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CONTENTS

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THINK

or Thwim

Matth 22.42

THIS text and its graffito comment do not constitute a true alternative—one could compromise and float!

In the imperfect world in which we live straightforward alternatives are sometimes available but compromise is much more common. In recent years compromise has become a rather "dirty" word particularly in those fields where extreme positions are adopted in an attempt to ensure that the eventual solution is to the advantage of the more exaggerated first position. The most usual employment of the word compromise implies weakness—"coming to terms by giving up part of claim". One of the alternative meanings is of much greater importance—"adjustment of (between) conflicting opinions, courses, etc by modification of each". There is no suggestion of weakness in this definition, in this sense compromise is indicative of sound judgement.

From these opening paragraphs your attention is drawn to two pairs of words, "extreme positions" and "sound judgement". These are essentially incompatible. Above all other qualities the Military Engineer must be blessed with sound judgement. It would therefore appear reasonable to suppose that those who assume "extreme positions" are unlikely to be good Military Engineers. The situation is exacerbated because the extremists are generally vociferous, there is little point in being an extremist unless you wish to impress others with your extreme views!

One only has to listen-in at Conferences, Study Periods and Course Discussions to spot the extremist. The officer who believes that all artisan trade training is a waste of time which could be more usefully devoted to Combat training; the officer who believes that combat engineering is for the illiterate; the RSM who believes that bright young NCOs should have QMSI and RSM as their sole objectives; the Clerk of Works who believes that if one is incapable of learning a trade then combat engineering is the answer. "Technically arrogant", "Galloping Gas Fitters", "Slide Rule Cowboys", "Camberley Cavalry", "Latimer Layabouts", "Royal Engineers and Real Engineers", these are some of the terms bandied about by the extremists.

Do these extremists really believe what they say? Are the statements made solely for effect? To create an image? To gain a reputation as a character?

Some senior Members of the Institution have been known to say that the Corps seems to have lost the ability to produce "characters", those who did the unusual, who could be remembered, invariably with affection and admiration, years later. These genuine characters did not take up "extreme positions", they had the facility to be outrageous on occasions but they tempered this with "sound judgement", particularly in relation to time, place and audience. In fairness to younger Members it is more difficult to be a character in the mid-seventies. Before and between the two World Wars the pattern of normal behaviour was confined to a relatively narrow band, and there was ample scope for outrageous behaviour. Now the band is much wider, some would say too wide, and the opportunity to behave outrageously is correspondingly reduced.

Is it sound judgment to give the extremist respectability by referring to him as a character? Would it not be more accurate and honest to call him a menace to the Corps?

The extremist must be a divisive influence, to be devisive is damaging to the Corps. That the extremist views are genuinely held or are only expressed to create the image is beside the point. No lasting good can come out of extremism.

Think! Thwim!! or Thuffer!!! the choice is ours.

The Modern Airship and its Defence Application

MAJOR M W WREN, RE

MEETING OF INSTITUTION OF ROYAL ENGINEERS

A MEETING of The Institution of Royal Engineers, at Chattenden Study Centre on 5 February 1974, was attended by fifty-nine members and guests. The Chairman, Major-General Sir Gerald Duke KBE CB DSO BA CEng FICE DL, President of the Institution welcomed the guests and introduced the speaker.

PRESENTATION

So far as I know, the last lecture on this subject here at Chatham, was given by Colonel John Capper in May 1908. For those of you that were here on that occasion, I will try not to cover the same ground! However his lecture and mine have two important features in common. He was addressing an equivalent gathering and his aim was substantially the same. Let me quote him. He said "I am speaking with a view to stimulating the inventive faculties of those among you who may be inclined to make a serious study of a novel instrument of war." If you substitute the word "defence" for "war" you have my aim tonight in a nutshell.

John Capper had a big advantage over me. His audience already believed in the future of lighter-than-air flight. The best I can hope for is that you have open minds. I also have to remember that demonstrating an important defence application is not enough, the facts of life in 1974 are such that before any military application can be considered, commercial viability must be established. Although the case is overwhelming you would be surprised to know how difficult it has been to get to the stage at which we are today. There is a tremendous weight of ignorant prejudice through which we have had to smash our way. This has its roots in the past and I am going to have to tell you a little about it. Aviation is still an emotional subject and whereas the train and the lorry, or the ship and the hovercraft, can exist quite happily side by side, up to now this has not been so for the airship and the aeroplane. They have always seen each other as implacable enemies and since 1937 the aeroplane has had the upper hand.

I am often asked why, if the airship has so much to offer, nothing has been done all these years. In 1947 a special United States Senate Committee was set up to evaluate the commercial airship. Their report clearly establishes the case. Nevertheless it lies on a dusty shelf and no action has been taken. It seems that to fly is almost an end in itself. Since we have one effective method there is general unthinking acceptance of the notion that there is no need to develop others. We have allowed ourselves to become overawed by the technicalities of the aeroplane and are, as a result, blind to its limitations.

Both types of flying machine were originally developed for military purposes, by which I mean as military weapons. The aeroplane was eminently suitable and the airship was not. The aeroplane had such tremendous potential that by the late thirties, with war on the horizon, the aviation industry concentrated upon it to the exclusion of all else. Many people clung to the view that air-power alone could be decisive in war. The heavier-than-air industry received a tremendous boost from World War II and it has ridden on the crest of a wave ever since. In this country the aeroplane acquired a halo in the Battle of Britain (the name alone indicates the emotion involved) and it has been almost sacrilegious to question its supremacy. Furthermore it is a symbol of our technological prestige—we may not make the most but we certainly expect to make the best. I am not attacking the aeroplane—it has its place, but people are at last beginning to realize that it also has severe limitations, and there is a price beyond which we cannot go for speed alone. A price that has to be paid

not only in money but in environmental effects, consumption of natural resources, convenience, comfort, mental anguish and lives. There are many important applications for which the aeroplane is unsuitable, the mass movement of people and the carriage of large quantities of freight to give two examples. It is too dangerous and expensive for the wholesale movement of passengers—the public and the insurance underwriters are waiting with bated breath for the first Jumbo disaster[1]—and too small and difficult to operate for the wholesale movement of freight. Apart from the containerization revolution there has been no significant step forward in this field for thirty or forty years. The movement of large quantities of freight over long distances still takes a hell of a long time and it is not cheap.

If a large payload and technically sound airship can be built then its commercial future must be assured. In the wake of such development we will get it for military use. All the indications are that in the next three or four years just such a vessel will be flying and that before 1980 sizable fleets will begin to come into operation.

It may seem strange to you that an invention from the past, apparently a failure, is now to be resurrected and tried again. But when you think about it at all, you find that this is a surprisingly common phenomena and very often meets with startling success. A splendid example is the military rocket, which was tried and abandoned several times after its first appearance in the Peninsular War before reaching its present state of acceptability. The plain fact of the matter is that inventors are visionaries and deal with the future, whereas your down-to-earth engineer has to cope with the present. The airship, between 1900 and 1937 was beyond the technology of its time and yet, despite this, was much more of a success than people realize.

Most scepticism on this subject is based upon sketchy and inaccurate knowledge of airship history so I will take five minutes to put the record straight.

The significant incidents are the five major crashes, the *Shenandoah* in 1925, the *R101* in 1930, the *Akron* in 1933, the *Macon* in 1935 and the *Hindenburg* in 1937. Only three great airships avoided disaster during this last decade of development, the British *R100*, which had a very short flying life and the German-built *Los Angeles* and *Graf Zeppelin*. Five failures from eight attempts. If one uses these bald figures as a basis for assessment then one comes to the conclusion that the thing doesn't work; and this is precisely what has happened. In the thirties it was very easy to take this view for a powerful and compelling reason. At that time it cost over half a million pounds to build a large airship and money was very scarce. On the other hand the largest contemporary aeroplane cost less than £10,000 and so the financial risk in experimenting with it was within an acceptable order of magnitude. This was hardly the case with the airship no matter what promise it appeared to hold out.

But was the very high disaster rate the whole story? What caused the crashes? Was it the inherent unsoundness of the concept or was it inadequate technology or some other reason? A close study of the subject is necessary in order to find the answers to these questions. I have spent the last four years engaged in such a study and there is only one possible conclusion. The concept was and is entirely sound but the materials and the technology available before the war were inadequate. Let's take a quick look at these five major crashes.

The *Hindenburg* disaster occurred simply because it was filled with hydrogen. The reason it was so filled was purely political and unrelated to either the concept or the engineering connected with it. As a result of operating experience during the year before the disaster the *Hindenburg* had been modified to carry additional passengers, and was flying at a profit during 1937. The *Hindenburg* proved two things—the soundness of the concept when supported by adequate engineering, and the absolute necessity for an inert gas as the lifting agent.

The *R101* was a botch job from the beginning. It was under-powered, overweight, and filled with hydrogen. The design was much too ambitious for the current technology and when an impossible time-table was imposed upon it, for purely political reasons, the disaster that followed was inevitable. It was never tested in anything

but fine weather. Owing to serious miscalculations its disposable lift was only 60% of what it should have been. In order to overcome this the ship was cut in half and a new bay and gas bag were inserted. After this major modification only one trial was carried out, again in ideal weather conditions. The test was meant to last twenty-four hours and include speed trials but this proved impossible because one engine was defective and the trial was abandoned after sixteen-hours. Four days later, in stormy conditions, *R101* took off on the journey that was to end in disaster. None of the experts considered her to be airworthy and a provisional airworthiness certificate was only issued on the express orders of the Air Minister, Lord Thomson, himself. I am sure most of you will be as sorry as I was to learn that he was a Sapper, as indeed was the designer of *R101*. In fact when I am asked why I spend so much of my time arguing the case for the airship I usually say that it is because we, the Sappers, made such a hash of it last time that it is up to one of us to make amends now! The *R101* crashed because it was under-powered and the engineering inadequate. The crash became a disaster only because it was filled with hydrogen. None of these factors had anything to do with the concept.

The *Shenandoah* and the *Macon* crashes were the direct consequence of design faults that resulted in structural weakness. In both cases there was component failure under conditions of stress. The *Graf Zeppelin* survived far worse conditions on many occasions and came through unscathed or with only minor damage to the fabric of the outer cover.

The only one of the five crashes that bears comparison with a modern aircraft disaster was the one that concerned the *Akron*. In this case it was almost certainly caused by failure to adjust the altimeter in conditions of falling atmospheric pressure and, as a result, flying too low in bad weather.

What these disasters proved was that the correct lifting agent for airships was helium, and that the contemporary technology was barely up to the task of building a sufficiently robust and high-powered airship. Given that these problems could not be overcome at that time it would have been right to mark time until it became possible to do so.

What made no sense at all was to decide to abandon development altogether, an error compounded by the blind acceptance of this decision ever since, despite the change in the factors that effect it.

I have concentrated upon the disasters and shortcomings of the old airships because they are of considerable significance. The successes are also important, notably the transatlantic flights of *R34* which demonstrated how far ahead of the aeroplane the airship was in 1919. In the same year the German *Bodensee* demonstrated the ability of an airship to carry passengers on a commercial schedule, regardless of snow or fog, in a way that the aeroplane cannot match even today. Throughout the period 1928 to 1937 the *Graf Zeppelin* roamed the skies carrying out commercial operations and achieving some remarkable feats. Nevertheless it still had the same inherent faults as all the other airships of its time and could easily have come to the same end as the *Hindenburg* (an end that occurred in the full view of radio commentators and newsreel photographers giving the ill-informed press a spectacular picture on which to hang every airship story published ever since). The public believes that airships burn, they still believe it, and this has been a major factor holding up modern development. A Boeing 707 crashed outside Paris in July last year and burst into flames killing 122 people, but it did not make the front page of the *Telegraph* the following day. At the same time newspapers refer to the *Hindenburg* crash as a terrifying holocaust although only forty-one people, less than half those on board, were actually killed. Of these only twelve were fare-paying passengers—the first and last ever to be killed in an airship. Delag, the Company that operated the *Hindenburg* was the worlds first passenger carrying Airline and had been carrying them without injury since 1909. They built a total of six airships between the wars, and the *Hindenburg* was their only disaster. If the airship were judged by their performance alone, and if you take account of the fact that they knew helium was

necessary to replace hydrogen as the lifting agent but were unable, for political reasons, to obtain any from the Americans, then it can only be judged a resounding success.

I cannot afford to spend any more time on the past—I have too much to tell you about the present and the future—but I hope I have said enough to put it into perspective for you. The public's attitude to airships these last thirty-five years has been based on grave misconceptions fostered by sensation-seeking journalism.

What is an airship? There are three types, non-rigid or pressure (commonly known as the blimp), semi-rigid and rigid. The non-rigid is simply a gas bag which maintains its shape due to the pressure of the gas inside. The semi-rigid is a pressure ship with a rigid keel. *Europa* is a good example of the non-rigid and the US Navy had quite a number like this (some quite large), in service until the early sixties. There is a definite limit on the size and speed possible with the non- and semi-rigid and they can never be big enough to be truly efficient.

