He was sure that if the helmet shape had not been British, then he and every man in his patrol would have been "for the chop." It was his first meeting with them and he asked many questions. He asked what *Tikh hai*" meant. I explained that it was "Okay" in Gurkhali, or literally "Pass friend."

More Mines. On the morning that Mozzagrogna was taken, a tank officer died when his jeep was blown up on the road to the village, almost certainly by a buried mine over which vehicles had driven before. That road had been swept, but even the best mine detectors failed to find box mines with 6in of cover. The road was swept seven times before it and the verges were clear. Later that day, a Sapper corporal was killed on another box mine, reported as buried over a foot deep, on the Maintenance "A" exit. That track had been swept and had carried vehicles before. I remember a more humorous incident on the same track. An agitated but very lucky Gunner colonel came rushing up on foot, to complain that something had gone "poof" under his jeep wheel. It was a box mine over which many others had travelled. The main igniters, at least one or two, had fired without detonating the main charge. Many days later, I was very sorry to hear that Lieut Colonel C M MacLachlan had lost a foot on a mine beyond the Moro river. I was told that he was trying to rescue his driver in a minefield. "Wee Mac" as he was often called, never lacked courage and that action could be expected of him.

Epilogue

The reputation of 8 Indian Division's Sappers was enhanced by the way in which "Impossible Bridge" enabled the Division to advance far beyond the Moro river. This was at a time when the Canadians and New Zealanders were stopped in Ortona and Orsogna. The story of the bridge is told well in "The Tiger Strikes", from the concept by the CRE, to the building by 69 Field Company and the strengthening by 7 Company. It omits to tell that 66 Company extended the bridge by 30ft and that 69 Company was later presented with the Army Commander's flag in recognition of their work on the Moro river and elsewhere. It seemed to me as an observer, that these Bengal Sappers had graduated in Bailey bridging during their two hectic months with Eighth Army.

I also learned a lot in that time, from the methods used by others, to speed up bridging so that tanks could attack, and to minimize the hazards of mine clearance. I came to admire the performance of 78 Division, particularly that of their Sappers. The Division's reputation was recognized by the Germans in the way their propaganda service attempted to demean them as "Churchill's Hatchet Men" – a reference to their battleaxe divisional sign. The particular lesson taught to me in the battle with the River Sangro and in breaching the *Gustav Line* was that centuries old one – "If at first you don't succeed, then try, try and try again."

Sapper Geology: Part 3

Engineer Specialist Pool Geologists

COLONEL E P F ROSE TD MA DPHIL MIWEM CGEOL FGS,
AND COLONEL N F HUGHES TD ERD MA ScD FGS

The first of this brief series of articles (Rose & Hughes, 1993a) reviewed the military use of geologists in the two world wars; the second (Rose & Hughes, 1993b) the establishment of a Pool of Geologists initially in the Territorial Army, later transferred to the Army Emergency Reserve. This concluding article documents the service of geologists in the succeeding Engineer Specialist Pool of the TAVR, from its foundation in 1967 until reconstitution as the RE Specialist Advisory Team (V) in 1988. For 21 years these geologists served the Corps widely – and cost-effectively.

INTRODUCTION

IN 1967 the Territorial Army (TA) and Army Emergency Reserve (AER) were severely reduced in manpower and amalgamated to form a single organization, the Territorial and Army Volunteer Reserve (TAVR). The Geologists' Pool and the Works Pool of officers of the former AER were amalgamated to form the Engineer Specialist Pool (ESP), a unit placed in Category IIB of the new TAVR, initially with an establishment of 12 officers. Between 1969 and 1972 minor charges were made to tidy up the reorganization, and the ESP was recategorized and expanded to 16 officers, to include up to five geologists plus one engineering geologist. A geologist (Lt Col T G Miller) commanded the unit, albeit briefly, as it began by amalgamation in 1967. Another geologist (Col E P F Rose) commanded as it came to an end, by redesignation as the RE Specialist Advisory Team (V) (RESAT) on 1 April 1988. Between these times geologists were constantly on tap – but never on top.

GEOLOGIST OFFICERS

FIVE very experienced geologists transferred into the ESP from the AER Pool: Lt Col T G Miller, Majors N F Hughes, A F Fox, F Moseley, and P I Manning. As already documented (Rose & Hughes, 1993b), Miller left later in 1967 on moving to Africa when appointed Principal of the University College of Rhodesia; Hughes was promoted substantive lieut colonel in 1967 and served until reaching the age of 52 in 1970; Fox remained on strength until the age of 49 in 1969, but was prevented by business commitments from completing sufficient training to earn a TD; Moseley served until 1971 when he too reached the age of 49; Manning briefly enjoyed promotion to lieut colonel in 1971 but left the TA in 1972 on posting by the British Geological Survey to Ethiopia. Thus within five years the Corps lost the considerable military geotechnical expertise on which it had been able to rely for much (and in the case of Miller and Hughes, effectively for all) of the nineteen-year existence of the TA/AER pools.

An attempt was made to keep up the by now traditional high academic standards of military geologists. G S Boulton, a 1st class graduate of Birmingham University who had trained under the professorial supervision of one of the most distinguished military geologists of World War Two, Fred Shotton, joined the ESP as a subaltern for 1967 and 1968, undertaking geological tasks in Germany and Kenya. He left, however, to concentrate on an academic career – very successfully, for Geoffrey Boulton is currently Regius Professor and Head of the Department of Geology in the University of Edinburgh, and has in recent years been elected a Fellow of the Royal Society in recognition of his distinguished research on polar, Quaternary, glacial and marine geology, and glaciology.

Replacements for the fast-disappearing geological leadership were at hand – but in the gunners! E P F Rose joined the ESP in February 1969. Too young to qualify for National Service, he had gained a TA commission in the Royal Artillery sub-unit of the Oxford University Officers' Training Corps whilst an undergraduate, transferred on becoming a research student into the local yeomanry – Q (The Queen's Own Oxfordshire Hussars) Battery of 299 Field Regiment RA (TA) – and in 1967 transferred into the infantry as Q Battery merged with part of the Oxfordshire and Buckinghamshire Light

Infantry (TA) to form the short-lived Oxfordshire Territorials of the new TAVR. With the Oxfordshire Territorials doomed by the reorganization of 1969, a speculative letter of enquiry as to whether the Corps could use a potentially "spare" geologist brought transfer into the ESP and posting to Thailand within six weeks! It was to be 21 years before his Corps use came to an end. By 1972 Ted Rose was effectively senior ESP geologist (as a captain), and from 1974 officially in post as such (initially as a major).

To fill a vacancy in 1971, Rose nominated L R M Cocks. Both had graduated with 1st class honours in geology from Oxford, in 1963 (from St Edmund Hall) and 1962 (from Hertford College) respectively. Both went on to complete doctoral theses there. Like N F Hughes before them, both were later to serve on the Council and as Vice-President of the Palaeontological Association. Robin Cocks, however, had experienced National Service before matriculating at Oxford. Commissioned into L (Néry) Battery, 2nd Regiment Royal Horse Artillery (subsequently 2nd Field Regt RA), he had served at Hildesheim in Germany before active service (1958 to 1959) during the emergency in Malaya, and he continued as a gunner subaltern in the AER from 1962 to 1968. Joining the ESP in 1971 as a captain, he served for 12 years and left as a major in 1983 only when promoted in his civilian career to the post of Deputy Keeper of Palaeontology at the Natural History Museum, London. Freed from TA commitments, he then gained increasing distinction as a geologist. He was promoted Keeper of Palaeontology at the Museum in 1986, elected Secretary of the Geological Society of London 1985-89, elected President of the Palaeontological Association 1986-88, and in 1984 awarded a DSc degree by the University of Oxford for his numerous research publications on brachiopod palaeontology and Silurian stratigraphy.

Other geologists came and went more quickly. S C L Hobden, a soils engineer and TA Sapper officer of considerable experience en route finally to a colonelcy in the Engineer and Transport Staff Corps, briefly filled a geologist vacancy in the ESP 1970 to 1972 until reaching his age limit as a major – and became an external BSc geology student at London University at the same time so as to acquire the appropriate skills. M H L Pickford, a graduate geologist and ex-regular army signals officer, served whilst a geological PhD student at Bedford College before returning to a museum appointment in his native East Africa. A J Willis, a graduate engineering geologist, served briefly before taking employment in Hong Kong. G A P Peace, a geologist who later gained an MSc degree and undertook postgraduate research in engineering geology, served before commanding the TA well-drilling Specialist Team and later moving out of relevant civilian geological employment. D L Loughman, a graduate of New College Oxford who had gained a PhD at Birmingham via a prestigious Shell Studentship, had a Short Service Volunteer Commission in the Royal Green Jackets and six years of TA service to his credit before joining the ESP, where he soon became a captain and seemed destined to fly high. Sadly, his employer (Shell Petroleum) also thought he should go far – and soon specified North America.

In 1978 geologists set a precedent for the "sponsored" units administered by Central Volunteer HQRE – they admitted a woman. Hazel Chapman, who had graduated in geology from Oxford, joined the ESP from Oxford University OTC whilst completing her doctoral thesis. Lt Chapman soon became Dr Chapman, but then Mrs Bickle – leaving the ESP to accompany her husband when he obtained a temporary geological appointment in Australia.

All these geologists contributed to Corps projects worldwide during their service, but being generally younger and less well established in their civilian careers than their TA/AER predecessors, left the ESP after a few years as a direct consequence of civilian career moves – mostly in the rank of captain. Attempts to recruit 30 year old geologists already well established in their profession proved generally unsuccessful: Dr S J Cribb, for example, found it impossible to meet the time requirement to rise from the ranks as a conventional TA Sapper officer before appointment to the ESP. The exception to this rule was Dr (now Major) M S Rosenbaum, who interrupted his career as a university lecturer in engineering geology with an average of 70 days of military training per year in his first two years of TA service.

Officially, the commitment for an ESP officer was to complete 30 days of "training" over a two-year period, to be medically fit, and to fire an annual range course. In practice, geologists

were expected to contribute some 30 to 40 days each year, to meet the need for military training (important in this post-National Service era) in addition to providing the "on call" geotechnical consultancy service expected from the ESP – "ubique." M S Foster and J C Eaton began their association with the ESP in 1987 and are still meeting that commitment through RESAT.

The Far East: Thailand, Nepal and Hong Kong

Between 1969 and 1981 ESP geologists were used on a number of tasks in the Far East, primarily relating to groundwater development, slope stability, and quarrying for aggregates. Some were concerned with military sites; others contributed to military training through tasks approved as Military Aid to the Civilian Community.

Groundwater tasks took geologists to Thailand in 1969 and 1970, to Nepal in 1973 and 1976, and to Hong Kong in 1970, 1973 and 1977. Earlier reference to these in the *Journal* (Rose, 1978) excludes names of geologists then still serving, but all have now left the Corps, so they can be recorded here.

In Thailand, support was given to Specialist Team RE (Thailand), deployed for well-drilling and minor tasks in an area some 250km to the west of Bangkok. A geologist subaltern (E P F Rose) joined the recce team mounted by HQ FARELF in Singapore to guide initial deployment and tasking of the STRE. Data search in Bangkok, notably at the Bureau of Mineral Resources and at Chulalongkorn University, established that no borehole records or detailed geological maps existed for the area under consideration, so some three weeks were spent on photogeological interpretations and reconnaissance geological mapping in Kanchanaburi and Ratburi provinces. Here the hills protruding through an alluvium or jungle cover revealed outcrops of metamorphic rocks, thick Permian limestones, occasional redbeds, and some extensive granite intrusions. A combination of geological, political and administrative reasons led subsequently to deployment of the STRE to Ratburi province, and after an early phase of essentially exploration drilling, geologists (P I Manning, E P F Rose) returned to examine the well logs and rock cuttings, undertake more detailed ground surveys, and predict areas for productive drilling.

In Nepal, L R M Cocks was tasked to provide advice on water supply for the Dharan Cantonment, built as a recruiting centre for the British Gurkhas and developed as HQ BRIGNEPAL. Water supply was drawn through an 8km gravity pipeline from the head waters of the Seoti Khola, potentially vulnerable to earthquake and other damage. An alternative or emergency source was sought, and on the basis of geological information plans for an expensive (and potentially unsuccessful) deep-drilling project through a thick sequence of coarse clastic sediments were replaced by a programme of hand-dug shallow wells at a fraction of the cost.

In Hong Kong, following an earlier visit to the Territory in 1970 by P I Manning, L R M Cocks recommended sites for new wells in Yuen Long district as part of a community relations project. New wells were needed to avoid serious pollution problems reported at Chau Tau village, and to supplement the supply to Tai Tseng Wai which proved inadequate in the dry season. Later, as part of a larger programme of tasks, E P F Rose and H J Chapman produced a report on a potential well site on Kat O Chau (Crooked Island) off the NE coast of the New Territories. They commented on the relative merits of a potential large diameter dug well versus a smaller drilled well as the source of water for a new combined military/police post planned to deter illegal immigrants from entering the area.

Slope stability and quarrying in Hong Kong formed the basis of reports in 1977 (by E P F Rose, H J Chapman) and 1978 (E P F Rose, G A P Peace). Geologically, this region is now part of a stable continental margin with a history of sedimentation (from Devonian to Cretaceous times, when sands and clays, now sandstones and shales, were deposited over the general area), volcanism (in the Jurassic, when a thick sequence of acid lavas and ashes was extruded), intrusion (of granite bosses in the latest Jurassic, and a variety of dykes in the late Cretaceous/early Tertiary), and erosion (to form a mountainous peninsula and series of islands, the mountain sides covered by a locally thick layer of colluvium *(Photo 1)* – weathered rock which has moved downslope). Slope failure is a particularly common occurrence in Hong Kong, notably after prolonged heavy rain has raised the level of ground (pore) water, and sudden torrential (typhoon) rain (up to 150mm/hour) has raised this above a critical value. Slope failure may be frequent (only when the rate exceeds 50 failures per day is the scale of failure termed "disastrous"); sometimes it is tragic

(loss of life in the Sau Mau Ping and Po Shan disasters of the 1970s concentrated engineering minds wonderfully). Serious failures were largely the result of engineering works producing unstable cut slopes in rock or more commonly in colluvium or soil, or generating steep slopes of uncompacted fill. ESP geologists contributed to a rapidly-expanding programme of slope studies directed by the Hong Kong Government as a response to the Po Shan/Sau Mau Ping disasters by a study of factors affecting slope stability in the Lai King area of the New Territories, some 6km NW of Kowloon, and a safety analysis of the major rockslide which occurred at Anderson Road No 3 (granite) quarry during the night of 29/30 July 1978. They also produced reports on two potential quarry sites in Hong Kong and the New Territories; on the suitability of a potential quarry source for the aggregate required for a friction course overlay at Kai Tak airport; on sources of building sand; and on calcareous rocks suitable for use as asphalt filler. L R M Cocks had earlier (1973) reported on potential quarry sites for road metal needed for a proposed new military road round the Castle Peak peninsula. Overall, these projects demonstrated the need for versatility in ESP geologist expertise!

Photo 1. Slope cut through granite colluvium in Hong Kong: note striking contrast in tone, with large dark grey core stones of massive granite rock in a light grey, soft matrix of granite now weathered to sand and clay. This produces a wide variety of rock strength, and potential for confusing large boulders with bedrock during site investigation. Geological factors influence route alignment; means and speed of excavation; and slope stability. Additionally for military purposes, they influence the effectiveness of explosive cratering for route denial.

The need for geologist expertise in the Far East declined with closure of the British base at Singapore and decline in military commitments east of Suez. Moreover, development of a Geotechnical Control Office within the Hong Kong Government Public Works Department subsequently provided the expertise to which ESP geologists and civilian consultants had contributed as a response to earlier emergencies. One major task remained. In 1981 the Hong Kong Public Works Department asked through Military Engineer Services (Works) that ESP geologists, because of their range of expertise, local knowledge, and lack of vested commercial interests, undertake a feasibility study for an entirely new geological survey and geological map of Hong Kong, Kowloon and the New Territories. Recommendations of this study (by E P F Rose, L R M Cocks, and G A P Peace) led to the establishment of a Geological Survey section within the Public Works Department, to its geological mapping of the Territory culminating in a series of 1:20,000 scale geological maps, and to a series of geological and geotechnical publications. As so often in its history, the Corps had contributed to the foundation of a new, technically-based organization which thereafter developed as a separate, successful entity.

The Mediterranean: Malta, Cyprus and Gibraltar

Within the Mediterranean region, military geological tasks in Libya came to an end in 1969, those in Malta in 1974, but projects in Cyprus and Gibraltar have continued to the present day.

In Libya, the need to locate potable groundwater supplies for British troops training in the

Sapper Geology Part 3, p309.

Photo 2. Limestone cliffs fringing RAF Akrotiri, Cyprus: note variation in weathering resistance, only partly a guide to building stone durability. (Extract from a stereo-line overlap of photographs prepared by F Moseley in 1970 to guide military quarrying, and used subsequently as a case history to demonstrate the value of this photographic technique in rapid reconnaissance.) Geological factors influence cliff erosion and climbability; also beach stability and trafficability, whose military significance became most obvious from World War Two.

area had generated a series of military geologist visits and reports through the 1960s. A concluding account was published in the *Journal* (Moseley & Cruse, 1969). On the basis of geology and an analysis of existing wells, this defined the most favourable area in northeastern Libya for groundwater abstraction from the main water table, and criteria for siting of new boreholes – in a region largely underlain by a thick sequence of Cenozoic limestones with subordinate marls. However, with the revolutionary change of government in Libya, and subsequent withdrawal of British troops, the need and opportunities for further work ceased.

Malta, too, witnessed a British troop withdrawal, but sappers lingered longer than most in the guise of Specialist Team RE (Malta), which provided expertise to the Maltese government Public Works Department. E P F Rose, with several university-based studies on Libyan and Maltese limestones to his credit, was a natural choice to contribute as an ESP geologist to the construction work being supervised by the STRE to the south of Grand Harbour in 1973 and 1974. He reported on the rippability of Maltese Cenozoic limestones as inferred from seismic velocities, and therefore potential excavation techniques for a new road cutting through the Corradino Heights; on fault patterns and potential causes of ground subsidence in the Laboratory Wharf area; on the possibility of damage to pipelines due to ground vibrations from blasting; and on the interpretation of seismic surveys. But opportunities for further work soon departed with our troops.

The island of Cyprus, however, has retained a British military presence to the present day. Larger and geologically more varied than Malta, it has provided scope for a more numerous and diverse range of geotechnical tasks. The basic geology is of a core of igneous rocks, both intrusive and extrusive, forming the Troodos mountains and outliers, surrounded by sedimentary rocks, mainly limestones. In 1970 F Moseley reported on potential groundwater sources and sites for roadstone quarries for camps and new roads in the Akamas training area, the peninsula extending to the northwest of the island. He also reported on potential quarry sites to supply the large stone blocks required for armouring the new mole at Akrotiri harbour, on the peninsula to the southwest – a study later published to form an instructive case history (Hutchings, 1974; Moseley, 1976; 1981) *(Photo 2)*. In 1974 L R M Cocks reported further on water supply for the Invicta Camp Akamas, and on sources of road metal for the Akamas track, together with a review of water supply for the Western Sovereign Base Area from the Akrotiri aquifer. He followed this in 1975, 1977 and 1980 with reports on groundwater supply to Ayios Nikolaos Camp in the Eastern Sovereign Base Area, and to the Eastern SBA in general. A J Willis and G A P Peace reported on well-drilling tasks in 1978, G A P Peace on a proposed borehole site on Mount Olympus in 1981, and in 1983 E P F Rose and S J Cribb traversed the 100km UN Patrol Track carefully from one end of the island to the other so as to report on potential sources of aggregate and fill required for its repair. E P F Rose returned alone to Cyprus in 1985, to produce a substantial report on the geology and hydrogeology of the RAF airfield at Akrotiri, plus brief comments on the water supply to the Episkopi Garrison derived from Kissousa spring. In 1986 he returned again, to report on coastal erosion and the need for preventative measures along the Akrotiri peninsula. In 1987 it was the turn of M S Rosenbaum and M S Foster, who together reported on the stability of the beach cliffs in the Episkopi Cantonment; the stability of a high rock face at Platres; and the engineering geological feasibility of locating a proposed new

dam site and reservoir in the northern part of the Episkopi Cantonment, later to be designed by civilian consultants and constructed as the Synvoulos Dam. Mark Foster additionally reported alone on the geological aspects of perimeter track deterioration at Pergamos and Ayios Nikolaos. With the transformation of the ESP into RESAT in 1988, continuing support has been provided by a new generation of geologists.

