THE ROYAL ENGINEERS JOURNAL JUNE 1976

THE ROYAL ENGINEERS JOURNAL

Volume 90 JUNE 1976 No. 2

VOL 90 No 2

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THE ROYAL ENGINEERS JOURNAL

Published Quarterly by The Institution of Royal Engineers, Chatham, Kent ME4 4UG. Telephone Medway (0634) 42669

Printed by W & J Mackay Ltd, Lordswood, Chatham, Kent ME5 8TD

Volume 90 JUNE 1976 No. 2

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

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Editorial

"LOGICALLY YOURS"

Two children, a boy aged eight and his sister aged six, were taken to see ballet for the first time. They were very impressed, terribly well behaved and thoroughly enjoyed the performance. Afterwards the little girl said to her elder brother, "Why did all the ladies dance on their tip-toes?" The boy, with all the confidence he could muster, replied, "Because they couldn't find ladies tall enough". There is an attractive logic in this reply.

In the written discussion following the Centenary Meeting, which is the lead article in this issue of the *Journal*, the views expressed are logically deduced from some of the facts presented. Only further articles and correspondence will show if the deductions are really valid. The March *Journal* was late, for which I apologize, and this may have given insufficient time for ideas to germinate and for putting pen to paper, at least I hope this was the reason for a relatively poor reaction to a very stimulating Meeting.

In this issue we have concentrated on a number of well-illustrated shorter articles covering a fairly wide range of interests. One of the reasons for this is that "photographs" are now marginally cheaper than text! This has given the Editor an opportunity to achieve the "70/70" ratio which is the dream of all editors, that 70% of his readers will enjoy reading 70% of each issue. At first sight this may seem to be a low ratio but a little thought should show that 70/70 is really a high enjoyment rate.

The change in type and style of submissions for publication is quite fascinating. For example we have recently had a number of very good articles on India and life in India. This increased the number of articles submitted on India, it was as though Members suddenly remembered interesting things they had forgotten and decided to write about them. But it also set up a reaction which might indicate that non-India Members wanted a change and some Members were even prepared to provide the wherewithal to make such a change possible. Logical? As regular readers of these Editorials will have guessed by now I am slowly (but logically!) returning to the theme that *more* more and MORE articles are always required.

In our Charter it states that the Journal publishes ". . . papers on subjects connected with the Science and Art of Engineering in its application to military purposes . . .", ". . . for the purpose of an early dissemination of important information of a professional character with a view to assisting its Members in the solution of current problems relating to the defence of our Realm. . . ." The Rules of the Institution state, "*The Royal Engineer Journal* will contain military and other articles of interest to the Army at large, technical articles of interest to Members of the Institution, Memoirs, Professional Notes. . . ." This is a wide field and every Member is capable of producing something towards the achievement of the aim. It is of interest, (at least we think so!) that there have been no complaints on the general content of the Journal in recent years although we have had our legs pulled (I hope in a friendly fashion!) on misprints and minor peccadilloes. Logically the Editor should be happy—I am not! No Journal can stand still for any length of time, it must get better or worse. We must therefore work at improving it. This can only be done with better and more varied articles; without a "bank" of articles to fall back on there can be no alternative to publishing all that is available at any "dead line".

This logic may not be attractive but it is irrefutable.

Stop Press:

A tribute to Field Marshal Lord Montgomery of Alamein is published giving a fascinating account of his meetings with one of our distinguished Members.

Centenary Meeting of the Institution of Royal Engineers

ARTICLES AND CORRESPONDENCE INSPIRED BY THE MEETING

Training for Internal Security

LIEUT-COLONEL P L DELL,
MBE, CEng, MICE, MIE(Aust), MBIM

THE necessary brevity of the debate after the Centenary Meeting of the Institution resulted in a limited opportunity to discuss some of the ideas that were put forward, though there were some spirited arguments during the less formal part of the meeting later that evening. This article explores two ideas that were mentioned, in the hope that the vitality which has long been a hallmark of the Corps will provoke an argument to develop them into a form which can contribute to its future strength.

The first idea was concerned with the nature of the likely threat to the security of the United Kingdom. The second was related to certain aspects of the training which might need to be developed to meet this threat. A number of speakers either referred to these points directly, or alluded to them while covering subjects closer to their direct interest. Clearly there must be a link between these two ideas. That supposition is much in keeping with the fairly assertive style which the inevitably confined period of the Centenary Meeting stimulated. Therefore without curtailing a provocative yet constructive argument, these ideas should be redefined, the link confirmed and an outline solution offered.

The suggestion was made that the predominant threat to the security of this country over the next twenty years is internal. The contentious style in which this idea is often presented seems to anticipate an emotive response, which since the Second World War has attracted a number of titles that derive from the surnames of certain champions, McCarthy being the most familiar. The mention of an internal threat to security has become synonymous with communist inspired activities. Yet the threat to internal security can and does come from any group who feel that they can more quickly achieve their political, economic, social or anarchical aims by selected acts of violence. It is not particular to a political or ethnic group; it can be used by an individual or group driven by a fundamental physical or mental desire. The techniques have been well chronicled by active participants of all sectors of the political spectrum and closely analysed by others of less partisan views.

A common technique, regardless of motive, is a well coordinated attack on selected elements of the service industries. These attacks can have one of two main aims, either physically to disrupt the industry in question to the extent that it fails, or to demoralize society by the denigration of a service upon which it has become too dependent. Successful examples from outside the United Kingdom are readily quoted, yet the realization that we have in the last decade experienced some serious, though as yet not wholly successful, attempts within the United Kingdom is being acknowledged and discussed. It is important that the debate of the ultimate threat to our society by disruptive action is both specific and full. The origin could be from industrial action pressed to the extreme by either a Union containing some members with professed communist affiliations, or a profession including members with unimpeachable ethical standards. These situations are man-made, but there are also natural disasters which through storm and flood can produce equally severe threats to our society, though the variable nature of our climate ensures that the severely affected areas are small in extent.

The threat to our society outlined above is consistent in result, yet indiscriminate in its origin and motive. At the stage where it reaches a level of physical violence this

will most probably be directed against service industries. Our society has had direct experience in varying degrees during the last decade of some of the man-made disasters, which coupled with a more selective experience of some of the natural disasters, has sharpened society's acknowledgement that contingency plans should be made to prevent the ultimate breakdown of our society by such a disaster. The acceptance of a need for these plans implies the training of people to execute them. That is an appropriate stage to leave the definition of the internal security threat, accepting that the threat is consistent in the next twenty years, but not necessarily the predominant threat to our national security.

The training required to lend credibility to any plans developed to meet this threat will include developing the technical skills of people who are able to operate public service industries. The engineering knowledge required is obvious, but in addition they must be people trained to withstand extreme mental and political pressure and retain their loyalty to a democratic system of government. There is no particular faction of society which can be confident of its steadfastness in this respect, but there are certain organizations which are specifically trained for this situation, whilst there are others who, given suitable training, could make a significant contribution. The first category obviously includes the civil and armed services, the police forces and parts of the emergency services. The second category is more diverse and could include professional bodies, charitable institutions and Unions. The record for impartiality of the first group is certainly not faultless, conversely the reputation of the second group for taking partisan views is not without exception. The requirement is for a more liberal view from both sides to recognize their ability to contribute towards the training needed to meet an internal security threat. History of times of stress is witness to the sense of purpose our nation can develop, traditionally in response to an external threat; there is some slight evidence to suggest that the current gathering awareness of an internal threat can generate a similar identity.

The training facilities in the technical and managerial skills which the first group of organizations, loosely gathered under the title of government bodies, can provide is extensive. It includes technical and staff colleges, the multi-industry training boards and centres, together with elements of the normal educational system at tertiary level. The facilities of the second group, whose equivalent loose definition would be voluntary bodies, can provide matching elements less formally organized, but providing an originality and zeal to temper the logic and convention of the first. The joint development of successful training by these two groups would require a much greater interchange of techniques and personnel than exists at present. It would not involve the replacement of one person by another, more the duplication of appointments. Such a scheme would anticipate the criticism that the replacement of civilians by government officials, in particular servicemen, is both undemocratic and a threat to employment. Logically the scheme would be in accord with Government plans to create employment through training. The Corps has considerable experience in joint training with its civilian counterparts, both through exchange officer training and MACC schemes. The challenge of extending this to organizations which might be thought to oppose such ideas, a supposition which is often without foundation, is one which would certainly be stimulating and possibly rewarding.

The argument presented suggests that an internal threat is consistent; that its motivation can be from the widest possible range of political or personal origins; that when the situation reaches the stage of physical violence the most likely target is public service industries. Thus there is a need to plan on a contingency basis to sustain the sectors under attack, which gives rise to the training required to make these plans credible. This may be a familiar theme, but perhaps the suggested diversity of the origin of the threat and the means of developing the necessary cooperative training to support the contingency plans is more radical. It is essential that we develop a solution that is acceptable to society; conventional approaches have as yet failed to resolve the situation, so an alternative is to probe less conventional suggestions by critical and constructive debate.

The seed of these ideas originated at the Centenary Meeting. This article is offered as evidence of some germination to be nurtured or destroyed by future debate.

Are you a Royal Engineer?

THE subject of Combat Engineer versus Professionally Qualified Engineer (PQE) versus Pioneer was raised at the Centenary Meeting but was not argued through. This article merely exhorts us all to be engineers and to remember that, when the crunch comes, combat engineering is not likely to be confined to the use of purpose made equipment in the way suggested in the handbooks.

Without exception, I believe, the RE Officer rejects the suggestion that he be designated a Pioneer. However, would the average RE Officer be eligible for the qualification "Professionally Qualified Combat Engineer" (PQCE)? Sadly I suggest not—he knows where to find the most appropriate handbook and an interpreter, usually a SNCO. But this interpretation is at technician level or lower. Does he understand what improvisation would overcome a missing part of a MGB or a field lighting set? No—because he is not trained to do so, nor could he be. Regardless of training does the officer make sufficient effort to understand the fundamentals?

You may say it's all too difficult. "The PQE's may dabble in clever stuff like that, but not I." Well, it would be a foolhardy man who so dabbled on a peacetime exercise if lives were put at risk—but in war?

The PQCE will take a lively interest in the conduct of battle; particularly in all ways that engineering might enable him the better to advise his commander to defeat the enemy, or, at parochial level, to enable him to complete allotted tasks in the face of inadequate resources—a common enough situation!

Could you make an improvised culvert to cross the Weser with a few lorry loads of large diameter gas main? Of course—but would you think of it?

Could you form a barrier by remotely felling a row of high voltage electricity pylons as a booby trap? Of course—but would it be worthwhile?

How does one acquire a feel for the value or effort/effectiveness of an improvisation? Only by project training—lots of it—to become familiar with those engineering materials which may be available and their potential uses. Such training is not possible without artisan tradesmen, nor will the junior ranks understand this enlightened approach to military engineering unless there be a sprinkling of competent artisans amongst them. Better still, such men may give good advice as to ways and means of accomplishing the aim.

We now have an argument for both Engineers and tradesmen in the battle area and for project training. Haven't we always had such an argument?—Yes—but it's going out of fashion because "we don't need sticks and string, or ingenuity, when we have meccano".

We have meccano, but to use it to its best advantage, and not to use it when it is unnecessary requires an *Engineer*—a Royal Engineer.

Anon (PQCE?) PQE RE

PS. This article may be an oversimplification but it is a heartfelt reaction to the RE Officer who is a soldier first and last, and an engineer by-the-by. There are many such officers.

The Corps of Royal Engineers will not retain its traditional position of high regard if our officers are only exercised in combat engineer drills without greater emphasis being put upon the probable requirement for improvisation. However, any improvised solution must meet the requirement. We do not need "long courses" in combat engineering but we do need more than the mere passing acquaintance with engineering generally absorbed on YO courses. It is an attitude of mind which is difficult to foster when combat engineer competence is necessarily measured during peacetime all-arm exercises in terms of drills and "meccano", notional or otherwise.

Pasley on Retaining Walls

BRIGADIER J R E HAMILTON-BAILLIE, MC, MA, CEng, MICE

As most sappers will know, Charles Pasley was the first Commandant of the Royal School of Military Engineering (or Director of the Royal Engineer Establishment as it was then called). He held the post from 1812 to 1841, rising in rank from Major to Major-General during this time. He was a notable engineer, a friend of men such as Rennie and Brunel, and became a Fellow of the Royal Society.

Among many books, he published in 1817 the second volume of *A Course of Elementary Fortification*, which was subtitled as "Including Rules, Deduced from Experiment, for Determining the Strength of Revetments, treated on a Principle of Peculiar Perspicuity". He was evidently pleased with his own work, but as will be shown, with some justification.

The book contains much sound engineering advice, of which the following note on site investigation is an example:—

> "Before the foundation of any great work is commenced, the nature of the soil beneath must always be examined with great care, which is done by probing with an earth borer, or large augre, made for the purpose, having its shank composed of a great number of joints of moderate length, screwing into each other, by means of which the operation may be continued to any depth judged necessary. This instrument, being occasionally pulled out of the ground, by a gin and tackle, or other convenient machine, always brings up, in the hollow part of the augre, a specimen of the lowest stratum of soil pierced by it. The persons employed, in thus sounding for a foundation, ought not to stop, on finding a hard stratum, such as gravel, &c. but should ascertain by boring deeper, whether the thickness of it is sufficient to insure the safety of the proposed work."

There is nothing one can fault in this. The last sentence in particular needs to be emphasized now as then.

Pasley was led to study Retaining Walls, or Revetments as he called them, because of their importance in the fortifications of that date. A typical section is shown in Figure 1, from which it can be seen that the main obstacle consisted of a ditch, often about 10 metres deep, with steep front and rear faces, called the Counterscarp and Scarp respectively. These were revetted in brick or masonry, usually strengthened by counterforts. The ground at the top of the Counterscarp was level, as there was an infantry position called the Covered Way here, but the Scarp supported the main rampart topped by an earthern parapet, constituting a surcharge.

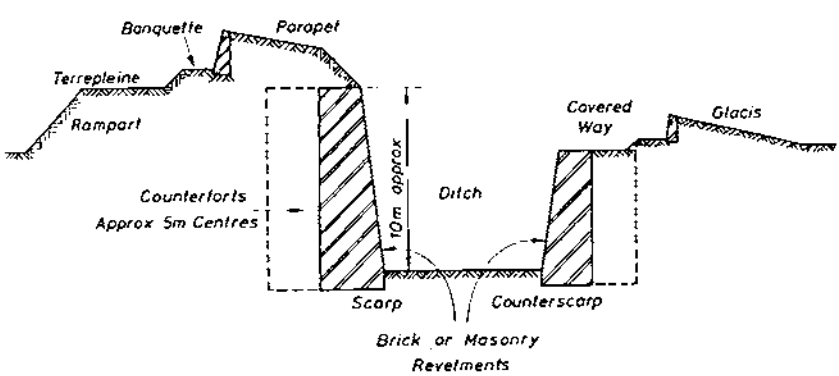


Fig 1. XVIII and Early XIX Century Fortification.

In Chapter XXIV of his book, Pasley sets out the rules then generally accepted for the design of revetments. Briefly these were as follows. A line was drawn on a section of the work at the natural angle of repose of the earth (Figure 2a). It was argued that without the wall all the earth above this line would eventually fall, so that the weight of soil represented by the triangle *abe* (per unit length of wall) represented the load on the wall. This was restrained by the weight of masonry or brickwork represented by the cross sectional area of the wall, *adcb*. Any surcharge (eg parapet) above the line *aec* was included in the earth, and additional construction such as counterforts were included (averaged per unit run of wall) in the area of wall. The work of the masters, especially Vauban, was then examined and the ratio of these two areas determined for various heights of construction. No work of Vauban was known to have failed, so if the ratio of area of earth supported to area of supporting masonry was kept as he made it, the design should be satisfactory. The dimensions of Vauban's revetments are tabulated by Pasley.

Having set out this theory, Pasley realized how very unsatisfactory it was. In particular he saw that it was the moment of the weight of the wall about the toe that gave the wall stability, and that this could vary very much in different designs with the same total cross sectional area. Furthermore the cross sections of the earth supported in different circumstances were not geometrically similar, for instance a parapet would remain the same size on top of scarps of differing height. He therefore attempted to work out a more satisfactory theory. In doing so, he evidently had not

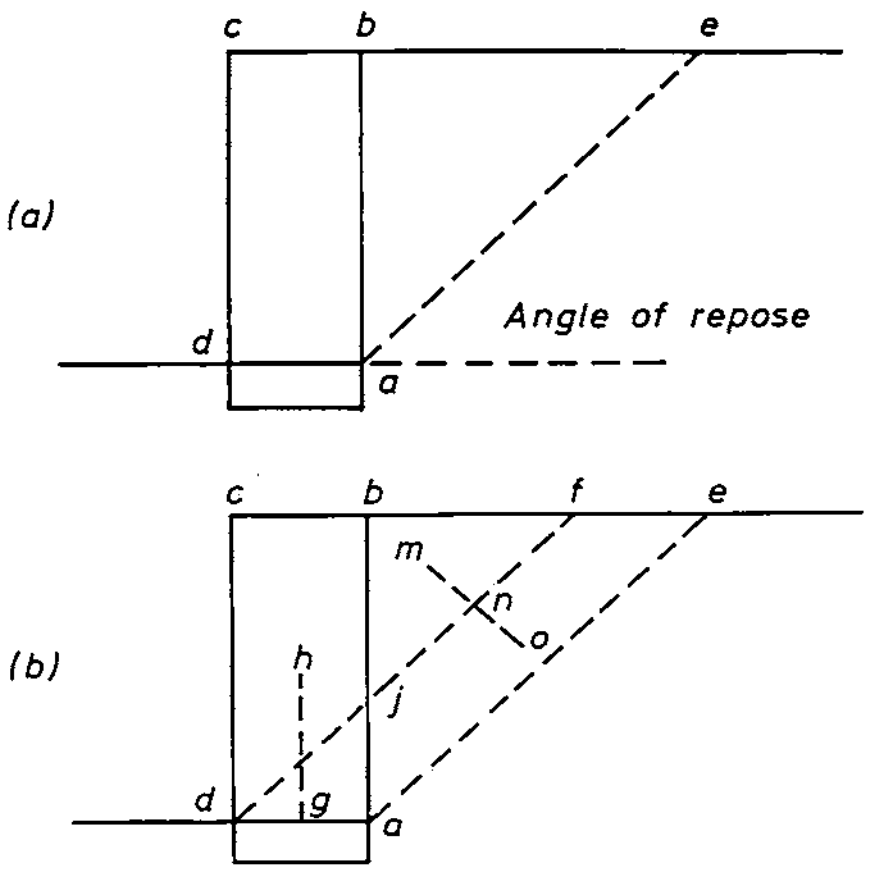


Fig 2. Theories on Revetments.

heard of the work of Coulomb, unless he was one of the "speculative writers" whom he dismisses as basing their values on mathematical calculations, without establishing their principles by experiment. However, Rankine also did not quote Coulomb when he published his theory many years later, so Pasley is not to be blamed.

Pasley considered, as we would do, the three modes of failure, of overturning about the toe, sliding, and foundation failure. He discounted the last two; no foundation failure should occur if these were properly designed (ie as he lays down elsewhere in his book!) and sliding is unlikely to occur as it can in any case be prevented by sloping the foundation to the rear. He therefore concentrated on overturning about the toe at point *d* (Figure 2b). This excludes the foundation, which was no doubt justified when one remembers he is thinking of brickwork in lime mortar, with little tensile strength. He uses areas on the figure to represent weights, on the basis that the density of brickwork is approximately the same as that of earth, admitting this to be an artificial simplication. He then calculates the strength of the revetment as its area times the lever arm *dg*. Turning to the earth pressure he considers that the soil in the area *ajfea* is not contributing to overturning the wall, but is in fact adding to its stability due to the pressure on *ja*. Only the area *jbf* is acting to overturn it, so that if *m* and *o* are the respective centres of gravity then the net moment is *jbf* x *mn*—*ajfe* x *no*. In limiting conditions this will equal *adch* x *dg*. There is of course a fallacy here, but perhaps it is not immediately obvious.

Pasley himself was not altogether happy with it and set up a series of experiments to test it and derive empirical results. His apparatus is shown in Figure 3. The model revetments were wooden boxes filled with earth, all 3 feet long and 26 inches high, and of each of the four cross sections shown in Figure 4. They were loaded by filling the open fronted box behind them to the various profiles shown in Figure 4. The original intention was to repeat the experiments with shingle and with rammed earth "as the two extremes, the former being the loosest, and the latter the most tenacious kind of soil . . ." ie a cohesionless and a cohesive soil, as we would say now. In

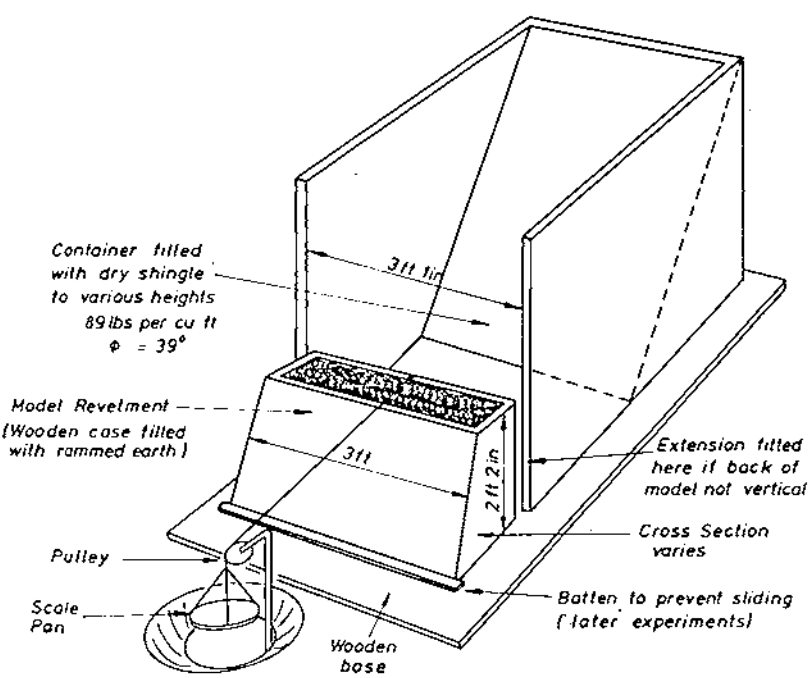
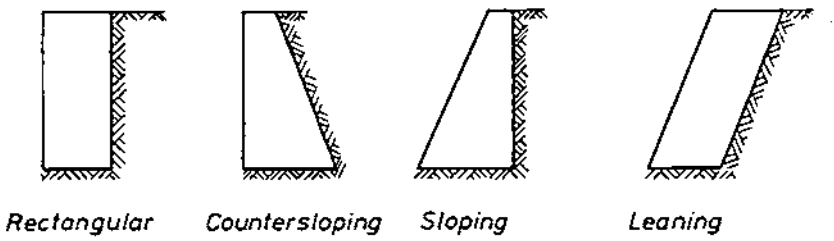


Fig 3. Pasley's Apparatus for Experiments on Revetments.