When I use the word airship, I mean a rigid airship which consists of a frame-work with the lift cells restrained inside, and an outer cover. There is no theoretical limit on the size that a rigid airship can be, although there may be a practical one. Size is all important because the lift varies with the volume of air displaced. The volume of course varies as the *cube* of the linear dimensions so that a small increase in the one gives a large increase in the other. So far as power is concerned, this is a function of the *square* of the linear dimensions since resistance to movement through the air is related to area. It follows therefore that as you increase the linear dimensions the lift increases at a greater rate than the power requirement and therefore you become more and more efficient, particularly when you add the fact that as you get larger the structure weight absorbs a smaller and smaller proportion of the total lift.

I am sure you can see where this leads us. If one is considering breaking into the freight market, all one has to do is to determine the price per ton-mile that fills the cargo hold. The basic design is then scaled up until the desired freight rate is reached. This is quite apart from the other advantages that the airship has over other forms of transport but I will go into these later.

I don't wish to give you the impression that there are no snags from the technical point of view. There are and it is as well to be aware of them.

The airship is a low level aircraft, the lower the better, because the density of the air it displaces decreases with height and so therefore does the lift. This is compensated for up to a point by starting with the lift cells not quite full and increasing your displacement as you rise due to the expansion of the gas in the cells with the decrease in atmospheric pressure. The height at which the cells are full is known as the pressure height and you cannot go above it without valving off gas, or building your lift cells to withstand pressure—the one solution being expensive in terms of money and the other in terms of structure weight. It is therefore a basic principle of commercial airship operation that the pressure height is not exceeded. If however it became possible to compress the helium in the lift cells at an effective rate the pressure height would lose its significance. Many experts say that this is not a practical proposition—but this is by no means certain. When airships begin to operate again I have no doubt that research and development programmes will investigate helium compression.

Like the aeroplane, the airship loses payload with range, due to the weight of fuel that has to be carried. On the other hand it gains lift with range due to the weight of fuel that is burned off. This can be either a disadvantage or an advantage depending on the difference in atmospheric conditions between the start and finish points of the journey. If the temperature is the same at both ends then when you arrive you will be light by an amount equal to the weight of fuel consumed. On the other hand, if it is hotter at your destination this is partly compensated for by the reduction in atmospheric density. Furthermore, increase in lift due to fuel consumption can be controlled in a number of ways that involve taking on water in flight and again helium compression sounds attractive. Now this is a fairly simple problem that can be greatly alleviated by good staff work. It can also be solved by using a fuel that has

approximately the same weight as air and several gases meet this specification. Because of the available space in an airship there is no problem on this score and safety requirements can be met by surrounding the fuel with helium.

The only major problems that exist concern landing, take off, and hovering in adverse wind conditions.

It is a popularly held misconception that because an airship when properly trimmed has no weight, is in fact lighter than air, that it is susceptible to the least breath of wind, rather like a feather. I am sure I don't need to point out to this audience that such a notion is quite false. An airship, capable of carrying 500 tons, which is the sort of size currently considered to be the likely standard, with about 600 tons of structure weight, has a total mass of some 1,100 tons and a mass of 1,100 tons has considerable inertia. The point is that there is some time lag between the change in the wind conditions and the airships reaction to them. This time lag can be further increased by the deployment of sensors around terminals which give advance warning of wind speed and direction thus enabling the amount and direction of thrust from the motors to be adjusted to compensate. This can be done accurately through the use of an on-board computer fed directly from the sensors. The problems inherent in this situation arise from three different sources.

The first is the complication caused by the shape of the airship. The bow must be kept into the wind if it is to hold steady and this means that when the wind is veering as well as gusting not only must the engines be swivelled to meet the changing conditions, but the whole ship must be turned this way and that, and when stationary this can only be done quickly on the engines, thus reducing the amount of power available to combat the wind.

The second is that in such conditions, due to buildings, the configuration of the ground and so on, there will be a vertical component of the wind which will give the airship a tendency to pitch. The pre-war vessels got over this problem by releasing ballast from one end or the other but we wish to avoid wasting payload by the carriage of too much water ballast and in any case do not consider the periodic drenching of the people below a particularly sophisticated procedure! The modern answer is to use power to overcome this problem but this of course means yet another drain on the power resources already heavily committed to combating the horizontal wind forces and turning the airship, all of which require thrust in different directions.

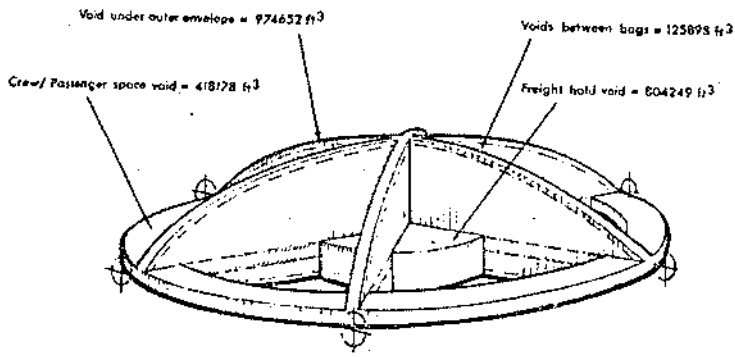
The third source of difficulty is the purely technical one of altering the direction of thrust rapidly. The airship is slow by aeroplane standards, 120 knots being the likely maximum speed, and this coupled with its low operating altitude effectively rules out the pure jet. On the other hand its great size enables the use of very large, highly efficient propellers, up to 27 ft in diameter, but the gyroscopic effect of such propellers turning at high speed is such that it will not be easy to alter the direction of thrust rapidly, although the amount can be changed quickly enough by varying the pitch.

There are a number of solutions to the problems of altering the direction of thrust. So far as horizontal changes are concerned the use of counter-rotating propellers will reduce the difficulty and the advanced warning given by the sensors will allow a fair amount of time. Research into the propeller problem is going on now and further research will be necessary to determine how far away the sensors can be and still provide reliable information and this will vary from location to location. It may even prove to be desirable to have a line of sensors in each direction each one giving finer and finer adjustments. A sensor 1 mile away gives two minutes warning of a 30 mph variation.

So far as a vertical gust is concerned, the nearer the airship is to the ground the less warning of its intensity, point of application and duration will there be, and the more rapid must be the reaction. However, the engine considered most appropriate by most of the British airship companies is the Rolls Royce Tyne which in addition to driving the props produces an appreciable amount of jet thrust which can be vectored through multidirectional nozzles, as on the Harrier, very quickly indeed.

If some other solution to the problem of keeping the bow into the wind can be found all the power produced by the propellers will be available for the main task of coping with the horizontal wind forces and provided this does not rise above the airships maximum speed the vessel will be able to maintain station.

The real answer to the problem of keeping the bow into the wind is to abandon the conventional cigar shape altogether and go for something that presents the same cross section from any angle. The design for a family of such airships is nearing completion and an artists impression of the smallest is shown in the photograph. The main features are self-evident, particularly the engines round the circumference.



SKYSHIP

The elevators for vertical control in flight will probably be free to move around the circumference on a rail so that the vessel can travel in any direction without having to turn the whole structure. This very interesting shape has all kinds of advantages in addition to the one I have already mentioned. It is strong, it is simple from a structural point of view, it allows a great deal of useable space for passengers and cargo and it is aerodynamically exciting. It is also significant that it is modern and forward looking. It can be put flat on the ground, very important when you realize that the entire hold—which may include some passenger lounges and bars—can be disconnected and left there. Each route will have one hold per terminal and one for each ship employed on the service. This feature allows the operators to take the container principle to its logical conclusion and makes for a very fast turn-round. No other large-scale cargo carrier can achieve such a feat.

This vessel is called the Skyship. I had expected to tell you a great deal more about it but the fuel crisis and the three-day week have caused delays in the programme, the wind tunnel tests for example, which should have been completed last month will not now be finished until mid-March. This displacement aircraft is expected to be ready for airworthiness tests in 1977 and will cost around £5 million. The standard version will have a payload of 500 tons over a 4,000-mile range.

The other new airship design currently available in this country is the CA4 produced by Cargo Airships Limited. This Company, now independent, was a subsidiary of Manchester Liners in the Furness Withy Group and they have been working steadily on the project for the last four years. Their designer has also come up with something new although it is not quite as advanced as Skyship.

The CA4 has a payload of 30 tons and is priced at a million pounds. It is intended for eventual use as a lighter to load and unload much larger versions which remain

in the hover for this operation and form what will be known as the Merchant Air Cargo Satellite System. This system is perhaps ten years away but in the meantime the small CA4 has a part to play in various specialized fields. Most of the tasks that can be carried out by a helicopter for example can be performed by the CA4 at a fraction of the cost. Furthermore, it can carry up to 300 people and again its costs are a very long way below those for an aeroplane with equivalent passenger-carrying capability. The important point here is that any airship has the space available to carry ten passengers to the ton whereas the best the aeroplane can manage is six or less. The construction of the CA4 is being negotiated now and the prototype will be in the air eighteen months from the time that the negotiations are brought to a successful conclusion.

These are two of the designs current in this country, there are others. Some of you may have seen one of them in the *Observer* early last month. What they all have in common is the acceptance of the basic specifications, a standard payload of around 500 tons and a speed of 100 knots or more. The main characteristics of the modern airship can be listed:

1 Helium filled.
2 New and original shapes.
3 Removeable holds.
4 Large power reserves.
5 Air speed between 100 and 190 knots.
6 Vertical take off and landing.
7 Quiet engines.
8 Large space/payload relationship.
9 Ability to load/discharge in the hover.
10 Flexibility of payload.

As I have already said, we are unlikely to get this machine for military use unless it is first established in the commercial field. I will therefore spend a few minutes explaining to you just why this is about to happen. World trade and international passenger movement are both increasing at a tremendous rate, apart from brief interludes like the last few months. The necessity for advanced planning of the vehicles and facilities to support this increase is now well recognized and future projects are being instituted against carefully drawn forecasts. Heathrow Airport is not saturated today although it is possible to predict with some degree of accuracy that it will be in the not too distant future. The cost, in terms of money and environmental damage, of building yet another airport is enormous and we all know the controversy that surrounds this particular proposal. There is also the cost of providing the additional aeroplanes to carry the extra passengers to take into account. Altogether the price of catering for the additional air traffic expected by the early eighties could be as high as £2,000 million. This problem could be solved by the use of modern airships for a fraction of that amount even if the most pessimistic forecasts for research and development costs are used. Furthermore the airship can carry ten times as many passengers as an aeroplane for a given quantity of fuel, and this aspect of the situation is beginning to assume greater and greater significance. These are the political arguments.

From a purely commercial point of view the case is overwhelming. Freight rates work out at about the same as those for a surface route that contains a sea leg of trans-atlantic proportions and considerably less as the land leg increases. For goods moving to and from UK to all destinations in the EEC freight rates can be considerably lower than those used at present, without taking into account the fact that delivery times will be as good as, or better than, those achieved by the present *air* cargo system. In other words the airship offers air cargo performance at surface rates.

When it comes to passengers the situation is also startling. On a long-range journey, say London to New York, schedule fares can be as low as £30 return, or Birmingham to Cologne for £10 return. For short haul passenger movement total journey time will be comparable with existing air movement and on the longer routes there isn't as much real difference as you would expect, although this will vary with the individual traveller. Take the business man for example travelling from London to New York.

If he travels by airship he will arrive thirty hours after leaving London ready for work, the comforts of the airship being comparable with any reasonable hotel. If he travels by aeroplane on the other hand, between leaving London and starting work in New York he will have completed the flight *and* made use of hotel accommodation; occupying a total of at least eighteen hours of his time. In other words at best he only saves twelve hours. However, the difference in cost will be well over £100 (if he is a first-class passenger it will be well over £200), and hardly worth it. Only if the business he is travelling to conduct is so urgent that it is to be dealt with as soon as he arrives is it worth his while to travel by aeroplane. In this case I imagine he would go by Concorde anyway—and I have more to say about Concorde in a moment.

The order of magnitude of air fares is extremely important because it limits the market at which the airlines can aim. You are all familiar with the recent spate of advertising for the special low air fares now available in certain circumstances. They are still sufficiently high only to be of use to the lone traveller. Most of us could probably scrape together the cheap fare to Australia, £300-odd isn't such a lot of money these days. But if we want to take our wives and one or more of our children —then the cost rapidly escalates to four figures and is no longer feasible. A real reduction in such fares does not just widen the net so far as the income groups that can take advantage of them are concerned, it also increases the number of people in each group who will travel. Suppose you had a wife and one child and had decided that you could afford to spend £300 on holiday travel. If you wanted to go to USA the fare would have to be £100 or less before you could consider it. The present average tourist fare on a normal schedule flight is around £210, and no matter how much it was reduced it would not affect you until it reached £100. When the fare stood at £110 the airlines wouldn't get a penny from you—reduce it by another ten and they get £300. I won't labour the point further, there are flaws in the argument, but in general there are points in the fare scale at which the flood gates tend to open and these points are sure to be within the range of possible airship charges. I know that it is possible to travel very cheaply on aeroplane by using charter flights but this is only possible if the fairly stringent conditions of the charter flight suit your requirement. Airlines use cheap charter flights to fill seats that would otherwise be empty, in the same way as the railways have cheap fares at awkward times. The airship will not have this problem because of its great flexibility and empty passenger seats will be made up for by extra cargo in the hold.