The peninsula of Gibraltar is largely of Jurassic limestone and dolomite overlain by Quaternary sands and screes. Conspicuously smaller than Cyprus (5.8 rather than 9251km^2), it has nevertheless provided a significant range and number of ESP geotechnical tasks – principally relating to groundwater, roads, slope stability, movement of beach sand and above all, tunnel stability. P I Manning visited the Rock in 1967 to report on the feasibility of drilling for groundwater – contributing to a series of studies ranging from 1877 to the present day. From 1971 to 1973 L R M Cocks contributed to studies for the realignment of the Europa Road, and to practical problems of rock excavation. In 1973 S C L Hobden and E P F Rose provided a weighty engineering geology review of the major water catchment slopes which form so spectacular a feature of the east side of the Rock. Reports on stability problems in parts of the 50km complex of tunnels and chambers which honeycomb its interior were provided by E P F Rose in 1974, 1981; E P F Rose and M S Rosenbaum in 1983; M S Rosenbaum and G A P Peace in 1984; M S Rosenbaum and D L Loughman in 1985; E P F Rose and M S Rosenbaum 1987; and RESAT geologists in later years. These studies extended wartime and postwar military geological activities on the Rock, as reviewed by Rose & Rosenbaum (1990). They led to publication of its first detailed geological map (Rosenbaum & Rose, 1991a), as already described in the *Journal* (Rose & Rosenbaum, 1992). Also to publication of a complementary geological field guide (Rose & Rosenbaum, 1991), and description of the geological aspects of tunnelling (Rosenbaum & Rose, 1991b). They provide a useful adjunct for detailed geotechnical studies which still continue, under government, academic or military auspices.

The Caribbean: Dominica and Belize

In Dominica, a one-off training opportunity in 1974 took M H L Pickford to undertake a detailed reconnaissance for sources of road construction materials. Great difficulty had been experienced in locating and working suitable sources of good crusher-run and natural gravels for road base and sealing materials. Martin Pickford was required to assess existing reports and conduct field studies so as to determine sites for new borrow areas and quarries; advise on further research and investigation required; recommend probable best methods of working new quarries; and provide comment on existing quarry potentials and working methods. He located four deposits of good crusher-run material suitable for road surfacing, and four marginally suitable deposits – all on the youngest, least weathered series of volcanic rocks which occupied the general area.

In Belize, also in 1974, Pickford made a further reconnaissance for road metal, locating numerous deposits of weathered but unmetamorphosed limestone of Cretaceous and Eocene age suitable for road base aggregate, together with a small deposit of sand and gravel. A possible site for a quarry to yield high grade road sealing material was located in the central part of the country, utilizing quartzites in the complex of metamorphosed sediments and granites of Palaeozoic age which form the Maya Mountains. Groundwater problems took another ESP geologist to Belize ten years later, in 1984, when E P F Rose was tasked to report on potential groundwater resources at Salamanca Camp, sited partly on faulted Cretaceous limestones and partly on overlying Tertiary mudrocks. Existing wells gave insufficient yield in the dry season, and recommendations were given to improve the yield, and to site a new borehole. This visit initiated not only a programme of drilling (*Photo 3* on the next page), but a geological survey by M S Rosenbaum in 1987 to advise on further well locations and a series of subsequent visits by RESAT geologists.

Germany: BAOR and I(BR) Corps (now HQ UKSC(G))

As described earlier (Rose & Hughes, 1993b), when the TA pool of Sapper geologists was first formed, its members all trained regularly in Germany. ESP geologists, however, as indicated above, were used initially on tasks in warmer, more exciting localities "out of area."

Between 1967 (a visit by G S Boulton) and 1977 (a visit by E P F Rose) there was only a single ESP geologist visit to Germany, by E P F Rose in 1971. This generated reports on a potential quarry

Photo 3. Military well-drilling in Belize. (Photo courtesy of the Librarian, Technical Information Centre RE.) There has been a close association between geologists and Sapper well-drilling teams, regular army and TA, in both peace and war. Geological factors influence the siting and depth of boreholes; drilling speed and technique; and casing requirement.

site in the Sennelager Range Area, to provide road metal for new tracks; prevention of flooding by groundwater infiltration from a perched aquifer into a borrow pit at Bracht; potential groundwater resources of a nearby training area; and aspects of the engineering geology on the four RAF airfields in Germany. Rose carried out laboratory studies on "rock" samples from a well drilled at Brüggen in 1974, but there were no further site visits.

In 1977 the emphasis changed, and (except for 1981) from that year onwards at least one ESP geologist "trained" in Germany annually. E P F Rose visited 1977 to 1980, and again in 1982; L R M Cocks 1980 and 1982; D L Loughman 1982 to 1985; M S Rosenbaum 1982 and annually from 1985; M S Foster and J C Eaton both in 1987. In addition to a wide variety of specific technical tasks which were dealt with in this period, there were two noteworthy innovations:

1. Appointment of a Corps geologist for 1(BR) Corps. With an ESP geologist designated in this role, 1(BR) Corps now had an appointment equivalent to the Corps geologist serving with each of the German *Korps* – facilitating liaison between British and German staffs on geotechnical matters, and also facilitating access to the geological resources of the "host nation" through the Geophysikälischer Beratungsdienst and Militargeographischer Dienst. Germany had made far more extensive use of geological expertise than had the allies in both world wars, and the Bundeswehr too was well served by geologists. Until it had its own geologist, 1(BR) Corps was at a disadvantage when defining requirements for "host nation" geological data, and with interpretation of information available when required to provide answers to specific ground engineering questions.

2. Preparation of Terrain Engineering Characteristics maps. ESP geologists provided the technical guidance necessary for Survey to convert basic geological information into a map series destined for widespread use.

At the time of transformation into RESAT, geologists had therefore established a potential operational role in Germany, regularly exercised in it, and developed an appropriate resource base – with particular emphasis on cross-country mobility and on ground diggability *(Photo 4)*.

The South Atlantic: Falkland Islands

However, when war came in 1982, it was (perhaps predictably) not within Germany but far "out of area" – in the Falklands, an area for which no ESP geologist had trained.

The conflict brought a requirement for ESP geologist advice on terrain, groundwater, and quarrying. A major requirement was for a terrain evaluation, a summary to be provided in the form of a briefing map (EinC(A), 1982). This was to indicate the various natural obstacles that would hinder or prevent cross-country movement. The map was produced in a very short timeframe by a Royal Engineers team which included an ESP geologist, L R M Cocks. The work was based on published geological maps and records, supplemented by study of satellite imagery and aerial photographs, and interviews with people who had visited or studied various parts of the islands. The 1:250,000 scale geological map had been generated by the British Antarctic Survey (the ultimate source for detailed information) when based at the University of Birmingham and then coincidentally subject to the influence of Professor Fred Shotton, whose military geological career we have already reviewed. The closest Cocks had come as an ESP geologist to the South Atlantic was to carry out a desk study for water supply on the volcanic island of St Helena in 1978, but his special field of

civilian expertise was in Palaeozoic geology, and the Falklands succession is almost entirely of clastic Palaeozoic (Devonian to Permain) sediments overlying a Precambrian igneous and metamorphic basement. The present land surface has been modified by some 200 million years of terrestrial weathering, and extensive periglacial activity during the Pleistocene "Ice Age". Geologically-related hazards include localized areas of peat and extensive periglacial stone-runs which significantly impede cross-country mobility, and tectonically controlled upland regions where differential erosion has left extensive ridge lines of Palaeozoic quartzite overlooking peneplained lowlands of less well-cemented clastic sediments. The high water table and frequent groundwater recharge combined to generate waterlogged conditions in particular areas, which consequently caused problems of concealment (for equipment hides had to be sited in ground hollows owing to the lack of vegetational cover) and siting of artillery (since on soft ground the rear recoil blades of the guns sank so deeply into the ground that the weapons quickly came off line). A comparison between the briefing map and the geological maps for the islands shows a clear correlation between many features affecting "going" and the underlying geology.

Photo 4. Trial antitank ditch. Geologically-related factors combined with weather conditions strongly influence cross-country mobility, and the position, nature, and speed/means of construction of earthworks designed to impede it.

Other ESP geologists, E P F Rose and G A P Peace, contributed verbal and written advice on potential groundwater supplies both for Ascension Island and the Falklands from the outset of the campaign. As a consequence, water sources other than narrow-bore drilled wells were developed for operational support.

After the battle, an ESP geologist subaltern was sent virtually straight from his commissioning course at Sandhurst to guide quarrying for the large quantities of aggregate needed for road and airfield construction and reconstruction – but that is a story whose technical aspects have already been told (Rosenbaum, 1984; 1985a, b) (Photo 5).

The Middle East: Aden and Oman

ESP geologists visited Aden (South Arabia) in 1967, and Oman in 1970, and contributed desk studies in later years.

The Federation of South Arabia (now the Republic of South Yemen) is largely covered for thousands of square kilometres by volcanic rocks of Mesozoic age which extend from Habilayn, west almost to the Red Sea, and north into Yemen. Shapland & Little (1967) have described in the *Journal* how water supplies to selected military sites were improved during the operational conditions prevailing in 1966-7 by the drilling of tube wells. "The success of the well-drilling programme has shown the value of the work of the AER Pool of Geologists and of Major Moseley in particular." F Moseley had carried out reconnaissance studies in 1966, notably for water supply for the army camp in the region of Wadi Beihan close to the Saudi Arabian border (Moseley, 1971a). He returned to the Federation as an ESP geologist in 1967,

Photo 5. Military quarrying, Falkland Islands. (Photo courtesy of the Librarian, Technical Information Centre RE.) Aggregates have often been required in large quantities during or after military operations, primarily for road or airfield construction. Geological factors influence both siting and development of quarries.

describing later in the *Journal* (Moseley, 1967; 1973) that although the basaltic lavas of this region, as generally elsewhere, were impermeable and poor water-bearing rocks, there were sandy ashes and agglomerates of variable thickness within the sequence which could yield reasonable supplies of groundwater. Favourable borehole sites could be predicted from studies of the geological succession and regional structure by stereoscopic study of aerial photographs and confirmatory ground survey. Overall his survey covered an area of some 500 square miles, and made a preliminary assessment of most of the water regimes likely to be found there (Moseley, 1971b) – some better exploited by galleries than by conventional boreholes *(Figure 1)*.

Masirah Island, 15 miles off the SE coast of Oman, 40 miles long by 10 miles wide and rising to a height of approximately 1000 feet in its northern half, was about this time considered as a possible alternative base to Aden for British troops. A true desert island with less than 1 inch (24mm) of rain per annum, and largely bare rock fringed with gravel fans, geological studies by Frank Moseley in 1966 demonstrated that natural water supplies would be inadequate for this purpose. The island is almost entirely composed of highly faulted and unmetamorphosed but folded ophiolites – a volcanic sequence originally (in Cretaceous times) extruded upon an ocean floor and later thrust into its present position. The ophiolites (which include serpentine, basalt, pyroclastics and some radiolarite) are unconformably overlain by unfolded Eocene limestone (Moseley, 1969). Geological data discouraged development of Masirah as a major base, but were used in 1970-71 and subsequently to guide development of water resources adequate for local purposes – and relatively recent transits.

The mainland of Oman, extending from "Aden" northwards along the eastern margin of the Arabian peninsula, has a largely similar, if more complex geology. Much of the exposed bedrock is formed by limestones of Cretaceous age, but in the north slices of ancient ocean floor ("ophiolites") were thrust over them during obduction in late Cretaceous times, before deposition of a Cenozoic limestone/marl capping and subsequent erosion. British military activities in the area in the early 1970s have not been widely publicized, but led in 1970 to a visit by P I Manning to report on potential sources of water from wadi gravels near Nizwa in northern Oman, and on potential borehole sites in Dhofar, near Salalah in the south. The wadi site was not developed because of the effort required to build sub-surface dams, but the work in Dhofar formed the basis for a well-drilling programme conducted in 1971. Eleven wells were sunk, the first five producing good yields of potable water, the remaining six proving saline to various degrees but providing water still acceptable locally for irrigation purposes. In total, the exercise produced wells yielding water in excess of half a million gallons per day.

Thereafter military geological interest in the Middle East was allowed to lapse. L R M Cocks completed a desk study on water supply in the Musandam peninsula of northern Oman in 1979, but there were no opportunities for ESP geologist visits. When the Gulf crisis developed in 1990, RESAT geologists had to rely on their civilian expertise when asked for advice.

The UK and Ubique

The UK provided numerous if less exotic tasks for ESP geologists. Examples of field projects include a study by F Moseley in 1970 for roadstones on the Isle of Rhum off western Scotland; reports by M H L Pickford in 1973 and 1974 on the hydrogeology of Havergate Island and of the Wildfowl Trust Reserve at Arundel in England respectively; reports by L R M Cocks in 1975 on a dam site for proposed coarse fishery lakes near Liskeard in Cornwall, and on suspension bridge foundations in Scotland; comments by E P F Rose in 1976 on the geology of Broadford airfield, Isle of Skye, to supplement a resistivity survey; a geological report by H J Chapman in 1977 on a water supply reconnaissance of Egilsay and Wyre, also in Scotland; studies by L R M Cocks for an all-weather track in the Larkhill training area in 1978, and stability studies of cliffs at Tregantle in Cornwall in 1979; and reports by M S Rosenbaum in 1984 on bridge foundations, rock deterioration, river bank erosion and slope stability, all for CRE Scotland. There were many more, of similar geotechnical range, usually requiring only brief geological site investigation of not more than a few days.

Other tasks usefully performed largely in the UK included participation in equipment trials; providing teaching for the Corps and geotechnical review of appropriate Corps proposals or publications; public lectures for recruiting

purposes; and numerous desk studies. ESP geologists commented at various times on several items of geophysical equipment, and on kit for digging, drilling or cratering being trialled for use by the Corps, with respect to suitability for use in particular ground conditions. They contributed occasionally to Corps symposia (such as on site investigation and well-drilling) and to courses at the Royal School of Military Engineering, as well as steering and contributing to the rewriting of the Corps textbook "Military Engineering" Volume XV (anon, 1978). Desk studies ranged from reports on the possibilities of well-drilling in St Helena in the South Atlantic, through comments on the geology of Pitcairn Island, Botswana, and the British Virgin Islands, to rock classification in the Sultanate of Oman.

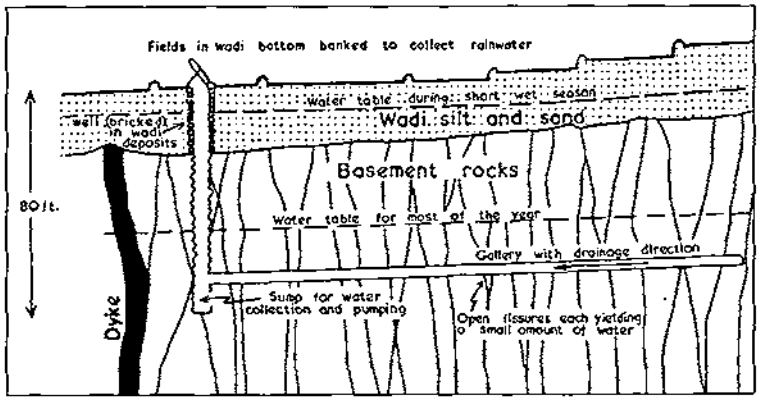

Figure 1. Recommended method of water development in fractured rock otherwise with low porosity and permeability on the Audhali Plateau, South Yemen. (From Moseley, 1971b. Natural Environment Research Council copyright: reproduced with permission.) Geological factors influence the means required to produce an adequate secure water supply at most military localities.

Lack of time rather than willingness prevented geologist participation on the ground in one-off projects in many remote areas overseas but G S Boulton did get to Kenya in 1968 to participate in water supply projects, E P F Rose to Belgium in 1972 for a major site investigation, and J C Eaton to Norway in 1985 to survey water resources at British Outward Bound Centres and recommend borehole sites to replace existing contaminated sources.

Conclusion

From a military point of view, the most important tasks undertaken by ESP geologists are those for which details cannot yet be published. Soldiers and geologists share a common interest in ground, and it must be left to the imagination as to how useful the militarily-informed, confidential, geological expertise in the ESP may have proved in the period covered by this review. The fact that P I Manning qualified for a General Service Medal whilst an ESP geologist at a time few other members of the TA were able to do so may help to indicate that members of the ESP were not typical TA officers.

Details given above, however, are sufficient to indicate that the ESP was able to maintain an establishment of about half a dozen geologists, all of whom were very well qualified academically and who had appropriate civilian employment. Those geologists more than met their "training" commitment of 15 days per year, most averaging some 30 days per year. Exceptionally, two geologists contributed over 80 days in single years to the Corps. Most "training" days were used to provide consultancy expertise to Corps projects, the rest to undertake the military training expected of all Sapper officers to equip them for a potential war role and provide the skills necessary to survive on a battlefield. Peacetime projects ranged through groundwater location and abstraction, identifying aggregate sources and optimum means of extraction, route alignment, site investigations, slope and tunnel stability problems, and specialist geotechnical mapping. ESP geologists thus trained more intensively, and were overall used more effectively, than their TA/AER predecessors. Their "training" contributed to lasting achievements by the Corps for the benefit of military and civilian communities, home and overseas. Since military pay plus bounty never exceeded per day the rate a civilian consultant might have charged per hour, the ESP proved a remarkably cost-effective source of technical expertise – only partly geological. Although the ESP came to an end in 1988, that cost-effective expertise is still available – from Central Volunteer Headquarters Royal Engineers, through the Royal Engineers Specialist Advisory Team (V) (RESAT).

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A Walk With Heroes

Sir Joseph Bazalgette (1819-1891)

STROLLING in fresh spring sunshine along Victoria Embankment, London's loveliest riverside walk, I give thanks for sanitary engineers! They may not work at the most glamorous end of the profession, but they are nevertheless the unsung heroes of civilization without whom modern city life would be utterly unbearable, as Victorian Londoners discovered to their cost.

The problem was filth. Until 1870 there was only one main drain in London – the Thames. Open sewers discharged straight into the river where they backed up at high tide to form vast static cesspools. When cholera reached Britain in the 1830s and 40s, public health became a scandal. Disease reached epidemic proportions, killing an estimated 400 people a day in central London alone. The problem went from bad to worse until the summer of 1858, the year of "The Great Stink", when pollution reached such an appalling level that life along the riverside became virtually impossible. Windows in the Palace of Westminster had to be hung with curtains soaked in chloride of lime against the "dreadful effluvium", but when Benjamin Disraeli, Chancellor of the Exchequer, actually collapsed from the stench on 8 June, Parliament finally resolved to act. Legislation was passed in August 1858, and the spotlight turned on Joseph William Bazalgette (1819-91), Engineer in Chief to the Metropolitan Board of Works and greatest of the Victorian sanitary reformers.

Bazalgette knew his stuff and wasted no time. Drawing on the Royal Engineers London survey of 1848, he immediately set about assembling data and making plans for a comprehensive main drainage system. Construction started on site on 31 January 1859 following the award of all contracts by competitive tender. His grand design included a 1300-mile network of brick built, circular section sewers with 82 miles of interceptor drain laid at a fall of 2ft per mile to carry 420,000,000 gallons of effluent a day. 318,000,000 bricks were laid and 880,000 cubic yards of earth excavated at a total cost of £4,600,000. High and mid-level sewers drained into low-level sewers at 30ft below ground level running parallel to the river and discharging, via four pumping stations, well down stream. Bazalgette incorporated these low-level sewers into a new Thames Embankment plan, of which the first section to be completed was the 1.5 miles of Victoria Embankment from Westminster to Blackfriars Bridge. Besides the sewer itself, Bazalgette's massive granite Embankment pushed back the river nearly 130yds in order to include a road and promenade on top, a service tunnel inside and the new "Underground Railway" (today's District and Central lines) below. This ambitious scheme encountered many new and complex engineering problems as it gradually advanced along the riverbank behind a vast iron and timber cofferdam. At last however, when all obstacles had eventually been overcome, the resulting structure simultaneously solved the public health, traffic congestion and urban transport problems of the day at a single stroke. Hailed as a triumph of civic engineering, the Victoria Embankment was opened with great pomp and ceremony by

the Prince of Wales on 13 July 1870. Chelsea and Albert Embankments followed shortly afterwards. Bazalgette was knighted in 1874.