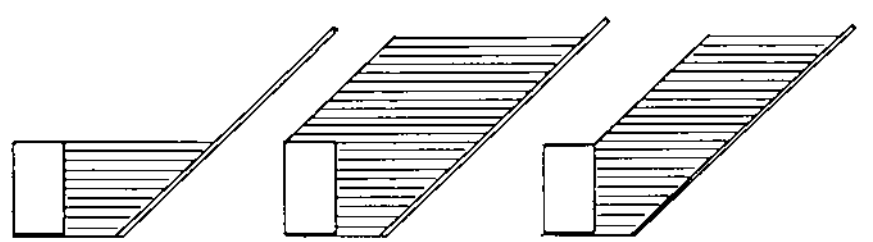
practice the "tenacious" soil stood unsupported to the height of his model revetment, so only the experiments with cohesionless shingle were successful. The combination of different shapes and mean thicknesses, and different types of loading, gave a total of 415 experiments, each repeated several times.



Slopes 1 in 5 and 1 in 8

Various mean thicknesses (4 in. to 12 in)

TYPES OF LOADING



Height of surcharge varies (usually 30 or 60 inches)

Each loading with each cross section

Total 415 Experiments

Fig 4. Cross-sections of Model Revetments.

In each test the model revetment was first pulled over by weights in the scale pan to give its "stability" with no load. The shingle was then added and if the required height was reached without the revetment overturning, it was again pulled over with weights in the pan. The reduction in stability, to zero, if it overturned, or to the second figure if pulled over, gives the overturning moment of the shingle. Pasley tabulated his results and an example of them is shown in Table 1. Having studied the results, Pasley discarded his own theory as incorrect, and published his empirical "Rules on Revetment" based entirely on his experiments. A summary of them is as follows:

Use "Countersloping" profile, with vertical front face, back sloping at 1 in 5 and rough or stepped (for maximum "friction or cohesion").

TABLE I.

Models standing loose.	Without Shingle. The Revetment's Height.	Mean Thickness.	Weight.	Stability.	With Shingle. Height of Shingle.	Berm = Mean Thickness.	Stability.	No. of the Experiment.
Rectangular.	20	4	182	13	—4	....	0	1
Sloping at $\frac{1}{6}$.	20	4	182	23	$\frac{1}{2}$	....	0	2
Leaning at $\frac{1}{6}$.	20	4	182	24	—1	No	0	3
Countersloping at $\frac{1}{6}$.	20	4	182	12½	—1	....	0	4
					....	....	5½	5
Sloping at $\frac{1}{3}$.	20	4	182	27	3	No	0	6
					10	Yes	0	7
					....	....	6½	8
Leaning at $\frac{1}{3}$.	20	4	182	25	3	No	0	9
					7	Yes	0	10
Countersloping at $\frac{1}{3}$.	20	4	182	12½	....	....	0	11
					....	....	4½	12
Rectangular.	20	6	273	27	5	No	0	13
					5	Yes	0	14
					....	....	23	15
					30	No	5	16
Sloping at $\frac{1}{6}$.	20	6	273	43	30	Yes	14	17
					60	No	15	18
					60	Yes	15	19
					....	....	20	20
					30	No	5	21
Leaning at $\frac{1}{6}$.	20	6	273	40	30	Yes	12	22
					60	No	16	23
					60	Yes	14	24
					....	....	10	25
Countersloping at $\frac{1}{6}$.	20	6	273	27½	6½	No	0	26
					12	Yes	0	27
					....	....	35	28
					30	No	20	29
Sloping at $\frac{1}{3}$.	20	6	273	51	30	Yes	29½	30
					60	No	18	31
					60	Yes	25	32

Use counterforts (dimensions and spacing are specified), but wall should be stable without them.

Ratio of mean thickness to height to be:—

For level surface	1 : 4
For sloping surface without berm	3 : 10
For sloping surface with berm	17 : 60

Thickness should be increased:—

For bad foundations
For varying moisture content
For low walls (for durability)
To round up to the nearest half brick

Foundations to slope down towards the back but otherwise joints to be horizontal (against penetration of rain water).

This choice of the countersloping profile was not only because it came out well in his tests, but also because he favoured a vertical front face to discourage the establishment of vegetation in the joints, with damage to the brickwork. It is noteworthy that in the context of recommending a rough or stepped back, to achieve a maximum down-ward pressure from the soil, Pasley uses the modern expression cohesion, instead of tenacity which he uses elsewhere.

That his rules were in general sound is proved by their successful use until ditches as obstacles were replaced by barbed wire at the end of the century. Major Lewis RE, writing a textbook on fortification in 1890, said that though the use of Rankine's method might give a more economical revetment, he still recommended Pasley's rules, as the stronger wall resulting from them would stand up better to bombardment. Lewis was designing in mass concrete in which material these rules must have given a high factor of safety.

To see how Pasley's experimental results compared with those of modern conventional retaining wall theory, the writer calculated the overturning moment in a selection of the experiments. Pasley gives an angle of repose of his dry cohesionless shingle as 39°. This equals ϕ, the angle of shearing resistance. He also gives its density as 89 lb per cubic foot. What is missing is δ, the angle of friction of the shingle on the wood of his model revetments. This was first assumed to be 2/3 of ϕ, ie 26°, but trial showed that 31° gave more consistent results, so this was adopted.

A selection of tests with level surface, and vertical or leaning back, when worked out by Coulombs theory with the aid of a calculator gave the results tabulated below. The percent difference column shows the amount by which Pasley's experimental results differ from those calculated.

PASLEY'S TEST				OVERTURNING MOMENTS (lb—ins)		
No	Type (1)	Mean Thickness	Load (2)	Pasley	Calc	% difference
1	R	4	L 22	312	398	−20
2	S 1/8	4	L 26·5	598	619	− 3
3	L 1/8	4	L 25	624	527	+18
5	S 1/5	4	L 26	559	530	+ 5
8	L 1/5	4	L 26	481	540	−11
12	R	6	L 26	585	570	+ 3
15	S 1/8	6	L 26	520	460	+13
20	L 1/8	6	L 26	520	517	+·06
28	S 1/5	6	L 26	416	394	+ 6
33	L 1/5	6	L 26	416	482	−13

By the standards of soil mechanics experiments the agreement here is good, showing both that Pasley's experimental apparatus worked satisfactorily, and that Coulomb's assumptions apply to his conditions in these particular tests.

Next here are four results for revetments with a countersloping back:—

PASLEY'S TEST				OVERTURNING MOMENTS (lb—ins)				
							Virtual Back	
No	Type (1)	Mean Thick-ness	Load (2)	Pasley	Calc	% error	Calc	% difference
4	C 1/8	4	L 25	325	574	−43	369	−12
11	C 1/5	4	L 26	325	589	−45	351	− 7
25	C 1/8	6	L 26	455	463	− 2	263	+70
38	C 1/5	6	L 26	156	341	−54	180	−13

Three of the four show a much larger error. By recalculating on the "virtual back" assumption, ie taking the earth pressure on a vertical line through the heel of the wall and $\delta = \phi$, these three come out about correct. Experiment 25, which was right the first time goes wrong and must have differed in some way. Pasley himself gives a clue as to what may have happened. He noticed some models slipped forward slightly before overturning and in later experiments added a batten (see Figure 3) to prevent this. He also pointed out that from the geometry of the arrangement, the heel of countersloping models (if they did not slip) dug into the shingle as they overturned. It is probably this action that makes the virtual back assumption more appropriate.

Lastly here are two further groups of experiments all with surcharges, four without berm and six with:—

PASLEY'S TEST				OVERTURNING MOMENTS (lb—ins)		
No	Type (1)	Mean Thickness	Load (2)	Pasley	Calc	% difference
21	L 1/8	6	S 56	1066	1920	−44
23	L 1/8	6	S 86	780	2276	−65
29	S 1/5	6	S 56	806	1223	−34
31	S 1/5	6	S 86	858	1434	−40
17	S 1/8	6	B 56	728	920	−21
19	S 1/8	6	B 86	754	920	−18
22	L 1/8	6	B 56	884	1143	−22
24	L 1/8	6	B 86	832	1188	−30
30	S 1/5	6	B 56	559	755	−25
32	S 1/5	6	B 86	676	820	−18

(1) R : Rectangular
S : Sloping
L : Leaning
C : Countersloping

(2) L : Level
S : Surcharge, no berm
B : Surcharge, with berm
Figure is height of shingle in ins

Both sets show consistent differences, surcharge without berm averaging −46% and surcharge with berm averaging −22%. The regularity suggests that it is the calcula-

tions (done in these examples graphically by Culmann's construction) that are on the wrong assumptions, rather than that it is Pasley's experimental error. Probably Coulomb's assumptions cease to apply with so steeply sloping a surcharge.

Rankine's solution for a sloping surface does not strictly apply, as the surcharge is not infinite nor does the slope in these examples start exactly at the top of the wall back. (The berm is equal to the mean width, which is more than the thickness at the top for a sloping revetment). However, it might be expected to give a reasonable approximation to tests 30 and 32 and rather underestimate 29 and 31. The value for the overturning moment obtained was 584 lb-in, within 5% of the average of 30 and 32, and as expected, rather less than 29 and 31. In these conditions Rankine's method thus seems to give the best answer.

To sum up, Pasley's experimental results are good and consistent, and prove the well known lesson that in applying conventional retaining wall theories one must be careful about the assumptions.

After his main series of experiments Pasley considered, and experimented with, other methods of improving the performance of retaining walls. The following is an extract from Chapter XXVI of his book:—

> "But it is not absolutely necessary, in order to produce the effect of greatly diminishing the pressure on the back of a revetment, that the intermediate substance, which breaks the continuity of the loose particles of the supported mass, should be an inflexible body, like strong woodwork—for the same object may be attained, to any required degree, by using flexible substances, such as canvass, thin layers of brushwood, etc as we ascertained by the two following experiments, both of which were tried with the counter-sloping model, 52 inches high, having a mean thickness of 8 inches, and a counterslope of one fifth.
>
> On applying shingle to the back of the above model, in horizontal layers of four inches in height, divided from each other by courses of canvass,* the stability of this profile, as a counterscarp revetment, proved to be 54 lbs, its original stability before the shingle and canvass were applied being 62 lbs, so that the loss of stability, occasioned by the pressure of shingle thus applied, may be estimated at 8 lbs which is in the proportion of about 1/8th only of the original stability.
>
> In three several trials with shingle and canvass, the stability was successively, 44, 57, and 61 lbs, the average being 54 lbs."

He does not use the expression "Reinforced Earth" but it seems quite clear that he understood the principle. He recommends layers of hurdles as the best reinforcement for temporary work. He suggests flat brick arches spanning between the counterforts as a method in permanent work. Metal reinforcement would not, of course, have been an economic proposition in his day.

All in all it can be said that while Pasley failed to solve correctly the fundamental theories of soil mechanics, he understood much of their practical effects, and established sound working rules based on systematic experiment.

* We used empty sand-bags for this purpose.

* * *

Sappers in Sudan—1972–1975

MAJOR R M STANCOMBE, RE, BSc, MICE

Introduction

Two of the most successful Royal Engineer Exercises in recent years have been undertaken in Southern Sudan; the rebuilding of the Tonj bridges by 32 Field Squadron in 1974 and Mundri Bridge by 11 Field Squadron in 1975. This has meant that Sappers have had a presence in Sudan since 1972, when the initial reconnaissance was undertaken by 62 CRE (Construction), until May 1975 when the rear party from 38 Engineer Regiment returned to Ripon. Thus the way was paved for the Parachute Brigade who deployed to Sudan for a combined Anglo-Sudanese exercise in Autumn 1975.

It is now prudent to look back on these two major Sapper exercises in order to assess their value in the field of Anglo-Sudanese relations as well as to the exercising units; the former being of great importance if future exercises are to be undertaken in the Sudan and the latter being the concern of the Royal Engineers both collectively and individually.

I am writing this article as the exercise commander during the rebuilding of Mundri Bridge—called Exercise Mirza 2. Details of the reconnaissances and of Exercise Mirza 1 have been obtained mainly from reports although I was fortunate enough to visit Tonj briefly for discussions with Major Tony Merrifield, Officer Commanding 32 Field Squadron, during the latter stages of his exercise. The emphasis will therefore be on my Squadron's exercise, although the story is incomplete without reference to the valuable entrée provided by 62 CRE and our sister squadron from Ripon.

Relevant History

The attention of soldiers participating in the exercises was drawn to the deeds of General Gordon in Southern Sudan as Governor of Equatoria province before the Mahdist Revolution began in 1881, culminating in his death at the hands of the dervishes on the steps of the palace in Khartoum four years later. Also emphasized were the activities of General Kitchener in defeating the Khalifa north of Omdurman in 1898 and retaking Khartoum.

The subsequent Anglo-Egyptian condominium ended in 1953 after a period when communications in Sudan had been steadily improved; there is a concrete bridge built by Royal Engineers in about 1946/1947 on the Juba to Mundri road, for instance. Within two years of British influence being withdrawn from the Sudan, the Equatoria Corps mutinied and set off seventeen years of civil strife between northern (mainly Moslem) and southern (pagan and Christian) peoples in Sudan. During this period Christian missionaries were forced to leave and havoc was created by both government soldiers and Anyanya guerillas. Communications in the south were severely disrupted with bridges being damaged and roads cratered.

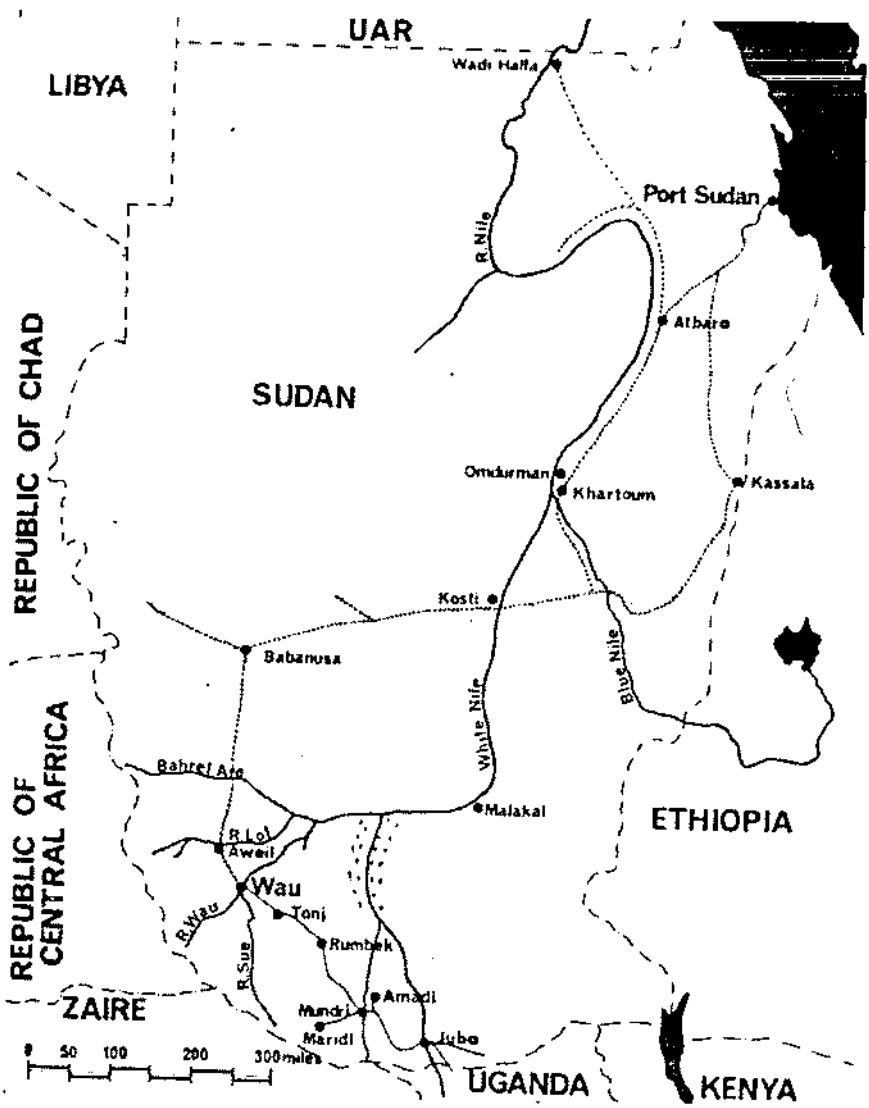
Russian aid was accepted by President Nimeri in 1969. A communist inspired coup in 1971 resulted in the Russians being expelled, leaving behind them military equipment, aircraft and missiles with only very limited spare parts. A few technicans remained but most of them were soon to return to Russia. Thus the Sudanese Armed Forces were left with a large quantity of equipment, much of it unsuitable for use in Sudan and most of it soon to be unusable without the necessary replacement parts.

In 1972 the President made a major breakthrough at Addis Ababa by coming to an agreement with the secessionist Anyanya leaders and bringing to a halt the devastation being carried out in the south. A British Army Training Team (BATT) was invited to return to Khartoum with the task of remodelling the Staff College at Omdurman on Camberley lines. The team was subsequently expanded to include instructors at the Sudanese Military College, the Armour School and the Signals School.

Following the return of comparative peace in Southern Sudan, foreign aid began to manifest itself in the shape of an Italian concrete bridge at Wau and a Dutch Bailey Bridge over the River White Nile at Juba. A multiplicity of relief organizations also arrived and began a major redevelopment programme.

During 1972 the Royal Engineers were ordered to examine the possibility of undertaking a project on the main supply route from Juba, which is near the Kenya and Uganda border, to Wau which is the southern extremity of the single track railway line from Port Sudan via Khartoum; some 340 miles to the west of Juba along a very poor earth track which received inadequate maintenance.

62 CRE undertook an initial reconnaissance during the autumn of 1972, producing a report recommending that three bridges be rebuilt during a three month "Category 2" exercise by a field squadron or a Royal Engineer Management Team in four months. The detailed reconnaissance party who visited Sudan for three weeks



during late 1972 found on closer examination that the reconstruction of the two bridges at Tonj would take longer than anticipated as the piers were unsound and required to be rebuilt or at least encased in reinforced concrete jackets to strengthen them. It was therefore decided to rebuild the Tonj bridges during the first exercise and tackle the remaining eight span bridge at Mundri the following year. Mundri was 270 miles further from the Wau railhead than Tonj which meant that the logistic problems during the latter exercise were going to be far greater; Tonj was only 60 miles from Wau. The Bailey Bridge used for the diversion at Tonj was re-erected at Ringasi on the southernmost lateral route across Sudan, thus increasing the benefit of the exercise to the local people.

The estimated cost to HM Government of the two year project was nearly £0·5 million. This figure excluded the additional cost of transporting approximately 200 men each year, together with all their equipment, to Sudan and back by RAF aircraft. Included in the amount was a large sum to cover the movement by sea of 500 tons of freight which contained nearly all the bridging materials. In the case of the first exercise, the sea freight included prefabricated pier formwork and a Bailey Bridge for the diversion.

The actual bridge construction work was relatively straightforward; although a thoroughly good test of stamina for the Sappers working against the clock in temperatures up to 130°F. It was the logistic aspect of the Sudan exercises which was the most interesting and, in many instances, the most frustrating for those involved. I shall examine this in some detail and also describe the elaborate system of command and control that was adopted throughout the exercise periods, including the activity before and after the main part of each exercise.

Description of the Exercises

Both exercises followed the same pattern: a planning cell was established at Ripon in May; a liaison officer went to Khartoum in mid-summer; the confirmatory reconnaissance took place in late September; the advance party deployed to site in mid-November; the main party followed in late December until late March and the rear party returned to UK in May to complete the annual cycle. I will deal briefly with each of these phases in turn, considering particularly Ex Mirza 2 with which I was intimately involved throughout.

The importance and usefulness of a Mirza Planning Cell at Ripon was proved by 32 Field Squadron and confirmed by 11 Field Squadron. The cell consisted of a squadron officer, a clerk, a Resources Warrant Officer on loan from 62 CRE, a storeman technical NCO, an RAOC storeman and a unit sergeant. They were responsible for implementing my exercise directives, indenting for all the freight, supervising the collection and repacking of freight and all documentation which included visas for every man going to Sudan. The clerk was also the contact with whom all outside units and headquarters dealt, thus providing continuity throughout the whole exercise period as he stayed in Ripon.

The liaison officer from the squadron was needed in Khartoum six weeks before the confirmatory reconnaissance in order to establish a link with the Sudanese Army and supervise the build up for the exercise; the Defence Attache's Staff being too small to cope with this extra work. Apart from coordinating the arrangements for the reconnaissance by the unit and members of the staff, he had to place initial contracts for vehicle and aircraft fuel, brief the movements and project teams deploying to Sudan and arrange the accommodation for the unit rear party and RAF personnel in Khartoum—the Sudanese were building a "villa" for the purpose. The job of liaison officer required patience and perseverence, coupled with tact and diplomacy. The Sudanese were very willing to help and eager to agree to the detailed plans but had great difficulty in implementing them for various reasons. Communication between north and south were often very limited which meant that decisions made at GHQ in Khartoum were slow to percolate to the garrisons in Equatoria and Bahr el Ghazel provinces nearly 1,000 miles to the south. In spite of these difficulties

the liaison officer achieved his aim together with his deputy who was a troop Staff-sergeant from the Squadron.