So much for the conventional fields, passengers and normal cargo. What about the other possibilities that are opened up by the introduction of a vessel with the characteristics I have described. If I succeed in firing your imaginations and you think at all about the subject in your bath, or wherever you do your thinking, you will find yourselves becoming aware of the mind-boggling possibilities without any prompting from me. I could rattle off a long list but I would rather leave it to you. Instead I will give just three examples of the kind of thing that can be done.

Last November there was a ship in Capetown with its holds filled with nuts destined for the UK Christmas trade. The value of the cargo was $2 million. Unfortunately the ship had a broken crank shaft and could go no further until it was replaced. There was no way in which a new crank shaft could be got to it in time using conventional transport. An airship fitted with heavy lift equipment could have delivered the necessary part in a matter of days; at almost any price it would have been worth it to the company concerned.

The second example takes me back to Concorde which I mentioned earlier. The trouble with Concorde is that the environmentalists have their fangs into it and it looks pretty sick at the moment. However a compromise is possible. If Concorde were to operate to and from coast terminals and these terminals were connected to city centres by a really rapid service the problem on the transatlantic route at least, would be solved. Provided the saucer shaped skyship is used, city centre terminals (bridge-like structures over rivers or railway stations), are possible. Such terminals, capable of handling one skyship an hour have been costed at around £20 million each

for Central London. A regular London/Paris schedule taking about two hours from the Thames to the Seine would put a Concorde coast terminal on either side of the Channel within an hour of the centre of either capital. A similar operation is possible at the American end of the route. Because there will be so much space on the sky-ship, on-board passenger processing will be normal, so that delays at the Concorde airport will be an absolute minimum, simply the time it will take to transfer from one aircraft to another. Such a system will give the fastest possible journey between European and American city centres. In fact there are other trans-ocean Concorde routes that can be dealt with in the same way, thus defeating some of the main arguments against it. This example well illustrates one of the basic principles of airship operation in the passenger carrying role—to make up for lack of airspeed by doing in flight that which with conventional aircraft has to be done before and after the actual journey.

The third special use that I wish to mention is in the field of disaster relief. As this is almost military application I will deal with it later.

When the first serious work was done on the airship, by Graf Von Zeppelin at the beginning of the century, it was with a military application in mind. When I started this evening I referred to John Capper's lecture in 1908. He saw the airship as a terrible instrument of war and like Von Zeppelin was thinking of it as a weapon. Let me quote you a short extract from what he said:—

"I wish to say a few words regarding the probable uses of a dirigible balloon in war; and here I can only speak, of course, from theory, and do not presume to lay down the law. It appears to me that we shall have to possess two different classes of vessels. The first will be the comparatively harmless small class of balloon to be used for scouting, and possibly for attempts at destroying, by high explosives or incendiary mixtures, important iron bridges or store depots close to the army or fortress; or for harassing the enemy by dropping a few bombs into his camps at night, and so keeping him constantly on the *qui vive*. The radius of action of such a balloon will be, perhaps, 100 or 150 miles.

"The second class (and the more important one if really seriously developed) may revolutionize the strategy of war. Large vessels of from 500,000 to 1,000,000 cu ft capacity, capable of travelling at a speed of 40 miles per hour in a calm, and of carrying considerable quantities of high explosives, can set out and, with a favourable wind, can cover vast distances in a few hours. When they will come, and what their objective will be, cannot possibly be known to the enemy, who cannot always be looking with guns ready pointed into the air; whilst they will pass over country so quickly as to be out of range almost as soon as seen. Keeping high up in the daytime and descending at night, they can keep their direction with practical certainty, and hovering close over any desired spot, may launch explosives with delay action fuses, which will enable them to retire to a safe distance before the explosion occurs; or they may even risk destruction to effect some notable exploit.

"Their objectives would be not the enemy's armies, but his dockyards, arsenals, storehouses, railway centres, etc, where the maximum degree of damage can be caused at a minimum of cost. Possibly they might even attack the enemy's navy if he has one; but probably the same effect would be produced in a more humane manner by merely destroying the docks, etc.

"There would appear to be but little difficulty in lodging the explosives with great accuracy if good plans are available to work by, whilst the expense, even should several airships be lost, would be insignificant."

That was the thinking when the rigid airship first took to the air and so it remained until the USS *Macon* plunged into the Pacific in 1935, ending an era of military development, first as a scout and bomber, just as John Capper predicted, and then purely as a naval scout, albeit equipped with its own aeroplanes that could land and take-off in flight.

In the first quarter of this century there was a tremendous amount of novel develop-

ment, particularly in the field of aviation, and we should not perhaps be too hard on our fathers and grandfathers for being so carried away with the technicalities of their machinery that they often misjudged its practical application. From a British point of view it was very fortunate that this was so during the first World War although in the second the boot was on the other foot. Let me explain, because it is relevant to modern defence applications.

During World War I the Germans were obsessed with the idea that the airship was a strategic bomber. It failed in this role due to the inadequacy of its navigational systems, and the invention of the incendiary bullet. It also failed as a naval scout in that war for the same reasons. Only once was a Zeppelin used in the role in which it could have been only too successful and this came about by accident and its significance overlooked.

In November 1917 LZ59, one of the latest airships, left Jamboli in Bulgaria bound for East Africa, carrying a cargo of essential stores for General Von Lettow Vorbeck's hard pressed forces. In fact British Intelligence became aware of this operation and by skilful use of phoney radio messages were able to cause the airship to turn back at the last minute. When it finally returned to its start point it had covered 4,200 miles non-stop and had been continuously airborne for ninety-five hours. This was a pretty impressive performance for 1917 but the point of the story is that here we had the airship being used in war in a role to which it was suited. Of course the relatively primitive zeppelins of 1917 were not really up to very long range movement on a grand scale, the East African trip took months to organize, but over short ranges it was a different matter.

If all the zeppelins that the Germans built during World War I had been used for strategic movement their effect upon that war might have been decisive. They could have had, by 1917, the capability of moving up to 50,000 troops from one point on the Western Front to another up to sixty or seventy miles away in under two hours. Using the zeppelin as a troop carrier behind their own lines, under cover of their own fighters, and or darkness, the Germans could have achieved a concentration of force at almost any point in the line that they cared to choose, building up at a rate that we could not hope to match. They could also have landed and maintained large numbers of troops behind our lines in an airborne operation had they only realized the potential of the zeppelin in this role. Fortunately they did not.

Had airship development been properly pursued between the wars, Britain, America and Germany at least could have had sizable fleets with payloads of up to 200 and 300 tons by 1939. Provided these had been used out of range of enemy fighter cover, even filled with hydrogen they would have been invaluable in World War II.

From our point of view, the route from Northern Ireland to North America was completely clear and the airship could have carried men and materials backwards and forwards at will—and what an effect this would have had on the battle of the Atlantic if it could have been done on a sufficient scale. The same thing applies to the reinforcement of North Africa and the Far East.

The thing to remember about the military airship is that it is only vulnerable if it can be attacked—and even then it is no more vulnerable than the ship. Since however, on most of the worlds oceans the sea-going ship was always vulnerable to the submarine and the surface raider the airship in fact had, and has, an enormous advantage—which we failed to exploit, through short-sightedness and a lack of imagination.

In recent history there are numerous situations upon which the military airship could have had a significant influence. Two good examples are the Malayan emergency in the early fifties and the Borneo affair in the middle sixties. So far as Malaya was concerned one can only speculate on what the tactical doctrine would have been but it is difficult to see how the terrorists could have survived as long as they did if every security force patrol had had the capability of massive reinforcement at an hour or two's notice, to mention just one of the possibilities.

In Borneo movement by air was absolutely basic to the operation. Almost everything that was moved anywhere was moved by aeroplane or helicopter and we were involved in a massive effort to build jungle airstrips, most of which couldn't take much more than a Twin Pioneer with a payload of a few tons; how different the situation would have been had we had at our disposal a few of the 500-ton monsters that I have been talking about; capable of carrying out resupply, reinforcement and tactical deployment from the hover. This application remains relevant and should such operations be required again it is to be hoped that we will have some airships at our disposal.

When it comes to a consideration of a major European conflict involving NATO and the Warsaw Pact the airship becomes extremely significant.

I am not suggesting that it should be used anywhere near the area of the battle, either in terms of distance or time. It is obvious to anyone that as soon as hostilities start it would be extremely vulnerable in all the areas in which we could wish to use it. It is "before the shooting starts" that it has its contribution to make.

It is no secret that the British and American Forces currently located in continental Europe would need considerable reinforcement before the outbreak of war, and as time goes on, whether for economic or political reasons, this is likely to become more and more the case. The main stumbling block to mutual balanced force reductions is the fact that Russia can put back what she takes out so much more quickly than Britain or America.

I would ask you to consider the problem of the large-scale movement of men, vehicles and stores into north-west Europe. At present this has to be done by ship or aeroplane to port or airfield and then by road or rail.

The limiting factor is the capacity of the ports and airfields, and then the road and rail systems that are available to us. Such reinforcement plans have to be extremely complicated in order to utilize the facilities to a maximum and complicated plans, that must include the use of bottlenecks like ports and airfields, are highly susceptible to disruption through sabotage and political agitation (both of which can be expected to be rife), during the period of tension that will precede hostilities. Even without disruption such plans will take a considerable time to complete and it is anyone's guess whether or not we will be allowed enough time before we reach a general war situation. Once the shooting does start we will have to fight with what we've got and further reinforcement may well be either impossible or too late.

The problem of time is central to the issue. The only thing one can bank on is that the political decision to start the ball rolling will be taken as late as possible since the prime political aim will almost certainly be to reduce tension and to placate the potential enemy, rather than to embark on a course of action that may provoke him. Furthermore since this is a national decision there may well be considerable variations which could lead to further difficulties. What happens for example if one country decides to go ahead with a military build up that necessitates the use of the transport facilities of another which has not yet taken the decision?

The solution to the problem is simple in theory. We can make a realistic assessment of the time that will be available and then deduce how many aeroplanes and how many airfields near our deployment areas will be needed. The snag is the airfields. The cost of providing what we would need to complete all our movement within the minimum time available to us—and this could be as little as five days—would be quite prohibitive—even assuming that suitable real estate would be available.

The only way it can be done at reasonable cost is through the use of airships—a fleet of fifty to sixty of them. Such a fleet could move all that we might have available to Northern Germany in three or four days.

Furthermore such movement could be direct from peacetime locations in UK to military training areas in Germany near their final deployment locations. Because of the great flexibility that the modern airship will have in the payload it can carry, integral movement of units and formations will be the norm. This will solve another

of the problems that occur during the functioning of a conventional movement plan —the loss of control over his formation that a commander suffers, and the delays he experiences, before becoming effective due to the non-arrival of key elements.

In terms of complete units one ship can carry two strategic reserve infantry battalions complete with their vehicles and equipment.

The advantages of military movement using this system are overwhelming. Everything can move from point to point avoiding all the bottlenecks on both sides of the channel (railway stations, airfields, and ports), arriving at its destination with its integral transport, so that the final leg of the journey to the deployment location can be completed without calling on local transport resources, already heavily committed. What then are the snags? I see only one of any importance, the "improvised" handling of these machines.

The principle on which an airship flies requires that it should be in a state of equilibrium in the air. This means that its weight must remain more or less constant and therefore it must carry ballast when not carrying a payload. To carry out any reinforcement plan involves return journeys with no payload, and therefore ballast must be provided. Furthermore, handling facilities will be required at each end of the journey and it would probably not be cost effective to provide these on a permanent basis at all possible terminals in peace time. These seem to me to be pure sapper problems, and as such are capable of solution by sappers.

Take the ballast problem first, and examine the sequence of events. There will be the initial journey by the airship from its civil base to the first pickup point, say Colchester, under ballast. This ballast will almost certainly be water and so the first problem is its disposal at Colchester. It then takes on its payload and flies to say Sennelager where this payload must be exchanged for 500 tons of ballast—again I suggest it would be water. When this system becomes part of the plans I have no doubt that the necessary total quantity of water will constantly be available at the many possible unloading sites in Germany. If these can be located near lakes or rivers the problem is greatly simplified. Remember the water does not need to be clean or fresh, although one must bear in mind its disposal at the other end.

In addition to the problem of providing ballast there is the question of handling these monsters in the various locations, and this will undoubtedly call for special equipment and specialist teams. So far as routine civilian handling is concerned, at permanent terminals, the present plan is to winch the ship down to its dock making use of modern techniques in guided missilry and remote controlled drones for the rapid location of the hawsers. When it comes to emergency use improvised or temporary facilities will be required. However, the engines can provide up to sixty tons of downward thrust, depending on meteorological conditions so that some items of equipment can be unloaded from the ship before the taking on of ballast becomes essential.