Reviewing the Embankment today, I am not at all surprised that in 1870 it was regarded as something wonderful and utterly new. Its aesthetic and technical qualities stand as an eloquent memorial to Bazalgette's genius. But as he once confessed: "I get most credit for the Thames Embankment, but it wasn't anything like such a job as the drainage." Maybe; but the fact remains that his Embankment transformed life in London, and as its architect he was honoured in 1899 by a fine bronze bust by George Simmonds. Set in monumental granite and surrounded by elaborate symbols of building and engineering, it stands on the river wall opposite Northumberland Avenue in the distinguished company of Hawkshaw's Hungerford Bridge (1864) and Brunel's elegant red brick pier (1841). It makes an appropriate landmark for the start of this walk.

Wandering gently upstream, I have time to reflect on the full splendour of Bazalgette's masterpiece beneath a skyline dominated by the soaring spires and steeply sloping roofs of Barry's New Palace of Westminster (1836). For me, the scale and breadth of Bazalgette's style are refreshing relief from the congestion of contemporary design. And I am struck by his comprehensive attention to detail: the graceful London plane trees, vivid gardens (paid for by W H Smith), and imposing monuments all serve to complete the sense of simple grandeur. The promenade itself, in the form of an urban quay, features magnificent coiling dolphin lamp standards and vast lion head mooring rings. Its iron benches, another gift from W H Smith, celebrate British control of the Suez Canal (1869) with a strong Egyptian theme in the form of winged sphinxes and crouching camels. Otto von Bismarck, Iron Chancellor of Germany, once slept on one of them for half an hour in 1880 after becoming the only man ever to drink two half-gallons of "Special Brew" ale straight down at Barclay's Brewery in Southwark. On awaking from his snooze, he resumed his journey to Downing Street where he outmanoeuvred the Foreign Office at every turn.

This stretch of riverbank is stiff with heroes. Beside the road in front of the National Liberal Club is a bronze bust of Samuel Plimsoll (1824-98), social reformer and sailor's friend, who

introduced the Plimsoll Line in 1874. Within the verdant oasis of Victoria Embankment Gardens rise imposing monuments to General Sir James Outram, Sir Henry Bartle Frere and William Tyndale all of which, it is good to see, have been recently cleaned by Westminster City Council. Further along on the left, soaring above Whitehall Stairs in lofty splendour, glistens the gilded eagle of the RAF Memorial designed by Sir Reginald Bloomfield and Sir William Reid Dick and erected in 1923. On the other side of the road, the lush lawn in front of MOD Main Building bristles with military monuments to General Gordon, Viscount Portal of Hungerford, Air Chief Marshal Viscount Trenchard, Major General Orde Wingate and the Chindits.

After Richmond Terrace (Thomas Cawner, 1822), the next memorial to catch my eye is the stone medallion by Hamo Thornycroft of the influential Victorian architect Norman Shaw (1831-1912). His profile adorns the second floor frontage of his masterpiece, the massive red brick New Scotland Yard built in the 1880's as a physical manifestation of the inexorable power of the Law. Confronting him across the glistening Thames lurks the vacant shell of County Hall. Designed by the 28 year old architect Ralph Knott in 1908 as a headquarters for the

A walk with heroes, p318.

London County Council, it was subsequently transmogrified by "Red" Ken Livingstone into the spectre of radical socialism until finally exorcised by Margaret Thatcher in 1987.

My walk ends at Westminster Bridge beneath Big Ben's 316ft of Yorkshire limestone. Curiously, Bazalgette decided to connect his embankment to the 1000 rooms, 100 staircases and two miles of corridors of the Palace of Westminster with an underground passage here. Closely guarded by Police, it seems to serve as an exit for Members of Parliament wishing to escape unnoticed from all-night sittings on the Maastricht bill.

Bazalgette died in Wimbledon on 15 March 1891, just two years after retiring from the Metropolitan Board of Works. He dedicated his life to public service and had been rewarded by becoming the unchallenged leader in his field. Although elected President of the Institution of Civil Engineers in 1884, and despite a coruscating international reputation, he remained a very private person. His public works, however, flourished in every corner of the Metropolis where, in addition to sewers, public conveniences, roads and railways, he also built new bridges over the Thames at Putney, Hammersmith and Battersea and the steam ferry at Woolwich. In so doing, and virtually single-handed, he created the new science of "civic planning" and his advice was sought the world over, even at Windsor Castle (1868).

Gazing back along the river from beneath Thomas Thornycroft's wild and reinless chariot of Queen Boadicea (1902) on the northern abutment of Westminster Bridge, I feel sure that posterity will confirm the Victoria Embankment as his finest achievement. It has certainly stood the test of time: his London Main Drainage saved countless thousands of lives, and today after more than 120 years of constant use, it remains as efficient and effective as ever. Thus in his own quiet, modest way Bazalgette achieved far more for the public good than most of his more famous political contemporaries. London therefore owes him an immense debt of gratitude, and he truly deserves to be remembered as the father of modern sanitary engineering. I like to think that William Cubitt had Sir Joseph Bazalgette in mind when he said:

"Engineers have always been the real sanitary reformers, as they are the originators of all onward movements; all their labours tend to the amelioration of their fellow men."

Semper Idem.

This is the fourth in the series of short articles featuring great 19th Century personalities, written and photographed by Lt Col T H E Foulkes.

August 1993 Journal Awards

The Publications Committee announces the following awards for articles of special merit published in the August 1993 *Journal:*

Engineer Support for Operation Grapple – by Colonel J S Field OBE ... **£75**
Jedan Most Previse. Bridge Inspections in Bosnia – Operation Grapple – by Captain J F Pelton ... **£50**
German Engineers. History, Structure and Tasks – by Lieut Colonel R Von Reden ... **£25**
Northern Ireland – The Border Campaign. An Example of Counter Mobility Operations in Internal Security Operations – Anon ... **£25**
"Valecti Garde (Corporis) Domini Regis", (Yeomen of the Guard (of our Body) of our Lord The King) – by Captain J E Borer ... **£25**
The Rideau Canal, An Engineering Feat – by Major P E Crook ... **£25**
Butterflies Over Grimsby/Cleethorpes – June 1943 – by Lieut Colonel E E Wakeling ERD ... **£25**
Minefield Clearance in Guernsey – Captain H W Beckingham ... **£25**

Junior Officer Award

Non eligible

The "Daley" Water Container

WOII P DALEY

The author began his army career at the Army Apprentices College, Chepstow, in September 1971, training as a fitter. He successfully completed the Clerk of Works (Mechanical) course in December 1983.

Following a two-year tour with 52 Field Squadron (Construction), he was detached to the PSA for almost seven years in Gibraltar and the UK. He joined 519 Specialist Team Royal Engineers (Works) in June 1992 and, following a short period in Cyprus with the team, deployed to Bosnia as part of the preactivation party for Operation Grapple *in early October 1992.*

MEMBERS of 519 Specialist Team Royal Engineers (Works) (519 STRE(Wks)) were deployed on *Operation Grapple* as part of 35 Engineer Regiment in October 1992.

One of the primary aims of the engineer group was to create an environment in which the British Force (BRITFOR) could live, move and operate. This article covers the early stages of the deployment in broad terms and then describes how an engineering problem was solved using resources available in theatre.

Prior to the main deployment, an initial reconnaissance had identified a number of sites which would be suitable bases for BRITFOR to operate from. These sites varied from an old and badly damaged ex-Yugoslavian army barracks to schools, factories and warehouses. On receipt of the warning order for deployment, some broad planning was carried out based upon the findings of the reconnaissance, together with data from a study being conducted into accommodation in the field, by the Military Works Force at the time. This planning enabled early action to be taken to procure a wide range of items, most of which had lengthy delivery periods. On arrival in theatre the team carried out a detailed reconnaissance of the sites which enabled the remainder of the "shopping list" for stores to be completed and construction work to begin in earnest.

Movement between the various locations presented immense difficulties due to the disposition of the warring factions, and it therefore became necessary to open up and maintain new Main Supply Routes (MSRs), to safeguard the movement of both aid convoys and our own resupply vehicles. Improvement and maintenance of the routes across the mountainous region between the Tomislavgrad base, in the south, and the northern bases of Gornji Vakuf and Vitez became a major area of Sapper effort. These MSRs were to be maintained by hardy groups of Sappers who would live in strategically located MSR sites positioned along the routes. The sites would also provide a welcome rest point for United Nations (UN) convoys. Each site was to be as self-sufficient as possible in terms of accommodation and utilities, to minimize the need for resupply.

Three sites were planned, each to be constructed according to the principle that a site component should conform to a standard 20ft ISO (International Standards Organization) container footprint for ease of transportation to site and subsequent relocation if required. Each site was to comprise eight 4-man accommodation units, a containerized kitchen and an ablution unit. Power would be provided by service generators.

WO2 P Daley
The Daley water container, p320

Unfortunately the three selected sites which met most of the requirements, had no readily available water supplies, or even a nearby raw water source that could be developed, and would have to rely on deliveries of packed water. This created a number of problems:

- There would be a requirement to store water at each site to minimize the frequency of water resupply deliveries.
- With expected mid-winter temperatures of around -35°C, severe problems with freezing of stored water were anticipated.
- Water heaters fitted in kitchen and ablution units require a cold water feed pressure of between 1.5 and 6 bar in order to operate. The water system would therefore have to be capable of providing pressurized supplies.

The only available in-service tanks were Water Carriage Packs (680 litres), Collapsible Tanks (1500 litres) and DROPS (demountable rack offloading and pick-up system) Water Tanks (22,400 litres). The DROPS Water Tank (or "Beancan") provides an ideal storage capacity for one week based upon 100 litres/man/day for 32 men. This allowance covers all requirements except toilets as the plan was to provide chemical toilets.

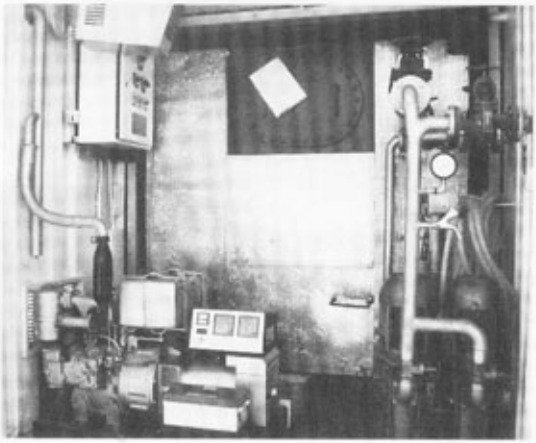
The "Beancan" is provided with a small delivery pump and in the early days it proved adequate for the job but by mid-November it was found to be susceptible to freezing. By December the water in the tank itself began to freeze.

A number of possible solutions were considered including carrying out major modifications to three "Beancans", but this was ruled out when authority to release them was not forthcoming. It soon became clear that the problem would have to be solved by designing equipment which could be manufactured quickly locally, to meet specific site problems.

The initial concept was to provide a tank and pressurization unit to fit within a standard 20ft ISO container thus complying with the basic requirements of the other site components. To prevent freezing, the tank had to be fitted with immersion heaters and also insulated. Pressurization would be achieved by fitting twin pumps within the container to give a "duty" and "standby" pump facility. It was further decided that, to make the unit self-sufficient, it should be fitted with a small diesel-fuelled, stand-by generator capable of powering the pressurization unit and immersion heaters. As the design evolved, a number of refinements were added including:

- The ability to recirculate water around a distribution system (using flow and return connections)

External view of the water storage container at Redoubt camp.



Internal view of the working area with the standby generator on the right-hand side and pump arrangement on the left.

The Daley water container, p321

As the temperature plummeted, water was recirculated around a ring main to prevent freezing. Water pressure was maintained by fitting a mechanical pressure relief valve in the return pipework.

to reduce the possibility of water freezing in the system.

- The provision of a sampling point so that water samples could be easily drawn from the unit for testing.

The container was effectively divided into two areas, the water tank in one and a stand-by generator, pump sets, pipework and controls in the second. With the low temperatures expected, I considered it prudent to fit heating within the working area and, being the eternal optimist, my expectations were that if anything went wrong it would go wrong in the worst possible conditions and at night, therefore a light would no doubt be necessary.

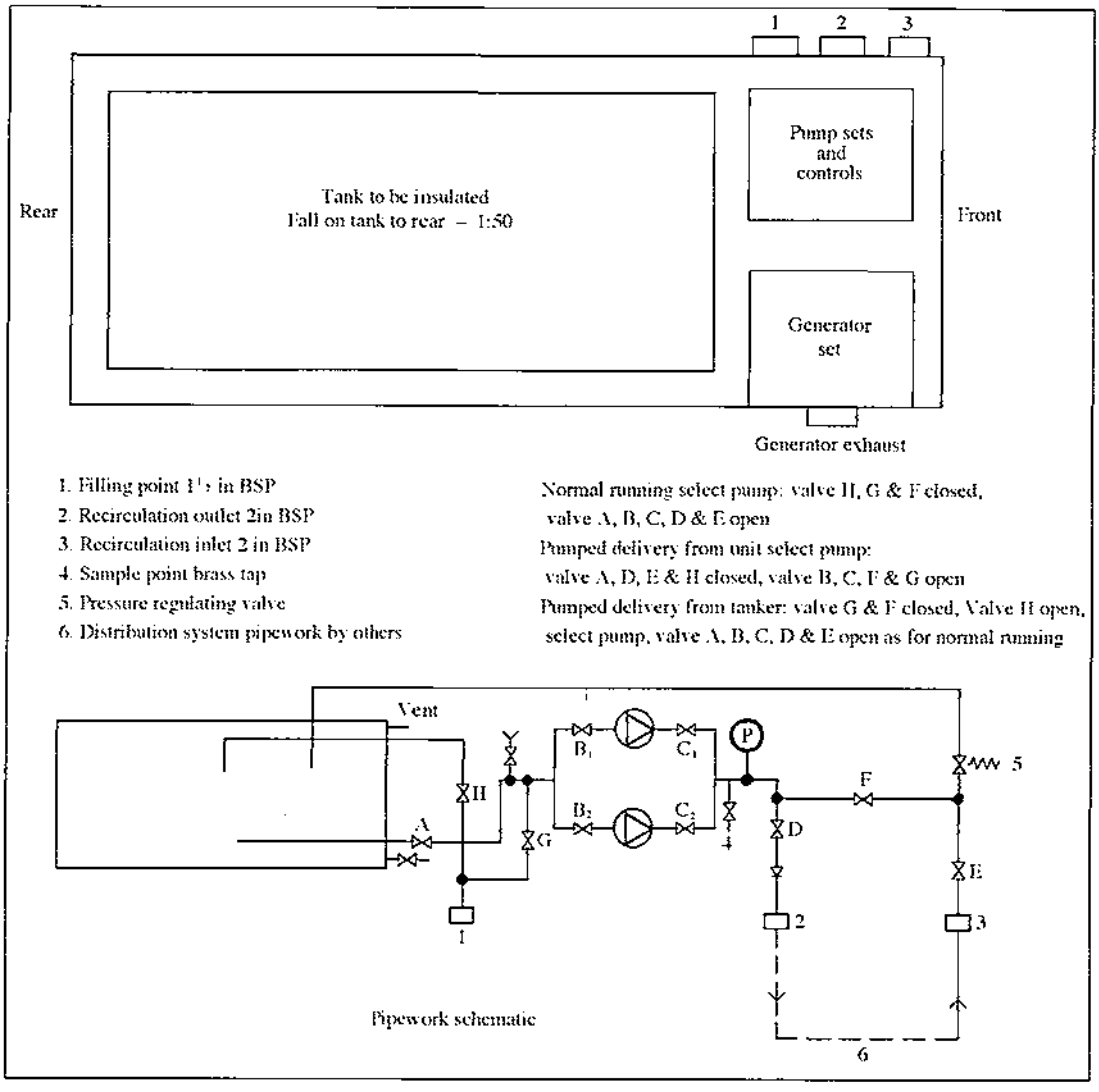
A local engineering firm was contracted to manufacture a prototype unit from our specification. At this point the international politics and problems of the region came into play and a number of compromises had to be made to allow the units to be completed within a reasonable timescale. It should be appreciated that engineering equipment and raw materials were not always readily available in the former Yugoslavia, however, the local engineers were extremely adaptable and resourceful. Whilst they were often unable to provide exactly what we wanted they showed a good understanding of what the aim was and invariably produced an acceptable alternative. During construction of the prototype a number of other features and improvements were incorporated including the provision of a chemical dosing point. It was also requested that each unit be supplied with hose sets to simplify the transfer of water from delivery "Beancans". The unit was designed to allow water to be delivered to the unit using the "Beancan" pumps or the unit's pumps.

As the prototype neared completion, it began to be referred to as "The Daley Container" in 35 Engineer Regiment SITREPS (situation reports), and I began to appreciate that considerable faith was being shown in it.

Unfortunately time does not stand still and whilst the units were being constructed, the MSR maintenance camps were constructed and occupied. At the main site, named Redoubt, a temporary storage and distribution system was installed. This used the ubiquitous "S" tank with a Grindex submersible pump providing the pressurization. The only available protection from the elements being a 12ft x 12ft tent. This system worked reasonably well and the shower unit became operational fairly quickly, much to the delight of the troops manning the site. However, when the temperature plunged to -55°C, the water distribution system froze.

A float switch (centre) prevented the unit from being run dry. The heating elements can be seen to the left of the picture.

The Daley water container, p322



"Daley" water storage distribution container plan and pipe arrangement.

causing some damage to the pipework and the "S" tank became the largest ice cube in theatre!

As the first "Daley" container was nearing completion, Redoubt's water distribution system was stripped out ready for its replacement. After being factory tested and commissioned, it was delivered and connected and, on Saturday 23 January 1993, was brought into full use for the first time and proceeded to do all that was expected of it. Only later was it realized that as well as providing a self-sufficient, containerized water storage and pressurization unit capable of operating in extremely low temperatures, the unit also provided an excellent means of producing pressurized water supplies for fire fighting, giving up to an hour of continuous output.

At the time of writing, all three MSR sites have had these units installed and reports suggest that they have made considerable improvements to quality of life for the users.

The assistance of all the members of 519 STRE(Wks), in pushing forward and developing this piece of equipment, as well as producing this article, was much appreciated by the author.

A Wartime Pip

MAJOR D R VERNON FCIT

The author was commissioned into th Corps in 1943, and went to Normandy with 24th Field Company shortly after D-day, remaining with them until the end of the campaign in North-West Europe. He was wounded on the Rhine crossing and awarded a Commander-in-Chief's certificate for "outstanding good service and great devotion to duty."

Subsequently he spent two years in India, being promoted captain in 1945 and, aged 23, Major in 1946 serving on the North-West Frontier of India as SO RE1 with 10th Indian Division. Lieut Colonel H C W Eking DSO was his CRE. Major Vernon later held several senior appointments in the road passenger transport industry, retiring in 1985 from Greater Manchester Transport, where he was also Director of the Manchester Transport Band.

LITTLE thinking I would eventually receive the King's Commission into the Corps of Royal Engineers, I joined the 8th Battalion (Home Guard) Royal Warwickshire Regiment, on my 17th birthday. The battalion was a mixture of enthusiastic youngsters like myself, be-ribboned veterans of World War One (and even one or two from South Africa), and a sprinkling of others not so easily categorized; training was quite unlike the amusing image created by "Dad's Army".