The sea freight was despatched from Hull in late August, some eighteen days after the planned sailing date. This delay by the shipping company enabled some outstanding FAMTO and loan items from other units to be included in the cargo. The ship duly arrived on time at Port Sudan in early October, some seven days after the recce party had deployed together with a movements team and a project team. The former team, led by a RCT movement control staff-sergeant were in position at the port to meet the ship and supervise the off-loading onto two special trains which had been arranged by the liaison officer. Before the three week unit reconnaissance was completed, the stores from Port Sudan were on their way by train to the rail head in the south at Wau, a journey which took three to four weeks. A third train was despatched from Khartoum with twenty-seven trucks for transporting the 500 tons of sea freight plus another 100 tons of cement and fuel purchased in Sudan. The Russian made trucks were to perform possibly the most important part of the exercise build-up; moving the stores and vehicles from Wau to Mundri which was 340 miles over an appalling earth road.

As well as the movements team, which, although elaborate proved itself on both exercises, I had decided to deploy a small project team in late September. Initially four in number, it consisted of the project officer; a Clerk of Works (Construction); a CLO and a driver/radio operator. They brought two unit landrovers from Ripon and were to live with the local Sudanese army unit at Mundri. In spite of an initial trauma with a landrover bogged down thirty miles from the road in search of an aggregate source, the team successfully completed their mission. They arranged for local Moru tribesmen to clear the long grass from the bridge approaches, camp site and light airstrip. They also paved the way for the Advance Party by making local contacts and familiarizing with local customs. In retrospect a Combat Engineer AI would have been a useful addition to the small team.

The Advance Party of eighty men flew to Juba in mid-November, having six weeks to build the camp for the main party and prepare the diversion bridge so that work could begin on demolishing the old bridge at Mundri in early January. By the time they arrived the Sudanese had already begun moving priority stores from Wau to the site; the journey by train from Port Sudan having taken only a month in spite of severe flooding on the line north of Wau. RCT drivers had been brought out with the Advance Party to drive the Sudanese vehicles and operate the important system of convoys between the site and the railhead. Unfortunately, permission for the RCT to drive Sudanese vehicles was withheld by the Garrison Commander at Wau, a decision which severely curtailed the effectiveness of the RCT drivers who had a particularly frustrating period of six weeks acting as vehicle escorts. The convoy system did improve after the arrival of the Advance Party but this was mainly due to the Sudanese drivers getting to know the route. By Christmas the camp at Mundri was nearly finished and the Advance Party was able to celebrate a job well done—the camp was excellent. Anyone who had been in Sudan since the beginning of the reconnaissance flew home for Christmas and then returned to Sudan with the Main Party on New Year's Eve.

One hundred and twenty men flew from RAF Leeming to Juba in a VC 10, to be welcomed by General Joseph Lagu, GOC Southern Sudan. After a night in a school in Juba the 180 mile journey to Mundri was undertaken in a conglomeration of ancient Russian vehicles—Gaz 53, Maz 500 and Zil. The Zils had no batteries and stalled on average every hour. The journey had taken me seven hours in a landrover but was to take the trucks well over twelve hours. It was at midnight that night that I was told at Mundri that an RAOC soldier had gone missing from one of the Zils which had stopped fifty miles from site. A search had been made at once but the man could not be found. I returned to the scene by first light next morning and continued the search with Sudanese soldiers, police and the AAC Beaver in the air which I directed from the ground with a SR A41, but with no success. While this

hopeless search was going on in the thick bush, the Main Party were settling into the camp at Mundri and the Project Officer was checking bridging stores and so preparing for demolishing the bridge. The diversion bridge, made from old Mercedes truck chassis found in a nearby dump, was standing up extremely well in spite of a rain storm and subsequent rise in river level.

The exercise was now well under way with the rear party back in Khartoum functioning and supplying the RAF Andover with rations, mail and spare parts for its flight to Maridi and back every three days. The RAF crew of fifteen lived at the base, called Mundri Villa, and provided a first class service missing only a few flights due to the haboob, a severe dust storm which reduced visibility to several hundred yards. A small base was also manned at Maridi which was seventy-four miles from the site. Three men from the squadron were trained in the use of an RAF crash tender which they manned at the Maridi airhead throughout the exercise. Unfortunately RAF Hercules were unable to use Maridi or any other earth strip in Southern Sudan as they had done so successfully during Ex Mirza I, using the strip built by the Squadron. Thus we had to rely solely on the regular Andover flights for re-supply and plan a recovery at the end of the exercise by air from Juba and rail from Wau to Khartoum—Wau airstrip also being an earth strip. The RAF air support proved vital on both exercises; as did the AAC Beaver which was used for liaison, reconnaissance, medevac and movements of VIPs.

The reconstruction of the 76 metre span Mundri Bridge went smoothly and was completed three weeks ahead of schedule. It had always been realized that the project would not occupy a whole squadron for three months, but the problem of getting the stores from Wau to the site in the right order was certain to be critical. Although this did prove to be the case, the system of colour code marking of all packages paid dividends and the bridge project was never delayed. On a number of occasions, however, it was a "damned close run thing"! Once the old concrete deck and beams had been removed, the piers were capped with 900 mm of reinforced concrete before five beams were replaced on each of the eight spans and a new reinforced concrete deck was cast. The abutment wing-walls were rebuilt in local stone by Sudanese Army stone masons who did an excellent job.

The advantages of getting well ahead of schedule were threefold: morale was always high, the recovery of equipment to Wau could be started and, most important of all, sections could be deployed on other tasks away from Mundri during the last month of the exercise. This enabled troop management to be fully exercised and the men saw more of Southern Sudan. The value of these additional tasks far outweighed the time and effort that went into them as British soldiers were seen to be helping the community at large and in the south. Even the effect of one sapper tradesman undertaking a small job brought rich benefits in terms of Anglo-Sudanese relations. The main subsidiary tasks undertaken were a 1,500 metre long airstrip for a relief organization (ACROSS) at Amadi together with the replacement of a 10 metre span steel and concrete bridge on the Amadi to Mundri road, two 10 metre span bridges on the Zaire border, a prefabricated building for the Lutheran World Federation at Malakal and numerous tasks in Wau. Wau is the capital of Bahr el Ghazal province and as it was the railhead as well as our fuel dump it was necessary to maintain a presence in the town throughout the exercise. It also happened that the anniversary of the Addis Ababa Agreement was to be celebrated during our stay. As the President was inviting guests from other African countries the town was to be given a face lift in preparation for the day. Upon being asked for help by the Commissioner, I was able to provide some tradesmen to help the local people with the Unity Day preparations and also to undertake some more long-term projects such as assisting in building Child Welfare Clinics and rewiring the town hospital. A RAMC sergeant from my hygiene team also gave some lectures to the hospital staff and advised them on hygiene matters generally. As with the small engineering tasks, the effect of these projects on the local community was enormous; the soldiers also gaining useful experience at carrying out their trades in most unfamiliar and often exceedingly

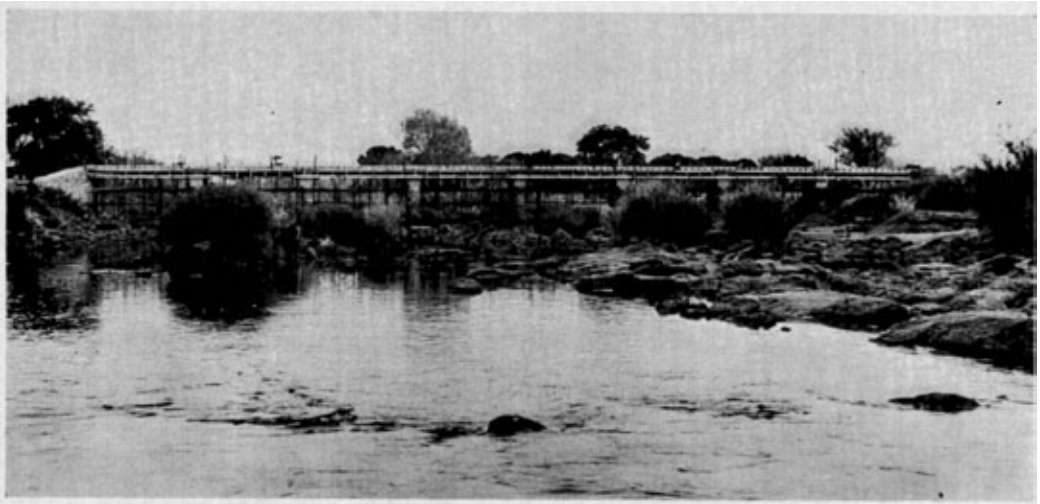


Photo 1. The Mundri Bridge over the River Yei, Southern Sudan.

Sappers in Sudan -1972 1975 (1)

difficult surroundings. I was particularly pleased with the work done by the young sapper electrician who completely rewired six wards of the hospital in a month—a patient having been electrocuted by a bare wire the previous month.

Every person at Mundri was able to take five days rest and recuperation in Khartoum during the exercise by courtesy of the RAF Andover. This made a welcome break from work on site where temperatures rose regularly in excess of 120°F. In spite of the heat the squadron soccer team became involved in a highly competitive series of matches with the Sudanese army and even arranged their R and R in Khartoum together so that they could play two matches. The second was against a premier Sudanese professional team in front of 10,000 spectators which, although we were decisively beaten, was an unforgettable experience for the players.

Although long hours were worked on site at Mundri, Saturday afternoons were always kept free for sport and Sundays for rest and recreation. A number of big game shooting expeditions were arranged and met with some success, being a useful source of meat as well as good sport. For the less adventurous there were countless brightly coloured birds to watch and the river was full of good-sized fish. Needless to say, the river is still full of good-sized fish such was the expertise of our fishermen who were not able to match their enthusiasm with the necessary skill. In the evenings at the campsite the monotony was broken by regular open air film shows and by Radio Mundri, our own pirate radio station operated by the Squadron signals staff with the help of the Royal Signals telecommunications technician. Taped recordings and requests from wives in Ripon were played and the usual cheerful "news" bulletins broadcast. The station could be heard by those on detachment at Wau and Maridi. We had a number of senior visitors at Mundri including the British Ambassador and C-in-C UKLF. As we were so remotely situated and the AAC Beaver was awaiting spare parts for the last four weeks of the exercise following an accident with a Sudanese M 18 helicopter, we did not receive the constant stream of visitors experienced during Ex Mirza 1. Their colocated Hercules airstrip was an immense help to them in some ways but made them rather vulnerable to day-trippers from Khartoum. Fortunately the weather conditions were favourable for bridge opening when the Vice-President of Sudan attended the ceremony with the usual flock of dignitaries. We were fortunate in having Chief Engineer UKLF with us for the occasion. He was immensely popular with the Sudanese and was entertained to an open-air jazz concert in his honour.

The culmination of Anglo/Sudanese cooperation at Mundri was the combined guard-of-honour for the Vice President—thirty Sudanese soldiers and thirty British soldiers in alternative files. The guard was commanded by a Sudanese lieutenant who gave all orders in Arabic and the British soldiers carried the Sudanese M 13 rifles. The Sudanese soldiers were amazed by the speed and enthusiasm shown by their British counterparts in learning the unfamiliar drill movements. During bridge construction, soldiers from both nations had worked side by side. The language barrier made progress slow—only two Sudanese other ranks could speak English—but a certain amount of trade expertise was picked up by the hosts who, after two such projects, should now be capable of building other such bridges on their own.

I worked very closely with my opposite number in the Sudanese Engineer Corps. He had been trained in India and had a good grasp of the project. He and all his officers spoke English fluently but because they had not taken part in the initial planning stages they found it difficult to involve themselves in the project. Progress was monitored throughout by a series of conferences in the Military Training Branch at GHQ Khartoum attended by all the interested parties. These meetings were started by the liaison officer and continued through the preparatory phase into the exercise proper. I attended several of the conferences myself and found them extremely useful in coordinating effort and planning ahead. Despite the occasional breakdown in Sudanese communications the system was sound and basically successful.

After the bridge reopening the exercise rapidly drew to a close. The main party repeated the mounting procedure in reverse, flying from Juba to Teesside in another

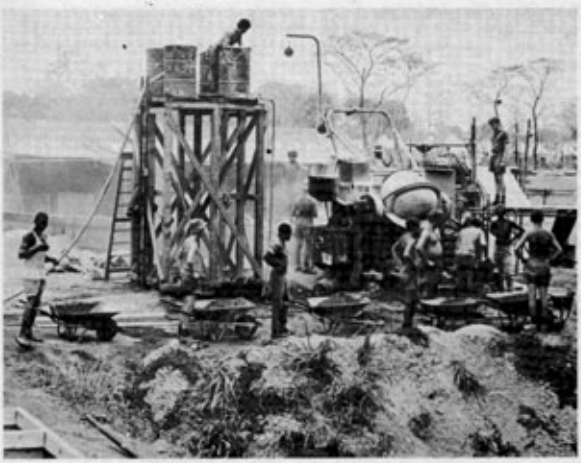


Photo 2. *Barrow Boys* at the "mixer" site at Mundri.

Photo 3. The British and Sudanese Commanders discuss a technical point during the construction of the Mundri Bridge.

Sappers in Sudan -1972 1975 (2 & 3)

RAF VC 10. We were fortunate in being able to fly to an airport so close to home. After such a tortuous drive along the earth tracks of Southern Sudan to get to Juba and several nights packed into the school buildings once again, the flight home ensured that morale remained high to the last.

The recovery of exercise stores and equipment, however, now became a major problem with the rains approaching and Sudanese interest naturally lessening a bit. The track between Mundri and Wau began to cut up badly as it had never been effectively repaired since the previous rainy season. Much of the heavier equipment had been returned to the railhead before the main party left, but this still left a large quantity of camping stores and equipment which could not be left behind. The rear party was strengthened by a vehicle preservation team fresh from Ripon, who were to prepare vehicles and equipment for the arduous return journey. The glamour having now gone from the exercise, the fifty strong rear party were faced with a journey by truck to Wau, by rail to Khartoum and then the "luxury" of an RAF Hercules to UK. Many stories have still to be told about this epic journey: stores vehicles being held up at gunpoint; the gale blowing the camp at Mundri to pieces; the problem of stores security at each stage, and finally the endless days and nights on the train escorting all the stores to Khartoum.

The rear party flew back to England in early May, leaving a small movement control team monitoring the return of equipment via Port Sudan and another team from the unit stockpiling stores from Mundri for the Parachute Brigade exercise. The Project Officer had volunteered to return to Khartoum to help the Squadron Quartermaster do this job; just a week after returning to Ripon with the main party.

Thus, Exercise Mirza 2 drew to a close; the Sappers having completed three large steel and concrete bridges during two years in Southern Sudan among a host of other jobs, some of which I have briefly described. The attachment of a senior Royal Engineer Warrant Officer during the exercise each year to the Sudanese Military Engineering School at Omdurman added a great deal to the success of each exercise —a QMSI Fieldworks in 1974 and a Military Plant Foreman in 1975. Lectures by the exercise commanders to military and civilian audiences in Khartoum and at the Wadi Seidna Military College also added to the general appreciation of the two year project. I shall now complete the story, although much regrettably is still left untold, by drawing a few conclusions from the two Mirza exercises.

Conclusions

The Mirza series did involve the staff and units in more planning time than is usually the case; stores and equipment needed to be committed for the second exercise before those from the first had been returned and some key personnel were required to spend up to six months away from the unit in preparation for the exercise. It must be remembered that a field squadron is normally fully committed nowadays with roulement tours, deployment exercises and training at home. It was therefore undoubtedly a considerable strain on resources both in UK and Sudan to have two such exercises so close together. However, this had to be weighed against the advantage during Ex Mirza 2, a much more difficult logistic exercise, of using the knowledge gained by Sudanese personnel who were operating a proven system. If there had been a delay of a year or more between the two exercises then this expertise would have been reduced considerably as personalities were posted. On balance the decision to mount Ex Mirza 2 in 1975 was correct although it is clear that the system cannot stand the strain regularly, either in UK or Sudan.

It was established after both exercises that at least six months warning should be given to the unit ideally so that stores and equipment can be properly prepared and depots given adequate time for special packaging and marking. This has been a recommendation after many similar exercises in recent years but for political, financial and military reasons it is rarely possible to give such warning. The unit needs to be warned six months before stores have to be despatched from UK, which is often nine months before the unit deploys to site.

During the preparatory phase the formation of a planning cell at Ripon proved very successful. This had to be supplemented by a constant round of liaison visits by myself and other unit officers to headquarters, units and stores depots involved in the build-up. The importance and value of such visits cannot be emphasized enough, especially when such a short time was allowed for procuring the necessary stores and equipment. It was also important to me that the correct items were obtained and that they were in good enough order to survive the arduous journey. Packaging was often inadequate and I had to employ a team from the squadron who built timber crates for nearly everything. The RAOC triwall container was not normally adequate except for certain items and only if it was packed very carefully and its pallet strengthened. We learnt from 32 Field Squadron that it was necessary to collect as many stores as possible together centrally, check them, repack many of them, mark them with our own colour code indicating priority to site and double check the vouchers. Only in this way could we maintain control throughout and be able to indentify and indent for replacements following damage or loss to packages. Clearly, containerisation was desirable wherever possible but the Sudanese railway trucks limited the size to the mini-containers provided by NAAFI for their stores. More of these would have reduced loss and damage en route.

I have already mentioned the value of the liaison officer and his assistant in Sudan for several months before the Advance Party arrived. This is unnecessary when British Army Liaison Staff are stationed in the country as in Kenya, for instance. But it was needed in Sudan and the exercises owed their ultimate success to groundwork carried out by the LO each year. The progress meetings held at GHQ every few weeks served as a framework for the detailed build-up which involved the movement of the freight, positioning of fuel, movement of the Sudanese transport vehicles to the south, the fitting out of Mundri Villa as a base acceptable to both the unit and the RAF crews, arrangement of reconnaissance time tables and the reception/briefing of everyone coming to Sudan.

The importance of briefing all exercise personnel, especially the fifty attached from other units, was emphasized by the sad loss of an RAOC soldier during the deployment phase. He had been briefed fully and no blame was attached to the unit, but nevertheless, the tragic incident did amplify the importance of pre-exercise briefings and training. Soldiers did undergo general fitness training and special technical training. Health lectures were given and films shown so that everyone was thoroughly prepared. A Sudanese General also addressed the men on the local climate and habits shortly after arrival at Juba airport.

The value of the short refresher training courses at RSME for artisans prior to the exercise was considerable. The courses were organized by the Clerk of Works (Construction) from 62 CRE, with the help of RSME staff, who was to come to Sudan for the project. The knowledge and personal understanding gained during this period ensured that the strong unit project team were confident and capable of overcoming all the problems at Mundri. The Project Officer was always in complete control of the task, aided by the familiarization period spent in Southern Sudan prior to the arrival of the Advance Party. It was therefore possible for me to carry out my function as exercise commander properly without getting too involved in the technical problems of the project—although as a qualified civil engineer I was often sorely tempted! But with such a long line of communications, additional tasks, liaison work and visitors to be hosted, I needed to rely on the Squadron management to operate efficiently.

I was pleasantly surprised by the good effect on Anglo-Sudanese relationships of the additional tasks that we undertook. Coupled with the training value to troop management and tradesmen, the tasks were an unprecedented success. We were fortunate to have the ability and resources at hand to undertake them—the value of some tasks not being proportional to the number of men involved. I have described the young electrician's impact in Wau.

Both exercises achieved the aim. They were hard but valuable training for the

soldiers involved. The Sudanese were able to see the procedures adopted by British units deploying to and away from an unfamiliar country. They also learnt from their British counterparts on the project site and Anglo-Sudanese relations were improved during the two years of reconnaissances and exercises. The Mirza projects at Tonj and Mundri have provided the Sudanese with three major bridges on an important supply route in Southern Sudan—the British soldiers and airmen being given the unforgettable experience of working in the largest country in Africa. Both Squadrons were awarded the Sudanese Order of Merit and 32 Field Squadron the Engineer-in-Chief's award as well.

Early Days

MLC

THE *Royal Engineer Journal* (readers will remember that it was many years before the title was changed to the *Royal Engineers Journal*) seems to have been then as now, in regular financial difficulties. Even in those seemingly lusher days 100 years ago, the Editor was complaining that the funds of the Journal were in debt. In 1876, at the request of the Editor, free copies were no longer to be issued to Commanding Royal Engineers, and the Editor was also at pains to explain his attempts to keep postal costs down—"the Journal does not come within the conditions of a registered Newspaper, and consequently is charged a higher rate of postage".

If printing and postal costs were troublesome, the present reader can only be amazed at the make up of the montly issue. Eight large foolscap sized papers of (often not very inspiring) articles of various sorts, were accompanied by no less than sixteen pages of "RE List" material (to use the modern equivalent) giving a complete roll of the Corps, both by name and then by station, together with some items of Corps news such as the results of matches. Most of this was, as can be imagined, the same from month to month. One wonders why this format was chosen.

To be fair the search for the right make up of the Journal was of much concern. "Some officers are of the opinion that the *RE Journal* should not concern itself with matters of a scientific character . . . but should be of a light character containing personal experiences . . . others would suppress its publication altogether." Officers were invited to write to the Secretary giving their opinion. Officers were also exhorted to join the Institution and "to oblige by doing so as soon as they conveniently can".

In the March 1876 issue, in a special "Editorial", readers were told that "the Journal is intended to deal only with subjects of a professional scientific and general interest. Discussion of official measures, matters of discipline and other similar subjects are not within its scope". Indeed "such things were to be excluded from its pages". One has the feeling that the Editor himself made this momentous decision, as there is no indication that anyone had written in as a result of his appeal a month or two before.

This continuing (again up to present times!) controversy as to exactly what purpose the Journal and Supplement should serve may have had "mad, married, methodist" undertones! The Royal Artillery, for instance, seemed to have been quite happy with their more sedately titled *Proceedings of the Royal Artillery Institution*. This was also a monthly publication. It contained perhaps four or five essentially "learned" articles together with a page or two of Station Notes. It could be that it was too much to attempt to keep the *RE Journal* going monthly (including this seemingly wasteful repetition of the "List"), and also to publish the *Professional Papers of the Royal Engineers* annually—this latter being made up of items similar to those in the RA Proceedings. Indeed judging by much of the material in the Journal, the Editor was struggling merely to "fill in", and the Corps might have been wiser to follow the example of the Artillery. But then the Gunners had founded their

Institution (not "Institute"!) in 1837, and perhaps their early days had also had their share of publication teething troubles.