The techniques, equipment, and trained specialist teams may well find employment on peacetime tasks since the modern airship is ideally suited to the movement of sapper units and their equipment to most of the projects in out-of-the-way places that currently come our way. It is fairly obvious that it will greatly increase our range in this respect and in most cases the handling specialist teams and their equipment will be required. This is where there is a tie-up between defence requirements and disaster relief since a skyship could place a fully equipped hospital in the centre of a disaster area anywhere in the world within four days, and usually in considerably less, provided specialist handling teams and their equipment, were available.

So much for strategic movement and its spin-offs. The other defence application for the modern airship is in the field of anti-submarine warfare and this too may be of the utmost significance.

Very few people seem to realize that, in World War II, the United States Navy had a large fleet of non-rigid airships for this very purpose, a total of 145 being in commission between 1941 and April 1944. Considering their record it is surprising that so little is known of them. They operated off the East and West coasts of the

United States on mine-sweeping tasks in conjunction with surface ships, and as convoy escorts. The airships in the fleet made 55,900 operational flights logging 550,000 flying hours. They escorted 89,000 surface craft and although a total of 532 ships were sunk in American waters not one was sunk by mine or torpedo when an airship was in attendance. Each airship averaged ten flying hours a day and operational availability never fell below 87%. One Atlantic Squadron, in existence from 1 November 1942 to 15 May 1945 flew on every one of the 926 consecutive days. In June 1944 a squadron flew the Atlantic to patrol the Straights of Gibraltar and from that moment no U-boat passed the Straights without being detected and destroyed. Their success can be attributed to their unique ability to fly slowly or hover low over the sea in all weathers and at night, their ability to operate from any service airfield using only a small transportable mast and their endurance and unrivalled degree of serviceability. So far as I have been able to ascertain they suffered no casualties themselves throughout the war. I think you will agree that this is a remarkable record. It was most unfortunate that these blimps did not have the range to cover the whole of the Atlantic route. Had the development of the large "rigid" been properly pursued it would have been a different story. Complete coverage of the route by anti-submarine airships, plus a reduced number of ships in the convoys if cargo carrying airships had also been used, and the battle of the Atlantic would have been no contest.

Today the submarine is again significant because of the long endurance possible using nuclear power and its armoury of long-range missiles. Again the airship provides the answer to the problem. A naval airship, confined to operating over the sea could certainly have nuclear motors and thus match the submarine for endurance. Given the money (and I suggest its cheap at the price), every potentially hostile missile-carrying submarine could have its attendant shadow, permanently poised to destroy it at the first indication that its missiles are being fired. All this is well within the capabilities of current technology.

Well there it is, the modern airship and its application to defence. The pressure for its introduction is mounting rapidly and this country has a good chance of being the leader in the field. As soon as there is general acceptance of the very reasonable proposition that there is more than one way to fly progress will be rapid. This machine, large though it is, is much simpler to design and build than an aeroplane, and it will be able to achieve the same sort of timetable as a ship, in other words about three years from drawing board to operation. Unless some completely unforeseen difficulty crops up I have no doubt that by 1977 you will see at least one of the machines I have described in the skies over this country.

I hope I have succeeded in opening your minds to the enormous possibilities of this exciting, too long neglected, form of transport.

REPORT ON DISCUSSION

The discussion was almost entirely devoted to technical and commercial considerations. There was little doubt that commercial viability was accepted as the first essential.

The size of the airship to carry a 500 ton payload was estimated as a 680 ft diameter saucer or a 1,300 ft long cigar. Although the airship would be lighter-than-air it would not behave like a "feather". The Skyship design presented exiting possibilities from an aerodynamic point of view and offered considerable opportunity for overcoming drag problems. The aerodynamic shape of the saucer would give "lift". A major advantage of the saucer would be that this potential lift could be used as a fine tuning device and this would improve control. There were problems in the control field but none were insoluble. The ability to manoeuvre the ship, its response to controls, were discussed at some length. The power to mass response was important. The size and weight of the ship would of course damp down many of the minor weather and wind changes but power (some 30–40,000 horsepower) was available when required.

Pressure height had been explained but no indication had been given as to just what height was being considered. It would of course be dependent on the climatic conditions but in general terms a conventional cigar shaped ship would have a pressure height of about 3,500 ft but the saucer-shaped ship would have a pressure height of 6–7,000 ft. These relatively low operating heights could be a cause for concern. It was accepted that away from the existing airports there was no real problem as aeroplanes operated at a much greater height. In the early stages, that is until airships had re-established themselves, it would be necessary to operate them well away from high-density aeroplane air traffic. However once the airship was established the position would change. Which aircraft would be given priority, a Skyship carrying up to 3,000 or an aeroplane carrying up to 500? Only time would tell! It must be remembered that any airship can stop, hover, or even fly backwards and it may be that the aeroplane will always take precedence into airfields, regardless of the number of people involved, because of its much smaller margin for error and greater inflexibility. It was accepted that operations would be away from the existing airports in the early stage then the construction of new airship terminals would be essential. No one in the airship business is considering using conventional airfields, except for the small blimps like Europa. Airship requirements are quite different from those necessary for aeroplanes. The construction of Skyship terminals are an integral part of the plan and the cost of these is included in operating costs. Traditionally the cigar-shaped airship had used mooring masts. In the future this would not necessarily be the case (although there was nothing really wrong with the mast concept), for the saucer-shaped skyship a mast is not required. To take full advantage of the saucer shape the two normal modes would be the "hover" and the "winch down and anchor" methods. This gave great flexibility and reduced the terminal facilities required. It was anticipated that the minimum size for a simple freight terminal will be about 50 acres, and a small freight and passenger terminal about 100 acres, assuming one ship at a time. When more than one ship is on the ground at once a general planning figure of 50 acres per ship was contemplated. The actual landing pad would be some 8 or 9 acres. This area with a little "sappering" would be all that was really needed in the early stages. The degree of sophistication required was largely dependent on the "inboard" facilities provided on the airship.

The discussion moved on to the question of capacity. Was it fair to talk about capacity or pay load without consideration of turn-round, speed through the air and the number of pay load trips in a given period? It wasn't really fair but this was an over-simplification of the problem as flexibility and demand were equally important considerations. The ability to carry 100 passengers six times a day could be compared with 600 capacity once a day only if 600 people wished to travel that route. However, the extremely low fares gave considerable incentive (a quarter of current air fares). The ability of the airship to fill up with freight (of large physical size and low density), to utilize its pay load capacity should not be ignored, and a completely variable mix of passengers and freight is expected to be normal for the Skyship.

Routing would be vital for successful airship operation. Wind speed in particular would affect speed over the ground. It was accepted that the quickest route between two points would seldom be the spherical trigonometric "straight line". It was of interest to note that in one particular part of the Arctic Ocean for example, statistics showed that the wind, at heights between 3–6,000 ft, was less than 30 mph for 95% of the time.

Temperature variations did present problems, they were capable of solution now, the real problem was which method would be the most effective and efficient. The final solution must await operational trials. As had been indicated in the paper, one method would involve heating the helium under certain circumstances and compressing it under others. The Skyship would contain some 50 million cu ft of helium, to compress a significant proportion of this at a sufficient rate to be effective would require a lot of energy. Against this of course one could lay off the advantage of not

having to travel "in ballast". "Ballast" was an anathema to anyone concerned with overall efficiency.

"Blimps" were still being built in Germany and had a capacity of about 2 tons at present. West Deutch Luftwerbung are planning versions with pay loads up to 30 tons. The most optimistic possibility envisaged was in the order of 100 tons capacity which would require a maximum length of about 600 ft. Beyond this the chances of "hogging" was very real. Rigid cigar shapes could of course be bigger. The use of containers, hence the utilization of the advantage of containerization, was obviously a sound proposition. It was essential however that potential customers made their requirements known in the early stages so that the basic design could be "right first time". This is particularly true of the Services if they want Skyship to carry tanks for example. In the early years it was fairly probable that low density commercial loads would be the most likely.

Although Skyship was a new conception the maximum use would be made of proven techniques, proven ancillaries and proven engines. Those may not be the most advantageous in the long term but it was essential that as few problems as possible should be built into the first ships. Even with this approach it was anticipated that at least 35 % of the all-up weight would be available as pay-load. Future engines would need very careful thought, no possibility would be ruled out, jet diesel and gas all had possibilities. Gas in particular had very attractive advantages as had been explained. In the long term central engines with the power transmitted to the propulsion units, probably by hydraulics, seemed a real possibility.

It was agreed that the skin of any airship would be exposed to the elements 24 hrs a day, it was unlikely that "hangar" space would be economically practicable or indeed necessary. The problem of corrosion was therefore real, as it is with an aeroplane. The probable answer was that the outer fabric would have to be replaced periodically.

Insurance was presenting no problems. The Insurance Companies appreciated that basically the airship was a safe ship, if in trouble it could stay aloft whilst repairs were carried out (unlike an aeroplane!). It is even possible to deliver spare parts by helicopter should this prove necessary in an emergency. The only real risk with a helium-filled Skyship was the chance of an aeroplane ploughing through it!

Among the many who took part in the discussion were: Lieut-Colonel A Harris (of Imperial College), Dr Rogers (of Aerodynamics Department, RAF Farnborough), Captain Stanley, RN (of Vice Chief of Naval Staff), Major Edwards (of Army Aviation), Major-General Tickell, Brigadier Purser, Colonels Bird and Coombe, Lieut-Colonel Peacey, Major Storr and Captain Bradbury.

1. Editor's Note: This has now happened, on 3 March 1974, when as many people were killed in one DC10 as in all the airships of the past put together.

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THE BIBLE ON MINEFIELDS

Extract from *The Maple Leaf*, Canadian Army Service paper (Italy edition)

THEY talk of King's Regulations, Canadian, as the barrack-room lawyer's bible. We are a bit surprised this week to learn that for a group of engineers their Bible is actually The Bible. The group of Canadian sappers makes good use of it, too. Recently they looked for a suitable warning to place in a field sown with German mines. Their choice:

"Ponder the path of thy feet, and let all thy ways be established. Turn not to the right hand nor to the left: remove thy feet from evil"—Prov 4:26–27.

The sign was the work of the Company Sergeant Major.

JLM

The Indian Sappers and Miners Some Aspects

FOREWORD AND PART ONE

COLONEL P A EASTON, OBE

FOREWORD

A QUERY from the RE Association is the real cause for this series of articles. "Why cannot the widow of an officer, late of the Royal Indian Engineers, be assisted from the funds of one of the late Corps of Indian Sappers and Miners? After all, they were all RIE." Having given a reasonably satisfactory reply it seemed that a short article in the *RE Journal* would clear up the matter. "Not so," said the Editor, "no short article, but a series of three or four." He was right, of course. One article could not possibly cover the history of these three proud Corps, indeed it is doubtful if three or four would suffice, it is for this reason that the articles are limited to "some aspects" only.

A mere recital of important dates, accounts of the deeds of each of the three Corps, in campaigns and so on, would seem dry and almost irrelevant and, again, there is in the Corps Library a copy of *The Indian Sappers and Miners* by the late Lieut-Colonel E W C Sandes, which describes in some detail the history of the three Corps as well as giving accounts and histories of the many campaigns in which the three Corps partook. In fact, wherever the Indian Army was in action there were Sappers and Miners to be found. And it is a matter of interest that the Corps of Indian Engineers now carry the Hindi equivalent of "Ubique" in Hindi script below their Sappers' grenade.

Any account of the three Corps must go deeper than a mere history. Then the thought arose "What were we told when we first arrived in the Sappers and Miners?" I remembered that I had been "told off" for not bringing a lighted hurricane lamp to dinner on the first night on account of the fear of snakes and that also, as we were allowed two chargers, to play polo was well within the grasp of a junior officer. Of any account of India or the Indian Army I could recall nothing. I then made a vow. Should I ever be in the position where newly-arrived subalterns would be serving under me, I would try to introduce them to some degree into the customs and problems of their men. This actually happened in the War when I subjected several newly-arrived young officers to talks on the subject. They actually told me that they were of great use.