I quickly learned the rudiments of soldiering, ranging from the techniques of using a pike and a truncheon, to unarmed combat, making a Molotov cocktail, and learning a few (hopefully) useful German phrases eg *hände hoch, sie sind mein Gefangene* (hands up, you are my prisoner), to firing a variety of weapons. Indeed on my first shoot with a Canadian Ross, I obtained a 5in group at 200yds, and I could throw a 36 grenade some 50yds or more. We had the use of the Infantry street-fighting school in a bombed-out area of Birmingham and enjoyed a number of exercises with regular troops. In one of these I distinguished myself by incapacitating a number of the enemy, as well as most of my platoon and some civilian onlookers, with canisters of tear gas taken from our "prisoners".

Armed with truncheons – the church seemingly objected to anything more offensive – one of the regular night duties was to watch for parachutists from the freezing top of Saint Peter's (Harborne) ancient church tower. On the night of 10 December 1940 a low-flying Dornier, caught in searchlights, came in from the west on its bombing run to the city; if only we had been armed with firearms of any sort instead of the useless truncheons!

Nevertheless, morale and discipline were good, there was much enthusiasm, and weapons and training improved. By mid-1941 there is no doubt the Home Guard was a formidable defensive force; but Hitler turned his attention to Russia and the threat to our homeland diminished.

In 1942 I arrived in Perth at No 8 Infantry Training Centre, attached to the Black Watch Regimental Headquarters, where for six weeks I endured the spartan life of a training company with 600 others; indeed one recruit deserted the same day he arrived! I was Number Two man of a squad of 34, a position of some importance I was told. Certainly it ensured I often caught the critical eye of RSM Alexander Drummond MBE, (the fourth senior RSM in the Army at that time) a formidable disciplinarian whose immaculate presence haunted us night and day. Five of the squad had previous training in the Home Guard, which conferred considerable advantage.

Our quarters at Perth were, to say the least, primitive. We 600 were in Shiels Works, a

Maj D R Vernon
A wartime pip, p324

former linen factory with loose flagstone walkways between the crammed low-height double beds. It was always cold and it seemed that all 600 took it in turns to relieve themselves during the night. This meant a noisy passage to and fro over the loose flagstone walkways and through the spring-loaded door. Coughing and snoring were endemic, the early risers were up at 0500hrs to make sure of the limited hot water and sleep was therefore intermittent.

It seems the Joint Recruiting Board had recommended me for the Royal Artillery with the possibility of a commission; I was duly interviewed by Major Sir George Nairn and Captain The Lord Lock, Black Watch. The consequence of this interview and other selection procedures was a recommendation to the Royal Signals! It was also rumoured that the majority of recruits was retained by the Black Watch or the Argyll and Sutherland Highlanders. In the event most of the squad, myself included,were posted to 59th Training Regiment (Armoured Cars) Royal Armoured Corps! – not entirely surprising perhaps as it was the time of El Alamein, and there were armoured losses to make good.

I was on a day pass in Kinghorn, Fifeshire, when the church bells, silent since mid-1940, were rung throughout the country in thanksgiving and celebration for the victory at El Alamein and, if one had known, the turning of the tide.

The train journey from Perth to Barnard Castle – Barford Camp No 5 to be exact – was memorable, for at Edinburgh, in addition to steaming mugs of tea supplied by the Women's Voluntary Service, we were given a day's rations which, on reflection, seemed very generous. A letter to my parents records we each received half a pound of biscuits, two bars of chocolate, four sandwiches, half a pound of cake, one sausage roll, two cubes of Oxo and ten cigarettes.

Barford Camp, some miles from Barnard Castle, contained every necessary facility except a gymnasium. All physical training (PT) – and there was plenty of it – was outdoors regardless of the weather, and always in boots.

59th Training Regiment was distinguished by bright brasses and khaki blanco, whereas the nearby 60th and 61st Tank Training Regiments favoured eau de nil and jonquil yellow. We were not too displeased with khaki, but quite overjoyed when told that polished brass was contrary to Army Council Instructions (ACIs) and that offenders would be subject to disciplinary action. One wonders what happened to the Commanding Officer.

Apart from the PT, we were trained by the "Cherrypickers," Prince Albert's Own 11th Hussars, fresh from North Africa, and drilled and marched to perfection by Sergeant Van Rijen, a South African. Over a period of 20 weeks we were taught to drive and maintain 9-ton Daimler and Humber armoured cars, the Daimler "Dingo" Scout Car, and most of the trucks and lorries then in use; to fight and maintain their guns, and smaller weapons, and the art of radio-communication with the standard No 19 set.

I was interviewed after six weeks by a formal but friendly Regimental Board, promoted to the exalted rank of local acting unpaid lance corporal, placed in charge of a 40-man barrack hut and referred to No 2 War Office Selection Board (WOSB) at Catterick. I was also interviewed by a joint services panel at Newcastle-on-Tyne and offered an engineering cadetship. There were six referrals from the Regiment to Catterick; I had the good fortune to be one of the two who were accepted by the Royal Armoured Corps. However at Catterick I had indicated the Royal Engineers as the Corps of my first choice and so I attended the RE Selection Board at Monk Fryston Hall near Selby, where I was also accepted, and my immediate future settled in a favourable manner. (Monk Fryston Hall is now a first class country hotel.)

I had good reason to feel confident at all these interviews for whilst on window cleaning fatigues I had perchance seen my training report lying on the squadron office table! Good soldiers must keep their eyes open!

I was much impressed by two questions asked at Catterick and duly recorded them in a letter at the time. First, "What would your best friend say of you if asked to describe your temperament, ways and characteristics?" And second, "What would your most severe critic say?" And at Monk Fryston I was otherwise impressed by slipping off the greasy pole into five feet of stagnant water!

At the time the Army was reputedly short of 30,000 junior officers. Those who so aspired were lectured by Brigadier Powell, the Commandant of Sandhurst, and by General Sir William Dobbie, Governor of Malta 1940/42, and distinguished Royal Engineer.

Encouraged by the chance sighting of my training report and the propitious outcome of three interviews, I thoroughly enjoyed my time with the

29th. I regret to say I was not a model soldier! I paraded behind the guard. I did my share of various fatigues for minor indiscretions, I shared in illegal midnight forays for fuel to warm our cold barrack hut (showing initiative!) and was reported for being in the lounge bar of licensed premises whilst wearing hospital "blues".

I was posted to the RE Wing of 148 Training Brigade, located in Orchard Hospital, a World War One complex of timber huts at Dartford. The sergeant major's promise that the life of an officer cadet was blood and sweat was about to be fulfilled. ACIs did not apply in Dartford and by now dulled brasses had to be repolished to an even brighter finish!

We were wakened at 0600hrs by the rattling of the orderly's cane along the half-lap boards of the corridor, restricted to within 12 miles of the Wing, and London was out of bounds. We spent two hard weeks on basic Sapper training and were then dispatched to the tender mercies of the instructors of 8 Battalion Sherwood Foresters at Wrotham, the all-Arms pre-Officer Cadet Training Unit (OCTU) situated on a well chosen site at the edge of the North Downs facing the Weald of Kent (the area is now Trosley Country Park). The escarpment, with its alternating dusty chalk or chalky mud, became our life for four exhausting weeks which included some gruelling forced marches in full battle order; not everyone survived. (Does any member recall the unique latrines at Wrotham?) There followed a further four weeks of intensive Sapper training at Dartford, where my pay was £1 5s 0d per week.

"An officer cadet's life leaves much to be desired, a commission is not there for the taking", I opined in a letter to my parents, but 140 RE (Field) OCTU Newark, commanded by Colonel J R T Aldous MC, at least conformed with ACIs and shining brass was forbidden! Class 142, with a strength of 29 at the outset and 37 at the finish, was there for 22 weeks. the diminishing numbers (likely to occur under conditions of active service) making the dry and wet bridging courses exceedingly onerous.

The first seven weeks – the 'freshers course which concluded with Battle School at Penmaenmawr – was a period of continued probation. Failure to obtain the necessary grade meant at best to do it all again and at worst to be returned to one's original unit. Unacceptable misconduct such as travelling on a platform ticket could result in the same thing. But under the fatherly eye of RSM Robert (Bob) English, I thought discipline was very fair – one was expected to conform without being told. Bob English ensured we all became life members of the Royal Engineers' Association – and who would dare disregard his appeal? He also knew a thing or two about the many military tailors in the town only too anxious for perhaps £2000 worth of business from every commissioned batch. Bob English was particular about great-coats – the hems had to be exactly 12in from the ground, the uniform allowance was about £50. (I hardly ever wore the cumbersome 34oz cloth greatcoat – but it gave service for many years as a super dressing gown!)

A ceremonial parade was staged for the visit and address by Jean Knox, the then Commandant of the Auxiliary Territorial Service (ATS). She was loudly applauded. An even better show was put on for the inspection by Her Royal Highness, Princess Alice, the Princess Royal. As always for these occasions, and the regular Saturday morning parades, the RE Band was in attendance playing pleasant music during the minute inspections (little was ever found wrong) and raising spirits for the march past.

The training programme during the early weeks was essentially a further mixture of basic Sapper activities and technical lectures with considerable emphasis on physical fitness, for instance running 2½ miles in full equipment in 15 minutes exhorted by a major – I dare not repeat his nick-name – riding a bicycle and waving a cane. Then came Battle School where dire things were reputed to happen. Certainly it was not without risk, two cadets were killed on "crack and thump" shortly after our visit. (I remember clearly "crack and thump", a somewhat unnerving experience when, low overhead, live rounds from various weapons were fired on fixed lines from concealed positions, requiring the weapons and their location to be identified.) Such repute was not ill-founded for, after a confined six-hour train journey, we were doubled with full kit up the one in six gradient out of Penmaenmawr station to the point of collapse. "Just a start" said the lightly clad sergeant with a grin on his face; he did not exaggerate.

Naturally, detailed recollections of Battle School are hazy. It was meant to be tough however, and I have a vivid memory of two particular days experiencing the magnificent scenery of the Welsh mountains. I dissemble; we cursed the scenery.

140th RE (Field) OCTU 142 Class, 3 Coy. December, 1943

2/Lts Isaac G, Curtiss D A, Langley E R, Green F, Ellis J H, Mason W J, Dewar D, Ellis R A.
2/Lts Edwards F W, Shaw T, Wilkins F, Millar D F, Fraser W, Gilmour J, Vince P M, Clarey J, Parsons D S.
2/Lts Truesdale S A, Davies E, Morris E F, Rees D I, Partington E C, Vernon D R, Lewtas E, Gaine J H, Fisher A, Tavener A B,
2/Lts Morgan D W, Clarke A C, Pratt D L, Harding G O B, Maintland J D, Lt Lakin, 2/Lts Benson R E, Harries D H, Craig C N, Bailey T D, Cook P L.

A wartime pip, (p327)

Loaded with the full equipment of an infantry platoon we left Penmaenmawr at a fast pace early one morning, shot targets to pieces in a quarry at Dwygyfylchi, yomped (this word was not known then!) over the Drum (2528ft), Foel Fras (3091ft) and Carnedd Llewelyn (3484ft) to Lake Ogwen – a distance I suppose of some 15 miles in mist and rain. After a short break and the usual jokes about the lack of stimulating drinks, there followed another yomp over the Glyders Fach and Fawr (3279ft) and back to Ogwen to sleep rough. During the night there was a cloudburst and we were soaked. However there was no time to worry about such minor details as after a scratch breakfast there began a punishing forced march though the Nant Ffrancon Pass to Bethesda and on towards Aber where we were cleverly ambushed by a group of smirking instructors. After a noisy battle we plodded the remaining miles to our spartan billet.

We returned from Battle School with bent backs and sore feet, (some with upset stomachs having been unable to resist the temptation of crystal clear mountain water) but with some relief not to have endured this rigorous course in mid-winter. For various misdemeanours and shortcomings I noted six of the class had to sample Battle School for a second time.

To describe every activity over the remaining 15 weeks would be tedious, but one extra curricula event deserves mention. A War Office Instruction ordered the whole OCTU to spend the weekend pulling flax at local farms. From the Commandant down there was uproar as it was thought prisoners of war could more usefully perform this task. In the event I was excused; I had blistered arms from the poisonous mayweed!

As training progressed it became more physical and as a team the class became increasingly committed. For instance, the night exercise *Sapper* entailed the clearance of a booby-trapped minefield, breaching a triple barbed wire fence, man-handling a four girder CL40 Box bridge for 200yds, erecting it over a 50ft gap and then dismantling it before first light. We were exercised in all aspects of composite bridging. The end of the bridging course concentrated on the construction of dry and set Bailey.

The last exercise was the most testing of all, reduced as we were to 37, not all of whom pulled their weight – in fact shirker number one was thrown into the Trent! We had to construct and dismantle a CL40 120ft floating bridge over the flooding Trent in daylight, followed the same night by a CL40 180ft floating bridge on a different site. All went well with the day bridge but at night the bowman missed the rope thrown from the centre section floating downsteam. The section was swept several hundred yards away, and we had visions of it being wrapped round a pier of the old A1 Great North Road bridge, but it was caught just in time, wearily pulled back against the strong current, and inched into position. Incidentally I doubt if many heavy lorry drivers or locomotive dirvers on the east coast ever knew how many times the road and rail bridges were "demolished".

The bridge was dismantled the following morning. We then had the rest of the day free to recuperate and prepare for our last dinner night for which a souvenir menu was printed and during which the RE Orchestra played for our pleasure. We were attended by our friends of the ATS, with whom we enjoyed excellent relations as a consequence of taking them on a weekly drinking spree. The musicians were again in attendance for the final parade when we received the King's Commission the following day.

Reflecting on my path to a wartime pip 50 years after the event, some memories linger. Then, with the urgency of war – and it must still be so – there was great emphasis on military matters, physical fitness and the ability to endure long hours of tough work and hardship. However the consequence of this was that often during the all-important theoretical lectures, where the ability to think was *sine qua non*, cadets were so exhausted they would often fall asleep; lectures would have been more beneficial after first parade rather than after tea. There was also the problem of one's relationship with certain NCO instructors. One simply had to show that anything they could do, one would endeavour to do at least as well or better – an essential requirement for leadership in a front line unit. Lastly there was the serious matter of dealing with fear, the greatest enemy of all thinking men and, if one was fearful, how not to show it to others. I do not recall this problem being addressed in any significant way.

Nevertheless the gaining of a wartime pip was all very serious fun. I left 140 OCTU to become the newest recruit of 507 Field Company (47th London (Bowbells) Division) until very soon I found my Sapper feet with 24 Field Company, recently returned after 20 years service in Malta.

International Tientsin

DESIREE BATTYE

In 1860 the Chinese "abrogated" the *Treaty of Nanking* – and indeed the more recent treaty of 1858 – by barring the vital Peiho trading waterway to Tientsin in North China, and thus direct communication to Peking. On 1 August, in defence of their treaty rights, a combined French and British force disembarked from the Gulf of Pohai in what became known as the 3rd China War. It was one of the muddiest landings any expeditionary force has had to tackle.

General de Montauban "led the way with his trousers, boots and socks slung over his sword which he carried over his shoulder, and nothing left on him but a large white helmet, a dirty serge jacket, and a very narrow margin of grey flannel shirt below it!" For the British, Lieutenant General Sir John Hope-Grant, was quick to follow, leading Probyns Horse, together with other units of the Indian Army, in equally bare garb. In no time they too were covered in mire in the shelving mud flats. However, they were soon to become covered in glory whilst fighting the enemy.

Ten miles south of where they landed in the unsalubrious area, in order to avoid forcing a passage past some heavily guarded posts, Major General Sir Robert Napier's Division assaulted the Taku Forts. They soon discovered that the first fort had the most elaborate defences, consisting of a dry ditch, followed by some abatis, a wet ditch, a "forest of bamboo spikes" (every man by now had his nether garment on, mud or no mud), yet another ditch, more spikes, and finally a strong high wall. Under heavy fire, Sappers ran over a bridge-of-boots, carrying bamboo ladders which they proceeded to hold overhead in the wet ditch, themselves half submerged, so that troops could crawl over and escalade the rest of the obstacles; meanwhile the rake of fire from the fort took its toll. During this initial stubborn defence, General Napier had his field-glass shot out of his hand, his sword-hilt broken, three bullet holes shot through his coat, and one in his boot! The attack was successful, the second fort falling more easily, and the more southerly ones giving in.

The allied forces proceeded to take Tientsin at the end of August, after which ensued a battle in the plains of Chang-kia-wan in which 4000 British routed 20,000 Chinese; during which both sides formed considerable respect for each other.

The Tartar enemy, mounted on small sturdy ponies, were smooth-faced, slant-eyed Mongolians of fearsome aspect who wore white leggings tucked into soft leather boots, and short pigtails curving out stiffly from under flat caps. Fearsome though their appearance in battle was, they faced a terrifying foe, riding on curly-eared Marwari horses. These were the no less tough Sikhs of Probyns Horse, with their bulky *pugris* and horrendous moustaches and whiskers. The Chinese called them "the Black Princes who ride on thrones of blue and gold saddle cloths."

The British troops called General Sankolinsin, leading the Tartars, "Sam Collison," and what the French called the English (against whom for two pins they would have turned and fought), official history does not relate, though it does record that General Hope-Grant found it "a great bore being tied down by the French."

After another defeat near Tangchao, the Chinese had had enough, and the victorious British entered Peking – from where the Emperor Hsien-Feng had fled, to beyond the Great Wall. The French sacked the Summer Palace, some miles out of Peking. The British were also to blame for the sacrilege. Evidently General Hope-Grant had agreed to the action after hearing of "the revolting barbarity and torture to which British and Indian prisoners have been subjected." Major Charles Gordon (as "Chinese" Gordon of Khartoum, was then) saved the Emperor's carved throne from pillage, and sent it back to the Royal Engineers Mess in Chatham; it can be seen to this day near his portrait which shows him very fine looking in Mandarin robes. While in Tientsin, Major Gordon was responsible for drawing up the Concession lines.

After the Boxer uprising of 1900, during which time Tientsin's ancient glaze-topped yellow walls were razed, the town, as well as being a Treaty Port, became an international city in the wake of the force that had combined that year to rescue the besieged Legations in Peking. To join the British and

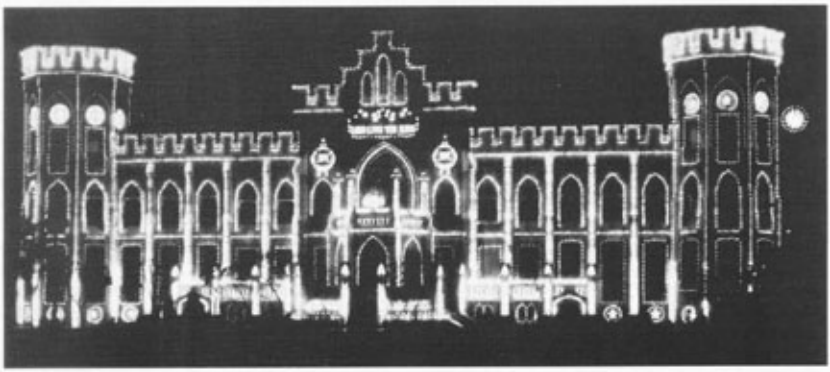
HMS Whiting, China Seas.

French garrisons already firmly established since 1860, came the Japanese, Russians, Americans, Italians, Austro-Hungarians, Germans, and Belgians. Gordon Town Hall, overlooking Victoria Park, personified the British presence. The large forecourt was used for weekly Church Parade – from where the regimental band led the way to All Saints Church – the imposing edifice itself housing a concert hall, municipal buildings, police station and law courts.

On 22 June 1911, in the year of the Chinese revolution, at which period the Japanese and Germans were staunch allies of the British, Gordon Hall's crenellated fortress outline and innumerable arched windows were picked out in small lights for the coronation of King George V. My father, then Lieutenant G B Hartford RN, commanding the destroyer *HMS Whiting*, was present at the celebrations, together with the crew of *HMS Fame*. Every year subsequently, Gordon Hall was lit up on the evening of 24 May, Empire Day, lavish fireworks the order of the night.