Otherwise in 1876 the Institute followed its expected path. The subject of the prize essay was "The duties of the RE in time of war and the best organization for enabling them to carry out these duties". There is certainly a familiar ring about that! In July 1876 we are informed that the Museum "is now in process of formation". Officers were invited to contribute objects under one of three heads, Geology and Mineralogy, Chemistry and Electricity and Artillery—the latter denoting projectiles, fuses etc. All worthy enough no doubt, but curiously there was no mention of the more conventional historical items—perhaps these would have been too unscientific for a professionally minded organization! It is fortunate that our excellent Museum of today has branched further afield than "minerals used in the Arts and manufacturing processes" or "specimens illustrating the chemistry of materials used in military engineering"! In fact, and judging by acknowledgements printed in later Journals, almost at once donors appeared to have eschewed mineralogy and to have presented items of more general interest than "ores of different metals".

In August 1876 appeared a notice requesting nominations for the post of Secretary of the RE Institute. Serving Majors and Captains were eligible. Seven shillings per day was allowed over and above the pay and allowances for an officer on Home Service scales. As it was a post which would have brought the holder well to the fore in the conduct of Corps affairs, one suspects there was some competition to be nominated!

During 1876 there was considerable interest, both in Whitehall and within the Corps, about the employment of soldiers after discharge. This was particularly so because of the introduction of short service engagements into the Army, and a Parliamentary Committee was set up to investigate. There was, it seems, a need to "show the unskilled working classes that a soldier on his discharge is a man in whose welfare and prosperity the State is much concerned". The object of the Committee was to consider whether soldiers could, with advantage, be employed in the Civil Service. Much of the evidence must have been unwelcome, as the following extracts only too readily show; "Their long military service renders them machine like and unable to understand the new work imposed on them . . . there is a tendency to idleness on the part of military warders—we want more than obedience, we want them to think . . . soldiers have a tendency to drink—this unhappily is far too prevalent in our service . . . military service is not any special advantage for the peculiar work of the police; the soldier is not taught to depend on himself and a policeman has to use his judgement according to the circumstances of the moment . . . in Government factories the physical labour is great and the soldier, besides being unaccustomed to hard work while in the Services, is generally a man who has enlisted purposefully to avoid it." Admittedly, the burden of much of this evidence was intended to show that "long service, hitherto the rule, has the effect of transforming men into something like machines and of rendering them unreliant on themselves. Most, if not all, of these objections would be removed if the men came to their new found work after a short period in the Army". Hopefully this was the case, but the evidence, even from this distance, makes depressing reading.

For part of 1876 the Journal published a list of Sappers, who were desiring employment and who had recently been, or were about to be, discharged. Details of age, trade, length of service etc, were given. These lists were abruptly started, and, perhaps unhappily, abruptly ended. It was noticeable that during the six months or so that they were published, there was very little change in their make up. They apparently must have had little effect on likely employers. Perhaps they only raised false hopes.

On the more encouraging side, some publicity was given to the promotion (in the Civil Service) of four individuals in the Ceylon Surveyor General's Department. "All had been Sappers in the Corps of Royal Engineers . . . The remarkable rise of the four men seems worthy of record, as a stimulus to men still in the ranks and as an

encouragement to men to enlist in a Corps whence such great prizes are occasionally derived."

One suggestion, also given in evidence to the Select Committee mentioned above, was that telegraph boys should be enlisted into the Corps, trained as Sappers, employed on Post Office duties (as certain RE units at that time were) and thence to remain in the Post Office after discharge. However, nothing seems to have come of this suggestion, as such. The Committee decided to "postpone" further detailed consideration of this point.

In this connection, readers of that delightful chronicle of village life in Oxfordshire in the '80s, *Larkrise to Candleford* by Flora Thompson, may remember how "the family was a bit snobbish" about all those who had joined the Army on the fathers side having been in the Royal Engineers. Indeed "had they not got a trade in their hands". For them, it was always the *Royal* Engineers. The mother's family "favoured the Field Artillery which, to be sure was Royal too although this was not insisted upon". The inhabitants of Larkrise, whether they conceded that the Artillery were Royal or not, agreed that the "Royal Engineers and the Artillery looked down on the county regiments", which, it seemed, prepared men only for marriage and the plough!

In view of some of the foregoing remarks before the Select Committee, a lecture given by Captain Ardagh, RE, at the Royal United Services Institution on the "Comparative cost of Armies" and which was later to raise some correspondence in the Journal, is of interest. A part of the argument was that the cheapest system was the one that "pays the soldier least for being idle". Against this it was also argued that the real cost should take account of the difference between the wages the soldier actually receives and the wages he might have received had he been more gainfully employed; alternatively it should be the loss the country sustains of the productive labour of the individual soldier plus the wages the country pays him.

There was clearly fuel here for the correspondence and editorial columns of any Journal, and argument ensued. As one correspondent pointed out, according to the above, the real cost of a soldier could be least when he is paid as much as he might have got in industry—which, as the Editor remarked "is absurd". The Editor, it seems, wished to condemn those who dredged up reasons for having a larger army—"either by introducing conscription or by having larger estimates. The argument is that you must have conscription or larger estimates, the former is not really cheaper than the latter, and is objectionable for other reasons, therefore you must have the latter". The Editor held that in both cases "the wish is father to the thought—and this we deprecate". The controversy, such as it was, nicely illustrated the plight of a hapless Editor seizing on any material to help his publication along!

The chance doings of Kitchener were, no doubt, to become a feature of the Journal from now on. In the June 1876 issue Lieutenants Conder and Kitchener are reported as working on the publication of the one-inch Survey of Palestine from Beersheba to Accra. In the same issue, is an account of an affray near Safad, in which both Conder and Kitchener were nearly killed. From small beginnings, a quarrel between some Arab employees of the Survey Party and local inhabitants grew into an alarming incident and "were it not for the arrival of Turkish troops nothing could have prevented the murdering of the party".

In 1876 Captain Abney, RE, was elected a Fellow of the Royal Society—the latest recruit from the Corps to that select body. This period was towards the end of the Corps' hey-day as regards membership of the Royal Society. Perhaps a later writer of these notes will record when the last Sapper Officer was to be so elected. Sadly it was probably some time ago. Abney was not the only Officer to be honoured academically that year. The July 1876 Journal quotes the following from the *Oxford Chronicle*, "In a Convocation, holden on Thursday, in the Convocation House, the proposal to confer the degree of MA *honoris causa* upon Captain L J Ferrier, RE, was carried unanimously . . ." Ferrier was OC of 16 Company (Survey) based in Oxford. To be given such a degree by Oxford University as OC of a locally

based RE unit seems to be a very unusual distinction. Unfortunately the Editor does not state exactly why the award was made.

There is a sad postscript which can aptly be added to these notes. Readers may remember (*RE Journal* December 1974) that in July 1874 the HQ Mess was very badly damaged by fire. The Dining Room was gutted and the whole suffered extensively from water and smoke. Fortunately, that time, it seems that there was little damage to the contents, and from all accounts (or rather from lack of accounts, as there was no further mention of the fire in the following issues of the Journal) the damage was smoothly put to rights. Let us hope that if history must repeat itself, it will repeat itself on that score too.

In Support of PSA

MAJOR N H THOMPSON RE, BSc (Eng), C Eng, MICE

THERE have been many situations in recent years in which the Corps has undertaken work in support of the Department of the Environment, and more specifically the Property Services Agency (PSA). Tasking, outside operational areas, has depended upon the availability of sub-units or detachments in a period of heavy commitment and much separation, and upon the suitability of possible projects bearing in mind the training value, potential economic savings, mounting problems and the local reaction to military involvement.

The majority of three-month overseas Squadron projects have, however, been undertaken for the Foreign and Commonwealth Office. The appeal of these has been the combination of travel to exotic places, the challenge of overcoming the engineering problems in difficult conditions and the obvious credit earned in the battle for hearts and minds. The real benefit in economic terms and the number of people using the new facility have certainly not been the only considerations. Pruning of the Defence expenditure has already affected many PSA projects. The financial cutbacks have highlighted the potential advantage of using Sappers to save money and produce rapid results where essential work might otherwise have to slip or be left undone. A recent major opportunity of this type presented itself in the latter part of 1974.

The publication of the *Kendrick Report* on *Gibraltar Living Accommodation* drew attention to the very serious shortage of married quarters there, with more than 25% of the actual requirement unfulfilled resulting in waiting frequently up to, and occasionally over, one year. Improvements in this unsatisfactory situation could not be expected until the completion in December 1976 of over 100 new married quarters and the conversion of a number of other buildings. Meanwhile the problem, with all its effects on morale, would remain. A partial short term solution, put forward by Kendrick, was the installation of mobile homes. These, combined with some building conversions, represented a potential project which could be undertaken by the Royal Engineers in support of PSA Gilbraltar. Valuable time and public money could be saved and there was to be a Field Squadron (Airfields) available for project work in mid 1975.

An initial reconnaissance was mounted by 12 Engineer Brigade in December 1974. Several sites for mobile homes were identified and potential conversions were viewed. In addition it was most important to balance the accommodation tasks with some plant work to provide suitable and satisfying employment for a Field Squadron (Airfields) which is heavy in plant tradesmen and technicians. PSA suggested the renovation and re-surfacing of four sports pitches, and this appeared to offer scope for plant experience and for saving money.

The detailed reconnaissance and planning team left in early January 1975. It was composed mainly of members of the earmarked Squadron and led by the ACRE (Civil) of 39 Engineer Regiment (Airfields). Their report was produced in early April 1975. Its recommendations were accepted and the planning details were

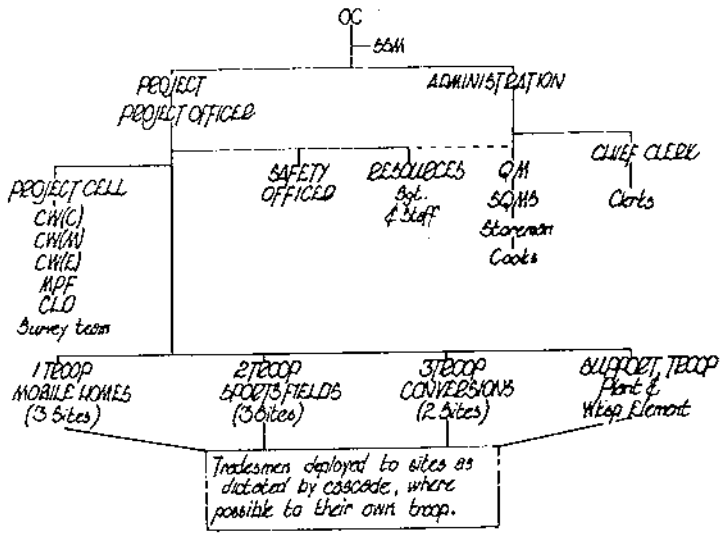


Fig 1. Project and Command Organization.

closely followed. The project dates were set for 1 July to 1 October 1975. The project was given the name of *Operation Safe Haven*. The confirmatory reconnaissance took place in mid April during which it became evident that the time scale for mounting the project was optimistic and checks of the stores available to PSA in Gibraltar revealed many critical deficiencies with neither the shipping time left nor the PSA resources staff geared to such an invasion. The only solution was to purchase deficient items in UK to be shipped out with Squadron plant and vehicles which had been allocated a Landing Ship Logistic at the end of May. Mounting and movement went smoothly with a steady build up of key individuals in Gibraltar during June while the remainder carried out pre-project training.

The finally agreed project tasks were: resurfacing four sports pitches (Total Civil Estimate (TCE) £350,000), installing twenty-one mobile homes (TCE £40,000), and two conversions (TCE £30,000). These tasks extended over eight sites. The project and command organization is shown at Fig. 1.

The sports pitches concerned were Navy 1 and Navy 2 on Queensway, just below the City Centre, and two at Europa Point. The design of all four was similar requiring a slightly sloping formation overlaid by a series of layers of free draining materials; a 150mm thick sub base of 75–100mm crushed limestone, a 75mm thick base course of 14–40mm limestone, a blinding layer of 6mm limestone chippings and a 50mm thick layer of Nortex. All these materials were delivered to stockpiles near

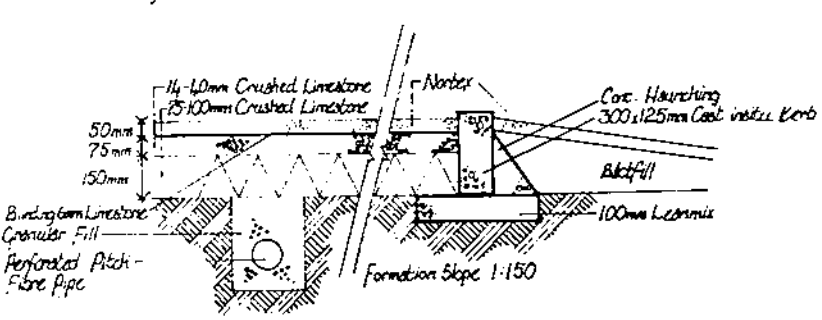


Fig 2. A sketch showing a typical cross section of the reconstructed sports pitches.

Photo 1. Sub-base material being laid on Navy No 1 pitch.

the sites under PSA arrangements. The new surface was retained laterally by cast-in-situ concrete kerbs on a lean mix-base. Rain water flowing down through the free draining structure was to flow away through stone filled trenches accommodating perforated pitch fibre pipes linked by catch pits.

Problems of compaction of the sub base caused PSA to reduce the specified thickness from 150mm to 110mm to enable the PF 90 paving machine to propel itself properly on the sub base when laying the base course. The method of compaction using smooth rollers and Bomags was barely satisfactory and very slow, and a 6 ton self-propelled vibrating roller was requested from UK. The degree of quality and survey control required while laying the Nortex reduced the output rate below

Photo 2. Navy No 2 pitch completed.

In support of PSA (1 & 2)

Photo 3. View of West End of Europa pitches at week two. Blasting and clearance of bedrock has started and a trial area has been surfaced.

planned figures, but speed and accuracy improved greatly with experience.

The Europa Pitches had a combined area of 15,500m² and were the most formidable of the plant tasks. The preparation of the formation was a major preliminary which started shortly after the arrival of the project cell in mid June continuing until the end of August. The specified gradient was 1:150 while the slope of the original pitch varied from level at one end to 1:60 in the North West Corner, and the exceedingly hard limestone underlying this surface had to be removed by drilling, blasting and ripping. A total volume of 500m³ was removed of which approximately 70% was rock. Concrete kerbs were similar to the Navy pitches but excavation for the North kerb and the open gully involved further blasting. Excavation of drainage

Photo 4. Taking levels on Europa prior to further blasting. Wooden pegs indicate holes already drilled.

In support of PSA (3 & 4)

trenches also involved blasting. Surfacing started slightly late because only one of the two PF 90 paving machines was serviceable, but the process went smoothly. The 6 ton vibrating roller had arrived by this time and proved ideal for compaction of sub base and base courses.

The twenty-one mobile homes were spread between three sites. Ten were at Edinburgh House site on an asphalted play-area between the harbour wall and an estate of Royal Navy married quarters flats. Ten were on an old hardstanding in the Royal Air Force officers married quarters area at Four Corners. The last one was an addition to the Europa mobile homes site. These tasks were straightforward once site clearance had been obtained and all stores collected. All stores for incorporation were drawn from PSA on arrival in Gibraltar and controlled by the Squadron. This ensured a twenty-four hour service and enabled early action to be taken on deficiencies. There were, even so, numerous minor but frustrating problems associated with resources which slowed progress. Examples were lack of hinges, plastic plumbing items, electricity meters, window fittings, wood preservative and bolts. There were also delays in delivery of doors and window frames produced by the term contractor. All the worst deficiencies were made up by local purchase and a few were left for PSA to fit when their longstanding orders were met from UK. It can be fairly said that all these problems were brought about by the strict time limit.

There were two totally different conversion tasks. One at Lathbury School House provided a spacious two bedroomed quarter. The work was mainly internal, although it involved all building construction trades. The other at Buena Vista Miniature Range provided two excellent three bedroomed quarters but involved extensive demolition of the original derelict shell before any new construction work was possible. Experience at Lathbury School House showed clearly that even Class 1 bricklayers with pre-project practice at RSME were not up to the task of plastering complete rooms and PSA were asked to provide professional plasterers. Fortunately the term contractor was able to step in and provide a gang to undertake the plastering —at a price. The Buena Vista Miniature Range conversion was the only part of the project where planning was seriously at fault. The original cascade plan was optimistic. The worst setback, revealed when the roof covering was stripped, was the need to replace all roof timbers. The removal of these and opening up of walls for the

Photo 5. The Launderette and store building under construction at Edinburgh House site.

Photo 6. Edinburgh House site with houses in position before construction of fencing. All services were provided and a sewage ejector pit constructed.

many doors and windows led to the demolition of about 50% of the existing side walls. Only the foundations and one end wall remained largely intact. Construction was put back by almost three weeks and the cost of new roof timbers was £3442·00, much of which was additional to the original estimate. Door and window frames were not delivered until the end of August. Brickwork (a total of 36,000 bricks) for the internal skin and partition walls progressed well, as did the whole of the remainder of the task which had to be re-programmed at the beginning of August leaving zero float once all the unknowns had been resolved. All services had to be brought to site and installed. The whole task probably involved as much work as would have been needed for two completely new quarters, but it did offer more

Photo 7. Showing the original miniature range structure.

Photo 8. The Buena Vista conversion nearing completion. All partition walls, door and window frames, roof and floors are new. All services had to be provided.

scope for ingenuity and resourcefulness by those concerned. The access to the site was exceptionally difficult and the time consumed in fetching and carrying was underestimated. The construction of external patios was a sizeable task as the rock sloped steeply on both sides of the building and concrete filled sandbag retaining walls were built instead of brick. Safety at this site needed constant attention.

From the outset of this project there was, for those on site, the feeling that support of this type for PSA was "on trial", that the Corps reputation was in some special way at stake, that the satisfactory completion of every minute detail of work was essential to underline success and any criticism of workmanship must be avoided at all costs. Even for a contractor these abstract pressures could only be defined in terms of prestige, but the Squadron was not a contractor because some of the functions normally undertaken by a contractor were being performed by PSA—in particular stores provision control of term contractors and PSA workshops output. This meant that the Squadron relied completely on PSA for these fundamentals and PSA staff themselves had a very strong incentive to prevent delays within their own areas of responsibility. The resulting co-operation was highly satisfactory. The last two sites were handed over complete and to the satisfaction of PSA on 30 September and the Squadron left Gibraltar on 1 October as planned.

The civil contract estimate for work undertaken was £420,000, of which £245,000 was saved by the mounting of this project. The lessons are many, and those which apply to future operations of this sort have already been heeded in the preparations for the 1976 tasks in support of PSA Gibraltar.

Training value at all levels was excellent and the project provided satisfying work and varied challenges in a pleasant area. The work done was clearly appreciated and support and co-operation of all those concerned was of a high order. The Regional Works Officer and his engineers were extremely helpful and flexible. They were prepared to delegate responsibility and accept decisions or amendments made to overcome the stores problems or avert delays. Mutual trust was maintained throughout and this was fundamental.

A tribute should be paid to the 2nd Bn The Royal Green Jackets whose relays of "volunteers" boosted the Squadron project strength from a peak of 145 to 163. With the Squadron, they helped lay 130,000 bricks, spread 11,000m^3 of surfacing,

excavate 3,500m³ of the hardest type of rock and mix and lay 750m³ of concrete. No statistics of potable liquids are available but the volume is thought to be considerable and like so many other commodities in Gibraltar its measurement was sometimes in metric but often in imperial units.

A calculated and bold decision was taken to accept a greatly reduced timescale in the setting up of the project. Together with an optimistic estimate of what could be achieved this meant that success was at risk and the challenge was proportionally greater. The experience gained by all involved, the saving of a quarter of a million pounds and the satisfactory and timely completion of the work for PSA Gibraltar proved the value of this type of project to the Corps and to PSA.

Nine Days In Colombia

BRIGADIER E C W MYERS, CBE, DSO, BA, MICE (Late RE, Retd)

IN 1967 I was Construction Manager in the Power Gas Corporation, a Company in the Davy-Ashmore Group of Companies, now renamed Davy Powergas and Davy International respectively. Power Gas, with its headquarters in Stockton-on-Tees, was primarily engaged in the design, world-wide construction and commissioning of a variety of major oil, petro-chemical, fertiliser and gas complexes.

Davy United, now called Davy Lowy, a heavy engineering Company in the same Group, with its headquarters in Sheffield, was at that time in the process of building a steel rolling mill for a South American client in Colombia. This was at a place called Belencito, on a 9000 feet high plateau in the Andes mountains, about 150 miles north east of Bogota, the capital of Colombia. Davy United had run into difficulties on the last stage of the transport of some exceptionally heavy pieces of the mill from the United Kingdom to site, as a result of the worst local rains for seventeen years having played havoc with a mountain approach road into the Andes; and my advice as an ex-sapper with field engineering, including road construction, experience had been sought.

I learnt that there were eight of these out-size loads, four of them mill housings weighing eighty seven tons apiece, the others including bulky crated armatures were almost as heavy. They had been shipped from the UK to the Colombian port of Barranquilla on the Caribbean sea, thence by barges three hundred miles up the Magdelena river to a point in virgin, tropical jungle, close to a "second class" gravel and dirt surfaced road, which for eighty miles wound its way up into the Andes, where it connected with a better one for a further fifty miles to site. More than a month earlier the mill housings and armatures had been successfully jacked up and winched off the barges onto timber cribwork on the river bank, where they awaited transport to site in relays, as soon as the road and its numerous small bridges were capable of taking such heavy loads. For this purpose there were already waiting at riverhead three low-loading trailers with prime movers. One of these trailers, a thirty-two wheeler with independent steering on rear as well as front bogies, had been specially designed and built in the UK and shipped out to Colombia for the transport in turn of each of the four mill housings.

The eighty miles length of road into the Andes had been built to take loads up to a maximum of twenty tons. Each of the mill housings, when loaded onto the specially built trailer, produced with its prime mover a train of 150 tons total weight, distributed over twenty-five yards. Although the pressures under each trailer wheel were unlikely to exceed five tons per square foot, the total shear load of 150 tons over a mere twenty-five yards was exceptional by any standards, leave alone on a country road with many embankments of doubtful stability.