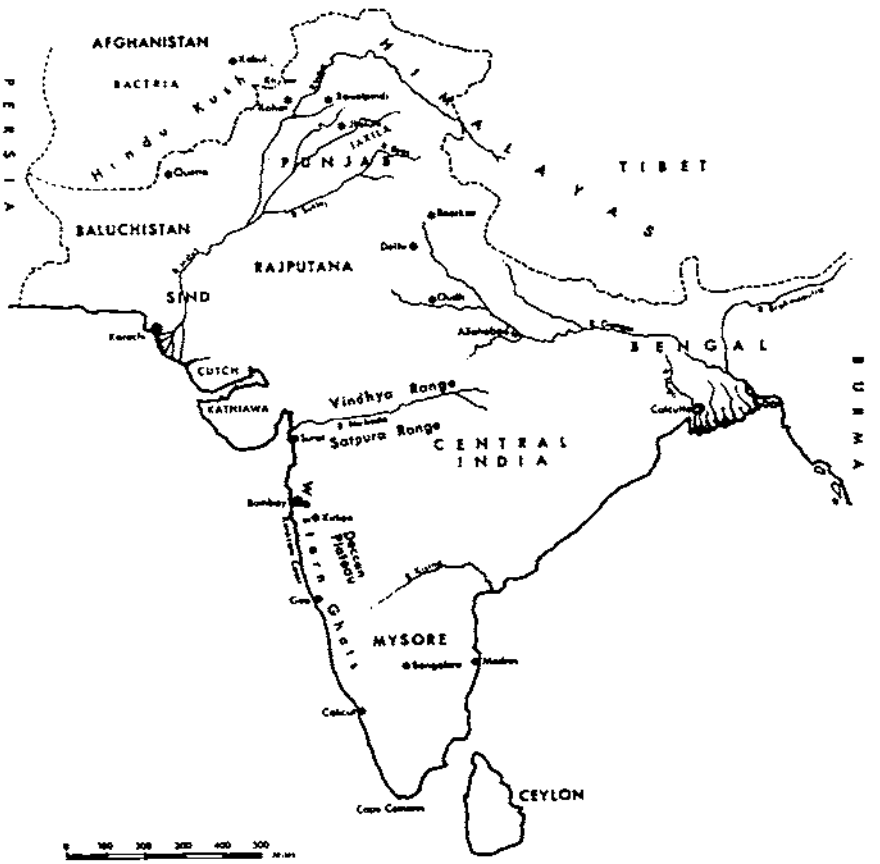
PART I

After an inspection of the map it is often difficult to realize that one has not been looking at a country, occupied by one homogeneous nation, but at a vast country, containing races of many different origins, many of which were enlisted in the Indian Army. Some regiments only enlisted one class or race, such as the Gurkha Regiments. Others were composed of men from two or three races. But the three Corps of Sappers and Miners, taken as a whole, although each was restricted to certain classes, drew from races of such dissimilar origin as Pathans from the North West Frontier, Madrassies from the south of the Peninsula, Mussulmans from the Punjab and Mahrattas from the Deccan Plateau and the Konkani Coast. Differing in many ways; creed, appearance and custom, it is important that some account of their origin be considered, especially as many are descendants of those invaders of India who either settled in the country or withdrew, leaving behind small settlements.

In name only the three Corps recall the old "John Company" as each bears the name of its original Presidency in its title. Each Presidency had its own army with its own engineers. For many reasons there was never any idea that there would be one Corps of Indian Engineers in the accepted sense. The three Corps remained independent of each other, each with its own headquarters and the like. After various

changes of location they eventually established their homes at Bangalore (Madras), Roorkee (Bengal) and at Kirkee (Bombay). In each centre were the institutions that go to make the home of a Corps; War Memorials, Officers' Messes, central places of worship for the various religions of the men, family welfare centres and the like; all of which contributed to the great family spirit in each of the three Corps. This spirit occasionally reappears in the *RE Supplement* by the announcement of some function for the British Officers, who served with one of the three Corps. And a spirit which has lasted; as those, who have had the good fortune to visit any of the three Groups of the Indian Sappers of today, must surely have found to be strongly emphasized.

As will be seen later; the British made three "firm bases" on the seaboard of India where they established three Presidencies; Bengal, Madras and Bombay. The purpose of these posts was initially purely for trading in India and with the East Indies. Each post was entirely independent in the early days but each found it necessary to have a small force for local defence and as these "private armies" developed some technical troops were found to be essential. From these early beginnings sprang the three Corps of Sappers and Miners which still bear the names of the three presidencies. In these early days only local Indians were enrolled for filling the ranks of, first, Pioneers, and later, Sappers and Miners. Later, these three armies developed and eventually were amalgmated into One Indian Army where



definite recruiting grounds were allotted, covering most of the Indian sub-continent.

To examine the origin and development of any army unit in a great country as "India of the Raj" some delving into history and even into geographical factors is inescapable. Again: in order to obtain a fair idea of Time and Space a comparison of the size of the country with that of, say, the United Kingdom should be made by a careful look in an atlas. In these days of air travel it is difficult to appreciate fully that a train journey from Bombay to Delhi took twenty-four hours; and a rail journey from Bombay to the Frontier required three days and two nights. Indeed; the author, when travelling by "passenger train" with his company, once spent five nights and nearly six days when travelling from Kohat in the North West Frontier Province to Kirkee. And that was in the days of Peace. But this slow rate of travel had its compensations to any one who was interested in the country. In gazing through the window one was able to note the change in habits, methods of agriculture, dress and customs; such factors that always played a great part in the life of the Indian Sapper.

But back to geography. A brief glance at an atlas will immediately reveal that the India of the time of the Raj was both a continent and a peninsula. The continental portion consisted of the great plains, formed by the basins of the two mighty rivers, the Indus and the Ganges, and is mainly tropical in nature. The Peninsula portion, almost equal in area to the continental portion, is for the major part of its area covered by the deforested area of the great plateau of the Deccan. South of the Deccan Plateau is a tropical tip to the peninsula, terminating at Cape Cormorin.

For centuries the vast and extensive range of the Himalayas in the north with its high passes proved an effective barrier, difficult to negotiate in the summer due to great heights and almost impassable in winter due to the cold and the depth of the snow. But the defensive was not the only advantage of this great range. Without the melting of its snows in the spring, there would not be the water in the two great rivers which make these plains so rich and fertile.

To the north west the Hindu Kush mountains again provide an obstacle, but not of the width or height of the Himalayas. In this range are negotiable passes such as the Khyber and the Bolan, through which have come invaders of the subcontinent over the ages. History discloses no invasions through the tropical jungles of the north east which were considered to be impenetrable until the Japanese proved this to be otherwise in World War II.

For numbers of years the hills and rivers of Central India, the Satpura and Vindhya ranges, covered with thick scrub and jungle, proved a formidable barrier between the rich plains of the north and the Deccan Plateau and the lands to the south. Savage and warlike occupants again increased the difficulties of transit between north and south.

Facing the fury of the South West Monsoon and its accompanying rains the Western Ghats form a steep scarp on their western side between a narrow and fertile coastal plain and the higher broad and arid plains of the Deccan Plateau with its flat-topped and steep-sided barren hills and deep pockets of black cotton soil. Entirely dependant upon the South West Monsoon for its irrigation the Plateau has an unreliable rainfall, often the cause of poor harvests and even famine.

Little is known of the history of India until the middle of the seventh century BC, the earliest known literature being in the Sanskrit, Pali or Tamil languages. V A Smith in his "Oxford History of India" states that from the earliest times there had been a distinction between the peoples of the north and those of the south, and that the dividing line was approximately the hill and jungle area of Central India. He found that it was not possible to say who were the earliest inhabitants, those in the north or in the south; but he distinguished between the fairer races and the short and dark type; most of the fairer types, originating from the north west and resembling the Afghan, the Persian or the Turks from Central Asia. These distinctions could still be seen between the different classes, enrolled into the Indian Army up to the time of Partition of India.

India for many centuries sustained invasions and the earliest invaders appear to be the Peoples of the Rig Veda hymns, who called themselves Aryans and who in appearance were sharply separate from non-Aryan groups. Roughly between 2400 BC and 1500 BC these early arrivals slowly worked their way easterly through the Punjab, along the Indus and then along the Ganges as far as Allahabad (Prayag), establishing themselves in the rich Indo-Ganges Plains, only later making an effective progress south through the difficult hilly tracts of Central India.

About 480 BC the riches of the Northern Plains of India had become known abroad and the great Darius of Persia sent a reconnaissance party to test the feasibility of a sea passage from Persia to the mouths of the Indus, annexing the Indus valley as his twentieth satrapy.

By now it seems clear that there was a settled kingdom in the plains of the north. Undoubtedly there is evidence of a large population in the year 326 BC. When Alexander the Great conquered the army of Poros at the battle of Hydaspes (Jhelum) the latter's army is said to have included over 30,000 infantry, 4,000 cavalry and 200 mighty war elephants. Alexander continued to advance to the Beas but was forced to withdraw through Upper Sind as his troops refused to go farther from home. At first sight this invasion by Alexander might only appear to be one more episode in the country's history. But its fact is more important in that it effectively marks the break-down of the wall of separation between India and the West through Baluchistan and Afghanistan. A further result of the invasion by Alexander the Great was that in his withdrawal from the Northern Plains his armies left behind small settlements which still to this day appear as small pockets of people in the Punjab of Greek origin. Alexander had made a temporary headquarters in Taxila. When visiting the homes of Punjabi Mussulman sappers in that area the author was told of many discoveries of broken pottery of those times that were brought to light when ploughing their fields.

Meanwhile the Hindu religion with its system of castes was slowly extending to the east and as far south as the Central India barrier. And it was about this time that the two new religions of Buddhism and Jainism also began to make themselves felt among the peoples of the Northern Plains. To the south of the peninsula the Dravidian religion flourished with a completely different social system from that of the north. Caste was practically unknown and the religion was a form of Demon worship. Slowly, however, as the Aryan religion with its customs and habits began to percolate to the south the original demons were adopted by the Brahmans and were both given names and identified with orthodox Hindu worship.

Ancient Tamil literature shows that at this time in the south of the peninsula there were wealthy cities with such riches as gold, pearls, pepper, and cotton goods, which attracted traders from across the seas. The ancient Dravidians too had no prejudice against sailing on the high seas.

It was still the era of invasions in the north and in 206 BC the son of a king of Bactria captured both the Punjab and Sindh. Fifty years later again there was a determined attempt by the Greek, Manander, who attempted to emulate Alexander. But by now Northern India was more organized and this Greek king beat a hasty retreat. Although of lesser importance this invasion was the last from Europe until the attempt by Vasco de Gama in AD 1520. It was, however, by no means the last invasion as the news of the riches of the plains of India had extended north into greater Asia. Two tribes, the Sakas and the Yeu Chi, overwhelmed Bactria and forced their way from the north west, penetrating as far south as Mathura and as far west as Kathiawar, where a dynasty was founded.

History now makes a jump to the beginning of the fourth century AD when was founded the great Gupta Empire, which flourished in the north for the next century and a half. A remark by Miss F M Steel in her "India through the Ages" is pertinent: "For India in those days was far more civilized than Europe; its peoples were refined, bound hand and foot by ritual and curiously conventional in custom". But this empire and its successors remained in the north only, whereas in the south or the

Peninsula of India there were separate kingdoms in the Deccan and further south in the peninsula which had little or no contact with those of the north.

In the middle of the fifth century AD there were more invasions and now by the Huns from Asia and, in particular, the White Huns, accompanied by Gurjaras and other tribes. And there is some belief that these invaders were the progenitors of some Rajput, Jat, Gujar and other classes or tribes, many of whom were enlisted in the India Army. Swarming through the passes of the North West Frontier, the Huns virtually occupied Northern India, which became a province of the Hun Empire.

In addition to war from invasion there were of course many internal wars within the Northern India, between kingdom and kingdom, usurpers and occupants of the various thrones. But this account is restricted to the arrivals of invaders because their settlement in the Punjab and the United Provinces would appear to account for the fair complexion of their inhabitants, free from any Mongolian features except in Himalayan and sub-Himalayan tracts.

There was now a lull from major invasions until the middle of the eighth century AD when Mohammedan settlers began to arrive and the Arab conquest of Sindh took place. But it was the beginning of the tenth century AD which really marked the beginning of the Mohammedan age and the end of the Hindu period. The great Mahmud of Ghazni with his Mohammedan armies came from the north west and from the closing years of the following century there appears to have been a systematic and successful endeavour to convert much of the population of the Punjab to Islam. Many Punjabi Mussulman tribes to this day claim descent from Rajput and other tribes that were converted to Islam during a long rein of terror. Indeed, when visiting one of these tribes in the Punjab the author was shown the tomb of the tribe's old Hindu saint where annually a pilgrimage continued to be made.

Early efforts were made to "mohamedanize" the southern or peninsula portion of the sub-continent. The barrier of the Central Indian hills had been pierced and some infiltration from the north took place. The kingdom of Vijaynagar effectively stemmed the tide of conversion by some bloody wars, but in the fourteenth century AD the Bahamani dynasty was founded which covered the majority of the Deccan Plateau and the Konkani coast. But complete conversion proved to be a failure and this dynasty which once ruled the Deccan broke up into five independent sultanates of Bijapur, Bihar, Berar, Golkonda and Ahmednagar.

The Mohammedan can be said to be the last of the invaders of India until the arrival of the Europeans in the sixteenth century. But in his endeavours to stem the Mohammedan invasion from the north a Deccan king engaged mercenaries from Abyssinia, whose descendants can be traced until the present day.

We have now seen the extent of the Aryan invasion from which rose a Brahaminical form of religion, which was at times influenced by the intrusion of Buddhism. After the invasion by the White Huns, when a prolonged state of anarchy existed, there was a return of the orthodox type of Hinduism, which in turn suffered from the Mussulman invasion when forcible conversion to Islam took place in the north. As the Mahomedan influence increased and slowly became firmly established in the Northern Plains and in Bengal the whole area became the geat Mogul Empire by the end of the twelfth century.

The last invasion was now at hand and in 1498 Vasco da Gama arrived at Calicut and in the following century the Portuguese began to establish trading posts on the west coast, including the island of Bombay.