If the coast was muddy, so was Tientsin itself. Meadow Road, where the British barracks and Officers' Mess were situated, was liable to flood. The city was riddled with canals, creeks and waterways. Six small streams and the Peiho River, where the naval ships anchored by the bund, caused the populace to live either in a rising damp mist enveloping their leaky boats, or in a wet morass of shacks on the river banks.

By contrast, the international set lived in luxury, and the nationalities gathered on the racecourse, in each other's clubs, and in winter for the sport of "le skating" on rivers and ponds. The shopping centre lay on Victoria Road, as did Astor House Hotel, filled with globe-trotters."Whiteway and Laidlaw's" was a favoured clothing store. The most famous meeting place was the Viennese "Kiessling and Bader" in the Kaiser Wilhelmstrasse, a restaurant with stringed orchestra. Herr Bader's Cafe, as it was more familiarly known, was one of a series on the China coast, reaching as far north as Vladivostok.



Gordon Hall lit up on Empire Day.

International Tientsin, p330

each renowned for delicious cream pastries. The Russian area became one of the most popular, with its colourful park, its fine Orthodox church, and its nostalgic concerts. Many destitute Siberian refugees found their way over the border and into the caring community, long before 1917 when a trickle of white Russians turned into a flood that continued into the twenties.

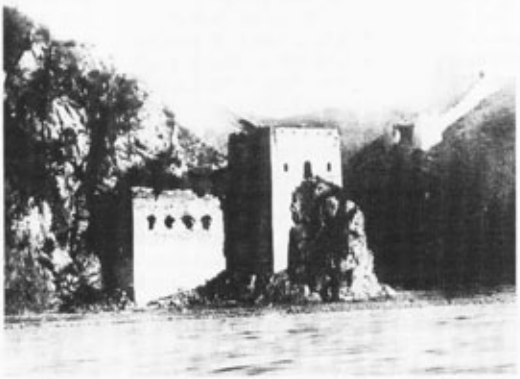
In the hot summers, the British garrison at Tientsin, holidayed out at Shan-hai-kwan, a resort reached by train veering northeastwards into the hills on the Manchurian border. The railway went on from here through the Great Wall to Mukden and Harbin, where passengers for Europe joined the Trans-Siberian line. Suddenly, almost unexpectedly after it has snaked its way for 6000 miles through China, the 2000 year old Great Wall comes to an abrupt end at Shan-hai-kwan, stopped by a line of rocks, the sea battering away at the final thirty foot high bastion. Nearby lay a fort camp for British soldiers and their families, a mule-drawn trolley, flying the Union Jack, railing them and their luggage the four miles from the station to their destination.

Mule trolley at Shan-hai-kwan Station.

Interest was added to Tientsin in the 1920s and 30s when Pu-Yi, the young ex-Emperor of China who, since the revolution, had been virtually held prisoner in the Forbidden City, aided by his Scots tutor Sir Reginald Johnston, fled from Peking to the sanctuary of the Japanese Concession. His slight bespectacled figure with satin button-topped skullcap and long black Manchu robes, became a familiar sight about the town. Together with his pretty wife and training concubine, they caused much speculation and gossip. But Tientsin was fast becoming a hotbed of spies, and Pu-Yi was as much a prisoner as ever. After Japan occupied Manchuria, he was conned into leaving under their aegis to become puppet Emperor, and everyone knows the sad story of how he was taken prisoner by the Russians and then returned to the Chinese communists to be "re-educated?"

In December 1940, a year before Pearl Harbour and the fall of Hong Kong, British and other alien residents were rounded up. Later they were sent to an internment camp in Shantung Province. Thus ended the long reign of sparkling International Tientsin with its British naval presence and British garrison.

And for five long years the white and red flag of the Rising Sun flew over Gordon Hall.



End of Great Wall, Shan-hai-kwan.

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War Office to War's End

MAJOR J D HARTE MB BS MRCS LRCP FRCGP FFOM DPH DMJ JSC ACII FRSH FRIPHH

John Harte enlisted as a Sapper in May 1939 in 103rd (Glasgow) Army Troops Company RE (supplementary reserve), and on the outbreak of War went to France with the British Expeditionary Force. He was commissioned in November 1940. As the result of an injury he was medically regraded and posted to No 3 Training Battalion RE, later becoming an instructor at the School of Military Engineering (Ripon). After passing the junior staff college course at Sandhurst, came a posting to the War Office, AG7, followed by the Engineer in Chief 's Directorate as Deputy Assistant Director Engineer Stores. He attained the rank of major before demobilization in 1946.

After the War he trained in medicine and qualified as a doctor. At one time he was Provost of the Bedfordshire and Hertfordshire Faculty of the College of General Practice. Acquiring postgraduate qualifications in public health, occupational medicine, and medical jurisprudence, he later set up the first occupational health department for hospital staff within the National Health Service. He was appointed deputy Coroner in 1962 and HM Coroner for Bedfordshire 1979 to 1992.

The following is a short extract taken from the author's war memoirs, a copy of which has been lodged in the Royal Engineers Library.

I ARRIVED at The War Office, on 23 March 1943, from Staff College, with some trepidation but was agreeably encouraged to find that there was an overwhelming sense of commitment and duty, and a determination to provide and meet the needs of the combat units which were being prepared at that time to form the 21st Army Group.

The various departments in the War Office were scattered throughout a variety of buildings in London. AG7 was in Hobart House which overlooked Buckingham Palace and we were responsible for the posting of Sapper officers throughout the world.

The head of AG7 was a full colonel, a W D Robertson, who had been at No 3 Training Battalion when I was commissioned. The other staff at AG7 consisted of a major, a DAAG and three staff captains. One was in charge of field units – myself, another lines of communication – Captain Douglas Clegg, and the third, Captain Gooch, was concerned with postal transport and work services. Our office was on the third floor of Hobart House in the northeast corner. We worked office hours although frequently did not finish until well into the evening and often travelled home in the blitz. Few bombs were dropped in the daytime but I well remember seeing, from Hobart House, the buzz bomb that fell into the Guard's Barracks a short distance away.

When I arrived at AG7 the main activity was the mobilization of units for 21st Army Group. We tried hard to fit round pegs into round holes and kept in touch with the various CREs in the different divisions. The output from Officer Cadet Training Units (OCTUs) was regularly posted and this meant visiting training battalions and OCTUs frequently and meeting newly commissioned officers. There was an excellent system of recording the establishment of units and we had a cardex system so that we knew exactly where officers were throughout the world. Also there was a good index of qualifications so that it was possible to find officers particularly those with civilian experience, who were required to fill positions in specialized types of units. I remember, for example, having to find experienced electrical engineers who had worked in power stations. They were needed, at very short notice, to man the power stations in Caen after the invasion took place on D-day. It took many hours searching for people with particular qualifications and I recall finding a commander for the Floating Harbour Mulberry. He was a man who had been working on the

Major J D Harte
War Office to War's End (p332)

railways in South America with experience of civil engineering, he was able to speak a number of languages. In addition he held a mate's certificate and was therefore familiar with navigation and seamanship. He was found in a unit in the north of Scotland where he was training a number of Sappers of different nationalities.

I soon discovered that it was not necessarily the officers with the highest qualifications that were the most acceptable. For example, I sent the best officers from the output of the OCTU to one of the armoured divisions and was surprised when the CRE rang up and asked whether I could instead send some officers who had attended certain public schools. I was perplexed with this request, having come from Scotland where I was unfamiliar with the public school tradition. I soon realized however, that in a closely knit team of officers, those who had been brought up in a certain tradition found it easier to live and work together under the demanding conditions of warfare. This by no means applied in all circumstances but for certain units it was an essential requirement. We sought at all times to give CREs the type of staff requested.

There were a number of changes taking place. For example, gas warfare units were being turned into assault troops, requiring a complete change of officer personnel and a different type of experience.

We worked very hard to build up the units in 21st Army Group and after D-day I met some officers I had trained at the School of Military Engineering. They expressed appreciation of their training which they had suddenly discovered was to their advantage when faced with conflict. I became aware of the high calibre of professional Sapper officers.

There were frequent demands for officers with particular skills. For example, a number of special units were formed called Combined Operation Police Patrol (COPP). These were units of officers and NCOs who would go out in submarines, land on beaches, take samples of soil and guide in craft when assaults took place. These cloak and dagger operations attracted a certain type of officer. One was Peter Matterson, who had been in charge of the demonstration platoon at the School of Military Engineering. He did useful work particularly during the invasion of Italy when he landed ahead of the assault troops and directed the landing crafts.

Hobart House as it is today.

Special units were formed under the auspices of the Chief Engineer, Combined Operations, who was then a Colonel Dove, later Quarter Master General. He was a man of deep Christian conviction and took a great personal interest in the selection of suitable officers.

At this time I regularly attended meetings of the Officers' Christian Union, held on Thursday lunchtimes, when officers working in The War Office from all Services would meet and study a chapter of the Bible over coffee and sandwiches. I was most impressed by their devotion and qualities. Often they carried the responsibility of the War and yet always found this time for prayer and Bible study.

When I arrived at AG7 the DAAG was a Major Tomlinson whose habit of not starting work until 5pm frequently meant working until well into the evening. He was replaced by Norman Cole, an industrious man who had been a publisher and a military historian, and he would spend no end of trouble trying to find suitable officers for special requirements. He lived in Bromley and we travelled home together. He was replaced by Walmsley White, who later went into survey.

War Office to War's End (p333)

In AG7 there was a large general office under the supervision of a warrant officer and staffed mainly by civilians who maintained records and updated postings. I learnt civil service procedures and was impressed by the hard work and devotion of all the staff who were totally dedicated to meeting the requirements of the AG.

On 6 June 1944 allied troops landed on the Cherbourg peninsula. It was a time of high excitement and relief that something was being done. Security was remarkable and despite working in The War Office I did not know when the invasion would take place.

On 14 June, Hitler's secret weapon, the V1, or buzz bomb, was released. Our home in Bromley was on the flight path into London. These pilotless planes came in at low altitude but their presence was easy to detect by the engine noise and trail of orange flame. On 9 September the first long range rocket arrived and landed a quarter of a mile from our home. These rockets gave no warning.

During this time my wife was pregnant and at night times we sheltered in the Chistlehurst Caves where there was protection from the bombs. After a month my wife was evacuated to a farm in Dorset and I slept at home in an Anderson shelter. Houses on either side were bombed but fortunately we had no direct hit.

Engineering Chief's Department

As the War developed in Europe I was moved from AG7 to the Engineer in Chief's Department at Romney House, the stores directorate, responsible for moving stores from Longmarston to Liphook and then across the Channel to 21st Army Group. As a DADES, I was responsible for general administration of the Directorate and worked under Lieutenant Colonel Samuels who later became a director of Courtaulds. One day a V2 exploded in the side of the building blowing down all the partitions. The Brigadier was concerned to have the damage repaired but there was little chance of the Office of Works doing the job so he said to me "Let's see what the Sappers can do, find a unit that will help us out." I contacted the local bomb disposal company which provided a number of tradesmen. Two lorries from Longmarston, carrying stores of timber and hardboard, were diverted and within a short time the damage and partitions were repaired. I put the men up in air-raid shelters at Romney House and told them they could have leave as soon as the work was finished. Consequently this was completed in three days and they had the rest of the week to themselves. There was no provision to pay for their meals so I paid for them myself and it took 18 months to recover this cost through War Office channels. The adaptability of Sappers was something I was always aware of – they seemed to enjoy the challenge of doing the impossible.

On 7 May 1945 peace came to a battered Europe and on 15 July 1945 the blackout was over and we were taking a second breath in preparation for war in the Far East. On 4 August 1945 the atom bomb dropped on Nagasaki. The Second World War was over and we all prepared for demobilization.

My last job before leaving the army was to organize courses under the education release scheme. I ran some 30 different courses on a variety of subjects and drew speakers from many sources. One of these was George Thomas, who later became Speaker of the House of Commons. Then a Member of Parliament he was very knowledgeable about parliamentary procedure and gave a number of talks on the work of Parliament. The courses were excellent and I am sure did a great deal to act as a bridge between serving personnel and their move back into civilian life.

In August 1946, after six year's service, I collected my demob suit and left the army. I obtained a place at St Mary's Hospital Medical School to study medicine and, although I was glad to see the end of the War, I felt nostalgia for the camaraderie I had found amongst my fellow Sappers.

Engineering Cadets

DR P S BULSON CBE DSc PhD FEng FICE FIMechE

Last year was the fiftieth anniversary of the initiation of the Engineering Cadetships scheme during the Second World War, so I'd like to take a moment or two to look back at this unique, relatively unknown and rarely remembered endeavour to increase the supply of technical officers for all three fighting services. In October 1942 a pamphlet was issued by the Ministry of Labour and National Service, the four pages of which are reproduced at the end of this article. It was circulated to schools, local offices of the Ministry, and a condensed version was issued as an advertisement in national and county newspapers. Boys between 16 and 19 were invited to apply for Cadetships leading to technical commissions if they had left school before October 1942, were not employed in any branch of engineering, and had suitable basic academic qualifications at School Certificate level. Boys with the right qualifications who showed a latent talent for repairing their bicycles and potential leadership qualities would stand a chance, but competition would be fierce.

The background to the scheme is contained in a couple of government files stored away in the Public Records Office at Kew. Files LAB 8961 CR/4283 and 965 CR/4126/3 describe an intriguing picture of the efforts of the British Government to increase the technical competence at junior officer level of the Services – particularly the Army and the Navy. It was clear that the Germans were better at the effective maintenance and repair of fighting equipment, and this was of course one of the main reasons behind the formation of the Corps of Royal Electrical and Mechanical Engineers (REME) at that time.

Applicants for Cadetships, most of whom were 17 years old, were drawn from a wide spectrum of employments: junior accountants, surveyors, police cadets, estate agents, reporters, crematorium assistants and many other fields, in hundreds of cities and towns in Britain. The majority were ex-grammar school boys who were marking time while they waited to be called for national service. After an initial sifting (during the autumn of 1942) of the application forms and references, candidates were usually subjected to an informal interview to judge their possible technical capabilities and then, a few weeks later, to an interview by a panel of service officers to judge their leadership potential, character and personality. In this way some 3440 cadets were selected between early and mid-1943, packed into groups of 20 or so, and sent to technical colleges and schools up and down Great Britain and Northern Ireland. The majority were sent to attend a training course for either two or two and a half years. The course was intensive and highly condensed. Nine months' continuous education, followed by an examination of similar standard to the Ordinary National Certificate. Those who failed were returned home and called up for national service in the usual way. For some cadets this initial period was followed by six months in manufacturing industry – a sort of concentrated workshop apprenticeship; for others there was not time for this. Then a further period of 15 months on another crash course to achieve the level of Higher National Certificate plus endorsements, followed by a final examination. Successful candidates became the proud possessors of an Engineering Cadet Diploma, which represented the basic engineering science required in the Associated Membership Examination of the Institutions of Mechanical or Electrical Engineers.

A second recruiting scheme was initiated in October 1943, and this led to a further 1100 cadets, making a grand total of about 4500. By the time most of the cadets had completed their college training, the war in Europe and the Far East was over. Of the original 3440, about 300 fell by the wayside at the first examination, and by this time the RAF was no longer interested. The remaining 3159 were asked whether they wished to opt for the navy or the army. The navy attracted 1424, the army 1735. However, by the end of 1945 the navy also lost interest, so the majority of cadets who finished their course at that time were booked for the army, like it or not. Some were attracted to REME, others to the RE.

Almost 2500 of the original 3440 successfully completed the course and became proud possessors of the diploma. Towards the end of the

course considerable numbers of the army-bound cadets attended No 11 War Office Selection Board (WOSB) at Golders Green as civilians. They were not completely without military knowledge, since one of the requirements of the scheme was that they should become members of a pre-service organization. Some cadet groups formed elite squads in the local company of Dad's Army, and were marched about local barrack squares by drill officers of varying competence. It was not clear whether this helped them get through their three days at WOSB, but some were proud to have been interviewed by a psychiatrist.

About half of those who attended WOSB were successful. They were booked for primary training, training battalion and Officer Cadet Training Unit (OCTU), the REME boys to Wrotham and Arborfield, the RE lads to Newark. So, with the war over, the Sappers were suddenly going to be saddled over the space of a year or so with several hundred young technical officers. What could be done? Someone, somewhere, had a brilliant inspiration: make them Garrison Engineers. A special 16-week course was initiated at Newark OCTU, where field and combat engineering subjects were replaced by lecturers on quantity measurement, the construction of brick buildings, drainage, sewage, water supply, works engineering and visits to cement factories. After commissioning there was a Young Officers' course for one month at Chatham, which consisted mainly of charging around Chatham lines with theodolites and levels and drawing up plans for field hospitals in the countryside of Kent. It was an unusual and never-to-be-repeated Sapper exercise, as far as the writer is aware.

The young garrison engineers were then posted to units in Britain, Germany, the Canal Zone, India and the Far East. Some never saw a garrison. The postwar army was contracting, the British were leaving India. Many ex-cadets were continually on the run as camp after camp closed about their ears. Others were posted to more dangerous activities like bomb disposal or checking the pressure levels in power station boilers run by the military.

Most engineering cadets, having completed their military service, were demobilized during 1948. A few applied for regular commissions and became career officers. A small number of these rose eventually to at least one star level. A much larger number of demobilized cadets used their diplomas to enter engineering degree courses as external students of London University. They were lucky in that the university accepted the diploma in lieu of the intermediate examination (London Inter as it was affectionately known), and the government accepted that because they were civilians as cadets it could be said that their training was "interrupted" by service in the army. This meant they were eligible for a "Further Education and Training" grant. The remainder went straight into local government as engineer assistants, joined oil companies or were recruited by large public service departments involved with electric power, water supply or building work. Of those who studied for an engineering degree, a few went on into academic research and the universities, others entered industry or the engineering and scientific branches of the civil service. Some became consulting engineers. The vast majority of the cadets stayed in civil mechanical or electrical engineering, and very few returned to the world of accounting, estate agencies or crematoriums.

For the services, was it worth it? Probably not. If the scheme had started in 1940 rather than 1942 it would doubtless have been a success. But in terms of engineering, the scheme brought thousands of reasonably bright young men into various aspects of the profession who might otherwise never have entered it. Many of them, who have enjoyed very good careers, owe their fortune to their successful application to the Ministry of Labour and National Service in 1942 or 1943.

The scheme is unlikely to be repeated, although the need to attract more young men into engineering remains. Most of the beneficiaries are now over, or nearing, 65, and most have retired. Some of the groups still hold reunions, and count themselves lucky to have been part of a unique episode. Some ex-cadets still possess the tie and badge of the National Council of Engineering Cadets. At least one is an honorary member of the RE Institution.

MINISTRY OF LABOUR AND NATIONAL SERVICE

ENGINEERING CADETSHIPS

Scheme for Engineering Cadetships leading to Technical Commissions In the Fight Services

Victory in a hard-fought war will never be won without courage; but the day has gone when courage alone can prevail. In the Battle of Britain "the Few" might not have secured the survival of "the Many" if they had not been given the Spitfire by the genius and labour of its designer and of the workers who built it and if our aircraft had not been kept in the air by skilled and devoted servicing. The Navy could not have carried out its prodigious tasks without the help of the secrets that our scientists have discovered and our engineers applied. In all its operations the Army depends not least upon the servicing of its tanks and other equipment.

All three Fighting Services are being given the best weapons in the world; but we need an ever-growing number of men to maintain and repair them. This is an engineers' war and it is vital to our cause that we secure an adequate supply of technical officers. We are meeting immediate requirements from existing sources, but for the future we are instituting in addition a scheme of Engineering Cadetships.

Selection of Cadets

Boys aged 16, 17, 18 and 19 are invited to apply for Engineering Cadetships if:-

(*a*) they left school before October, 1942;

(*b*) they are not employed in any branch of engineering;

(*c*) they have obtained at least one credit in mathematics or general science or physics in the School Certificate; or (in the case of boys from Scotland) they have gained the Senior Leaving Certificate or satisfactorily completed not less than four years of an approved Senior Leaving Certificate course and have, in either case, shown proficiency in mathematics or science (including physics) or technical subjects.