Although Davy United would be responsible for the actual transport of all materials to site, the Colombian Government had agreed that the client would be

contractually responsible for ensuring the necessary strengthening of the bridges and improvements to the roadway to cater for the transport of these heavy loads by the beginning of the dry season in January 1967. It was already late in January. Not only was the work nowhere near complete, but reinforcement timberwork under several of the bridges already strengthened had been washed away and there had recently been numerous new, some of them lengthy and almost complete, wash-outs of sections of the road on unstable mountain-sides. Davy United were becoming seriously worried by the slow progress of the Colombian contractors carrying out the road improvements, and now repairs, and the costly delays should the next rainy season, due in eight weeks time, be another exceptionally wet one and break on them whilst their heavy loads were still sitting on the banks of the Magdalena.

Before leaving England I refreshed my memory of road construction and soil stabilization lessons learnt during the war in Korea and brushed up my knowledge of elementary timber and RSJ bending moments and shear strength formulae. Armed with a *1956 RE Pocketbook*, *Military Engineering Volume V Roads and Airfields (1957)* and a *Molesworth Pocketbook of Engineering Formulae*, I set off by air for South America.

I reached Bogota on 1 February. This city has some unusual characteristics. Firstly, its altitude of 9000 feet above sea level takes a few days to get used to, particularly if one plunges straight away into hard work. Secondly, in spite of the height of the plateau on which it and its airfield are situated, it is surrounded by Andes mountain peaks many thousands of feet higher. This makes one's departure in an aeroplane quite an exciting and, in bad weather, sometimes a dangerous experience. Thirdly, it is located in an earthquake zone, as a result of which its comparatively well laid out modern city centre and rich residential areas, built to withstand shocks from earthquakes, are in stark contrast with the older, poorer areas of narrow streets of dilapidated shops and shanty dwellings. Lastly, its population of some very rich Colombians, a high proportion of dark haired, sallow skinned people of Spanish creole origin, with a leavening of urbanized indigenous Indians, a few Negroes and, inevitably, some "poor whites", seems collectively to have produced an exceptionally high proportion of beggars, thieves and cut-throats. I was told that the all-inclusive hire rate then for a murderer was equivalent to as little as £1, including the almost respectable agency fee and any progressively less respectable sub-agency fees.

On the third day after my arrival in Bogota I set off with Davy United's resident "Heavy Lifts" Manager and their Sheffield based Project Manager in a landrover on a reconnaissance of the troublesome eighty miles of mountain road. To reach it we travelled north east for nearly 100 miles over a gently undulating plateau of good pasture or well cultivated land, initially on a well constructed three-lane carriage-way with a bitumen surface. But soon after turning off north westwards and beginning our descent off the plateau on the route which would have to be used for the heavy lifts, the road rapidly deteriorated to a fifteen to eighteen feet carriageway with a gravel and dirt surface. The only thing which improved was the scenery. As the steep and now often heavily wooded valleys deepened below the road and the rugged mountain peaks surrounding us grew relatively higher, the views became progressively more dramatic and beautiful.

We spent the first night in a comparatively luxurious but almost deserted holiday hotel, only a few miles off our route. It was out of season and we were the only guests. Setting off early the next morning I was soon horrified by what I found. Although the road for the most part clung to the main mountain-sides as it wound its intricate way down to the broad valley of the Magdalena river on a generally constant gradient, inevitably there were numerous subsidiary transverse valleys which had to be crossed. "Class" 20 ton bridges across them had been reinforced by literally a forest of unnecessarily small freshly cut timber columns, mostly not more than six inches in diameter. Subsequent flood water, aided by debris, had already washed some of them away. In some instances the additional obstacle created by the

temporary reinforcement had caused the flood to swirl around and weaken bridge bankseats and adjacent road embankments. The columns, where they were still in position, were often inadequately braced for their slender length when under load; and there were some dangerous gaps between their tops and the transoms or bearers above them. On a few of the bridges the decking was still too weak. A little more time and trouble taken in gleaning larger diameter timber from the adjoining forest would have made it possible for the bridges to have been soundly strengthened by far fewer stouter timber trestles, thereby reducing the obstacle to any subsequent flood.

So far as the road repairs were concerned, the situation was every bit as serious. I examined in detail over forty places where repair work was still necessary. At twelve of these places recent wash-outs had made the road impassible except by light traffic. At the three worst places over half the road had fallen away for thirty, forty and fifty yards respectively. There were also a few places where curves or gradients were too severe for Davy United's heavy trains.

The quality of the repair work was ghastly. Practically every mistake in the book had been and was still being made. No thought had been given to diverting surface water on hill-sides above potentially unstable lengths of roadway and channelling it at selected points in culverts under, or even by "Irish" bridges over, the roadway. Small scree and fine granular fill, often with a high content of soil, absorbent and potentially unstable, was being tipped onto what was an already unstable and often waterlogged base without any compaction of the top, leave alone lower, layers, or thought about ultimate bearing capacity or shear strength. Virtually no use was being made of numerous local sources of much more suitable and self consolidatable rock fill for the deeper wash-outs, presumably because it was more troublesome to obtain than the granular material. In numerous places freshly rebuilt embankments had been childishly weakly revetted, inadequate timber revetment being often tied back by wire under the road surface to anchorages which themselves were in suspect ground. In no case had any serious attempt been made to re-align sections of the road which had fallen away, by increasing the cut into the hill-side rather than re-

Photo 1. On the banks of the Magdalena river. Davy United's Project and resident Heavy Lifts Managers.

Nine Days In Colombia 1

placing the fill onto unsound foundations. To cap it all, the workforce, earth moving plant and tippers were totally inadequate.

Long before we had completed our descent to the main valley of the Magdalena river, the steadily increasing temperature and humidity and the gradual change of the countryside to tropical jungle awakened me to the fact that we were only some 500 miles north of the equator. In the late afternoon we were glad to quench our thirst with some tepid bottles of coca-cola at a road-side café in the village of Cimitarra, before travelling the last few miles through hot, swampy jungle to the banks of the Magdalena.

Debris brought down by previous floods was still piled high against several of the concrete piers of the bridge which carried the road across the two hundred yards wide but now placid river. (See Photo 1). The heavy lifts had been unloaded at a point on the east bank only a hundred yards away from the road, to which it was now linked by a well founded length of new hard roadway. Optimistically, one crated armature was already on its low loader, ready for its journey into the Andes. (See Photo 2) The remainder of the loads had been dragged well clear of the banks, now four feet above the level of the river, to the edge of the jungle alongside the spur road. (See Photo 3)

We spent that night in the camp and mosquito-proof hut of a delightful and hospitable American oil prospecting engineer, under the luxurious draught of an electric fan. Early next morning we began our return journey, stopping at every weak

Photo 2. Awaiting the "off" from riverhead. A loaded crated armature.

Photo 3. An 87 ton piece of Mill Housing with two other pieces of Mill awaiting transport into the Andes from riverhead.

spot on the road, checking my notes and measurements of work still required. By nightfall we had reached the hotel where we had spent our first night out from Bogota. After a couple of hours work the following morning, deciding on the best way to complete the inadequate reinforcement of two quite large bridges in the vicinity of the town of Barbosa, we set off for Bogota.

I spent most of that night of 6 February in my hotel bedroom, drafting a full report on what I had found, what had been or was still being done wrong, how it should be put right, and listing in detail my estimate of materials, labour and plant hours required at each of the forty four points along the mountain road, to make it safely passible by Davy United's heavy loads. I estimated that, without further setbacks and even with greatly increased labour and plant, it would take the Colombian road contractor at least three weeks to complete all the essential work. By the following afternoon typed copies of my report had been handed to the contractors and the Client. But they virtually ignored it, stubbornly refusing to accept that the contractor had done or was doing anything wrong and blandly insisting that the road would be safe for Davy United to use in a few days time. Possibly because of my strongly worded report and the cheap hire rate for an assassin, I was advised by Davy United's Heavy Lifts Manager not to press either the facts or my opinions any further at that level. Instead we sought a meeting with the Client's senior representative in charge of the whole contract, to whom a copy of my report had already been submitted. We found him equally unwilling to accept the situation as reported by me and he supported his subordinates' views.

The situation was rapidly becoming ridiculous. Davy United's Project Manager from Sheffield and his resident Heavy Lifts Manager entirely supported my report and findings. An approach was therefore made without further delay to the President of the Client's Company, to whom we explaind the impasse which had been reached. Fortunately he had not been personally involved hitherto in the growing dissatisfaction and concern of Davy United with the progress of work on the mountain road, nor with any day to day dealings with their road contractor. He was beyond reach of

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any backhander from the contractor and had no face to save. He listened attentively to all I had to say and then immediately arranged a full meeting for the following morning with senior representatives of all parties concerned. He took a copy of my report home with him to read that night.

At the meeting next morning, in addition to my original report I tabled a number of sketches. These showed typical faulty repair work on the road and how major landslides and wash-outs should be rebuilt when it was quite impracticable to widen the road more soundly by increasing the inside cut by dozer, blasting, or both. I depicted the well tried sapper method of building up a stone filled timber cribwork at a 4 in 1 outside batter, on foundations at a 1 in 4 slope inwards, cleared to well below the original mountain surface. I also listed what I considered to be the minimum safe specifications for freshly rebuilt road. These included the necessity for proper consolidation in 10 cms layers of the top two metres of all new sub-base not of large rock. I listed the minimum widths of what I considered to be unsafe outside verges for load carrying over the various sub-bases. I stipulated that the safe carriageway should be marked by white stones and that all rebuilt sections should be travelled on by heavily laden lorries with at least four and a half tons wheel loadings before being considered fit for Davy United's special loads.

The meeting had not been long under way when I realized that the President accepted my factual report. His cross-examination of his subordinates soon showed up the hollowness of their contrary assertions. It did not take much longer to obtain acceptance of all my main recommendations regarding future methods, specifications and essential increases in plant and labour.

The meeting had been taking place on practically the top floor of one of the tallest, fortunately modern, buildings in Bogota. As it drew towards its successful conclusion, the city was hit by a violent earthquake. The whole building shuddered and rocked ominously, over and over again it seemed to me, for the best part of a minute. Girl secretaries screamed. Several people tried to leave the room. But the doors were jammed by the temporary distortion of the building. As I gathered my papers together I vividly recall deciding that the best place for me would, if necessary, be underneath the robust conference table. Some lethal coping stones fell off our building onto the street below, but the building remained substantially intact. Some smaller tremors followed. These were followed by an eerie stillness, except for occasional shouting in the street and the falling of shattered glass. I learnt later that a number of older buildings in Bogota had collapsed, causing considerable loss of life. It turned out that the epicentre of the earthquake had been fifty miles to the south of the city. It was felt as far afield as Caracas in Venezuela, where the British Embassy staff were evacuated from their offices to the Embassy garden for a while.

When I got back to my hotel, my bedroom was a sorry sight, with gaping cracks in the plasterwork between ceiling and walls. But, with my mission accomplished I felt temporarily free of all cares, even more so when I found I could leave for home on a Spanish aeroplane the following day.

And so ended a hectic and memorable nine day visit to Colombia. I did not envy the task of the stout-hearted resident Heavy Lifts Manager of Davy United, particularly in his job of keeping the Colombians in charge of the road works up to their promises. But in spite of the many trials and tribulations which he had to endure, this story has a happy ending. A month after my departure he was able to begin the transport of the first of the heavy lifts. He delivered the last one to site without serious mishap in August, well into the next rainy season, but fortunately not an abnormal one.

* * *

World War I—
25 October–21 November 1914
(Cont)

Part IV took the reader up to 24 October 1914 and the first five days of the First Battle of Ypres. Part V, which follows, takes us to the end of the battle. This is the period covered in Corps History, Volume V, pp 202–206.

Readers are reminded that during this battle 5 Field Company gained seven DCM's for its exploits in the vicinity of Polygon Wood on 11 November 1914.

PERSONAL NOTES JOTTED DOWN BY THE WAYSIDE (PART 5)

K B GODSELL, 17 FIELD COMPANY

Sunday, October 25th, 1914.

Poor old Smythe had his arm amputated just above the elbow soon after arriving at GORRE. I got back to billets about 4.0 am. We had a day of rest. There was a lot of shelling all the morning. The noise last night did not lead to any attack. In the afternoon No 1 and 2 Sections cut pickets and collected wire and No 4 went out at night to put it up. We had to stand-to during the night as there was a scare about a night attack which however came to nought. A filthy night, poured with rain, and we were most thankful it was our night in.

Monday, October 26th, 1914.

A very quiet morning. We heard a good rumour about the Russians which we swallowed gladly to cheer us up. The 1st Corps have also been doing very well. The Gunners have a most harrowing tale of the total destruction by them of two German Infantry Brigades. They gave a most graphic description of it obtained from the FOO. Everyone seems very pleased with the work of the Company. In the afternoon I went out and supervised an Infantry working party, found by the Cheshires, digging trenches. The men were all fresh out from England in charge of Second-Lieutenants. Not a very bright lot. Had a great joke with the owners of the house about "Les obus".

Tuesday, October 27th, 1914.

I was sent into BETHUNE in the morning to inspect a new wiring device of the French. It was made of a large springy wire and when rolled up looked like a large coil of plain wire. It came out like a concertina and stood up without support. It was very inconspicuous and very easily put up, each roll covering about fifteen yards. It could be easily flattened but would be nasty if unexpectedly met in the dark. It really requires strengthening with a few pickets and four or five strands of barbed wire. My section was employed wiring a rear line that ran just in front of our billets. We put up a lot of wire, in one case utilizing some existing hop poles. We put up three rows of apron fence all along the front. We had quite a lot of the French patent wire issued to us but it is being kept for a reserve for emergencies. Fowle is going out on night work tonight. Pottingers little trap of four posts unwired and a biscuit box in a hole was reported to have been a great success. When the Bosch saw it they ran. We get continual stories of the Bosch approaching our line by crying out "We are English, do not shoot". Also treachery of hands up and then firing. Some approached a French trench singing "God save the King" but fortunately they were found out.

Wednesday, October 28th, 1914.

Reveille 5.30 am. Breakfast 6.00 am. Parade 7.00 am. Very much like the battle of the AISNE only the country is most unprepossessing and the Germans are much more aggressive. Continued work all the morning on wiring the back line and stood by for night work, not a big job but there may be some sniping. The Bosch broke through the British lines today on the 3 Division front, but they hope to scupper the

lot. The Munsters had a man hit with shrapnel today working behind the entanglement. Aeroplanes have been very active all day but the guns rather quiet. In GIVENCHY now there is not a house standing, it has disappeared and is a village no more. MISSY was fortunate compared to GIVENCHY. Wiring was not a great success, there was a very bright moon and the snipers kept on having pot shots at us. They also threw a sort of star shell towards us which burned very brightly, if they spotted us a machine gun was turned on. I gave it up at 11.45 pm after we had repaired the broken places. Just after tea an aeroplane came down near the billet and all the officers of the 17th Company proceeded to capture it and the occupants but it turned out to be an English machine.

Thursday, October 29th, 1914.

Turned out at 7.20 am owing to heavy firing and stood by. Germans captured advanced trench with heavy loss, 100 killed but the Bedfords charged and turned them out capturing forty prisoners. Worked in the afternoon on the reserve line clearing the foreground and digging with No 1 Section under a harmless shrapnel fire. We are going to be relieved tomorrow they say. Two Companies of Sappers and Miners were badly cut up at NEUVE CHAPPELLE. There was some heavy firing round FESTUBERT at 8.30 am.

Friday, October 30th, 1914.

A very disturbed day with much firing. There is an attack in progress all along our front. As far as can be gathered the enemy has been repulsed with heavy loss everywhere but there is great anxiety about the centre which is in front of FESTUBERT. The Indian troops are coming up and the Black Watch and the Gurkhas are already in the trenches. We did two hours work this morning on the rear line clearing the foreground. I saw several Officers of the West Riding Regiment, my MISSY friends. The tale of FESTUBERT Church, I am not sure it ought to be told. FESTUBERT lies in a flat and featureless country and the church with its spire formed a very prominent landmark. So prominent that there was no doubt that the Germans used it as a sitting mark as they used to shell it every morning but never hit it. The OC Company suggested to the GOC Brigade that it be demolished. The GOC would not give his consent, sacrilege and the like being brought forward as arguments. Into these realms of higher theology I will not trespass. Sufficient be it that this church tower was a blinking danger and had already caused the death or maiming of many a good man. Therefore in the twilight of early dawn, thither repaired a gang of men led by a subaltern bold and after the labour of the deed was done they stealthily waited. Thereupon a Black Maria upon Black Marias came and lo and behold the church tower vanished among a cloud of dust and blinding flame. The next day a gunner Captain came to our HQ and reported that just before he got into FESTUBERT he had seen a big explosion and found the Church demolished. He had reported to his Brigade HQ that the Germans must have invented a new shell that made no noise coming through the air but exploded with the greatest violence on coming in contact with the earth. We smiled. The Germans (!) have got a new gun. FESTUBERT church suddenly disappeared in a cloud of smoke and loud explosion—cute devils but perhaps not the only ones. We are moving tomorrow, a twenty mile march where we hope to get a little rest. The Manchesters and Black Watch gave the Germans socks today and their losses must have been very heavy. Everyone seems pleased at the prospect of a change of locality.

Saturday, October 31st, 1914.

We were all turned out at 11.45 pm to dig trenches on account of a scare and were out until 5.00 am. We worked on a line just in front of FESTUBERT. We had a rotten time digging as we were being sniped all the time. Some odd Germans must have got through, or else it was civilians. We could see flashes or else sparks of ricochets against a cottage just in front. Thinking it was a sniper I attacked the cottage with two sappers but we found it unoccupied. While we were working they started shelling FESTUBERT and nearly got our transport. They then shortened their range and dropped shells all around us. Lucky the ground was soft and most of them did not go off.

One shell actually pitched in the middle of my section in the parapet and knocked it all in. Had it gone off it must have meant goodbye to most of us. We could hear the wretched things coming for ages and I thought this one would never come down, it kept getting nearer and nearer and I thought it was going to knock my hat off. You could hear the sigh of relief when it landed and did not go off. Several others landed just over our heads and it was not until they started pitching into the village that they really went off. While we were working a Company of Sappers and Miners filed along to continue the work on our right. They were a most extraordinary sight. All Indians with turbans and native kit. They all appeared to be the same height and filed along in silence like ghosts sillouhetted against a sky all lit up with burning haystacks and farms and occasionally illuminated with a Very light. We got back safely and slept all the morning and paraded at 11.00 am and marched to PARADUSE arriving about 3.30 pm where we billetted and had a good nights rest.

Sunday, November 1st, 1914.

Started off at 7.30 am to march to PRADELLES where we arrived at 11.45 am and halted. Something bound to happen today as it is Sunday and it always does. We heard that the Cavalry were being hard pressed so we shall probably be hurried up to help them. We halted at PRADELLES for two hours and had lunch and then started a real old fashioned march to BAILLEUL getting into billets at 8.00 pm taking six hours to do five and a half miles. The total march for the day was about seventeen miles. We were very lucky to get a good billet and spent an excellent night. We hear KAISER BILL is Commanding opposite and that there are massed troops against us. Personally this seems the decisive battle. The French are hurrying troops up and we have a strong force (if very tired) with a Division (?) in Reserve. There was rather a scare yesterday. Apparently the Cavalry were driven off a ridge near a village called MESSINES which seems to be of some tactical importance. However a counter-attack drove the Bosch out and the tension was relieved. The aeroplanes are going to attack what is believed to be Kaiser Bill's HQ tonight. Hope he has had a bad night.

Monday, November 2nd, 1914.

Reveille at 7.30 am. Paraded at 9.00 am. Had a clean arms inspection and a good wash and shave. This excessive cleanliness was closely followed by a hot bath in Captain Lees' patent bath—I never enjoyed one better. I feel as if I had left off a suit of clothes. The day was spent in rest and refitting and collecting rumours. Our billet was a poor class farm house within a hundred yards of the Franco-Belgian frontier. It was like many hundred others with a rickety farm house where the family lived and into which the officers went, sleeping in all quaint corners. In front of the house at a convenient throwing distance where Madame threw all her refuse was the glorious smelly, soft and mucky midden, and round the sides of the midden stood the barns well filled with straw, hay, beans, etc where the men found soft and warm beds. The ventilation of the barns were excellent but there was always a menace of fire from guttering candles and cigarette ends, however much orders were repeated forbidding smoking.

Tuesday, November 3rd, 1914.

Reveille 7.00 am. Breakfast 7.30 am. Spent the morning going through the tool carts and generally refitting without any stores. In the afternoon we marched three miles to some trenches. A rear line was being constructed. We remained there for some time, apparently as a reserve but did no work. The French are going to carry out a night attack. Met a character who I took for a rear admiral at least, being portly and having a well trimmed beard. He turned out to be a simple subaltern RE in charge of a section of a Fortress Company.

Wednesday, November 4th, 1914.

Lieutenant Spackman joined the Company with a sore throat. We went out at 8.30 pm to KEMMEL HILL and dug trenches and put up wire. There was a lot of artillery fire on both sides but nothing came near us. We were working in the middle of our gun positions and the whole place swarmed with French and English artillery. Our return journey was more exciting than we anticipated. The Bosch started shelling

a bend in the road putting over a salvo of four Marias at a time greatly to the discomfort of some gunners who were billeted in the farm at the bend. We waited for half an hour but the shelling continued. We therefore sent the dismounted men cross-country so as to avoid the danger zone by means of a detour. With the tool carts we got as close to the place as we could with safety and then dashed through between the salvoes. To see our tool carts with the old hairies—very hairy by now—fairly bristling with excitement, hair, tails and ears all perpendicular, covering the *Pavé* at a hand gallop was most inspiring. After this little excitement we reached the billets in safety and had another good night.

Thursday, November 5th, 1914.

Paraded at 8.30 am and again went out to work in the same locality as yesterday. I made a very tricky MG emplacement which was much admired. Large numbers of French infantry passed through on their way to the firing line, including a cyclist battalion. Aeroplanes were also very active, English, French and German—the air simply stank of 'em. We were working just in front of two batteries of 75's which kicked up the devil of a row. There was also a 4.5 howitzer battery just behind and in idle moments we amused ourselves in watching the shell leave the howitzer: you can see it quite plainly. While we were having lunch we watched the Bosch shelling the old bend in the road. In one of the farm-yards close by, the French Cyclist Battalion had stacked their bicycles. The Bosch put a Black Maria right in the middle of one of the dumps. The air seemed full of wheels, handle bars, pedals and things. Some of the weary cyclist Battalion must have felt more weary when they found the remains of their steeds. We came home by a different road and although we escaped the attention of Black Maria we got into the devil of a traffic block which was almost worse. Lieutenant Woolner joined the Company.