By the middle of the sixteenth century the situation on the sub-continent was roughly as follows. Those states on the Himalayas were entirely free from any Mogul influence. The provinces of Bengal, Bihar and Orissa, which had been part of the Mogul Empire, were now an independency under an Afghan Prince. The Mogul Empire under the mighty Akbar included the Punjab as far west as Multan and included the rich basins of the Ganges and the Jumna rivers as far as Allahabad (Prayag). To the west the states of Rajupatana were independent and a Muslim dynasty ruled in Gujerat. The Deccan states and Mysore were again independent

while the kingdom of Vijaynagar occupied most of the country south of the river Krishna. On the west coast a few small settlements were occupied by the Portuguese. The scene was now set for the arrival of the Dutch, the French and the British.

It might well be asked—"What has the above to do with the Indian Sapper and Miner?" To know one's men it helps to know their background. The Indian Sapper was drawn from races with different histories and antecedents. By some knowledge of the history of individual classes and tribes it is more easy to understand the complexities in customs and habits and so to resolve the peculiar problems, that occasionally came before commanders of Indian Sappers.

What? When? Where? Which? Who? Why? = W^6 ?

IN the March 74 issue of the *Journal*, MLC (in his "Early Days"), suggested that the return of puzzles and problems might interest Members. Like the traditional bigamist your Editor will try anything twice!

The photograph which follows, Problem 1, depicts an incident in the last half century of Corps activities. You are invited to deduce W^6? (or ^{5}? or ^{4}? or ^{3}? or ^{2}? or ^{1}?). A selection of (printable) replies will be published with the solution in a subsequent issue. Problem 2 will appear in the September *Journal*.

No 3 et seq depends on the acquisition of a suitable problem photograph (accompanied by the solution!)

Problem Photograph 1:

What?

When?

Why?

Where?

Which?

Who?

The Indian Sappers and Miners- some aspects

Holdfast Foxhounds I

LIEUT-COLONEL J R ALFORD, RE, BA

"Making war on a rebellion is slow and messy—like eating soup with a knife"
T E Lawrence

Introduction

IT is a little surprising that no article has appeared in this *Journal* at any time concerning Sappers in the Infantry role in Northern Ireland. This may be because the very many Sapper officers who have served as infantrymen are too busy or too lazy to write about their experiences or it may be that everybody is so heartily bored by the whole business that those who might have considered writing such an article were dissuaded from doing so by their fellow officers on the grounds that far too much had been written about Ulster anyway.

However I took the trouble, before committing myself wholly to the project, to ask the Editor whether he would welcome some reflections on what it is like to be, temporarily at least, an Infantry CO. His reply was encouraging. Deeply conscious that I am only one of a number who might equally well have written such an article, I intend to give my impressions of a tour in Belfast and the training and preparation for that tour while it is all fairly fresh in my mind. I will try to avoid both political judgements and the introduction of anything that might be considered actionable if it got into the wrong hands. I shall also assume that all have by now a general understanding of the issues involved and I shall confine myself to East Belfast and some of its specific issues where those seem to me to illustrate a general trend or problem. In any case, by the time this goes to press any political statements are almost certain to have been turned on their heads by circumstance so it would be most unwise to make them. I shall instead try to give an impression of what it is like being that rather lonely man—a CO in Belfast.

I had intended to write one article but it became two for both the training issues and the tour itself grew into full articles. This article will take us to the point at which we actually deployed and is concerned almost exclusively with the quite complicated business of reorganizing a Regiment for the Infantry role and with the training of the individual and the group. A second article will cover the four months spent in East Belfast.

Preliminary Planning

We were in Belfast from the end of July to the end of November 1973. In doing any time appreciation, it is best to work backwards in order to decide when to start doing something. In our assessment, we were bound to allow about two weeks at the end for final preparations for the air move and for getting away the Advance Parties—this included a few days leave over the last weekend. We were also bound to include the two weeks during which the Intensive Training Centre was allocated to us. I considered—after seeking the advice of those that had gone down the road before us—that a further six weeks would be needed to allow the soldier to learn all that he had to learn and practise all that he had to practise. This added up to ten weeks and takes us back to the middle of May. If you then add in a period of putting to bed all the machines that we were not going to need for the rest of the year and a period of block leave over Easter, we were back into March or thereabouts. All BAOR training in 1973 had to stop by the end of March which does not give one very long in which to maintain one's professional standards as combat engineers. I stress this point because the timing of the tour affects the whole question of converting and re-training on return. In many ways a tour timed to run from July to November is the worst from this point of view and we lost effectively almost 18 months in which training for our primary role was impossible: from October 1972 (the end of the previous exercise season) until March 1974 when we could start to get out and about again. It is not possible to start retraining as soon as one returns because:

a They still insist that we do an FFR for 73/74.
b There are a great many internal courses to be run for APC drivers, radio operators and combat engineers.
c Many will have fallen behind on their external trade courses and must be got away if they are not to suffer.
d It was the middle of winter.

In the case of a tour from March to July, there is still a lot of the year left on return from Ireland in which to catch up. In the case of a tour from December to March, much of the year on either side will be fairly "normal"; not all that much field training time need be lost. There are other advantages to compensate for this obvious drawback: the weather for training ought to be good, leave can be worked to cover both Easter and the following Christmas, and there was plenty of daylight. One should also offset the fact that the wives will have to cope on their own throughout the long summer holidays.

We were warned of our tour a year ahead and it was always a racing certainty that we would go into East Belfast for they would need a unit to replace a Gunner Regiment in July 1973, and, traditionally, Sapper Regiments had almost always gone into East Belfast. No member of one particular Regiment would now agree that it was the certainty that it seemed at the time as they were in fact switched at rather short notice from East Belfast to another Brigade altogether! But that is another story and may be told by them in this *Journal* in due course. However it gave us plenty of time to do what was necessary with AG7 and the Record Office to make sure that any changes of key appointments were made either well before the tour or after it but not in the middle and for the Records Office to overpost marginally to cover essential courses and wastage during the tour. The jigsaw took a little time to get right because you have to look for people to fill a number of rather unlikely appointments—Operations Officers (two extra if possible), Community Relations Officer, Press Officer, Search Team Adviser and Echelon Commander. You have to decide which QM to take and which to leave behind, and who will look after your Rear Party—normally the Regimental QM assisted by the Adminstrative Officers. This new and rather strange-looking family tree must be well filled in with names at least six months before you go—not only in fairness to individuals but also because some of them will need special courses, such as the IO, the UEO and the Search Team Adviser. In parenthesis, it always seemed unfair to me that we had to make do with no Families Officer whereas all battalions have them and this did mean that OC Rear Party was very pressed at times.

I was to go as an Arms Group, consisting of two of my own Squadrons with an additional Squadron from another Engineer Regiment. This increased my numbers up to nearly 540 which was made up of the three Squadrons at about 130 each, my Tactical HQ (which lived apart from Echelon) at about 35, and Echelon itself at about 115. Clearly one of the problems was to ensure that the "stranger" squadron was trained to the same standards and began as early as possible to identify itself with the Group; this is a two-way thing—they must be treated the same and feel themselves the same as the two indigenous squadrons. It involved quite a lot of extra travelling.

Training and Preparation

Training for the Infantry role is challenging, exciting and immensely rewarding. It requires a lot of imagination, drive and common sense from all members of the "Management". It also requires that one balances training for a specific role in a particular area with the possibility that the Regiment—either as a whole or in part—may be required to undertake a quite different role in a different area. To train for East Belfast is not at all the same as training for the Lower Falls or a country area. One must not forget, for example, rural patrolling in concentrating upon urban patrolling in half-sections. In the event we did send a total of six troops on rotation

to the country and one Squadron spent the last three weeks of their tour in the Ballymurphy ("The Murph") when I took under command a company of Welsh Guards who were to provide the continuity in East Belfast when we left, as I shall describe later.

I think that two things stand out. The first is that one draws upon all available experience and help during training. The second is that the Commanding Officer must get a feel of his area and the province generally as early as possible if he is to direct training along the right lines. As it turned out, I was very fortunate as I had visited Londonderry and East Belfast the previous year when my own Squadrons were on loan to other people and I was able to do my personal pre-reconnaissance when another Engineer Regiment were in East Belfast in February. This reinforced my earlier impressions of the area and gave me rather longer to look round the bases and talk to OCs about their specific problems and how they ran their own patches.

I therefore had a pretty clear idea of what was going to be required of us, how we should be organized and what the area looked like. I read as much as I could and assembled a fair pack of maps, slides and film so that I was able, quite early on, to give each Squadron an orientation lecture with the aim of describing as vividly as I could what it was going to be like. In a similar way, it is useful to decide early which Squadron is going where (even if there have to be minor changes to boundaries and tasks) so that they can focus on a particular set of problems and establish their own liaison with sub-units which have been to the area before. This was particularly valuable as there were in BAOR two Squadrons who had fairly recently been to the area—and one of them lived next door to the Squadron in Hameln which made it natural to prepare to deploy it to the same area. One of my Squadrons had already done a spell in the Catholic area known as Ballymacarrett. It was fairly obvious that I should get the best results if I sent them back in again (although they had probably the worst accommodation in the city—a bus station) which tied up who was going where. I warned the Squadrons by March of their probable areas and it worked out that although one Squadron were to have a small Catholic area the other two would look after sprawling and predominantly Protestant areas—the former would be patrolling almost exclusively on foot and the latter almost exclusively by vehicle.

Turning back to experience and help from outside the Regiment, there is an enormous reservoir of knowledge waiting to be tapped. Every Arms Group is affiliated for training to an Infantry Battalion and not less than one Senior NCO will be with each Squadron all the time and there should also be an officer to oversee and assist in coordination. They proved invaluable. In addition there is the Northern Ireland Training Team who do an enormous amount to advise, monitor training and lecture on specific topics to officers and NCOs. We found them extremely helpful and cooperative and very well aware of the kind of problems we faced in making infantry silk purses out of sappers sows' ears. They were thoughtful, sympathetic and made the right sort of encouraging noises when at last we stumbled upon some truth that every good infantryman has known all his life.

However, despite all this knowledge and wisdom distilled from operations of all kinds in all areas, it will still be necessary to go beyond both sources for techniques and background relating to your particular area. Invariably those who have the kind of first-hand knowledge you are looking for are only too delighted to be given the opportunity to share it with as many people as possible—and what I am really talking about is getting hold of the good Section NCO who has been on the ground and letting him loose with an audience of other NCOs over a glass of (preferably free) beer. They will be held spell-bound as he pours out his stories but they are far more likely to listen to him and question him than they are in more formal surroundings. That is how they will find out what it is really going to be like.

The point to be made here (and it will be made again) is that not only must the soldier be prepared in term of techniques and skills and ability for what he is going

to face but it is also up to "The Management" to do all that they can to reduce the sense of shock which a new boy to the scene is bound to experience when he hits the streets for the first time. We must help him to start living (however vicariously) the kind of life he will lead and to begin to experience, through the eyes of other people, the kind of situation with which he will be faced. This must be done gradually and with care to ensure that the impression received is the right (and not an exaggerated) impression and that in removing the sense of shock one does not lull the soldier into a sense of false security by making him think that all is easier than it really is.

Paperwork

Some paperwork is essential. Without clear directives sub-unit commanders will not know what they are required to teach nor will they know the standards expected. There will also be a need to coordinate training programmes with regard to ranges, instructors, training aids and central lectures. These directives and programmes must be stitched together early. It will also be essential to get out Regimental SOPs (purloined from some previous Regiment and updated after reference to current Brigade SOPs) quite early on for many of the procedures regarding arrest, searches, VCPs and so on will be detailed in those SOPs. It is handy to have them typed on a typewriter with small print and reproduced on half-foolscap so that they go in a pocket. It is also very nearly essential to produce a Section Commander's Aide Memoire which will remind him of what he ought to have with him for certain operations, what to think about when planning very simple tasks and other useful information of all kinds. This will be in addition to the coloured cards—yellow, blue and white—which everyone must carry because they contain the law as regards the soldier searching, arresting and opening fire. The other occasion when a good deal of paper will have to be generated is in coordinating the period of intensive training assisted by the NI Training Team for there are so many facilities to bid for and time on the most valuable is at such a premium. It is very easy at the time to overbook, miss something altogether or to double-book and a Regimental daily programme must be issued for the following twenty-four hours. These programmes must ensure that *every* soldier acquires a broad range of individual skills. Weapon training and weapon handling must head everybody's list but there is a great deal more—first aid, akido, police holds, EOD training, the law and the soldier, radio training, training in observation and reporting, the Rules of Engagement and arrest and search procedures. I will only cover weapon training specifically for the others are by now fairly well understood.