Boys satisfying these conditions who make application for Engineering Cadetships will be considered for interview by a Selection Board on which all three Services will be represented. Those judged by the Board to have the personality and other qualities required for potential technical officers will be accepted for Cadetships subject to medical examination. On acceptance Cadets will be required to sign an undertaking to complete their training. This undertaking must be countersigned by the cadet's parent or guardian.

Training

The training of Cadets will be carried out under the directions of the Education Departments. So far as can be arranged each cadet will attend a Technical College near his home. Cadets will cover during their courses in the Technical Colleges the basic engineering science required in the Associate Membership Examination of either the Institution of Mechanical Engineers or the Institution of Electrical Engineers. During his training a Cadet will be a member of one of the pre-Service organisations will, however, not necessarily determine the Service in which a Cadet will be commissioned upon the completion of his training.

Cadets will attend periodic lectures by Service Officers and visits will be arranged to technical units and workshops.

Duration of Training

Tenure of an Engineering Cadetship will be subject to satisfactory progress and conduct. Training will, as a rule, continue until the age of 20.

The length and character of the training of Cadets will be adjusted to their age and educational qualifications. In general Cadets aged 18 or 19 will attend courses of training at Technical Colleges for 18 to 24 months; Cadets aged 17 will attend similar courses for 2 years and 6 months.

Boys of 16 will receive preliminary instruction at an appropriate Technical College or other institution.

When the grant of new Engineering Cadetships ceases, a Cadet who has not then completed his training may be called upon to do so; if not so called upon and he wishes to complete the course which he has begun his Cadetship will be continued to enable him to do so.

Fees and Maintenance Grant

The Government will pay the necessary educational fees and allow each Cadet a maintenance grant of £140 a year (in London £160 a year) if he has to live away from home or £75 a year (in London £90 a year) if he lives at home.

Prospects after Training

Upon the successful completion of his Cadetship a Cadet will become a member of one of the Fighting Services and will receive special training in that Service. He will then be qualified to receive a commission as a technical officer. Every successful Cadet will be equipped to give outstanding service to our cause in time of war and to obtain for himself a foundation for a professional career in time of peace.

Application for Cadetships

The standard of ability and character required of Cadets will necessitate very careful selection in the award of Cadetships, but every boy who is eligible for consideration should not hesitate to make application at once for an Engineering Cadetship.

Forms of application can be obtained from the Ministry of Labour and National Service, Sardinia Street, London, WC2, or from any of the Appointments Officers at the addresses shown overleaf. Requests for forms of application should be marked on the envelope "Engineering Cadetships."

ADDRESSES OF APPOINTMENTS OFFICES

London	Sardinia Street, Kingsway WC2.
Brighton	74, The Drive, Hove, Sussex.
Tunbridge Wells ..	31 Upper Grosvenor Road, Tunbridge Wells, Kent.
Cambridge	2nd Floor, Lloyds Bank Chambers, Hobson Street, Cambridge.
Colchester	31, St John Street, Colchester, Essex.
Norwich	48 Prince of Wales Road, Norwich.
Oxford	Exeter College Annexe, Turl Street, Oxford.
Reading	10 Kendrick Road, Reading, Berks.
Southampton	14 Westwood Road, Southampton.
Bristol	1 Apsley Road, Clifton, Bristol 8.
Plymouth	1 Thorn Park Villas, Mannamead, Plymouth.
Birmingham	66½ Corporation Street, Birmingham 2.
Coventry	12 Manor Road, Coventry.
Wolverhampton ..	3 Queen Street, Wolverhampton, Staffs.
Leicester	10 Salisbury Road, Leicester.
Nottingham	40 Parliament Street, Nottingham.
Bradford	Britannia House, Broadway, Bradford.
Hull	Fitzwilliam Buildings, Alfred Gelder Street, Hull.
Leeds	Lloyds Bank Chambers, Vicar Lane, Leeds.
Sheffield	The White Building, Fitzalan Square, Sheffield
Liverpool	Cotton Exchange, Bixtech Street, Liverpool.
Manchester	Royal Exchange Buildings, Bank Street, St Anne Square, Manchester.
Preston	32 West Cliff, Preston, Lancs.
Newcastle-on-Tyne	38 Great North Road, Newcastle-on-Tyne 2.
Aberdeen	80 Union Street, Aberdeen.
Dundee	30 Meadowside, Dundee.
Edinburgh	41 Manor Place, Edinburgh 3.
Glasgow	145 St Vincent Street, Glasgow C2.
Cardiff	49 The Parade, Cardiff.
Swansea	Metropole Chambers, Salubrious Passage, Wind Street, Swansea.
Wrexham	30 Grosvenor Road, Wrexham, Denbighshire.

Your correspondence should be marked "Engineering Cadetships"

Ministry of Labour and National Service,
October 1942

P.L.112/1942
10/42 (17797) 35423/349 30,000 11/42 K.H.K. Gp 8/9.

Memoirs

SIR FRANCIS EDMUND TURTON HART KBE

Born 29 May 1908, died 6 February 1993, aged 84

BILL Turton Hart was one of that band of wartime sappers who later achieved great distinction in civilian life.

Educated at Uppingham, his working life began in East Africa, where, after starting on a coffee farm, he worked for a large mining group and served for seven years in the local defence force.

At the outbreak of the war, he was working in Portugal for the Standard Oil Company and, as a member of the Emergency Reserve, was immediately called up for service. Forbidden to leave, by the British Embassy in Lisbon, he eventually succeeded in getting back to England through Spain and France, penniless and without a passport. Soon afterwards, he was posted to the Middle East but his troopship was torpedoed and his draft returned to the UK He was posted to 551 Army Troops Compan which joined the 8th Army in the Middle Ea and there he remained through seven months o the siege of Tobruk, El Alamein, and the la battles of the North Africa Campaign. Som measure of the unit's work is given in a lett from Lieutenant General Ritchie, GOC-in-C 8th Army "... I express my especial admiratio for the work of your Bomb Disposal Squa which, though not specially trained an provided with only improvised equipment, ha dealt with over 700 bombs ... in keeping wit the highest traditions of the Royal Engineers. Bill himself was twice Mentioned i Despatches and appointed MBE for his work i Tobruk. He remained with the Compan through Salerno and the Italian Campaign.

On demobilization he went to Nigeria wher he formed the Amalgamated Engineerin Company which was to pioneer the local struc tural steel industry and later become Dorma Long West Africa. He was a founder member o the Nigerian Port Authority, Chairman of th Nigerian Road Federation and a Director o Northern Nigeria Development. He became special member of the House of Representative and in 1958, having served as an electe member of the Council of the Chamber o Commerce, was elected Vice-President an from 1960 to 1963, its President. His contribu tions to the foundations of local commerce an industry for an independent Nigeria wer rewarded in 1963 when he was appointed KBE unusual in that it was on the personal recom mendation of the President of Nigeria, Si Abubakar Tafawa Balewa PC KBE.

On retirement from Nigeria, he went to liv in South Devon. A keen and skilful golfer, h was Captain of the Thurlestone Golf Club an its President for seventeen years, taking a active interest in its running, and playin regularly until shortly before his death.

He is survived by his wife Margie an daughter Penny.

RGS

Sir Francis Edmund Turton Hart KBE

COLONEL B A E MAUDE MBE MA

Born 2 April 1916, died 10 May 1993, aged 77

BRUCE Maude was an officer with great ability who always put energy and purpose into whatever he was doing. He was helped in this by a debonair manner, natural charm and especially by his linguistic skills as an interpreter in both French and Urdu.

Educated in Wellington he was commissioned from the Shop in January 1936 (35 YO batch) and attended the usual YO courses at the SME, and Clare College, Cambridge. According to his own account he spent most of his time at Cambridge either having dancing lessons or at Fenners, where he represented the University in the 4 x 220yds relay. Munich found him at Bradford-on-Avon helping to build the Corsham Underground Ammunition Storage areas and a temporary lull in preparations for war led to his posting to the Bengal Sappers and Miners at Roorkee in January 1939 where he joined 8 Army Troops Company. His chance came in 1941 when he was posted to command the Faridkot State Forces Field Company.

Faridkot is a compact small State in the east Punjab, south of Amritsar, fairly close to what is now the border with Pakistan, with a population of about a quarter of a million. The Rajah was a highly intelligent individual, an able administrator, keenly interested in all that went on and extremely popular with his people. Bruce, on arrival in the State, found his company had been made up to strength by recruits from not the most usual of sources. Successful service with a State Forces Unit needs the ability to set up a working relationship with the ruler. Bruce was able to do this and had the satisfaction of turning his unusual company into one with the highest standards taking them, via Secunderabad and Kohat, into Assam and building most of the bridges between Dimapur and Manipur. One of these, launched in a hurricane, was promptly dropped on the floor but fortunately picked up again, repaired and relaunched without the Chief Engineer knowing. He was awarded the MBE for his services. He went to the Staff College Quetta in 1945 and then became AQMG Movements at GHQ Delhi, organizing the return of British troops to the UK at the end of the war. While in India he married the beautiful Marjorie Buller in 1942.

Next came service in HQ BAOR until, on the reopening of RMA at Sandhurst, he became an instructor and very successful company commander till 1950. He will be remembered by many who were there at the time for his highly stimulating practical exercise on "how to run an athletics meeting" where his grasp of detail and sense of humour were very much to the fore.

Posted to 37 Field Squadron, he then took part in Exercise *Merry Widow*, later moving to Cyrenaica. 1953 found him training the Iraq Army and from 1955 to 1957 he was an AQMG at Fontainebleau. From 1957 to 1959 he commanded 37 Field Engineer Regiment in Cyprus and his last appointment was as AAG PA6 in the War Office.

Bruce then started his second career in the City. Early days were traumatic and he was told that he was only good enough to sell insurance. He nevertheless persevered and after two false starts his excellent brain and enormous capacity for hard work eventually brought him success. He was typically philosophical about the setbacks, saying (rightly) to his friends that the first job or two after retirement very often do not work out. His determination was eventually rewarded and he built up with the help of many courteous company chairmen, a unique knowledge of British Industry. By 1979 he had two full-time jobs both as a successful investment manager and Master of the

Col B A E Maude MBE

Skinners Company and finally was running his own investment company. As a past Master he generously organized an elegant reunion in the Skinners Hall for all surviving members of his Batch and their ladies to celebrate the 50th Anniversary of their commissioning by HM King Edward VIII.

With a twinkle in his eye, he would describe his own yardstick for measuring the arrival of success – the moment when he was able to commute in comfort with a first class season ticket.

Bruce had many other interests. In his early days he had been an excellent portrait photographer. In 1960 he became Chairman of the Milocarians Athletic Club. In 1975 he became a Governor of Tonbridge School amongst others. He was later to say that the most interesting and rewarding task he ever undertook was to appoint a new headmaster. He served the Corps for many years as Investment Adviser and was always only too willing to help others who needed advice on educational and industrial matters.

Bruce was a great character, who will be sorely missed by his many friends. Unfortunately his wife Marjorie suffered a stroke in the 70s and was severely disabled until her death in 1990. Their latter years were fraught with problems as Bruce was to suffer from a severe crippling illness leading to problems in communication. During this period he fought his illness with indomitable courage remaining independent till the end and even writing a book with an original approach on investment practice. He was a devoted father and grandfather and our sympathy goes to his son, five daughters and their families who survive him.

MBA AGCJ JC

LIEUTENANT COLONEL H S FRANCIS OBE

Born 31 March 1903, died 27 April 1993, aged 90

LIEUT Colonel Hugh Stockley Francis, Curator of the Royal Engineer Museum from 1961 to 1974, was a keen sailor and photographer and had an interest in most subjects involving practical skills.

Educated at Clifton College and the Royal Military Academy, Woolwich, he was commissioned into the Corps on 31 January 1923. Prior to World War Two, he was seconded for two years to the Crown Agents for employment on the Gold Coast Survey and, after a Long Civil Engineering Course in 1933, was seconded for two years as assistant engineer and sub-agent to the contractors constructing the Gebel Aulia Dam in the Sudan.

In 1939 he served in the Army Field Survey Company with the British Expeditionary Force and, after promotion to major on 31 January 1940, was at Dunkirk as OC 514 Corps Field Survey Company. On 30 May his company marched to the Dunkirk beaches as a complete unit, fully armed and equipped, closed up in threes with officers in position, maintaining to the end the standard of a Royal Engineer unit. Subsequently he commanded this company in the Eritrean campaign. Later in the War he was AD Survey of the Western Desert Force and the 8th Army and, before the battle of Alam el Halfa, was involved in the planning and production of a false "going" map which was deliberately lost on patrol in the forward area. He was also AD Survey in 2nd Army in Normandy and North West Europe. He was Mentioned in Despatches in 1942 and appointed OBE in 1945.

After the War he held the appointment of CRE South West London until posted to GHQ Delhi as AD Air Force Works from 1946 to 1947, when he returned to Europe as CRE Lüneburg. From 1948 to 1950 he was Chief Instructor of the Civil Engineering School of the SME before again going overseas, this time as AD Works at GHQ MELF.

Returning to the UK in 1954, for a short period he was CRE Sussex and Surrey, and from the end of 1954, until he retired on 22 November 1956, he was CRE South London.

After retirement, he became a Grade 3 Retired Officer (RO3) in a Works post in Chatham Garrison and, in 1961, he was appointed to the newly established RO3 post of Curator of the Royal Engineers Museum. He took over what could be described as a collection of artefacts and, in his 13 years as Curator, he planned, designed and supervised the layout and construction of show cases to form this collection into an attractive historical museum worthy of the Corps. This was achieved with very little money and a very small staff. He finally retired at the end of 1974.

In retirement, he was able to spend more time on his hobby of the history and repair of antique

clocks. He had already rebuilt the gilded bracket clock in the RE Library and when the fire in the Headquarters Officers Mess damaged the long case clock in 1975 he completely rebuilt it.

Earlier in his career, as a keen amateur photographer, he took on the difficult project of producing a detailed photographic record of the Corps silver. The final results dated 1938, are held in the RE Library and show, with remarkable clarity, every detail of each piece of silver. To obtain such clarity, he collaborated with technicians at the Kodak laboratories to establish the best temperatures, timings and the correct strength of chemicals before photographing each piece of silver, from all relevant angles, then developing and printing the results in his own dark room.

A keen sailor, he sailed in *Ilex* in a number of RORC races, both as a crew member and as skipper. In the 1928 Fastnet race, *Ilex* lost her topmast and he scarfed the spar with a tenon saw, making a beautiful joint, and *Ilex* finished the race, coming fifth out of 12 starters. His skills as a carpenter were again put to good use in the 1930 Santander race when *Ilex's* jackyard spar bucked halfway across the Bay of Biscay. He soon had the spar almost as good as new and *Ilex* took first place and the Queen of Spain's Cup. In 1931 he sailed as a crew member in the Transatlantic Race, his duties listed as ship's plumber, assistant navigator, surgeon and camera man.

BGB writes: "I was fortunate to be one of his crew when he skippered *Ilex* in the RORC race to Bells Isle in 1935, and there were two events which particularly impressed me.

Quietly he was doing his very best to win the race whatever happened, yet nothing seemed to perturb him. We had just left Plymouth, the start and were on the wind with all light sails up when there was a nasty ping forward. *Ilex* had recently been fitted with a Bermudan rig and it had proved too much for the bobstay. Francis determined to make temporary repairs and these had to be made without slowing up the ship. More than half of our crew were immediately ordered out on the end of the bowsprit to ease the strain on it. We had to cling there while the mate, Ken Wylie, was lowered down the stem with a tackle to replace the bobstay. This took about half an hour, but *Ilex* was able to keep full speed on the wind throughout. We on the bowsprit were glad when the repair was completed!

The other occasion was near the end of the race when we were off the Roches de Penmarch. There was not a breath of wind and all sails were hanging limp. Two other yachts were almost half a mile astern of us. We, the crew, were lazing on deck, but not Francis, who was standing up most of the time and looking all around. Quietly and unexpectedly, he suddenly ordered "hoist spinnaker." We could not see any reason for it, but about five minutes after it was up we could just see a slight ripple on the water from astern. By the time the other two yachts had realized it, we were a mile ahead. Hugh Francis taught me so much about this sort of thing and also navigation.

He had a great love of sailing and while he was Curator he formed a REYC corner in the museum.

Hugh Francis was meticulous in everything he did and set great store in having things done properly. He was a stickler for etiquette and this, combined with a natural shyness and a superficially gruff manner, made him seem at times a rather formidable figure. His outward manner concealed a very kind man who was an interesting and generous host.

He married Margaret Gilder at Chatham on 27 December 1942 and they had two children, Charles and Elizabeth. Sadly his wife died on 2 December 1972 and he lived alone for his last 20 years. His children, who visited him regularly, survive him together with his three grandchildren.

JTH BGB

Memoirs

Corrections – RE Journal, August 1993 issue

MAJOR GENERAL E M HALL CB MBE DL

Please note that in this memoir. on page 228, RH column, it was stated that General Hall was High Sheriff of Treworgey; he was in fact High Sheriff of Cornwall.

We apologise for this error.

MAJOR GENERAL W G FRYER CB CBE

Please note that an error appeared on page 231, LH column, penultimate paragraph, which stated that General Hall was posted to 8th Corps in Normandy, as Chief Engineer; this should have read "as Deputy Chief Engineer."

BRIGADIER O J R ORR OBE

Born 23 September 1894, died 29 June 1993, aged 98

BRIGADIER James Orr, was an instructor at the School of Military Engineering, Chatham, when he was abruptly ordered to report in haste and secrecy to the Cabinet Offices in early 1938.

He was informed that he was to convert the Cabinet War Rooms – 10ft below ground – into a fortification capable of withstanding a direct hit from a high-explosive or gas bomb.

The recent speeches and actions of Hitler had convinced the British government that the German dictator was intent on war; a completely secure shelter was necessary to protect the Prime Minister, the War Cabinet and Service Chiefs against air attacks during their conferences.

Originally only three rooms, later extended to 21, the War Rooms were favoured because of the steel-frame building above. In constant use during the Second World War, they have now been restored, and opened to the public, by the Imperial War Museum.

Orr was subsequently appointed OBE for his work, but the whole process was so secret he was never given a citation.

Oswald James Ritchie Orr was educated at Fettes, Woolwich and Sidney Sussex College, Cambridge; his grandfather was a general in the Madras Staff Corps. He commissioned in 1925, and joined the Bengal Sappers and Miners in India in 1930, after which he served in the Mohmand operations in 1935 and was Mentioned in Despatches for his work in building a road through extremely hostile countryside. The strength of the opposition stirred up by the fanatical "Red Shirts" was underestimated by the British authorities, and casualties were heavy before it was overcome.

In 1936 Orr returned home. After the Cabinet War Room project he was engaged in training before attending the Staff College and later holding various specialized appointments.

In 1944 he was posted to Allied Forces HQ in Italy; two years later he became CRE, 78 Division in Austria, where he built the Army Winter Sports Facility. From 1946 he was CRE in Singapore, engaged in postwar reconstruction. On his return to London he worked in the War Office and then as Command Inspector for RE Stores.

In retirement he served on the Leybourne Grange Hospital management committee for ten years. He also became a poultry, pig and apple farmer.

Jim Orr was a talented athlete, had hurdled for the Corps and captained the TBRE team that reached the final of the Army Rugby Cup in 1929-30.

Orr used to say that his most dangerous moment in the war was when he took part in a mule race to celebrate the liberation of Caserta. Finding himself well in front, and much encouraged by the cheering, he turned round to wave to his supporters to discover they were not applauding him at all. They were trying to warn him he was heading directly for an uncleared minefield, from which the Achtung Minen! notice had been removed.

He married, in 1932, Joan Godfrey-Fausset-Osborne; they had a son and a daughter.