Friday, November 6th, 1914.

No 2 Section had a rest staying in all day. I had a bath and then rode into BAILLEUL with Captain Lees, to get some money. Had no luck but went into the CRE's office and heard we should be moving soon. Sergeant Geraghty not very well; he has just been presented with his Medaille Militaire for the second time by Smith—D.

Saturday, November 7th, 1914.

Reveille 7.00 am. We had breakfast at 8.00 am and moved off at 10.15 towards BAILLEUL. On arrival at the cross roads just outside the town we halted and waited for an hour. We finally got going and proceeded along the LOCRE DICKEBUSCH—YPRES road. The 59th Field Company joined us and we all had lunch just outside DICKEBUSCH, including Hudson Bebb and Ruddy Bloody. Our march was very old fashioned with long and frequent halts. We were met by large numbers of refugees leaving YPRES with most of their valuables on their backs or else in grossly laden farm carts. We were not allowed to enter YPRES until dark as it was being heavily shelled. Half the town seemed to be on fire and the glare from the flames playing on the many towers and spires producing a most weird effect. This effect was made more wonderful as we circled round the town on the far side of the moat and the above shades and shadows were reproduced in the water. While waiting to get through the town we heard many rumours of stressing times. The town also appeared to be infested with looters, spies and incendiaries. We were met by a guide who was to take us round the ramparts on the edge of the moat as it was not possible to get through the town owing to the fires and shelling. Our guide missed the way in the dark and got us jammed on a causeway. After great difficulty owing to the narrowness of the road we turned our wagons round and got onto the right path after an hours delay. We skirted the town and got onto the main road at the MENIN GATE and proceeded up the main road halting just short of the railway. We turned into the grounds of a white Chateau and bivouacked there. On the way we passed the 26th Field Company and I saw Wingate, Calthorp, Bateman and Ruso. Having got men and horses settled in we had an excellent meal by the light of our acetylene lamp, but this was most strongly objected to by our neighbours who swore it would draw

shell fire so we had to put it out. After the meal (10.15 pm) we went to bed.

Sunday, November 8th, 1914.

We hardly seemed to have closed our eyes, lying under the dripping trees in the fog, when we were violently woken up and told to get our sections fallen in as soon as possible. We got off about 4.00 am and proceeded by the MENIN ROAD to the front line some three miles off. There was great confusion in the neighbourhood of the front line as nobody knew where anybody was or where they were themselves. The front line was in the middle of a wood and as we entered the wood we met some of the 59th Field Company, Bebb among them who in a loud voice proclaimed everything to be alright up here but in a *sotto voce* to me informed me it was perfectly b . . . . y and that the Germans were all over the wood sniping in all directions. The only person to do any work was Herring with a small wiring party who put up a few strands round the trees in front of the Lincolns. By the time he had started it was almost daylight and the only cover was the fog. It was nasty walking about these dripping woods not knowing where was friend and where was foe, and bullets have such a horrid loud crack in a wood. I wandered about trying to get the hang of the place and was going to help Herring when I met the OC who told me to take my section back. We arrived back at 8.00 am and had breakfast.

We then slept all the morning and moved to a new billet at 1.30 pm near the village of POTIJZE which was *not* on the MENIN ROAD. We used an *estaminet* as an Officers' Mess and got the men into some cottages on the other side of the road. We paraded at 7.00 pm and went up to the firing line. We were working with the Bedfords who were holding part of the front line. It was very difficult finding one's way through the woods in the dark. We put some wire up in front of the Bedfords and then dug and strongly wired a supporting point in a valley about 120 yards behind the front line, to hold about a platoon. There was a lot of firing on the right by HOLLEBEKE where the French were holding the line. Except for a couple of hoorooshes our front was comparatively quiet but the road was being shelled all the way up. The MENIN ROAD is a nasty sight with big holes, broken wagons and dead horses. We got back to billets about 3.30 am.

Monday, November 9th, 1914.

Slept till noon and had lunch. My section had a rest, No 1 Section going out on night work. The Bosch continues to put an enormous shell into YPRES and is making a terrible mess of the place. These shells make a noise going through the air like a train going through a tunnel—they are horrible things to listen to—and where they explode they remove half the landscape. I saw one pitch in the town and throw a complete lamppost some 100 feet into the air. All the allied transport required to feed and supply the troops east of YPRES has to come through the town or round the ramparts. In consequence the Bosch keeps up an incessant bombardment all night on the town and its approaches. The old Cloth Hall was burning when we passed round the city and I hear it has had many more bad knocks since, also the Cathedral. They are evacuating all the inhabitants and I hear the POPERINGHE road is an appalling sight, blocked with refugees going one way and troops and transport coming the other. There has been a lot of looting going on especially of the wine cellars and chiefly by the French but I do not expect Tommy Atkins is altogether blameless.

Tuesday, November 10th, 1914.

The guns were very noisy last night and some shells came very near the billet but did no harm. I am taking my section out tonight. During the morning I had a shave and we cleared out the mess which was in a sad state owing to the mud. Pottinger and I started out with our sections at 5.00 pm and had a most engaging evening's entertainment. It was the darkest night I had ever known and you literally could not see a hand in front of your face. We waited a quarter of an hour on the road while a hooroosh was in progress. The Bosch had a machine gun playing on the road just in front of us, and every time a bullet hit the road it threw up a shower of sparks. When the firing had died down we went on but missed the Chateau and had to turn round tool carts and all and go back to it. When we got there it was so dark

that it took a long time to dish out our tools and get going. Finally we started off for the wood. The sentry on the gate of the Chateau knew less than I did of the tracks so we had to get on as best we could. It was dark outside but when we got into the wood it was pitch and to add to the difficulties of finding the way the wood had been shelled and trees were lying across the tracks totally obscuring them.

With great skill I led the section into the middle of the wood and discovered further progress was barred by the lake. After working back very carefully along the way we had come I at length discovered the right track which had been totally hidden by a fir tree fallen across it. We went along the track and finally came to the dug-outs. We waited here while Pottinger went to see Colonel Griffiths (OC Bedfords). We had great difficulty in getting a guide to take us up to the redoubt! I had two shots at it myself but each time took the wrong track. Finally by good chance we got there without waiting for our guide who was bringing up the ration party. We were to work on some dug-outs of primitive design being no more than trenches with a few branches over them. No 3 Section found great difficulty in discovering theirs and when they had, most of them were half full of water. We started work about midnight by making some new ones, improving the old ones and attempting to drain the wet ones.

Wednesday, 11th November, 1914.

After we had got the men to work Pottinger and I proceeded to the front line and carried out a reconnaissance. We were trying to clear up the actual position of our front line which was only imperfectly known behind. The situation on the Bedford front was interesting and involved. They held the further end of the wood which formed a salient in our line. The trenches were in a very poor condition and not dug along their whole length so that movement was impossible by day. At the tip of the salient two lines of trenches were held about forty yards apart. They were connected by a communication trench but its value was totally impaired by the fact that in order to get into it you had to crawl on your belly along a ten foot trench under the parapet of the rear trench. The front trench had a poor field of fire and had a dead end at a road that crossed it at right angles. We were just going to get out, cross the road, and go along the continuation on the other side which could be seen when a light went up, when the sentry near the road told us the Germans were occupying it, the Battalion on the left having been driven out of it in the morning. Pottinger went back and brought some men of both sections up and we put out some wire and improved the trenches but we were too few to do much in the digging line, but the wiring cheered the Infantry up no end. As we could not do much digging we left tools for the Infantry and confined our activities mainly to getting a decent communication through to the precariously situated front trench. A fat man with his pack on would have stuck in the tunnel anytime and there was always the danger of it falling in or being blown in as it was only sandy clay. We worked till nearly daylight and then returned getting into billets about 6.00 am. We had lunch at 12.00 am and were ordered to stand by under arms ready to repel an attack. There had been a heavy bombardment all the morning all along the line and it was quite obvious a big attack was going on. It was extraordinary that we should have been in front of YPRES so long and not heard any reliable news of what was going on. When working at nights we heard rumours from the Infantry of repeated German attacks and saw grim evidence of it in the corpses on the wire. Today seems to be a more general effort as compared with the local efforts of the last few days.

It was a filthy day, pouring with rain, making the already impossible mud even more slimy and impossible. We paraded at 4.00 pm and proceeded to HOOGE—Div HQ, where we waited for a long time in the rain. We managed to get the men into some half ruined cottages which gave a certain amount of shelter. The MENIN ROAD was a nasty place all night as the Bosch was searching it with shrapnel continuously. Div HQ could not make up their minds whether to use us as RE or as an Infantry Reserve. The men all carried an extra 120 rounds of SAA and the officers revolvers. There seemed to be a considerable amount of wind up on all sides but all we knew

was that there had been a devil of a scrap going on all morning. Finally at midnight we went off to the left of the MENIN ROAD to help the 9th Brigade. We then set to work and dug and wired 800 yards of trench in the open. We had to find our own covering party as there were no Infantry there. The covering party consisted of the Section Officers and their runners patrolling in front while the men worked like hell behind. We were told there was nothing between us and the Bosch and there appeared to be nothing on our right or left. After completing the digging we remained in the trench until it was taken over by an Infantry Garrison. We got back to billets about 6.30 am. A strenuous day.

Thursday, 12th November, 1914.

We slept until lunch and paraded at 6.45 pm for some digging work. The OC Company went up just before dark to see where we were to dig. We rendezvoused at the old Chateau beyond HOOGE, south of the MENIN ROAD, where we met a small party of Infantry who were going to help with the digging. Herring was my guide and some forty of us started off in single file—the guide in front and myself behind. It was a beastly night and very windy and wet and in consequence dark. I have always been anxious to meet a mathematician who could prove to me the reason why any carrying or other party when moving in file is going dead slow in front while the last ten men are always running, poor devils. It is always so. Tonight was no exception. Herring started off with a fine stride and before we had gone fifty yards we, the unfortunate last ten, were doubling. Doubling in the dark is never pleasant but over a slippery track bordered by still and deep shell holes full of water and carrying a good load it is impossible. I tried to double on and catch the head to get a better pace but was quickly pulled up by one of the aforesaid still and deeps. Emerging boiling inside and very damp outside I staggered on behind. We had not gone very far before we came to a halt. After waiting about for some time I walked up to the front to see what had happened. The language was sulphuric. On arriving at the head I found no Herring—followed by the first five men, he had disappeared into the darkness. No 6 had popped into a shell hole, No 7 and 8 had pulled him out, No 9 picked up his load, No 10 looked on and made some remarks and then the deed was done and the snakes head cut off. Then in the far distance out of the night came the the bleat of a lamb, something like, "Mind the wire you fool—damn you don't make such a row", then a shout, "Where are you", (no reply), "17th Company". Damp subaltern enters, "That you Fuzzy", subaltern approaches, "Fuzzy", the conversation is not interchanged but some fine oaths are interchanged and, "Sorry old bird", seems the last word. The snakes rear then joined up with its head which incidentally would never have discovered it had lost its head except for it being brought to a standstill by the wire fence and the guide with a brain wave decided to count the following. The head of the tail to the tail of the head, "That you, Spud", "Where the blazes have you been running off to", vice versa, "Why the 'ell you can't keep closed up I dunno", etc. We finally reached our destination where we started digging and wiring portions of a support line. We were unlucky as my trench ran through a grave so we had to make a diversion to avoid it. When the grave was opened the birds began to sing and it was most unpleasant. I don't think now with the diversion that I am very anxious to hold that bit of line. When we had got it half dug the OC came round and said it was in the wrong place so we had to leave it and start another trench further along and facing about right angles to the other. This rather fed us up. The men worked very well and we soon got the new bit finished. As we had used all the wire on the first trench we could not wire the second. During the morning the Bedfords had been driven out of the salient and the front line was somewhere just in front of us but no one seemed to know. While we were digging there was a spy scare. A reputed spy was said to have been walking round asking the men what they were doing. He did not come to my section. On the way up Sapper Featherstone fainted and we put him on the tool cart and when he was strong again sent him home with a cyclist. We were shelled all the way back and got in tired, wet and uncomfortable. Bibed tea and hot rum and went to bed feeling better.

Friday, November 13th, 1914.

We slept until lunch and had a parade in the afternoon. We paraded again at 5.00 pm and proceeded to the front line. Luckily we no longer relied on Infantry guides and ration parties but found our way direct and so saved no end of hanging about. The MENIN ROAD was much as usual, being sprayed with shrapnel all night and some bigger stuff went singing overhead into the deserted town of YPRES. The smells along this beastly road increase as the days are numbered. No one seems to have time to bury the horse carcasses which are rapidly decomposing, but they are not as bad as the horrible GIVENCHY cows with their four stiff legs pointing to the heavens. On reaching the line we constructed a new *point d'appin* just in rear to hold a platform, and strongly wired it. It was a comparatively short night's work and we got back to billets about 4.30 am. Rum, tea, bed, fed-up!

Saturday, November 14th, 1914.

Awoke at noon and had lunch. I went out at 12.45 pm with my section to mend a hole in the road. One of our 18" friends had dropped in the middle of the MENIN ROAD close to the asylum and had blown away a whole piece of road; there was only just room for a wagon to go round one side and that would have been impossible in the dark. We filled it up with all sorts of rubbish, starting with a broken down old French farm cart. There were plenty of bricks and bits of masonry from the cottages knocking about so we cleared up some of the mess by shoving them all in. The job was finished off with ashes from a footpath. The whole Company was turned out at 7.45 pm owing to a scare of the 15th Brigade. When we got up to the line we discovered that we had already done all that there was to be done so we were all marched home again hurling many imprecations. The Major and Spackman took beautiful tosses in the mud. I heard that poor little Bunny T had been killed. I met Pank, Pattison and Kiggell, (Field Troops) all of whom seemed very cheery. While we were at tea Major Foulkes came in. He seemed most depressed and had his Company outside on the road with nowhere to go and no idea where he was on the map. We again heard rumours of relief.

Sunday, November 15th, 1914.

A quiet day. Got up at noon and after lunch went to inspect the hole in the road and found it was standing the traffic strain very well. No 2 Section much appreciated the idea of a night in bed. Wooley went out with the 26th Company who were very short of officers.

Monday, November 16th, 1914.

Got up at 8.00 am after a good night's rest. About 2.00 am the Germans put some shrapnel much too close to our billet to be pleasant. It is most uncomfortable being shelled in bed. You hear the wretched thing coming and wonder when on earth it will explode. They always seem to be making a B-line for you. Some French Artillery had five horses killed next door and they put one shell in our lines but fortunately it did not go off. Captain Herring to our universal grief was transferred to the 23rd Field Company. Another night in bed.

Tuesday, November 17th, 1914.

Got up at 8.15 am and went for a walk. The mud was awful and I soon got fed up with it. The Bosch kept on dropping shells all round us for most of the night but beyond disturbing our slumbers and being most annoying did very little harm. The Wilts and KOSI retook some trenches that they had vacated during a heavy bombardment with much gusto. Spackman with No 1 Section is now living in the support line in some dug-outs. It will be my turn next. We hear Spackman is leaving to join the 5th Field Company who so far have lost fourteen Officers. A lot of French Officers came in and had tea, also Wells and Major Walker to lunch. This has become a sort of common Mess! No 3 Section are out working tonight. No 2 have had a very good rest.

Wednesday, November 18th, 1914.

Nothing happened in the morning but the Bosch again shelled the billet at night. I went up to Brigade HQ with the Major to take over Spackman's job. The Brigade

Staff were occupying the ground floor and basements but even these were unsafe as the Chateau and grounds were continually being shelled with coal boxes. My Section came up at 6.00 pm and we worked from 7.30 pm to 12.30 am clearing the foreground for a reserve line which ran through the Chateau gardens. No 1 Section with an Infantry working party dug a part of this line and then went back to billets while I took over the dug-outs and trench slits with my section. It was awfully cold at night and I could only get some shivering slumber in the dug-out as we had no fuel and had to rely on rum for warmth. Fowle came in and disturbed my rest with some yarn about the right of the French—Major Walker—I could not understand what he was talking about so I went to sleep again. Freezing hard.

Thursday, November 19th, 1914.

Got up at 7.00 am and turned Section out. We had breakfast and worked all the morning on clearing the field of fire which included cutting gaps in hedges and removing two wood piles. It was still beastly cold, but things were very quiet. We raided the kitchen garden for some wire netting which we fastened to some rough frames to lay over trenches to protect them from *mine-werfers*. We continued clearing the foreground from 4.00 pm till 7.00 pm in positions where it was impossible to work by day being exposed to the enemy's view. The digging was to have been carried on by an Infantry working party but they proved to be rather a myth, only a few very weary warriors turning up and then only digging twenty yards of trench. My "dugout" consisted of a short length of zig-zag trench, in the sides of which three enlargements had been made, the parlour, a bedroom and another room. We ate in the parlour. It was a very quiet night and good progress was made with the work. In the evening it started to snow and continued so all the night. When I returned to my dugout after knocking the men off I discovered a bearded stranger sitting in the parlour. He looked very depressed but said nothing for a moment but finally acknowledged my presence by exclaiming in a deep voice, "I've got lice". He turned out to be a Captain of the Bedfords who was Commanding a Reserve Company holding the line we were working on. We had a meal and some refreshing and warm rum and then tried to keep warm. As the brazier would not keep going in spite of all our efforts we were not successful in this last named. The night seemed to get colder and colder and we were not allowed to take our boots off in case we were required in a hurry to assist the front line. Consequently one's feet became like blocks of ice and it was impossible to keep them warm. The Bosch were putting a lot of mines over. At night they were extraordinary as you heard nothing coming and suddenly there appeared a red ball of flame followed by a colossal bang and large column of smoke. I had not seen much of the front line but one section came up each night and worked on it with the Infantry. The Bedford Officer who was in the big attack of the 11th told me the Germans came on in a succession of ten waves, all in open order. The first two or three passed over our front line without taking any notice of it and it was not until the fourth or fifth came up that the fun really started—poor fun at that. A Sapper writing home to describe the conditions of life said "I have fifty cigs, three boxes of matches and two frozen feet".

Friday, November 20th, 1914.

Got up at 7.00 am and after some difficulty procured some breakfast. A Bosch aeroplane came over and remained over us for a long time so we had to keep underground to avoid bringing shell fire on to the Chateau. Very soon after the aeroplane had gone the Bosch shelled the Chateau and put two heavy ones right into it. The General had a very narrow squeak and retired with HQ to my dugout so we had to clear out to make room for him. His BM was having a bath at the time and had to join him later! Bet he dried quickly. It was a beautifully clear morning and looked pretty with the sunrise on the trees which were all covered with snow. One almost forgot what was happening until a shell or two brought you back to earth again. The GOC seemed very annoyed at being shelled out of the Chateau. He had all along had extraordinary bad luck with his HQs. Twice in the FESTUBERT area they had scored direct hits against him. About 10.00 am I got orders to bring my section back to

Company HQ and that the section transport was waiting at HOOSE, the furthest point forward that transport was allowed in daylight. We had to make three trips to take out tools, bedding etc to the transport. I had great difficulty to get the men to keep still when the Bosch aeroplane reappeared. The GOC was much worried and swore we should draw more shell fire on to his devoted HQ. The aeroplane departed and we got away arriving at billets at 2.00 pm. We did not hand over to anyone. I understand the French are coming to relieve our Infantry tonight. By this time I was very footsore and had done a lot of walking about and not had my boots off for three days. My feet had been dead with cold most of the time. We had dinner on getting back and rested for the remainder of the afternoon. Several French Battalions passed the billets and appeared to be fresh troops. I believe they had been engaged a little time ago and were very short of officers. At 9.00 pm we started a night march to the neighbourhood of LOCKRE. The first incident was a complete failure to move any of the pontoon wagons as they had all got frozen in the mud. Luckily this difficulty had been foreseen and we started moving them early so that they were all got free before the march started. The approach to YPRES was more or less uneventful except that the Company got cut in two. The roads were frozen and very slippery, but the mud at the sides, (an eighteen inch drop off the *pavé* of the centre), was merely wet and cold. It was an awful job getting a heavy wagon back on to the *pavé* once a wheel got into the mud. We skirted the northern ramparts of the city and seemed to make a complete circuit of the town. The Bosch was still shelling the town and there were several fires burning. We could still hear the shrapnel bursting over the MENIN ROAD but as the noise got further away our hearts got lighter. We did not like YPRES. The incessant work and shelling of the past fortnight has been most trying. Once the city was behind us we encountered endless trouble on the road. Our march was continually being stopped by streams of French and British transport, either crossing our line of march or meeting us, compelling us to take the mud. The march was a perfect brute. I tried riding but got too cold and fell asleep, then I tried walking and I could not walk as my feet were so sore. I was bitterly cold and the wind cut through coats and mufflers and simply froze me. Finally I made my way along on a bicycle and found it the only possible means of progression for me. Three or four times we had to clear the road to let others go past and then we had all the job of getting on again. When we halted the troops behind would get impatient and would try to forge past thus double banking and completing the chaos and muddle. It was nearly 7.00 am, ten hours after we had started, that we reached our billets somewhere near LOCKRE. It had taken ten hours to cover some six or seven miles. Today has been the most trying day I have yet experienced and tonight I am entirely exhausted and it was with the greatest difficulty that I struggled round and saw the section comfortably settled in.

Saturday, November 21st, 1914.

We had breakfast when we were settled in and then went to bed till noon. After lunch I went for a short walk. It was very cold and an inch or two of snow on the ground. The billet was most comfortable both for men and officers but the poor old horses must have found it a bit cold. The Bosch shelled the hill opposite some two miles away with dud shells nearly the whole afternoon. It appears we are bound for NEUVE-EGLISE. Let's hope the crescendo is now at an end. MISSY—GIVENCHY—YPRES, it can't go on. What a jolly little village MISSY now seems and what fools we were to complain about it. However, what ever the future may hold it can hardly be worse than the last ten days in front of that doomed city YPRES.

* * *

"Operation Annabelle"

MAJOR J S FARMBROUGH, RE, BSc (Eng), C Eng, MICE

IN June of last year the war damage to the International Airport at Nicosia in Cyprus was repaired. The major part of the work was the re-instatement of the runway and taxiway pavements. This part of the project was carried out by a composite force of Sappers and Infanteers under the overall command of 62 (NE) Support Squadron Royal Engineers. This article is an account of their work, which took five weeks, and had the code name *Operation Annabelle*.