Weapon Training

Statistical analysis of actual shooting incidents during a part of 1973 indicated that the prime requirement was for the soldier to be able to get off a quick, well-aimed shot at ranges of less than 150 m (75% of all engagements were at less than this range and of less than 4 seconds exposure) at a moving target using the SLR (96% of all engagements) in the standing or kneeling position (84%) and preferably in the dark which accounted for a very high proportion of all contacts. Remember these figures and it isn't difficult to design a shoot which will practise most of the requirements. There are two other things to build into a practice which are less easy to achieve but are also important: the first is the soldier must also be selective in his shooting—that is he must also be presented with "non-targets" which are not to be engaged: the second is that he must also shoot when he is tired. The NI Training Gallery Shoot and the NI Training ETR Shoot do take account of all these factors except for the moving target; the best that can be done is to ensure on the ETR that targets appear successively at different ranges. Having said what the soldier must eventually practice, it is essential that the soldier first learns to group properly and there is now in "Shoot to Kill" the right emphasis on this skill.

I am sure that we were not good enough when we went to Ireland despite a great deal of shooting on gallery ranges and on ETRs with no shortage of training

ammunition. What appeared to happen was that every soldier—even the rabbits—made fairly sensational strides forward in the initial stages, indicating that we do not shoot nearly enough in a normal year (for all sorts of very good reasons). They then hit a kind of plateau from which it was very difficult to lift them without inordinate effort. The plateau was just a little below what I believe would have been acceptable. I was not particularly concerned for the soldiers were basically safe, handling their weapons with far more certainty and confidence than before and were giving fair results consistently. I think it points to the fact that if we are not able to get a great deal more range time in the year we shall always lag quite a long way behind the Infantry, however hard we try for short periods to catch them up: good shooting is not something that can be acquired quickly. What did plague us all the time because of the very short summer nights was the shortage of night range time. Range wardens have to go to bed, even if soldiers do not, and the "good neighbour" schemes tended to become rather meaningless occupations if the neighbours were kept awake into the small hours by the noise of rifle fire. We did not do enough night shooting and as 60% of all engagements do take place in the dark—or at least under lighting conditions other than daylight, to be pedantic—I did feel that we had not had the opportunity to practice nearly enough under the various combinations of lighting that can occur—car headlamps, spotlights, flares, fires and street lights. This is clearly something that is a great deal easier to get right in the winter months.

It is also worth saying at this point that the SLR is the only weapon that one should worry about apart from those very few who are rash enough to think that they can actually hit a gunman with a pistol. The fairly remarkable figure of 96% mentioned above indicates the reason for my remark. We had two accidental discharges, both with SMGs. Both were only to a limited extent the fault of the soldiers concerned. Both occurred because the cocking handle of the SMG caught on something when a loaded magazine was on the weapon—which was always the case outside a defended base—but without a round in the chamber. A very short movement of the cocking handle is sufficient to feed a round into the breach and fire it because the weapon has a fixed firing pin. Without any doubt neither soldier had the change lever at "safe" when the accidents happened, but the fact remains that an accidental discharge of this kind is not possible with an SLR. I therefore banned the SMG entirely and was given an overissue of SLRs to ensure that every man carried either an SLR or a pistol. By the Grace of God, neither mistake caused a casualty—but a number of soldiers were very very frightened. And two soldiers each spent 28 days in detention.

Finally under this heading—although properly a part of the second article—the need to check zero must never be forgotten—both during training and during the tour itself. Nearly every weapon that was re-zeroed during our tour required some sight adjustment. To meet this need, new bases are being equipped with pipe ranges so that there is no need for the man on the street to leave his job for half a day or more in order to re-zero on some country range. We made a point of re-zeroing every weapon before leaving for Ireland.

Collective Training

Moving from individual to half-section and sub-unit training, it must be remembered that the man will spend the greater part of his working life as a member of a patrol and that in our case—although not elsewhere—the patrol was always an NCO and three or four men. We would only operate in larger groups against crowds or during large-scale search or lift operations. The area we were going to was so large that the butter had to be spread very thinly indeed if some 500 soldiers were to police a population of 200,000. I therefore directed that the basic group had to be the half-section and that was the thing that one had to weld into a team—either on foot or in a vehicle. While some of the basic ground rules about patrol movement can be taught in barracks (and must be if full advantage is to be gained from the more sophisticated training areas which I shall discuss in a moment) it is only at the

Intensive Training Centre that the thing can really be licked into some sort of shape, for only there can the atmosphere be got right and only there can the patrol be fully stretched and tested. As these facilities are unusual and as it is not always easy to see how to get the best out of them, I intend to spend a little time describing them and giving my ideas on what to do and what not to do.

The Dry Training Area

Imagine if you can (and it is not an easy exercise if you haven't been there) a small group of streets in the Lower Falls area of Belfast. They consist of back-to-back two-up two-down Victorian slum houses, each with its tiny back yard leading on to a noisesome alleyway. Some are missing, some are gutted. They are covered in slogans —in this case appropriate to the Republican cause—describing the army and the RUC in somewhat pejorative terms. Now construct a kind of film-set version out of scaffolding poles and corrugated iron so that the dimensions are right and the fronts of the houses look right, add in streets and street-lighting and leave suitable areas of rubble and waste ground and you have the layout. It is a tin village and, especially at night, begins to look like the real thing. The streets are named and the houses numbered. They have proper doors and windows. You can do anything you like there except fire live rounds. Having got a tin village, how best to use it? That requires a good deal of planning and forethought.

One's first instinct is to give the area to one of the Squadrons under training and say, in effect, "get on with it". He—the Squadron Commander—will have his Infantry adviser to help him get it right and no CO should interfere with the way the OC runs his training unless he seems to be getting it wrong. It is very bad for his confidence and you—the CO—probably won't know how to do it any better than he does. I believe this to be a fundamentally wrong approach to the use of the area; it is inefficient and extremely wasteful of experience and the worst possible errors will start to appear in their training. I do not think that one's instinct should, in this case, be followed.

The main problem in using the area is to make the place come alive so that it does not resemble a piece of Belfast but begins to *feel* like a piece of Belfast. All this will

Photo 1. The Dry Training Area.

help the soldier in his job for it will tend to reduce the sense of shock he will feel when he gets there. The area must therefore be populated by "Irishmen" and the Squadron Commander must be able to call on a wide range of incidents and effects with which to train his half-sections. This requires a lot of coordination and a quite large number of people who are able realistically to play their parts.

My recommendation is that a full-time coordinator is given sole charge of this facility as a kind of stage-manager. He must have recent Ulster experience for he will have a lot to do in creating the kind of atmosphere that one is seeking. He must have a permanent crowd of about twenty under his control who he must train to behave like Ulstermen. They must talk like Irishmen and, above all, they must react like Irishmen react—drunk or sober. This crowd must be prepared—in shifts if necessary—to "live" in the area for eighteen hours or more in each twenty-four. They must have their own houses. The coordinator must work up a series of incidents which will require a wide range of "props" and personalities. Without going into too much detail, he must be able to provide cars—runners and non-runners—which can be used for checking at VCPs and for searching for arms and explosives concealed in various parts of the bodywork and as suspect car bombs. Some cars must just drive around the area in a perfectly innocent way in order to add realism to the scene.

The coordinator must build up an appropriate intelligence background on as many as possible of his crowd; this will mean photographs, family links and so on, so that Squadron Intelligence Cells can have something to go on when personality checks are being run. Not everyone will be a bad hat —most will be perfectly ordinary citizens, but even these will be "on card". Some must play the parts of "lift on sight" PIRA men to test the alertness of patrols in identifying wanted men or for search and lift operations. If the area that the Regiment is taking over is likely to have a Protestant problem as well as a Catholic problem, then there may well have to be a duplicate set of records and the cast must be increased.

He must be able to raise the temperature of the situation at a moment's notice with angry crowds and drunks. He must be able to stage a full-scale interface riot between the tribes. Suitable missiles must be provided in considerable quantity—we found that empty beer cans were excellent ammunition and there was no problem in emptying them of their contents as the hot summer days dragged on turning the tin village into something very hot indeed. I had a shrewd suspicion that, at least some of the time, there was no question of the drunks having to act their parts—but that didn't seem to matter as a stage Irishman can hardly be considered subject to military law if he is to play his part at all convincingly. We were going to an area where there was a very real and continuing threat of interface rioting and so we spent a fair length of time teaching how to keep the mobs apart and how to talk down an escalating situation and how to counter that very Irish argument "Why the hell should we put out our bonfire—they haven't put theirs out!" First speaker: "they are going to put theirs out." Second speaker: "We'll not put ours out till they put theirs out." First speaker: "They lit their bonfire because you lit yours." Second speaker: "We lit our bonfire because its the 12th (or the anniversary of internment or The Easter Rising or Batchelor's Walk or Wolfe Tone's Birthday . . .)." First speaker: "If you don't put your bonfire out, we will have to put it out ourselves." Second speaker: "If you interfere with our bonfire without putting out their bonfire, I won't answer for the consequences . . ." and so on and so on and so on. Played well by one of the leading members of your repertory company, the leaders of the two factions can give an officer or young NCO a very good idea of what he will be up against in "talking down" a potentially explosive situation.

At the top of the list will come the gunmen and the full-scale anti-SF riot. To support these elements in what we came to call "dial-an-incident" it was important to include in the cast such characters as ATO, the RUC Inspector or Constable, RMP Arrest and Finds Teams, the local Priest and so on as appropriate. The co-ordinator may, with care, introduce women and children but they too must be rehearsed. Officers and NCOs must assist the Coordinator as the managers of

Photo 2. View of The Dry Training Area showing detailed construction.

particular incidents in the repertoire; it is they who will direct the crowds and raise or lower the temperature depending on how the visiting team are controlling the situation. Needless to say, the crowd become very good at playing their parts and thoroughly professional providing they are gripped at the very start and made to understand what a vital part they are playing in the training of the Regiment and they must not over- or under-play their parts. They become fluent in the language of Catholic and Protestant with a full range of tribal songs and tribal cries. A casual visitor to the area ought to see a bunch of scruffy layabouts, often with cans or bottles of beer in their hands, lounging at street corners, lolling in doorways, sitting on pavements and generally behaving in a thoroughly unmilitary way. From time to time a dreadful old car will lurch round a corner. Some will be playing cards or kicking a football about. Patrols will pass in and out—sometimes they will check a personality, sometimes there will be a little rowdyism as they pass, sometimes the street will clear magically leaving only the tip-off man at a corner—a sure sign of a set-up for a shooting. This will go on all day.

Having established atmosphere, the important thing is to go slowly in training the patrols, remembering that almost all the time in Ulster they will be doing absolutely routine checks and providing a reassuring presence. Although they must, by the end of their training, be able to provide the appropriate level of response to the most violent of incidents, for the first days they must be taught the basic lessons of routine patrolling—movement, car checks, personality checks, handling drunks, breaking up groups of casual stone-throwing yobboes or yoblets. Many circuits of the facility should provoke no incident at all (unless the patrol does something stupid) for all must learn that most basic of all lessons—how to move along a street and across junctions or obstacles in such a way as to minimize the danger, always covering both sides of the street from pavement to rooftop, always facing the direction of the greatest threat, always keeping on the move, always looking for the tell-tales that smell of the bomb or the bullet.

Gradually, as the patrol and its commander build their confidence, the incidents will be introduced to test and teach. At first singly and then in groups of patrols (I am careful not to talk about sections and troops or platoons because it is unlikely that

Photo 3. General View of The Battle Range from the Control Tower.

formed sub-units will be used; rather it will be the coming together of a number of patrols from different sub-units) more will be brought in until the whole Squadron may be deployed to handle a major riot with as many as twelve patrols in the area at one time although this is tending to overcrowd the place and it is generally best to run at most two patrols for most of the time. At the climax, each Squadron should have the area for twenty-four hours and should build up and practice their patrol routine with patrols resting in a base at various states of readiness. During this time the Squadron net should be continuously manned and the intelligence cell working. In very close cooperation with the Coordinator, the Squadron will run the gamut of all that the "home team" can throw at them—literally and figuratively.

The Battle Range

The other interesting and somewhat novel training aid to be developed as a result of the Ulster situation is the Battle Range. This again is laid out as a small piece of Belfast—an area some 40 m long by 30 m wide (although plans are in hand to extend it). It is designed to test the reaction of a half-section patrol to coming under fire. It is extremely well designed and built of concrete units. These are real houses—not just a film-set as is the Dry Training Area—with all the trappings. By using a special breech-block, the SLR is modified to fire a special blue plastic round so that the patrol can engage targets that appear and observe the bullet strike. A controller in a tower has the ability to summon up a wide range of effects electrically to add realism and can bring up on command a considerable number of targets for engagement either in conjunction with a "splat"—a small puff charge to indicate the strike of a bullet on a wall—or without. He can also bring up "non-targets"—that is the innocent bystander without a weapon—which must not be engaged, to force the patrol to be selective. He can order the following: opening and closing of windows and doors, music, moving figures, nail or blast bombs from a grenade launcher, banging dustbins, explosive effects and a moving car (with or without gunman). To a limited extent he can move his targets from place to place but this takes time and the range is out of use while it is being done. It is a very sophisticated training aid and can be used by day and by night (with a wide range of differing light levels

including car headlights). The controller must use his effects with care if a patrol commander is not to be reduced to a state of sobbing hysteria in less than a minute as he is engaged by four gunmen from different directions at once while he is at the same time under nail bomb attack and falling over a woman with a push-chair beside a dustbin which has just exploded with the appalling noise of banging dustbin lids ringing in his ears.