FWEF writes: "I joined Engineer Branch of GHQ FARELF as SORE III in early 1948, working under Lt Col Jim Orr. It was my first staff experience and I just could not have had a nicer person to work for. He created a happy working atmosphere: he never left me in any doubt about what he wanted me to do but, having briefed me, was thereafter extremely approachable and was always prepared to listen

Brigadier O J R Orr OBE

to new ideas. Above all, he was a marvellous "encourager" who took great trouble to make a young SORE III's life interesting, enjoyable and fun, especially by giving him responsibility and getting him out and about away from his desk. 'Write me out a first draft establishment for a Gurkha Field Squadron': 'I want you to go up to Ipoh...to Kluang...': 'We haven't heard anything for a long time from the Combined RE/RASC Bomb Disposal Unit in Borneo – we don't even know where they are – go and find out what's happening.' I owe so much to Jim Orr for his thoughtful, wise and inspired tutelage of 45 years ago. And in later years, there was always a great welcome from him and his wife at Queendown Warren."

LIEUT COLONEL A B SHEPHERD BSc

Born 16 August 1921, died 26 August 1993, aged 72

TONY Shepherd, who died in a traffic accident, was the younger son of Brigadier G J W Shepherd CBE DSO, and brother of Colonel G W Shepherd OBE. He was the last survivor of three devoted Sappers in the family. Educated at Cheltenham College and Bristol University, he achieved a good honours degree in civil engineering despite a six-year gap in his course due to war service. He joined up in the ranks in 1940 and was commissioned into the Corps in 1941.

During the War he served with the Royal Bombay Sappers and Miners in India and Burma. His company was engaged in airfield construction at Imphal when the Japanese assault was launched. After the War he commanded a field squadron in Germany, served in a GHQ FARELF staff appointment after attending Staff College, and had two consecutive tours with the TA, the second as brigade major of a port construction and operating group. In 1956 he was sent as an observer to the atom bomb tests at Maralinga in Australia. He was the last British Army officer to command a Nigerian field squadron, which he took to the Cameroons during the difficult time when the future of the mandated territory was being determined and also to serve with the UN force in the Congo. Then, in yet another totally different career direction, he became an expert in biological and chemical warfare, serving successively on the staff in the Ministry of Defence, as an exchange officer at the US Army Chemical Warfare Centre at Fort McLellan, Alabama, and finally on the Directing Staff at the Royal Military College of Science at Shrivenham. This was at a particularly interesting time because the United States was still maintaining a chemical warfare capability whereas the UK was officially limited to developing protective measures only.

Retiring prematurely in 1970, he emigrated to South Africa where, with considerable success and patience, he held a senior engineering post in local government in Natal. He deemed it a great honour to represent the Corps at the Zulu War Centenary in 1978 at Isandhlwana and Rorke's Drift.

Tony Shepherd was a very able, unassuming, warm and, above all, cheerful man, who gave of his best whatever came his way in his very varied career. He accepted life as it came with inexhaustible good humour, complete loyalty and total lack of self-seeking. Though not a natural ball games player, he was always ready to have a go and especially enjoyed a game of golf when this was available. But it was in horsemanship, rowing and sailing that he was most proficient. In Singapore he was a leading light in the 14ft GP Dinghy Class, generously devoting time to teach and encourage newcomers to race and enjoy the Island waters. In Durban he advanced to his own yacht, which gave him and his family much pleasure along offshore Natal. Here, too, he became an active and respected Rotarian. He served as president of his local branch and was the recipient of a special award for his contributions, which covered nearly twenty years.

He was married to Elizabeth, daughter of the late Lt Col A F Toogood. They had a son and daughter. He was the brother of Rosemary, married to Brig D L Begbie. Tony will also be remembered with affection and gratitude by very many friends in and outside the Corps.

DLGB MFJB PJMP AHWS

BRIGADIER JOHN WILLIAM BRIDGE CBE
Known as Jack

Born 26 May 1922, died 13 August 1993, aged 71

BRIGADIER Jack Bridge served as a RAF pilot in the Second World War, but subsequently joined the Royal Engineers.

Throughout his army career he remembered his time with the RAF with great fondness and, in later years, was immensely proud to be the only surviving army officer entitled to wear a full set of wings on his uniform.

John William Bridge was educated at Brentwood School, Essex. He joined the General Post Office in 1939 but in 1941 volunteered for the RAF. Much of his training took place in America at Turner Field, Georgia, and Gunter Field, Alabama. When fully qualified as a pilot, he was posted to 183 Squadron.

After D-day, the Squadron was based in Normandy at Vaux-sur-Selles and subsequently at Ursel, Belgium and Nijmegen, Holland. During this time Bridge flew in 21 different types of fighter-bomber aircraft, including Typhoons, Spitfires, Hurricanes and Mosquitos. Most of his work was in tank and train-busting sorties.

In 1941 he met Joan and they were married in 1943. Their first son, Tony, was born in 1945 just after VE-day, with Chris following in 1946.

In 1950, Martin was born, and Jack joined the Royal Engineers, serving first of all in Korea, with the Commonwealth Division, and later, accompanied by his family, in Cyprus (twice), Germany and Singapore. A distinguished career culminated in his promotion to brigadier as Director of Army Postal and Courier Services.

He was known throughout the service as "Honest Jack" for the appealingly open and frank manner he displayed to all who came into contact with him.

Upon retirement in 1980, Jack was awarded the CBE. He moved with his wife, Joan, to Kings Lynn, continuing to lead a very busy life. He became the "Poppy man", and for eight years organized and collected contributions to the annual Earl Haig Poppy Appeal fund, which helps the Armed Forces, always close to his heart. Within the last three months of his life, he became President of the local British Legion, and was looking forward to devoting as much energy to this new interest as to all his others. Brigadier Jack never totally severed his links with the service and was proud to become a member of the Postal and Courier Services' Officers Association Committee.

Always a keen sportsman, Jack played in goal and captained both the Brentwood and Billericay local football teams throughout the '50s, as well as playing cricket in the summer months. In 1966, while in Singapore, he took up golf and this remained a major interest in his life. He joined Kings Lynn Golf Club and was an enthusiastic member, eventually captaining the club and making many close friends. As in every part of his life, he brought to golf an immense natural talent and competitiveness and meticulous attention to detail as well as forthright and strongly held opinions. Jack was particularly keen on retaining the links with his many good friends in the forces, and became President of the Royal Engineers Golfing Society, thus combining the two great interests in his life.

As well as golf, Jack enjoyed bridge and had recently taken up a new interest, bowls, and was looking forward to enjoying as much success in this as he had achieved in other sports. The PCS Officers' Association conveys its sincere sympathy to Joan and all the family circle.

Brigadier John William Bridge CBE

Memoirs in Brief

BRIEF memoirs are published below on distinguished men whose deaths have been notified recently in the national press and who served in the Royal Engineers during and after World War Two.

CAPTAIN MICHAEL GIBSON, who has died aged 67, was one of the most colourful of Wimbledon's referees from 1963 to 1975, during some of the most exciting and exacting years the All-England Tennis Championships have ever experienced. His tenure saw the coming of "open" tennis in 1968, followed by the banning of several contracted professionals in 1972. The next year more than 80 of the world's leading players boycotted the gentlemen's singles in support of Nikki Pilic, the Yugoslav, suspended by his country's tennis federation for missing a Davis Cup fixture.

Throughout this turbulent era Gibson implemented the often controversial decisions of committees with characteristic determination. A good officer, he knew when and where to fraternize, but ran his tournaments with military discipline.

The son of Lt Col B T Gibson, Michael Bradford Gibson was born in Manchester on 20 March 1926, and educated at Taunton School, Sandhurst and Sidney Sussex College, Cambridge. Commissioned into the Royal Engineers in 1948, he served in Tripoli, Cyprus and Germany.

In 1961 Gibson retired from the Army and the next year became assistant referee at Wimbledon under his father-in-law, Col John Legg, whom he later succeeded as referee. On his appointment it was suggested that he retain the title of Captain. "It made it easier for the players," he recalled. "And I liked them calling me Captain."

Gibson had an unsurpassed grasp of the rules and an inflexible attitude towards protocol. There were some who considered him too autocratic: "He is the worst referee in the world," said the mercurial Ilie Nastasie. "He thinks he is God, or a little higher." Away from the court Gibson and Nastasie had a warm relationship; Gibson described the Romanian as "a most delightful man".

At Wimbledon in 1972, Gibson told Jimmy Connors to cut down on the number of times he bounced the ball before serving. In the same year ordered Rosie Casals to change her dress (which was emblazoned with the slogan, "You've come a long way baby").

His firmness ensured that potentially explosive Davis Cup ties, major championships and tournaments in the United States, South Africa and Europe passed without incident. In 1975 he resigned from Winbledon but continued to referee internationally for some years.

Gibson married, in 1953, Elizabeth Legg; they had two sons.

BERNARD FREDERICK WILLETTS, who was born on 24 March 1927, has died recently. He was educated at Birmingham and Durham Universities before receiving his early industrial training at such companies as Dunlop, BSA, Serck, Morris Commercial and Harry Ferguson.

During the latter stages of the Second World War, he served with the Royal Engineers.

He was a remarkable leader in the British engineering industry during its most acute period of technological change in the 1970s. A brilliant mathematician and engineer, "Bill" Willetts had rare qualities of leadership and a clear vision of the effects of changing technology on working practices. A true "captain of industry", he rose, between 1958 and 1981, to become deputy managing director of Massey-Ferguson; deputy chief executive of the Plessey Group and Chairman of Plessey Telecommunications. From 1981 to 1988, he was enticed away from British Industry to run the Dubai Aluminium Company.

Willetts served many organizations in an advisory capacity including the Oxford Institute of Energy Studies. He leaves a wife and two sons.

ESME GORDON, one of Edinburgh's leading citizens who has died aged 82, was for many years a leading architect of Edinburgh and Scotland.

The son of a Writer to the Signet Esmè Gordon was born in Edinburgh on 12 September 1910 and was educated at Edinburgh Academy. He started to practise as an architect in London with the firm of Sir John Burnet Tait and Lorne but returned to Edinburgh as soon as he could in 1937 to set up his own practice of Gordon and Dey. During the Second World War he served with the Royal Engineers, building canteens and Bailey bridges, in the UK and in France and Holland.

After the War his practice grew and was regarded as one of the most creative and sensible in Edinburgh. Gordon's major buildings included the Third Extension for the Heriot-Watt College, the head office of the Scottish Life Assurance Company and the head office for the south of Scotland Electricity Board. He was for many years architect to the fabric of the High Kirk of St Giles and created the new East End design and reredos in coronation year, the War Memorial Chapel and in the Chapel of the Order of the Thistle, the memorial to King George VI. He was elected a full academician of the Royal Scottish Academy in 1967 and served as its honorary secretary from 1973 to 1978. He became the RSA's historian, publishing his major books, "The Royal Scottish Academy, 1826-1976" and "The Making of the Royal Scottish Academy". A recognized watercolourist he was persuaded in 1988 to have a one-man show of his paintings which was a great success.

His wife died in 1990. He is survived by their two sons, one of whom is the writer and literary agent Giles Gordon, and a daughter.

MAURICE HEGGIE, the former prominent Edinburgh businessman and bailie has died aged 73.

Born in 1920 in the Merchiston area, Maurice Heggie was educated at George Watson's College and Edinburgh College of Art (School of Architecture).

During the Second World War he served with the Royal Engineers, rising to the rank of captain. After initial service in the 3rd Division, he joined the 1st Airborne Division, serving in North Africa and Italy, before being wounded and taken prisoner at the Arnhem landing in September 1944.

After repatriation in 1945, he joined his father in the family business of Heggie and Aitchison, shop fitters. As managing director, first jointly with his father and later in sole charge, he built it into one of the best known businesses in its field in the Edinburgh area. He retired in 1982.

He represented the Merchiston Ward as a Progressive from 1961 for seven years – four as councillor, two as bailie and one as senior bailie. He served as chairman of the town council's highways and road safety committee, as convener of the transport committee, as deputy chairman of the planning committee and as a member of many other committees.

In the business sphere, he was also very active in the 1950s becoming in successive years president of the Edinburgh Junior Chambers of Commerce and the Association of Scottish Business Clubs.

He was assistant Master of the Merchant Company of Edinburgh from 1956-58 and President of the Edinburgh and District Master Builders' Association in 1960. At the invitation of the then Group Captain Leonard Cheshire, he set up the Cheshire Homes Foundation in Edinburgh and nurtured it throughout the sixties. He was also vice-chairman of the founding committee of St Columba's Hospice in Edinburgh.

Heggie is survived by his wife, son and daughter.

MICHAEL CHARLES FARRAR BELL, a stained glass artist and craftsman, has died recently. The son of a stained glass artist, he was born in 1911 and educated at Harrow and Edinburgh College of Art. During the Second World War he served in the Royal Engineers as a camouflage officer. Afterwards he settled in Buckinghamshire. One of his commissions was the design for the 2½d stamp when the Queen came to the throne; later he was responsible for one of the Coronation stamps and designed many others. On his father's death in 1950, Farrar Bell took on the completion of the west window in Exeter Cathedral, and the restoration of the great east window in Bath Abbey – originally designed by his great-grandfather. Another notable achievement was the design, manufacture and installation of all the windows in Her Majesty's Chapel of the Mohawks in London, Ontario. He was Master of the Worshipful Company of Glaziers and Painters of Glass. Farrar Bell married first in 1942, Frances Stewart; they had a son and a daughter. After her death he married, in 1952, Angela Gale.

Correspondence

STICKS AND STRINGS

From Lt Col H Filor

Sir – The note in the August *Journal* from Lt Col Farmbrough on the "Branch" bridge, led me to dig out the enclosed snap.

This "stick and string" effort was built in early

summer 1940 by 244 Field Company of 53rd (Welsh) Div Engineers at Limavady, Northern Ireland. It was a period, just after Dunkirk, where training stores were non-existent. We scrounged a lot of timber poles (on loan) from the local Forestry people, and with a lot of old rope produced the results shewn.

The twist to the story is that we had just had a new CRE appointed and on his first visit to meet his new command, the theme of his remarks was "The days of the stick and string are numbered." So we took great delight in mounting a lot of these plates on a sheet suitably inscribed "The days of the stick and string are numbered," and sent it to him. I cannot recall his reaction. Yours sincerely – H Filor.

MAJOR W G B SHAW MBE RE

From Mrs D M Lloyd

Sir – I would like to thank the officer responsible for representing the Royal Engineers at my uncle's funeral at St Augustine's Church, Gillingham, on Monday 4 October.

It was a very moving service and the bugler playing *Last Post* and *Reveille* was so appropriate. My uncle began his service career as a bugler, aged 14 I believe, and so his last journey was made with bugle call. The young bugler can now claim to have played at the funeral of an old soldier who played the bugle for Lord Kitchener at Brompton Barracks.

Uncle was a devoted Corps man, as was my grandfather, Major W J Shaw, and I have been to Brompton Barracks on many occasions as a child. I must now come to see the Museum, part of which uncle visited last year, promising to return to see the trenches! Yours sincerely – D M Lloyd (Mrs).

ST ALBAN'S HOT POT

From Lt Col D St J Edwards

Sir – In about 1932, Carter, the paid hand in *Ilex*, in a turbulent head sea off St Alban's head, devised a dish for heroes.

He named it "St Alban's Hot Pot."

The recipe would be much appreciated by Yours etc David Edwards, *Shenley, The Drive, Woking, Surrey, GU22 OJS. Tel: (0483) 761535.*

BRENNAN TORPEDO

From Brig A C S Ross

Sir – I have found the two parts of Michael Kitson's article on the Brennan Torpedo most interesting, surpassed in the *Journal* only by the tales of unimaginable bravery and fortitude of fifty or eighty years ago. While looking forward to the concluding Brennan article, I have some observations on what we have read so far: energy involved in propulsion, gyrostatic effects, and the steering system.

The method of propulsion is most attractive; the harder you pull the faster the torpedo goes away from you. As the wire length was only twice the range (p157 note 8) it means that a wind-in of one metre propelled the torpedo one metre in the opposite direction, at 30 knots. Taking into account the friction losses in the wires snaking, the ejected rings, internal worm drives, the inertia of the 24ft one-ton torpedo itself, and the fact that the wires drawn from the tail orifice at 60 knots (100ft per second) were tending to pull the torpedo in reverse then: a. the propeller design must have been very efficient, and b. the winding engines must have been pretty impressive. I would not expect to get a one-ton displacement hull boat moving at 30 knots with less than 100kw (say 135hp) and a boat does not have all the torpedo's hang-ups.

I am not convinced that gyroscopic effects had much bearing on the Brennan torpedo. I can see it could have in the Howell, where the flywheel weighed 112lb and rotated at 10,000rpm.

Correspondence, p347

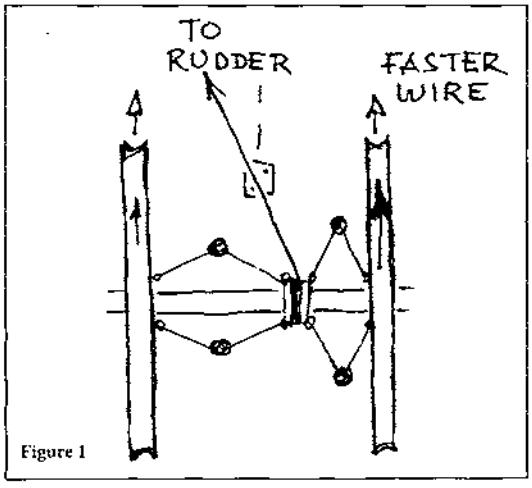


Figure 1

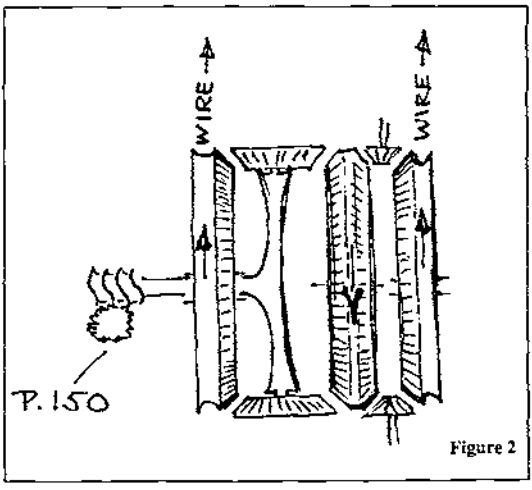


Figure 2

Brennan's two drums totalled 360lb but counter rotated and at only 1290rpm. More pertinent is the value of gyroscopic effect if one has a competent wire steering system; a tendency to go straight might be a handicap.

The steering mechanism is most absorbing perhaps because of the "secret ingredient". It seems clear that the only purpose in having two separate but ringed wires was that, by varying the speed of one relative to the other, the submarine could be steered laterally (the depth control appears to be quite independent). One may surmise, then, on just how, by pulling on the reins, one could change the torpedo's course. A differential in wire speeds will give different revs in the two propellers. This would induce torque leading to the torpedo heeling which in turn, depending on hull design, could cause it to turn without any rudder movement. I well remember 40 years ago, the exhilaration of motoring solo in a Malay longboat with an oversize outboard on the half mile wide Pahang river and steering to avoid the many sandbanks merely by kneeling in the bow and leaning on the gunwales.

The "secret" might also have been in the use of weighted governors such as steam engines sometimes use. Two governors would be mounted on a collar on the shaft linking the two final pulleys, one anchored to each pulley. An increase in one wire (hence pulley's) speed would throw the corresponding governor out hence moving the collar along the shaft. It would not be difficult to link this to the rudder – see figure 1.

However, I suspect the steering was achieved through mechanical gearing. One simple possibility would be a form of differential gear mounted between the two final pulleys which, when their speeds were different, would turn a shaft running through a final pulley and ending in the worm drive, seen in the top photo on p150 (figure 2). But why the secrecy?

Honker Henniker, CI Sticks and Strings for my YO course, encouraged an interest in such things as these. I am sure he would fathom Brennans secrets. Maybe, after the third part of Kitson's trilogy and reading all his bibliography, so could I! But would not a relaunched torpedo project for a YOs' or WOs' course be best of all? Pulling a ton away from you at 30knots would surpass any Great Egg Race. – Yours etc Alan Ross.

Incidentally, I feel sure that in note 8, p157, the wire diameter of 0.7in is a misprint; 0.07in perhaps.