BACKGROUND

During the Cyprus troubles of 1974 Nicosia International Airport was the centre of much fighting. Both sides and the United Nations became involved in the struggle for control of this important installation. During the period 20 to 22 July the Airport was attacked by Turkish aircraft. As a result of these attacks both the main and secondary runways were put out of action. After the troubles the airfield continued to be a United Nations protected area and neither side was allowed access to it. This situation continues up to the time of writing. It has always been a contentious issue as it lies virtually on the cease fire line between the two sides and thus could not be operated without the consent of both parties. Until such an agreement could be reached there seemed little point in repairing the airport. However in an effort to help the two sides to come to an agreement the United Nations offered to repair the airfield, the offer being made during the Vienna talks in the spring of 1975. The delicacy of the situation demanded that the whole operation be carried out by the neutral troops of the United Nations. As a result the British Government was approached to carry out the repairs on a full cost basis using only military manpower. The British contingent (BRITCON) of the United Nations Force in Cyprus (UNFICYP) was therefore temporarily boosted by a composite engineer force of some 130 all ranks for the duration of the task.

MOUNTING

The force used for the task was the Cyprus Support Squadron reinforced by an additional field troop from 48 Field Squadron and a platoon of one of the resident infantry batalions—the 1st Battalion Devon and Dorset Regiment. The work force thus consisted of two field troops, a plant troop and an infantry platoon. The overall command structure of the Cyprus Support Squadron was used as control and was assisted by the addition of three specialists from UK. These were, Captain Brian Paulding a soils expert from the Plant, Roads and Airfields School at Chatham, Staff Sergeant Calow a military plant foreman from the Airfield Regiment at Waterbeach and Corporal Winn a construction laboratory operator from 62 CRE at Barton Stacey.

The planning for this seemingly unlikely task was curtailed by the lack of access to the United Nations controlled area and also by the uncertain political situation. This latter factor had given rise to the thinking that the task was only a remote possibility and if it did happen a degree of civilian contract would be used. In the event, in May the reality became known and the operation was mounted at speed after a detailed reconnaissance. This updated the previous report that had been produced soon after the troubles. It was only during this investigation that limited digging out of craters and runway clearance was possible. The joint RE and PSA investigation recommended a series of phases of repair which started with patch repairs to both runways and taxiways and ended with the resurfacing of both runways completely. The report was produced on 23 May and eight days later 62 (NE) Support Squadron was instructed by signal from the MOD to commence work on 3 June. The instruction was to carry out work to stage one only, the patch repair of all damage. Other details included the arrangements for working as contractors to PSA/DOE and as part of BRITCON. The squadron, complete with its platoon of Devon and Dorsets,

deployed to Nicosia from its base in Dhekelia, forty miles away, on 2 June. It was joined later on 7 June by a troop from 48 Field Squadron stationed in Ripon. All ranks wore UN insignia and arms were carried.

THE DAMAGE

The extent of the damage was only finally tallied up after all repairs were completed as the initial reconnaissances had been hampered by debris, parked vehicles and aircraft, which covered extensive areas of the runways. The damage to the runway pavements fell into four distinct categories.

The first and most obvious category was the major bomb craters as illustrated by Photograph 1. There were sixteen of these and they varied in size but the one illustrated is typical. These were caused by 750 lb bombs.

The second category, were the lesser craters caused variously by bombs which had bounced but not exploded, air delivered rockets and ground delivered mortar bombs and shells. Also in this category were all small areas which had to be cut out and repaired. This included areas under damaged vehicles where fuel spillage had affected the surfacing and also where the Cyprus Airways Trident and One-Eleven aircraft had been parked for nearly a year. Both these had damaged the surface by fuel spillage and by hydraulic fluid seepage from their undercarriages. Some of the smaller craters are illustrated in Photograph 2. A total of eighty of these lesser craters and areas were repaired.

The third category of damage was that caused by aircraft cannon fire and shrapnel from bombs or shells. This method of attack produced small scabs in the surfacing which did not completely penetrate the wearing course and could be treated without cutting out the area around them. In all over 4000 of these were repaired.

Two large area repairs, each of nearly 1000 m², made up the last category. The first was where a Trident aircraft which had been parked on the runway centre line was burnt out due to enemy action. This caused damage over a large area due to the heat of the fire and the fuel spillage from the aircraft, some of which had penetrated between the wearing and base course asphalt. The remains of the aircraft after the fire is shown in Photograph 3. The second area to be completely resurfaced was that at the touch-down point on the main runway. Here a large area of scabbing straddled the centre line and it was considered that patch repairing of each scab was

Photo 1. Major bomb crater.

Operation Annabelle 1.

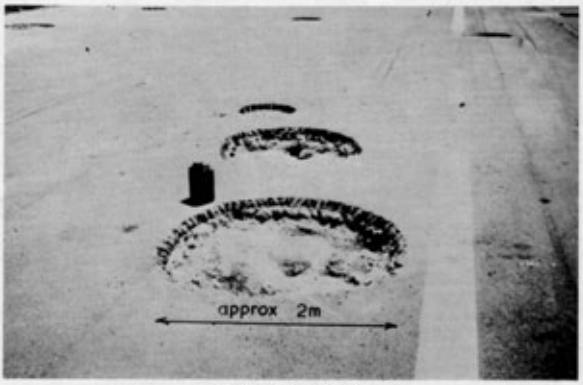

Photo 2. Minor craters.

not safe. Consequently the wearing course was cut out and replaced. Photograph 4 shows these two completed areas as seen from the air.

REPAIRS

The first task tackled when the squadron arrived was the removal of all debris from the runway so that the complete extent of the damage could be ascertained. This revealed many more scabs than had been anticipated. Next the major craters were excavated. All material had to be removed and the craters cut back to the limit of "heave". The sub-base was in many cases constructed of river boulders which tended to roll into the excavation and thus undercut the existing surfacing. To over-

Photo 3. Remains of Trident burnt out on the runway.

Operation Annabelle 2 & 3.

come this the craters had to be sloped gently in towards the centre. In general the bombs did not penetrate the cap rock which was located at an average depth of 1.5 m below the surface. The final task before filling was to cut back the existing surfacing into steps as is illustrated in Photograph 1. This was not always possible as in some places the layers of asphalt did not separate. When all loose material had been removed, backfilling started. The fill material was dry lean concrete which was placed and compacted in layers. Polythene membranes were laid between layers to prevent the fill from forming a monolithic mass. The concrete was continued up to the underside of the existing asphalt. Further preparation was then required before the new Marshall asphalt could be laid. Firstly the existing wearing course was cut with a concrete saw to produce a vertical joint which was either parallel or at right angles to the runway centre line. Secondly all horizontal surfaces were treated with bitumen emulsion and all vertical joints with hot bitumen before each new course of asphalt was laid.

The wearing course asphalt was laid by PF90D paver after trials had proved that it was impossible to reach the specification using hand laying techniques. This specified that the finish should have a surface accuracy of no greater variation than 3 mm under a 5 m straight edge. As is illustrated in the Photograph 1, in most cases the surfacing was laid in three layers. In the larger craters these were all laid by paver whereas in some of the lesser ones the base and regulating courses were laid by hand. This required a special technique which was developed during the project. In

Photo 4. Area of scabs after repair.

general it was carried out using wooden shuttering precisely levelled and set to the correct surcharge height. The problem here, as in machine laying, was to get the asphalt laid to the correct accuracy fast enough to enable compaction to be carried out at the correct temperature. The asphalt arrived on site at about 150°C and had to be compacted at a temperature between 120°C and 135°C.

The small craters were repaired in a similar way to the major ones. They did not need any dry lean concrete fill and in most cases only two courses of asphalt were required. They had all to be cut square once the wearing course level was reached. This was then laid by hand as they were too small for the minimum width of the paver. The rolling techniques were easier as the 6 ton roller could cover the whole patch with one pass thereby eliminating rolling creases. The main problem was that of

Photo 5. Runway threshold after repair.

producing the correct surcharge so that after rolling the patch did not remain proud of the surrounding surface or cause a small depression in the runway which was even worse.

The repair of the 4000 scabs was one of the most interesting aspects of the task. The PSA/DOE had evolved a method of using an epoxy mix based on Shell Eponite D4. After trials, which varied both the mix proportions and the treatment of the scabs, a satisfactory method specification was produced. 25% of the mix was made up of equal parts of epoxy and hardener with the remainder being aggregate which included 7% of cement. The aggregate was crushed rock which passed a No 7 sieve. The scabs were prepared by thorough cleaning and blowing out and then were treated with a coat of straight epoxy immediately prior to the mix being introduced into them. The mix was produced in a commercial food mixer which made a batch of 4–5 kg each time. The main problem was the short "pot" life of the mix which varied with the heat. All laying had to cease once the ambient temperature reached 100°F which it did generally by 11 am. To compensate for this, work started at first light around 4 am and on some occasions continued on again after 6 pm. The laying team consisted of six men with a generator to drive the mixer and a compressor to blow out the holes. The mix was tamped into the scabs with a steel rod and the finish produced with a wooden float. The only exception to this method of repair was to some of the scabs in the hardshoulder. In places these had pierced the thin asphalt surfacing and penetrated the base which was compacted Havara (a local naturally occuring mechanically stable soil similar to laterite). Repairs to these areas were carried out using wearing course asphalt.

The two area repairs were different in that one had to be excavated down to the sub-base and the other was just stripped of its wearing course. The first was that where the aircraft was burnt out. In this area the wearing and the base courses were inseparable and the full depth of 200 mm was removed in one operation. After some regulating fill had been introduced the asphalt was relaid in three courses, all by paving machine. In the other area, which was on the runway touchdown point, the wearing course came away with some difficulty. On removal it was found that it had a varying depth of between 20 and 60 mm. This meant that when the wearing course was relaid the paver screedboard height had to be continuously adjusted by the operator. He was able to correct the height by reference to a grid survey of the area which was used to compute the thickness required at every point in the hole.

In addition to the runway repairs various other tasks were carried out. The grass was cut over the area adjoining runways and taxiways, this totalled some 600,000 m^2. A visual sweep of the whole airfield was carried out to search for any live munitions. Various excavation tasks were carried out in support of the M&E work that was being executed simultaneously with the operation. Runway drainage damaged during the troubles was replaced which entailed excavation, laying and backfilling of some 50 m of drain. Finally some runway markings were repainted.

CONCLUSION

The task was completed in five weeks with a military force which averaged 130 all ranks. No civilians could be employed which meant that all contractors vehicles delivering materials to the site had to be driven by military drivers once they crossed the airfield boundary. It was a unique project in which the Royal Engineers were able to demonstrate their ability to mount an operation which could not have been done by anyone else within the notice given. They were admirably served by the unskilled but enthusiastic help of a platoon of infantry who were volunteers from their whole battalion. The work was controlled by the PSA/DOE with whom excellent relations were maintained. They provided all the materials and showed remarkable flexibility in helping to keep the work moving by ensuring that there was minimum delay to all supplies. This was of paramount importance when the client was being faced with full costs which included all manpower and plant hire charges making it essential to complete the project on time. The unit was fortunate in having the full facilities of

both the UNFICYP Headquarters, and its administration, at its disposal. This allowed it to concentrate on the work with minimum worries about its own administration. It was also very helpful being close to the squadron's own base location for support.

POSTSCRIPT

On 10 Dec 1975 the BAC 1-11 which had been parked at Nicosia since before the troubles of July 1974 successfully took off from the repaired main runway. The pilot commented that the "rideability" of the repair patches was better than that of the existing runway. Other than this movement no other use has so far been made of Nicosia International Airport.

The German Army Engineer School, Munich

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ALTHOUGH there is frequent contact between British and German engineer units in the area of I British Corps in North Germany not many British Sappers have actually visited the Engineer School of the Federal German Army Engineers located far to the south in Munich. The Federal German Republic (FRG) provides NATO's largest engineer contingent and it may therefore be of interest to read about some aspects of life at their equivalent of RSME Chatham, as well as about liaison activities between the two Corps.

The role and military strength of the Pionierschule equates roughly to that of the RSME; the Pionierschule being the central school of the Engineer Corps and providing for advanced and specialist training of officers and NCOs. The formidable title "Pionierschule und Fachschule des Heeres für Bautechnik" reflects the importance attached to qualifying soldiers for return to civilian life and can unofficially be abbreviated to "Pionierschule". The word "Pionier" should not be confused with "Pioneer" as found in the Royal Pioneer Corps of the British Army, for which the Germans have no equivalent, but means "Military Engineer" and equates directly with "Sapper" or "Royal Engineer".

The School lies on the north-east edge of the attractive city of Munich and is signed off the inner by-pass road connecting the Nürnberg and Salzburg motorways. Munich was chosen as the location for several reasons: historically it was the home of the Royal Bavarian Army Engineers until 1918 and subsequently that of the Engineer Corps of the Reichswehr until expansion and relocation to Berlin and Dessau in 1934. In 1956, after formation of the Bundeswehr, the School was re-established in Munich, this time in barracks which were later named "Prinz Eugen Kaserne" after Prince Eugene of Savoy, ally of Marlborough, who founded the first engineering academies in Vienna and Brussels in 1717. A further reason was the existence in Munich of a flourishing engineering industry, three universities, the famous science museum and the number of other service units and establishments in the area.

Commander of the School is Brigadegeneral Kinder, who in earlier days served as military assistant to General Lemnitzer at SHAPE in Paris and speaks excellent English. Under a recent regrouping of arms and services, which abolished individual service chiefs, General Kinder is now the senior engineer in a German national appointment. The School comes under the Army Office or Heeresamt 400 miles to the north of Cologne, which in turn is subordinate to the Ministry of Defence in Bonn. This remoteness from the MOD is not conducive to an intimate exchange of ideas but may have certain advantages! An outline organization of the School is given on the chart, additional comments being:

Training Wings are organized on a student instead of subject basis, the advantage being that staffs remain with their classes over the whole course and get to know them well. Specialist instructors are called in as required. A disadvantage to my mind is the lack of a definite focal point for expertise in a particular engineering field.

The Special Staff ATV, (Evaluation, Trials and Testing), works directly to the Army Office on technical and policy matters. It combines the responsibilities of the trials and manuals writing staff of RSME and, to some extent, combat development and is where I have been working up to now.

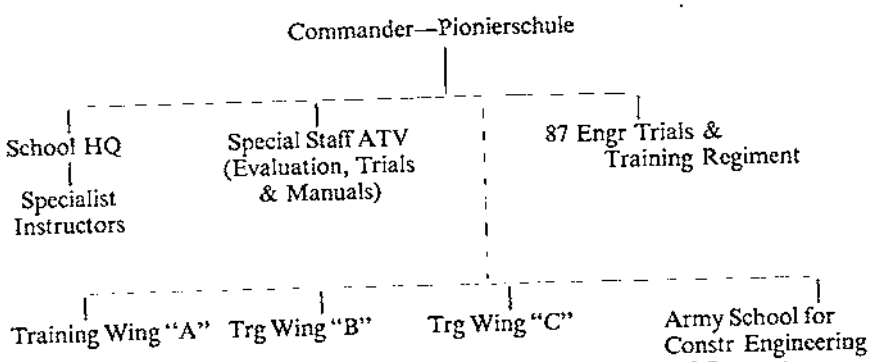
The Army School for Construction Engineering, (Fachschule des Heeres für Bautechnik), mainly instructs senior NCOs on two-year Clerk-of-Works type courses. These qualify them for infrastructure appointments as well as for building jobs in civilian life. Student output is seventy per year.

US Corps Of Engineers Liaison Officer is the only LO in the School—I enjoy a chat with him in my native tongue when exhausted with the intricacies of the German language.

87 Engineer Regiment, (Trials and Training), is located at a nearby barracks and has the dual function of supporting the School and fulfilling its operational role within 2nd German Corps.

A branch of the *Bundeswehr University, Munich*, is also in Prinz Eugen Kaserne but only for local administration, and will move in two years to new buildings just south of Munich. Under a new ruling all long service and regular officers must have a university degree. The College provides three-year degree courses for junior officers in civil engineering and has an instructing staff of ten and some 200 students, with an output of sixty per year.

The Pionierschule training areas and facilities are possibly even more scattered than at RSME. The excellent wet bridging training area on the Danube at Ingolstadt is one hours drive north up the Autobahn. Gaps are up to 100 metres with an average



Statistics

Military Staff	400
Civilian Staff	300
Accommodation Capacity	1415
Average number accommodated	1000
Annual Student Turnover	5500–6300
Total courses per year	300
Number of different courses	100

Outline Organization Chart—Pionierschule, Munich

Photo 1. Entrance to Pionierschule, Munich.

Photo 2. Brigadegeneral Kinder, School Commandant, greets Major-General Mackay Chief Engineer BAOR, on a recent visit.

The German Army Engineer School, Munich (1& 2)

Photo 3. The School Headquarter Block.

Photo 4. Inter-allied bridging instruction on the River Danube.

The German Army Engineer School, Munich (3 & 4)

Photo 5. The Armoured Vehicle Launched Bridge "BIBER" mounted on the Leopard tank chassis. Instructors for this equipment are trained at the school.

Photo 6. The Leopard Engineer tank.

The German Army Engineer School, Munich (5 & 6)

Photo 7. Entrance to Main Classroom Block.

Photo 8. From left to right: Corner of Canteen, Living Block, Classrooms and Main Lecture Hall.

The German Army Engineer School, Munich (7 & 8)

Photo 9. School Chapel.

current of 1·7 metres/second. Further downstream at Bogen amphibious aspects of armoured personnel carrier training (all arms) are taught. Diver training, which achieves a high degree of skill, is held on Lake Starnberg, south west of Munich. A purpose-built diving tank and swimming bath is shortly to come into operation at the Pionierschule. Petroleum engineer training is held at Krailling on the south west outskirts of Munich. Civilian type trades training is not so extensive as at RSME since most requirements are met by the national service intake. An unusual facility is the apprentice mechanics workshop with fifty-six apprentices on three and a half year courses. About 85% of them take short service or longer engagements with the Bundeswehr. The Engineer Museum has a very comprehensive display of uniforms, weapons, medals and other objects depicting the history of the Corps from earliest days. There is a good technical reference library (with copies of the *RE Journal* and *Sapper* magazine) as well as a good central manuals library. Manuals are called-in for central amendment by a civilian staff.

Hours of work are strenuous, with lectures starting punctually at 0715 and carrying on until 1650 hrs, five days a week. There is one choice of meal only, eaten by all ranks. I find it adequate and good value at DM1.40. Compulsory sports are held weekly and the whole school staff attend officer and NCO training for one afternoon every fortnight—updating them in tactics and other subjects. Wings hold coffee-work sessions after lunch once or twice a week at which any problem can be voiced in a relaxed atmosphere—a custom I find useful and enjoyable. I should say information and relaxed social relations between all ranks is a strong point with the Bundeswehr. The democratic spirit is illustrated by the fact that family quarters are allocated by size of family and not by rank, and the system operates remarkably well. However everything is not perfect and I still feel there is a lot to be said for the flexibility generated by the British system of delegation of authority—to quote one example.

On the subject of Anglo/German engineer liaison it was Brigadier Goodall, then Commandant of the RSME and his opposite number in Munich Brigadegeneral Böttcher who early in 1972 agreed on the need for an exchange of officers, and I took

The German Army Engineer School, Munich (9)

up my appointment here in the following April. RE Exchange or Liaison officers have existed for many years at the Engineer Schools in Australia, Canada, USA and at the French Engineer School at Angers while within Germany there are British Liaison Officers at the German Command and Staff College, the Armour and Artillery Schools as well as with each NATO Corps in the NORTHAG sector. It is good therefore that this gap in the engineer liaison field has been met. Some of the main advantages stem from the fact that:

a. Both Engineer Corps are busily engaged on the same priority task—how best to defend against a possible Warsaw Pact advance into the FRG—and the closer we work together on this problem the better.

b. We both make use of each other's equipment. The Germans are equipped with the Medium Girder Bridge and we have the German M2 amphibious bridge.

c. The Pionierschule is one of the main centres for creative engineer thought but lies remote from the BAOR area. RE representation is therefore important.

Commandants of both schools exchange visits at least once during their tour of duty, as well as Chief Engineer BAOR. MOD Anglo/German Working Parties often meet here and there are visits by individual RE officers and RSME staff. Visits in the reverse direction are not so frequent due to the very stringent MOD (Bonn) policy over travelling allowances. However the staging of the multi-national NORTHAG staff engineer exercise "Makefast" either at Chatham or within BAOR is a valuable asset and German engineer officers are full of praise for the British contribution and organization in this respect.

A useful contact point is the staging of inter-allied demolitions, minewarfare and bridging courses, which up till now have been held four times yearly at the Pionierschule, attended by British, American, Canadian and French military engineers. At higher levels direct contact of course takes place between Ministries of Defence and Research and Development centres in both countries, while the Germans themselves make good use of the services of my opposite number at RSME—Major Detlev Hattenhauer.

Although progress on the standardization of equipment is still not very apparent on the ground there is much cross-traffic in the field of ideas, and this must contribute to the efficiency of the final product. High regard is held for British and American research in the engineer equipment field and my main activity has been in the exchange of such information, including the production of six-monthly activity reports which are sent out on a wide distribution. A further contribution is a brochure "*Notes on the German Army Engineers*" which should soon be leaving the printers. On their side the Germans are very open and always ready to assist but remain keen, as we are, to produce the bulk of their equipment from national resources.

On the personal side there is a comfortable Type III Quarter with the job located in the former US Army area on the north edge of Munich. I am the only uniformed British Army officer here, my nearest colleague being the Gunner instructor at the NATO Special Weapons School at Oberammergau, an hour's drive to the south. Almost all our social life is spent fully integrated with our very cordial German neighbours. The Germans certainly chose well when deciding to locate the school in Munich which offers every opportunity for an active life. I close with the hope that my successor, when nominated, will qualify himself in the language in good time—German linguist being the level required.

* * *

Meetings with Monty

BRIGADIER SIR MARK HENNIKER, Bt, CBE, DSO, MC, DL

(Written a few days after the Field Marshal died)

So many people have asked me in the last few days if I had ever met Field Marshal Montgomery that I think these notes may be of general interest.

During the winter of 1939–40, during the phoney war, Monty, then a Major-General, was commanding the 3rd Division in the BEF deployed along the Franco-Belgian Frontier. At that time I was a Captain in the 2nd Division, some miles away. Though I had never met Monty I had heard on the grapevine all kinds of stories about him. His original military thinking attracted me, but the autocratic way in which he seemed to sack those who displeased him filled me with apprehension; for I had had a dream that I was to be promoted to Major and get command of a Field Company in Monty's division, and I certainly did not want to be sacked.