Correspondence

SEVENTY MEN – Correction, August 1993 issue

AN error was made in the text on page 236, in the fifth paragraph, line six. In the sentence which startes: "Brig Kirsch was a tall, slim...", Brig Kirsch's name should be replaced by "Colonel Shannon." Colonel Shannon was being described as tall, slim, gangling etc and not Brig Kirsch. We apologise for this error.

Reviews

BERLIN AND THE BRITISH ALLY 1945-1990

MAJOR GENERAL R J S CORBETT CB

Orders to "Berlin and the British Ally", 46 AEC, BFPO 45; cost DM53 or £22.50 payable to "Commander's Fund", plus DM4 or £1.50 postal and packing charges to non-military addresses.

WHY do we need another book about Berlin? Well, you might think that everything had already been said, but General Corbett shows that this isn't so. Whilst there have been other books about the Allied Occupation, none has concentrated on the 45-year history of the British Sector of Berlin. Besides, this is the first book which has been able to review this history with the benefit of hindsight, because it was not written until after the reunification of Germany, when the British Occupation had come to an end.

As many readers will know, General Corbett was the last Commandant and GOC of the British Sector of Berlin. He held the post for almost two years, during which time the astonishing events surrounding the collapse of communism in the former GDR took place. This has given him unparalleled access to official documents and photographs, and placed him in a unique position to compile a history of the British Sector.

The general modestly decries his abilities as an historian, but "Berlin and the British Ally" is meticulously researched and compiled. On the other hand his style is down to earth and readable, which most people will find more important than his academic credentials – many highly qualified academics are not born writers! The first half of the book tells the history of the British presence in Berlin in straightforward chronological order, beginning with the first arrivals in a rather jittery Soviet-occupied zone in 1945. It goes on to cover the Blockade, the uprising in East Berlin, the Kruschev ultimatum (which in effect threatened to end the Western occupation by force), the building of the Wall, the Quadripartite Agreement (which brought a long period of relative stability), and finally the collapse of the GDR and reunification. These subjects are covered succinctly, and without the inclusion of a welter of detail and documentation, although footnotes refer the interested reader to other documents and sources. The book is not primarily a photographic record, but a number of monochrome photographs do serve to illustrate many of the events which it covers.

The second half of the book contains a series of 48 annexes and appendices, many of which contain facsimiles of original documents or reproduce their text, including pages from newspapers and official announcements by political leaders. The annexes cover many interesting fields, including the history of RAF Gatow, the British Council in Berlin, and the role of BRIXMIS. Finally, in a pocket inside the back cover there is a removable fold-out time chart, summarising the Berlin-related events of each year from 1944 to 1990. This approach makes the history manageable for the casual reader, whilst providing the detail required by the reader who needs to dig deeper. The time chart, which folds out to 2.24 metres, could form the nucleus of an admirable school wall display!

Berlin has made amateur historians out of many Service people who became fascinated by its unique place in the postwar world, especially as a centre of tensions in the Cold War. For all of those, for any student of modern European history, and for anyone seeking a souvenir of a remarkable epoch in British and German history, "Berlin and the British Ally" will be an invaluable addition to their bookshelf.

BF

DON'T STEP ON A STONEFISH

DAN RASCHEN

Published by Buckland Publications Limited, 125 High Holborn, London, WC1V 6AQ - Price £14.95 Post Free
ISBN 0 7212 0848 7

THOSE who have enjoyed Dan Raschen's first two autobiographic volumes, "Wrong Again Dan" and "Send Port and Pyjamas", which took him to the end of the Korean War, will relish this latest book which is both entertaining and informative. Essentially it is concerned with what and who he saw and what he did in the course of eight weeks in 1960 spent reconnoitring the coral reefs surrounding 18 islands in the British Gilbert and Ellice Islands Colony, now the independent countries of Kiribati and Tuvalu, which lie astride the International Date Line and the Equator in the middle of the Pacific Ocean.

Dan's irrepressible *joie de vivre* shines through from the first page to the last. Never shy of laughing at himself, he kept an acute eye on all that went on around him in a part of the world that very few will ever be privileged to see. Not least he was determined to try to discover how coral atolls were formed; he sets out his interesting theories in an annex to his book.

The Resident Commissioner in the Islands had asked the Ministry of Defence if it might be possible for a party of Royal Engineers to improve existing channels which provided access through the reefs to the island lagoons, and perhaps to create additional ones, using explosives. A reconnaissance and all subsequent work had to be contained within a very limited budget.

Dan was about to go to Christmas Island to command the Christmas Island Squadron, which by then was the only Army unit left on the island, when

he was given the job of making the reconnaissance, which was to take priority over his role on his own island. How he contrived to travel between islands enjoying no regular means of communication is all part of the story, as is how he coped with the loss, through sickness, of the two Naval divers who had been considered essential, before the little party reached their first site.

The requirement arose because the economy of the islands was almost entirely dependent on the export of copra which had to be collected by ships which could only lie off-shore in deep water; movement of the copra from the islands to the ships was only possible using very small and fragile local craft which could get through the shallow tortuous and dangerous channels. More often than not the helmsmen had to use hazardous surfing techniques to cross the bars and thus were limited to short periods when the tides were right. How Dan boarded one of these boats at sea and made the subsequent passage is both one of the more hilarious and alarming episodes.

The voluminous report which went back to London, led in due course to the task being given to the Corps. The schemes proposed by Dan and his invaluable SSM, who accompanied him throughout the reconnaissance, all worked. Not least, the improved channels are still being used today.

It is to be hoped that there will be at least one more volume to come. Like its predecessors the comparatively slim volume is well produced and the photographs help round it off even if some of them reflect the fact that they were originally not intended to be more than snapshots.

This is a good tale told in a manner reminiscent of the best Blackwoods tradition; it stands alone and you don't need to have read the earlier volumes to enjoy this one. It illustrates well what can be done using basic techniques applied after thorough reconnaissance and experiment. The involvement of explosives added to the excitement, as it usually does whenever Dan is around. Aspiring Squadron Commanders can all learn from Dan's experiences, while older generations are sure to put down the book with more than a tinge of envy. They should certainly consider giving a copy to their children or grandchildren.

JNE

LAHORE TO LUCKNOW
THE INDIAN MUTINY JOURNAL OF ARTHUR MOFFAT LANG

EDITED BY DAVID BLOMFIELD

Published by Leo Cooper, 190 Shaftesbury Avenue, London, WC2H 8JL – Price £19.95
ISBN 0 85052 203 X

IF one goes into the Headquarters Officers Mess in Chatham and looks up the stairs to the left, there is a voluptuous and most unmilitary picture facing a similar one on the right. The inscription states that they were taken by Lieut Harrison RE from either side of the King of Oudh's throne in the reception room of the Kaiser Bagh, Lucknow, in 1858. Undoubtedly, they would have been seen by Lieut Arthur Lang, who was the only engineer officer to have been involved in fighting all the way from Delhi to the storming of the rebel stronghold in Lucknow, where there were "soft carpets, rich silk hangings, mirrors and chandeliers, tables covered with articles of vertu and bijouterie." And evidently pictures!

Arthur Lang was a subaltern in the Bengal Sappers, stationed in Lahore at the start of the Indian Mutiny in 1857. Within three months he was in the thick of the fighting at Delhi and kept a diary of events which has been edited by his grandson, David Blomfield (whose elder brother, Richard, left the Corps as a Brigadier a few years ago). The result is an excellent little book which helps, often in dramatic fashion, to bring to life the events of those traumatic days.

At the siege of Delhi, Arthur Lang carried out the most daring of reconnaissances to inspect the breach in the city walls and it was confidently expected by the assaulting troops, that he would be awarded a VC. His gallantry was seen again by all next day when he was with the storming parties and was said to have "fought like a paladin." Lang himself makes no reference to his own behaviour either then or in subsequent battles, though he was put in for a VC on at least two further occasions. Of the seven VCs awarded during the Mutiny, four went to officers of the Bengal Sappers but, to the dismay of his brother officers, Arthur Lang was not among the recipients.

Lang undoubtedly enjoyed the responsibility and one extract from his diary should gladden the heart of every Sapper subaltern when he says "It is grand what a position we Engineer subs have: we give our opinions more coolly and forcibly than any colonels would do to generals and they all tacitly agree that we are the managing minds. Were it not for us nothing would be done. We seem to propose, arrange and carry out everything." Such is the arrogance of youth, but how true!

His views on religion are unexpected and he comments that "I don't think that religion or a feeling of the uncertainties of life, or of man's nothingness are fostered by the dangers of warfare. On the contrary, on minds constituted as mine is, they have the opposite effect. They cause elation of spirits, scorn of danger, an inclination of confidence in pluck and strength, and a sort of feeling of self-satisfaction in escaping unhurt." Yet, later, he hopes that "...the gracious God...will I trust preserve us still."

Arthur Lang was eventually sickened by all the killing and, when the Mutiny ended he returned to the rather humdrum life of constructing roads and buildings. His subsequent career was distinguished without being

career. In fact the reader gets a lot more for his money. It is really three books wrapped into one; the story of a soldier who despite many setbacks and frustrations finally arrives at the top of his profession; the story of the US forces recovery from the shambles of Vietnam into the superb fighting machine it was in 1990; and finally the story of how the soldier, the machine and world events came together in the deserts of Arabia for the Gulf War.

Norman Schwarzkopf gives his family background in detail. He is immensely proud of his father, who had a very distinguished career in the military, the police, and as a diplomat, and who passed on to his son a sword inscribed "Duty, Honour, Country" – the creed the young Norman took as his own. He also explains his mother's problem of coping with life, her alcoholism, and analyses the family stresses which were so important in his early years. This in depth emotional self analysis may not appeal to the more reserved British reader, however it does help to build up the picture of Schwarzkopf, and throughout the book these personal revelations help to bring his character alive.

His military career began when he went to West Point, from where he graduated, in 1956, with a commission in the Infantry. He later went on to earn a Master's Degree in Guided Missile Engineering – not many UK generals can claim that! However, he was not prepared to stay at home when his country was tearing itself apart over the Vietnam war, and volunteered for service there, eventually completing two combat tours, first as an advisor with the Vietnamese Airborne Division, and second as a battalion commander. The detail of these tours is not as interesting as the scars they left on him. His disillusion with time-serving senior officers, the contempt of US civilians for the armed forces, the gradual breakdown in morale and discipline, all combined to give him severe doubts about the wisdom of soldiering on. But he did, and every so often crosses paths with other like-minded officers determined to restore US pride in its armed forces. As with his own character analysis, he ruthlessly exposes all the faults of the US army, and then shows how he helped to put them right.

So, from early in his career he was an officer with a reforming zeal. The principles he defines to help him in his crusade (professional excellence, full and realistic training at all levels, missions within the troops' capabilities, clear orders with definite and realizable goals) will all strike a chord among British officers. It was not a smooth ride, and his career had many ups and downs, including, eventually, four tours in Washington, which he did not enjoy at all. But, by the time he became a brigade commander in Alaska, his and the Army's ideas were beginning to run together. Whilst commanding 24th Infantry Division, he was lifted out to be the Deputy Commander of the Joint Task Force for the Grenada operation. Here he saw that the advances made by the US Army at formation level and below needed to be applied at the operational level, and his subsequent time was devoted to ensuring that joint operations could be mounted successfully.

The final chapter in his career began with his appointment as Commander in Chief, United States Central Command, where he was responsible for operational contingencies right across the horn of Africa, the Middle East and South West Asia. His experience told him that he had to get to know the leaders of the countries he could be called upon to help, to prepare in advance for any eventuality and to train the staffs and commands under him for likely operations. The story of the background to *Desert Shield*, the build up to *Desert Storm*, the subsequent air campaign, is told with the same mix of candour and emotion which characterizes the whole book. It is far too complex a series of events to be summarized satisfactorily here, but is very well written.

"It Doesn't Take a Hero" is an excellent read and should be enjoyed by all because it gives a fascinating insight into how one man's character and leadership abilities were shaped by his experience and how he had the will and intelligence to turn his ideas into reality, to the benefit of all who fought under him in the Gulf War.

The late publication of this revue is regretted, but the book is now available in paperback – and, therefore, a cheaper read.

AAW

particularly glamorous but, as one obituary said "...if success in life be gauged by personal happiness it must be owned that he had been abundantly successful."

In June, 1907, the fiftieth anniversary of the Mutiny, there was a commemorative dinner at Buckingham Palace and an opportunity for Lang's friends to raise a matter that had been overlooked for fifty years – that alone among the Mutiny heroes Lang had had no public acknowledgement of his heroism. The following year he laconically noted in his diary that "Birthday Honours contain CB for Colonel Arthur Moffatt Lang, Royal (Bengal) Engineers (Retired)."

Do read this book. It is quite short and is in the Corps Library. It should inspire every subaltern and make officers of all ranks proud to be a Sapper.

GLC

NEVER A SHOT IN ANGER

GERALD MORTIMER

Published by Square One Publications, Saga House, Sansome Place, Worcester, WR1 1VA – Price £15.50
ISBN 1 87201 771 1

THIS book is unusual, and interesting for several reasons, one of these being the relative paucity of books written by junior staff officers – a thought mentioned by the author himself. Another concerns the subject itself, as most of the Army, and even some Royal Engineers, are either ignorant of, or condescending towards, the Resources function of the Corps. A third reason derives from the fact that Mortimer's age coincided exactly with the opportunities open to him; school and university in peacetime, call-up and training just before and during the "phoney war" of 1939-40, regimental service as a junior officer in wartime UK, then his selection and entry into the specialized staff work of increasing intensity leading to the 1944 invasion of Normandy and the (mostly bridging) support for the British main thrust across Northern Europe.

The author assures us that, in accordance with the orders of that time, he did not keep a diary, but he certainly had a sharp eye and a most retentive memory, not only for the big events, which are, of course, chronicled in many well-known official (and private) histories of those times, but also for the inclusion of the smaller details of life, as he saw it. Younger readers might otherwise have had difficulty in imagining the more personal details revealed by Mortimer about his early days, especially with his first experience of military life as a "militiaman" in the prewar call-up. For such readers, as well as for those who spent the war years overseas, this book gives an insight into the many domestic circumstances, including courting, rarely featured in the plethora of World War Two historical accounts.

As mentioned above, the planning for the actual provision of all types of Engineer Resources has always been something of a Cinderella – vital as it admittedly is. In this book it inevitably provides the main thread of the author's story, almost from the days of his first posting. Clearly, Mortimer had a special flair for this task, and it is greatly to the credit of his superiors that this was noted early enough for his skill to be developed in good time for the Normandy landings.

In his description of the arrangements for the sequence of river crossings all the way from the beachhead to the Baltic, the author's experiences – good *and* bad – at the hands of several well-known senior officers, seems to have left him with considerable admiration for them, and for the Corps as a whole; in my own view, this is amply borne out by his choice of illustrations for the book.

Inevitably, a book of this sort is something of an "ego trip", so the story evolves around Mortimer's self-confidence being steadily augmented from his prewar attitude as a fairly diffident Boy Scout, towards the culmination of his wartime career, when he was pushy enough to be one of the very first British officers into Berlin. One can speculate that those experiences were, indeed, material in enhancing his ability, 30 years later, to become a captain of industry as chief executive of the powerful Consolidated Gold Fields Corporation, with financial and technical interests worldwide.

This very readable book ends with mention of his devotion to military service leading him to utilize some of his home leave, from his postwar civilian job in the South African mines, to brush up his military skills by spending a fortnight as a "Z" Reservist at Long Marston, during the period of the Korean War. A very worthy Sapper!

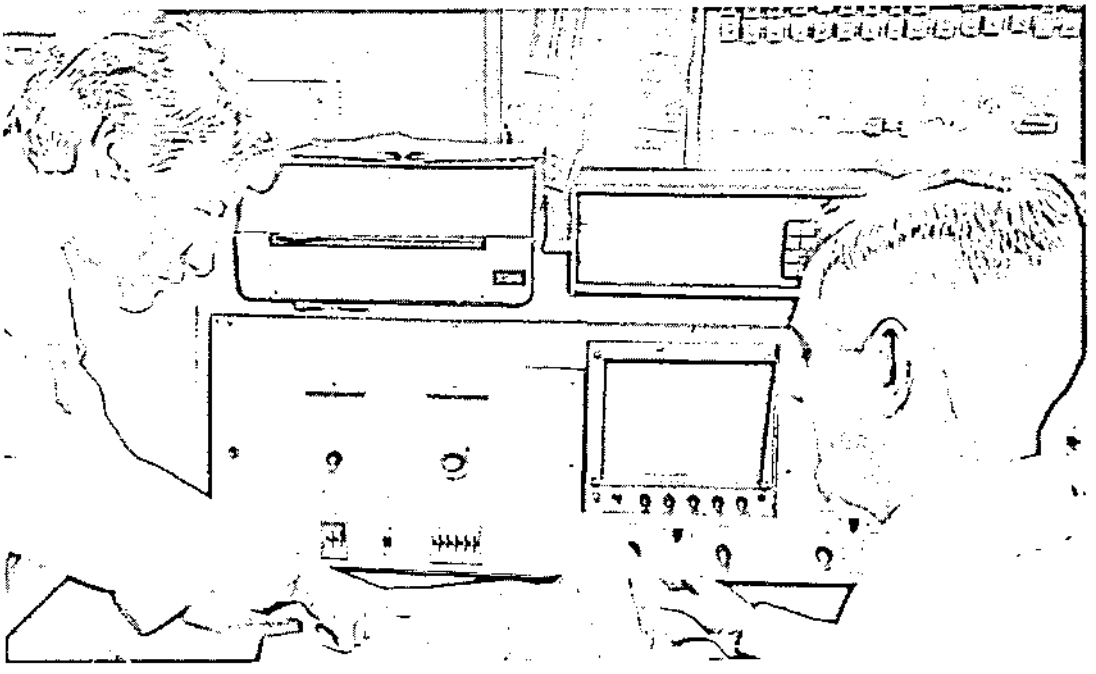
JC

IT DOESN'T TAKE A HERO

H NORMAN SCHWARZKOPF
WITH PETER PETRE

Published by Bantam Press, 61-63 Uxbridge Road, London, W5 5SA
– Price (Hardback) £17.99, (Paperback) £5.99
ISBN 0 553 40551 9

"STORMIN" Norman's autobiography would almost certainly never have been written if it had not been for the Gulf War, where he became an overnight hero for his handling of the coalition forces during *Desert Shield* and *Desert Storm*, and for his masterful television interviews. This would have been a pity. It was expected that his book would concentrate on the Gulf War, with, perhaps, a short summary of his previous



A doctor and scientist discuss the results of tests from a mass spectrometer.

Bridging the Gap Between Scientist and Doctor

EVERYONE can tell you about the failures of cancer treatment – the loss of a relative or close friend – few readily talk of its successes. Yet year by year the number of cancer sufferers leaving hospital after treatment to return to their normal lives, grows.

The Institute of Cancer Research – one of the leading cancer research organizations of its kind in the world – has made significant discoveries that have contributed to advances in the treatment, early diagnosis and prevention of the disease.

Many of its scientists work with specialists at the Royal Marsden Hospital as part of multi-disciplinary teams to spearhead attacks on specific types of tumour. According to the needs of individual patients, combinations of treatments – surgery, radiotherapy or chemotherapy – are used.

Cancer should be regarded as an array of malignant diseases, not a single illness, and it is more realistic to think in terms of a corresponding array of treatments. Most promise lies in improving existing methods of treatment by creating closer links between scientist and clinician, and at the same time continuing to search for radically new methods of treatment.

Nowhere is that link closer than between the Institute of Cancer Research and the Royal Marsden Hospital which, when it was founded some 150 years ago, was the first specialist cancer hospital of its kind in the world.

Next time you are asked to advise a client on where a legacy or donation can best contribute to cancer research, remind them that gifts to Charities do not attract Inheritance Tax. The Institute is a Charity recognized by the Inland Revenue as being exempt for taxation purposes (Ref X90004).

For more information about the work of The Institute of Cancer Research, please write to the Legacy Officer, 17A Onslow Gardens, London SW7 3AL. Tel: (071) 352 8133.

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