Hitler started his blitzkrieg on 10 May, and on 22 May I was, in fact, promoted to command 253 Field Company in Monty's division. The BEF was more or less surrounded and apparently in a bad way. With some difficulty I found my way to the Headquarters of the 3rd Divisional Engineers and reported to the CRE. His first sentence made my heart sink: "The General", he said, "wants to see you". It seemed to me extraordinary that a divisional commander in the middle of a critical battle could want to see a junior officer like me. As I was wearing corduroy trousers, having recently got soaked to the skin in a ditch full of mud and icy water, and had had to put on the only garment accessible, I was particularly apprehensive.

Monty never even raised an eyebrow. He sat me on a chair, and asked me the sort of questions one would have expected had we been in Aldershot. He then told me all about the military situation, bad as it was. Finally he told me about the Field Company I was going to command, ending with these words: "You go to your Company," he said; "and tell your men that you have spoken to me, and have been told that we, in the 3rd Division, are the best troops in the world; that there is nothing to be afraid of in the Germans. We shall see them off. All they must do is to *do what they're told*". He had a trick of repeating key sentences, and he repeated this last sentence several times. "*They must do what they're told.*"

I went to my new, and first, real command, and did what *I* had been told. I could see at once that my halting speech had a good effect. However we had other matters to attend to, including the preparation of a number of bridges over a riverline for demolition. One of these was an important bridge on a trunk road over a wide river. There is no technical difficulty in blowing up a bridge if you have lots of explosive, as we had; but there *is* difficulty in deciding when to do it. If you are too soon your own troops get marooned on the wrong side; if you leave it too late the enemy may be able to prevent you doing it at all. All the difficulties prepared by the umpires on manoeuvres presented themselves here in real life. The Commanding Officer of the battalion providing the immediate garrison on the bridge was carried off on a stretcher as I arrived—at the urgent call of my subaltern who had done the preparations for the demolition. The Adjutant of the battalion was not fully conversant with his CO's intention. The Germans were mortaring the bridge and frequently cut the electric cables whereby the charges would be blown. We repaired these cables as best we could, but it was clear to me that if we left it much longer all repairs would become impossible. On top of it all, a French General appeared and forbade the firing of the demolition because, as he told me, he had a light motorized division on the other side. I pleaded with him in bad French; but he was adamant. I went across the bridge myself on a motorbike to try and discover the score. I soon scuttled back like a rabbit to its burrow, having nearly run head-on into a German armoured car, whose crew were luckily brewing up at the side of the road.

The mortar fire was by now much more frequent. The Frenchman had gone, but his words were still ringing in my mind. The decision was evidently mine, but what

to do? Here was my first important decision in a real war. It seemed to offer me the chance, either way, of going down in history as the prize idiot of the campaign. Assailed by many doubts, I was about to give the order to blow the bridge and damn the consequences when a British staff car appeared from the rear; and who should step out but Monty?

"Hullo, Henniker," he said. "How are you getting on?" I explained to him—badly—the situation, expecting to be sacked out of hand. He thought a moment as a "stonk" of mortar fire came down all round. He never ducked his head, but said calmly: "Right-oh. Blow it up. Never mind the Frenchman".

We sent the staff car back a few hundred yards and sheltered behind a wall ourselves while the debris of the bridge fell in splinters around us. We then went to look at the wreckage. In the middle of the swirling torrent, (for the bridge had incorporated a sluice gate) lay a slab of concrete as large as a grand piano; and on top of this, blinking in amazement, was the largest pig I have ever seen. How it got there I cannot say. "Someone," remarked Monty, as he walked towards his car, "will have pork chops for supper." Before saying goodbye I could not refrain from observing that this was the first occasion in fifteen years' service that I was genuinely glad to see a General.

Monty never batted an eyelid. "Yes", he said. "One of the arts of command is to be at the proper place at the proper time". And he swept away, no doubt, to be at some other place at the proper time. I found myself beginning to like this chap; and I was certainly aware that he knew his business.

A day or two later, after a very harrowing night move, I received a verbal message from the CRE to take my company to a place called Furnes, not far from the point where the frontier between Belgium and France hits the sea. I had just seen the men have breakfast, so we got into our transport and battled through the streams of refugees and other traffic towards Furnes. It was a small place with a red Church and a high steeple, standing in a shady churchyard.

I forget how it came about, but we soon found ourselves in the churchyard with the lorries parked outside in the road. There were men and vehicles from the other two Field Companies and the more cumbersome vehicles of the Field Park Company. The OC of 17 Field Company, a regular officer and senior to me, was reported killed that afternoon. The OC of 246 Field Company, also a regular and senior to me, was out on a reconnaissance somewhere; and the OC of 15 Field Park Company was only a Captain. I was evidently the head boy of those present. It is a splendid thing to command a Field Company and a better to command what is now called a regiment; and here was I, still wearing my Captain's pips, in command of a thousand men and many vehicles. Unhappily there was a fly—not in the ointment, but overhead. About 500 feet above the village was a light German aeroplane, wheeling about lazily in the clear blue sky. It had been a moot question in the 2nd Division whether to shoot at these things with small arms or not. On the one hand you drew attention to your own position, on the other hand, even a 303 through the fabric of the wing would teach the pilot not to sneeze in Church. I adhered to this latter school and we certainly let off a lot of small arms ammunition at the aeroplane. This evidently shooed him away; but not before he had told his artillery friends that in Furnes there sat a splendid target.

Shells soon began to land here and there. One or two men sustained horrifying wounds and a couple of lorries went up in palls of black smoke. Someone said to me; "Don't you think we ought to quit?" Here I was, presented by another of these awkward questions, for which one might be sacked if one got the answer wrong. I thought of the boy who "stood on the burning deck when all but he had fled". Had he fled too, he would not have earned immortal glory; but perhaps his situation was not quite on all fours with mine. It seemed pretty clear, however, that if we remained here much longer there would not be many of us to reap the glory. So, with much heart-searching at quitting my place of duty in the face of the enemy, I

posted a subaltern and a couple of motor cyclists (the Sappers had no wireless in those days) in the entrance to the crypt to say where we had gone, and issued the Nelsonian order: "Follow me".

I thereupon led a column of vehicles loaded with troops out of the village and halted them under the poplar trees along a road about half a mile away. I soon noticed what had hitherto escaped me: namely, that 100 yards to our left was a totally deserted French or Belgian anti-aircraft battery, which presently excited the interest of a German flight of dive bombers. Having given a splendid display of flying they departed and were followed by another flight that concentrated on us alongside. I expect their display was equally impressive, but we were more interested in the ditch by the roadside. Anyone who has been dive-bombed will confirm that the roar of the aeroplanes, the whistle of the bombs and the explosions around one create a most demoralizing effect. They left a couple of lorries burning, but otherwise no one was much the worse. But I was most upset, not only by the bombing, but by having quitted my place of duty only to find somewhere that was not only contrary to my orders, but also equally exposed to the enemy.

I was wondering what the Hell to do, when I heard the whining of the types of a vehicle tearing along the cobbled road. It was a staff car with a pennant flying. It stopped; and an ADC, a subaltern in the Ulster Rifles, came running towards me. "The General," he announced; "wants a word with you".

It sounded most ominous and the General was undoubtedly Monty. My luck seemed to be out. However, when I got to the car Monty was as cool as a cucumber. He remembered who I was and asked what we were doing. I told him I hadn't the faintest idea, and then explained the situation. "Well done, well done", he said, putting me at ease in a flash. "When did you last have a meal?" I told him—breakfast. It was then about 6 pm. "Get into the car", he said. "Get into the car;" and he made room for me to sit beside him while the ADC produced a mug of tea from a thermos flask. I sipped it gratefully. "That makes you feel better, doesn't it?" I told him it certainly did. "Then take the men off to that little farm house over there (pointing) and get the cookers going and give them some tea too. Then you'll all feel better". Picking up his map he said: "You go along to 11 Brigade HQ and see if there are any orders for you".

I fumbled for my map, searching my haversack, but it wasn't there. It was back in the ditch where I had been crouching. I seemed to have boobed again. "Never mind," he said. "Take mine. I've got another", and he handed me one from the floor of the car. What a wonderful little man this is, I thought. He might have been irritated or cross, or even violently angry. But he was none of those things. He quietly put me and all those about me back on top of our form. It was an example of real leadership, and I have been one of his great admirers ever since.

Shortly after that, when my Company was in the line as a company of 2nd Suffolks, holding the Dunkirk perimeter, our Adjutant, Dick Walker, came out to see me. Remembering my lesson from Monty, I told the cook to give him a cup of tea, before listening to what he had to say. I saw the magic working, before my eyes. It turned out that the General intended to present medals to a number of men that afternoon. One of my officers had been awarded a Military Cross at Louvain, before I joined the Company. A Sergeant had to receive a DCM and a couple of private soldiers the MM. They were to be paraded at Brigade Headquarters at 3.00 pm dressed in their best, smart and soldier-like. The cares of battle were thrust from my mind; all my energies were directed to getting hold of some clean battledresses.

I assembled my men at the right time and place, looking reasonably respectable; and saw to my surprise, about five miles away over the German lines a captive balloon with a basket beneath it from which an observer with field glasses was visible searching the horizon in our direction. There was apparently no AA artillery about and the best that could be done was to fire 25 pounders in the right direction, hoping to frighten the balloonist.

Soon Monty arrived. He presented the medals, standing in the glorious sunshine, and summoned all of us to close up round him where we could hear what he had to say. By then it was known that evacuation was in progress from the beaches of Dunkirk.

"Go back to your units," he said. "Tell them you have seen me and that these are my instructions. We are the 3rd Division and we can give these Germans a bloody nose if they come near us. In a year or two, we'll come back and tan the hide off them. That's certain. But today, everyone has only one thing to do. That is to do exactly what they are told. Nothing will be too difficult if we all pull together. Nothing". With that he departed to tell the same tale to the rest of the Division. We now know that it all worked out exactly as he said. Nothing was difficult, and the Germans never molested us.

When we got back to England it was not long before Monty left the 3rd Division, and in about a year I left it too to become Commander Royal Engineers in the 1st Airborne Division under General Browning. Of course one saw Monty occasionally and heard about his doings; and I had vicarious contact in 1942. We were on Salisbury Plain at the time of the fall of Tobruk. At that time very few British officers had commanded a brigade in action. Fewer still could be said to have made an outstanding success of it; and no one had commanded a Parachute Brigade in action. So when the General sent for me and told me that I was to be promoted to command a Parachute Brigade, I felt that I had as good a chance of doing it properly as the next man. However, General Browning told me not to speak about it till his recommendation had "gone through the usual channels". Two or three days passed before I was sent for again. The General had bad news for me. The recommendation had apparently got as far as the GOC in C (Monty) where it had been turned down. It was said that Monty had written across it: "Only over my dead body. He is a Sapper."

Of course I was disappointed. Who wouldn't be? But we were busy, with new, interesting and sometimes complex problems to cope with; and it faded from my mind. Later we went to North Africa; invaded Sicily, where I was wounded, and landed in Italy. It was in November 1943 that we were pulled back to be re-embarked for England before the invasion of Europe. A few days before we departed, the Chief Engineer of the 8th Army, General Coxwell-Rogers, sent for me to say goodbye. We talked in his tent for a bit, till, looking at his watch and seeing it was lunch time, he asked me over to A Mess. The only people present were Monty, still commanding the 8th Army, Coxwell-Rogers, and a couple of ADCs. I sat between Coxwell and Monty. We had a light but civilized meal, during the course of which Monty turned to me and said: "I hope you weren't too disappointed over my refusing to have you in command of a Parachute Brigade." I told him that of course I was furious at the time, but that I had got over it, and could listen to the reason why without reopening any scars.

"It's like this," he said. "When a man has commanded an Infantry Battalion with success I *know* he won't make a mess of a Brigade. But however good a Gunner or a Sapper may be, I cannot be *sure* that he won't make mistakes when he commands an Infantry Brigade. So that's my rule. In peace time if a man makes a mistake, he may learn from it; but in battle, mistakes cost lives; and that won't do".

Anyone can see the sense in that, and our lunch was not spoilt. Presently Monty asked, as a sort of *ballon d'essai*; "Tell me now," he said. "How could I have used an Airborne Division in my battles in Africa?" Anyone can see how this might have been a rather difficult subject: an officer of no account lecturing a full General, still wearing the laurels of victory, on how he might have done better. But with Monty there did not seem to be the slightest impropriety. We discussed it as easily and naturally as though we had been talking about a campaign of the Peloponnesian War, fought between the Athenians and the Spartans of old. I only wished I had had time to collect my thoughts more adequately and express them better.

The next time I had a personal encounter with Monty was over ten years later. We met, both wearing plain clothes, in the High Street in Farnham, Surrey.

"Don't tell me your name", he said. "I'll get it. I'll get it". (Which, of course, he did). "D'you remember what I told you in Italy, about Sappers commanding Infantry Brigades?" "Yes", I replied. "Well, I hear that you have just returned from commanding an Infantry Brigade in Malaya. I hear you gave the bandits a very bad time! But you see, if you hadn't, you could have been replaced without having done any harm". Then, abruptly changing the subject, he continued. "Have you read my book? Have you read my book?"

I told him (truthfully) that I had begun reading it the evening before. "Then, bring it to my house next Tuesday at ten o'clock and I will autograph it for you. And bring your children too. I will show them my caravans".

My wife and I duly reported ourselves (with family) at Monty's house in Alton. The Field Marshal was about to set off in his car for the dentist (as he told us) but could give us twenty minutes. He must have kept the dentist waiting, for he gave us nearly an hour. We went all over the caravans, and then explored his house. Monty was the most wonderful host, and thrilled the children with his accounts of his many trophies. He also asked some pretty searching questions in geography, to any of which a correct answer produced the most evident delight; and a wrong answer the repeated comment: "Bad guess! Bad guess! Try again".

It was a most enjoyable hour, and I am glad to think that all their lives my children (now grown-up) will remember that they had the privilege of meeting this most remarkable person. Even if it were not for the Latin tag "*De mortuis . . .*" I could never speak but good of him.

Memoirs

COLONEL R McCREARY, OBE, MC

Born August 1890, died April 1975, at age of 84

ROBERT MCCREARY served in both World Wars in Transportation, this was his profession. Educated at Ballyclare National School, Belfast Institute and Queens University, in 1911 he graduated BA and one year later BSc with 1st Class Honours, the first time the new BSc Civil Engineering was conferred. Equipped with his honours degree his first professional job was as an "improver" with the Belfast Tramways at £2 per week. When WW1 broke out he was soon in uniform and in 1915 he was in France supervising the construction and maintenance of railway track up to the front line. In 1919 he was demobilized as a Major with the Military Cross.

He returned to the Tramway Department and in 1931 was appointed its General Manager and Engineer. A period of change and development in city transport was begun under his direction; trams gave way to trolley buses which in turn gave way to omnibuses.

Came 1939 and Major McCreary was back in France in uniform on railway construction. Evacuated at the last moment when France fell to the Germans he commanded engineer units in England until the Normandy landings. In 1945 he was demobilized again this time as Colonel McCreary, OBE, MC, Commander of the Order of Orange-Nassau, and returned to his old love the Belfast Transport Department as its Manager until his retirement in 1951.

In many respects he never ceased to be a Ballynure man, he loved the countryside and its people. He was a great churchman. Latterly he worshipped at the McCrackan Memorial Church, he was elected an elder in 1951, became its Clerk of Session in 1952 and in 1954 was appointed to be one of the joint-conveners for Church Extension by the General Assembly.

This Memoir is an extract from the address, given at his Funeral Service, by the Very Revd Dr John W Orr, former Moderator of the General Assembly.

MAJOR-GENERAL L D GRAND, CB, CIE, CBE, FICE

I SHOULD like to add two particular recollections, as a then young subaltern, to the *Memoir* published last March, and to extend slightly—"... in 1941 he was CRE in Iraq and later Deputy CE (Defences) North Iraq".

In August 1941 our Field Company of Madras Sappers and Miners sailed ahead of the Division, and was dumped a few miles north-west of Shaibah on a piece of flat and featureless, wind-blown desert with the misleading name of Chuwaibdah Wells where our query to a staff officer about water elicited the reply—"About six feet down, old boy! You'll have to dig for it, hope it isn't brackish".

Our role in this furnace like isolation of daily sandstorms—anyone who has experienced an Iraqi summer will know what I mean—and the reason for our rapid departure from India was to operate a central bar-bending and batching plant, the water for which (fortunately not brackish) was obtained from two large wells which we sank. The fruits of our labour were then to be collected by "Rice Corps" vehicles and delivered to scattered units, out of sight over the rim of the desert, for turning into a vast semi-circle of pill-boxes, gunpits, anti-tank obstacles and all the other architectural features of modern war—to defend Basrah.

This great multi-unit organization was known as "Grand's Circus" for it was he who, as a full colonel, commanded it and it was he, complete with his cigarette holder and kindly, friendly manner, who imparted tremendous enthusiasm to all engaged on the mammoth project. Realizing the conditions under which his force laboured he also, despite the urgency of the hour, insisted that every man under his command of whatever rank should have one complete day's rest per week. Not necessarily Sunday and not necessarily a whole unit at a time—but for every man one day in seven to potter, to make and mend, to write letters or perhaps wash clothes or even merely to lie in their tents smoking *biddis* and chatting about those far distant villages, in our Company's case in the lush greenness of South India.

This wise insistence caused all his "Circus" to work so much harder and better.

Then just as we were beginning to get settled into our desert life we suffered the loss of one of our British subalterns who was tragically killed one morning.

As four of us were having a gloomy lunch—the OC having gone off to make arrangements for the funeral—the Colonel arrived at our mess tent and when invited to join us said he had *intended* to. His presence cheered us up a lot, which was of course why, upon hearing of the accident, he had come, and he insisted that those of us who attended the funeral in Basrah that afternoon, for such things cannot be delayed in the tropics, stayed the night at the Airport Hotel and be his guests at dinner—a dinner over which he presided magnificently.

He had raised our morale again.

Shortly afterwards General Wavell paid a very brief visit to our masters in Iraq and, so the tale went, studied the plans of the proposed ring of defences around Basrah. Then, after one of his famous silences, stubbed them with his finger and said:—"Gentlemen! We are not planning an evacuation from the bridgehead of Basrah, we are planning the defence of the whole of Iraq and Persia. Move those defences north!"—or words to that effect.

Thus the Sappers' orders were changed and so it was that "Grand's Circus" moved north to Mosul while we stayed behind to rejoin our Division, the units of which were beginning to arrive in the country.

Although I was to meet Laurence Grand from time to time at Corps functions I was never privileged to serve under him again, but I have never forgotten how, during those early and at times difficult days in Iraq, we were so helped by the humanity, kindness and understanding of his skilled leadership.

GH

Book Reviews

ASSAULT FROM THE SEA

JAMES D LADD

(Published by David and Charles: Price £5·95)

BEFORE the Second World War, except for the brave chaotic failure at Gallipoli in 1915, no nation in modern times had attempted a landing in force from the sea against troops massed in strength behind well placed and cunning defences until the Allied landings in Italy and Normandy and the American reconquest of the Pacific Islands. New vessels had to be designed to carry troops, tanks, vehicles, heavy guns and other equipment into shallow waters where they could be off-loaded over ramps directly on to the shore. A new breed of intrepid servicemen had to be trained to man these often ungainly craft.

New tactics, specifically for beach assaults, had to be devised. Men of great courage and dedication were required to make undercover, and often underwater, reconnaissances of the proposed landing areas and to deal with the devilishly contrived anti-invasion contraptions guarding the enemy shores. These landings called for the utmost co-operation between the Navy, RAF and the seaborne forces. Detailed planning, thorough and realistic training, and mutual confidence were the keys to success. Surprise was vital.

In his book, illustrated with fifty plates and twenty-four figures, James Ladd gives detailed descriptions of the many and varied types of landing ships, landing craft and amphibians, their development and their use by all nations, enemy and allied, in the period 1939 to 1945. We are told of the long months of hazardous survey and beach work necessary to allow the planning staff to pinpoint underwater obstacles and define landing points; how the waves of landing craft were directed and co-ordinated by staffs on Headquarters and Control ships; and of the great bravery and determination of the underwater experts and the assault engineers who dealt with the underwater mines and obstacles and who led the advance under heavy fire over the beaches.

It is a history which had to be written so that the exploits of those who took part in the invasions shall not be forgotten. James Ladd has gone to great lengths to give a clear concise record of all that was involved. It cannot be classed as light reading because it is too factual and includes many detailed specifications. It is nevertheless an interesting book which will give pleasure to many, and to those servicemen who took part in the landings it will bring back memories of their youth.

HJ

BATTLES IN BRITAIN AND THEIR POLITICAL BACKGROUND

VOLUME 1 1066–1547; VOLUME 2 1642–1746

(Published by Sidgwick and Jackson Ltd. Price each volume £6·50 (hardback) and £3·75 (paperback))

THIS is a two volume account of all the major battles fought on British soil, illustrated with narrative accounts, aerial photography, battle plans, drawings, guides to the battlefields and weapon development. Anyone interested in military history will find it fascinating.

The author, formerly a regular officer in the Scots Guards and Staff College graduate, has visited all the main battlefields walking over the ground on which the armies fought. He uses his knowledge to recreate vividly the realities of these battles. The aerial photographs, the drawings and the battle plans are models of clarity and really do save "a thousand words".

This rather clinical assessment of the account fails to convey the joy it brought to your reviewer. As the format for each battle is similar let me take you through one of them. Bannockburn 23/24 June 1314. In his preamble the author explains how to get there and where to stand to get the best views, he refers to the exhibition on site with its model of the battlefield plus the audio-visual account which is available. He explains who the Bruces' were, the political background, the build up to the battle and why it took place there; he describes the battle, the immediate aftermath and the political consequences. He illustrates the actual battle with a battle map for each of the two days showing the dispositions of the forces and with two aerial photographs with the dispositions super-imposed. To add colour to the account he includes a section of a mural showing an action scene of the battle. With book in hand one could visit the site and feel that one was there on the crucial two days.

The author must be congratulated on a fine achievement though I must admit to being a little puzzled by a simultaneous hardback and paperback release.

EEP

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