If time allows, the patrol should be given a dry run first to familiarize themselves with the geography but time on the range will always be at a premium. The patrol can and must follow up an engagement by rushing and entering the appropriate house or houses after a shooting. All this requires very careful control for the plastic bullet is still lethal and can penetrate a flak jacket (which all must wear on the range) or 2 in of timber. Therefore a safety NCO—Sgt or above—must accompany every patrol to ensure that they only fire within the safe arcs and do not place themselves at risk from each other during an engagement. These safety NCOs also brief and debrief patrols so that two at least are needed if there is not to be considerable waste of time. They must be good and experienced NCOs for the most valuable part of the training lies in the debriefing where the good and bad points must be brought out. I recommend that they are not changed during the training period (although it is tiring and can become monotonous) because you are then able to monitor patrol progress very much more effectively.

As a test of alertness, of the speed and accuracy with which fire is returned or a target engaged and of patrol reaction it is very good indeed. Like all such aids, its usefulness begins to wane after three or four circuits as patrols start to "play the course" for they will come to know where the targets are likely to appear and what effects to expect. However it is unlikely that a Regiment will be able to achieve more than this number of runs for every patrol during the time it has the range, so it does not matter a great deal and the controller is, as I have said, able to provide some variety during the fortnight.

Though it may also become tedious for him, I would recommend that one officer runs the range during the whole period. He is then far better placed to gauge the state of training of the patrol and set up incidents of the right tempo and difficulty. As

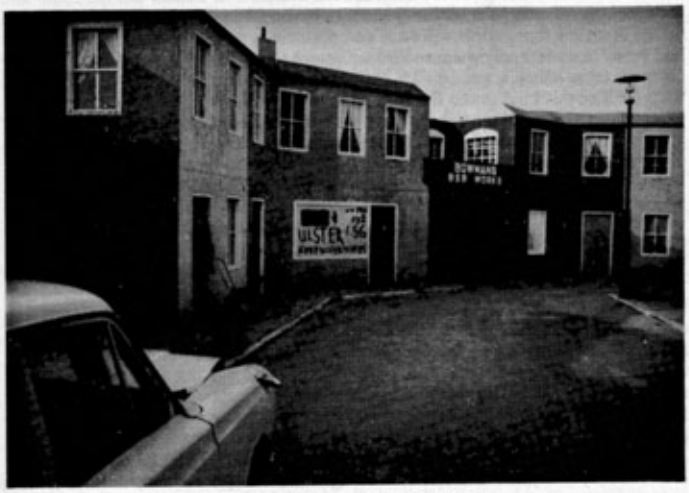


Photo 4. Detailed view of The Battle Range.

with the safety NCOs, by seeing all go through he is very useful as a monitor of training and can ensure that there is a comprehensive and intelligent feed-back procedure to improve standards.

One last point on the Battle Range. We were, I think, the first unit to get hold of and use a kind of pocketphone on the range and I am convinced that this is essential and plans had been made to incorporate the necessary equipment to use a Pye net—one-to-one—on the range. The patrol commander must become accustomed to passing accurate and useful information during an engagement—even if only of the "Contact—wait out" variety followed later by a summary of what had happened. The controller in the tower can operate the second set or can bring in a signals NCO to help him. It is really quite unrealistic to expect a patrol member to lug an A41 about the range when, on the streets, the patrol commander will always be carrying a pocketphone in the pocket of his flak-jacket.

Exercises

The Regiment was allocated the normal period of two weeks at the Intensive Training Centre—normal, that is, for an Arms Group. Ideally this period should end three weeks before the Regiment is due to move for it ought to be the climax of training and all that comes after it ought to be tidying up of loose ends. In fact we were forced to use it one week earlier than the ideal and there was a slightly anti-climactic air for a week or so. Although we used every range we were given as intensively as possible and there was never any time lost on ETRs and on the Battle Range, there is bound to be time at weekends when the ranges cannot be used. This was a good time to run Regimental exercises and we ran two; the first was a CPX designed to practise operations staffs and intelligence cells, the second a test exercise. The CPX was relatively simple to set up using my Tactical HQ as Higher Control/Players and small cells of Junior NCOs and one officer to inject patrol information and SITREPs as Lower Controls. Via these Section Commanders we were able to pass upwards the picture of developing situations and give Squadrons some practise in decision making and in reporting upwards and sideways. It was not possible to simulate the whole range of communications available in Belfast but net radio and telephones were used. It is very important to have SOPs printed and issued for it will be the first time that people will have an opportunity to get down to the small print and really start to apply them to real situations and problems. It would have done no harm to have had a second CPX but we were unable to fit it in. There is no need for a CPX of this kind to run for more than twelve hours.

During the same weekend we also set a test exercise to assess the reactions of young officers and troops to specific situations. Again twelve hours was sufficient to give everyone a chance to tackle a circus of some six situations. The six were: a car bomb in a rural setting, a search operation of an occupied house, a screening of a UDA drinking club, a VCP using a number of "clean" vehicles and one car in which was a wanted man and a weapon, an interface incident and a patrolling incident (staged on the Dry Training Area). A great deal was learnt.

Somewhat after the Intensive Training period, and as a climax to all that had gone before, we designed and ran a half-section competition, run over two days, to test preparedness, fitness, rapid accurate and selective shooting, powers of observation and reporting, first aid and VCP procedures. It proved a great success and no doubt many were egged on by some very generous prizes which we put up for the winning teams. The scoring had to be most carefully thought out but nobody complained afterwards that we had been unfair so it must have been more or less right. The main thing was that it enabled me to gain a very accurate impression of how good (or bad) people were and particularly enabled one to put the finger on the one or two weaker NCOs who had not responded to the challenge set. It required a lot of organization and virtually every member of the management was pressed into service in one capacity or another but it was intended to be a challenge and to be fun and so it

proved. The most difficult part of the competition, curiously enough, was the shooting for it had to take a relatively short time and combine the necessary speed, accuracy and selectivity together with control of fire by the NCO. In the end we evolved a falling plate competition with plates of different colours scoring different points and some being, as it were, negative scores if they were knocked down in error. The half-section were limited in time and in ammunition and the shoot involved a run-down. This worked well.

Those then were the only exercises set and run at Regimental level.

Final Preparations

We were left with two weeks in which to complete the packing for the air move, get the Advance Parties away to Ulster and tidy up any loose ends remaining. Some rezeroing was necessary during this time for many weapons had moved their sights during training. This is bound to be a period when everybody is longing to be gone but it is inevitable that some delay occurs between the despatch of the Advance Parties and the Main Body some ten days later. We ran a Regimental potted sports competition to help to fill the gap and stop that distressing feeling that people are "going off the boil" at a very critical time. There is no doubt that the training must be designed on progressive lines with the Regiment at the right pitch when they go and that means that the overall plan must be most carefully considered from the start. Where Regiments have been unlucky in being given an Intensive Training period too early in the training, it has been found very difficult to keep things at the right pitch up to departure. We were not unlucky in this although I would have wished for the Intensive Training period to be one week later. The Advance Party flew out on 23 July, I took a small Command Party on 26 July and the Main Body flew out on 30 and 31 July and on 1 August. I am convinced that it would have proved embarrassing to others and tedious for ourselves if the Command element had flown out any earlier. There was plenty of time for us to find out what we needed to know and it keeps to a minimum that rather itchy period when you are longing to get your hands on the tiller but dare not do so because the other chap is still steering.

Conclusion

I look back on the training period as one of intense interest and great enjoyment. It was something that few of us had tackled before and it was extremely encouraging to see how the soldiers responded to the challenge. I believe that in terms of both the necessary skilfulness and in terms of psychological preparedness the men were quite well equipped and when they moved on to the streets they looked and were purposeful and determined to tackle every problem in a spirit of adventure and pragmatically. How they did it and what happened to us will be the subject of my second article. Nevertheless I am bound to conclude this part with a tribute to the help we were given by the Northern Ireland Training Team, including the Range Staff and by the Battalion who suffered our amateurish efforts to become infantrymen with patience, common sense and good humour—1 Bn The Queen's Own Highlanders.

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Henry Yeveley, Military Engineer

LIEUT-COLONEL J G O WHITEHEAD, MC, RE (Rtd)

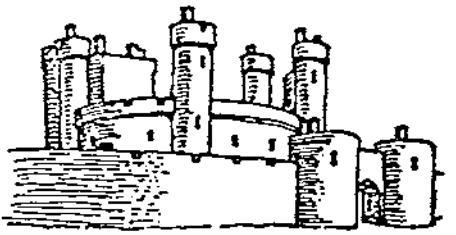
IF ever the opening chapter of the *Corps History* is rewritten, it is to be hoped that Henry Yeveley's name will find a place in it, because it is a matter for pride that "the English father of the science of artillery fortification"[1] was also "among the names of the (world's) very greatest architects",[2] on account of his masterpiece of Canterbury Cathedral nave. His life covered *c.* 1320–1400. His work is the more remarkable in that he provided against cannon fire before it had been experienced effectively, and he designed for handguns before they had been practicably developed; both of these weapons' value was speculative, so he must have possessed an outstanding degree of foresight and initiative. John Harvey, his biographer,[2] when listing his works has marked those not definitely authenticated, yet his reasons for judging them to be Yeveley's are convincing; nor is there much room for scepticsm when it is considered that an entirely new design was being introduced, and only a person such as the King's Mason (the equivalent of Chief Engineer) could have overcome the financial and technical objections bound to have been raised. Moreover the gravity of the French threat in 1383–85[3] makes it likely for works of that period to have been placed in hands of such responsibility.

Small consistencies of design are noticeable, and architectural touches that seem intended to inspire pride, in contrast with the customary stark utility of military buildings; many persons may have originated these touches, but when they are found characteristic and finance once more is considered, belief is enhanced that the mind behind them was his. Pride may sound unfamiliar today, when national ideals and readiness for military service for them come second to chasing money; but it deserves a thought, since recently it has been remarked that an engineer is not just a technician, but that his concern extends beyond technology to visualizing human needs and methods for satisfying them.[4] These details of design cannot be analyzed in the text of this article, but are contained in supporting Notes placed in the RE Library, together with drawings and relevant extracts, and referred to here as the *Glossary*.

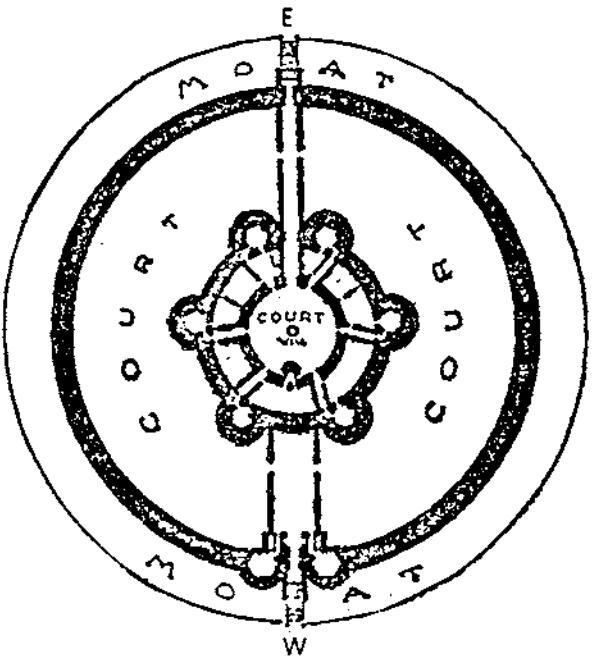
Thus Yeveley's character appears to resemble Sir Ernest Swinton's, whose first three tales in *The Green Curve*, with their captions, portray human nature shrewdly, and whose "Proportion, gentlemen, proportion" strikes the very note of Yeveley's architecture; while the parallel foresight in Swinton's prescience over the tank and Yeveley's discernment of the coming gunpowder era present the latter as a fourteenth-century "Backsight Forethought".

The circumstances which brought Yeveley into the Black Prince's employ are told by Harvey, who considers his civil training will have been in the Tutbury area of Stafford/Derby. As this is only three days from the Welsh Border, the present writer is surmising that he may have gained military experience there, where trouble was always smouldering; it is as though an Attock mason had worked in the Khyber. He may too have had a strain of the soldier in his blood.[5] His rise to prominence was remarkably swift: a year after his first work for the Prince he was being styled Prince's Mason; while two years later he was appointed to the Palace of Westminster and the Tower of London, which Harvey terms the equivalent of Chief Architect (or shall we say Engineer) for all Southern England. In that same year, 1361, he was presumably responsible for a new fort at Queenborough, Sheppey; and it is the importance of this fort, coupled with such speed of promotion, which seem to indicate he must have had much previous experience and studied the evolving trend in warfare.

The cause for the fort was that peace with the French was doubted. The treaty of Bretigny, 1360, was only a truce; and rumour was evidently abroad that cannon were being developed by them, because although that danger did not materialize until ten years later, Queenborough was designed against that contingency. A sketch and plan are reproduced in photo 1; Cromwell's demolition has left no further trace.[6] The



QUEENBOROUGH CASTLE: View from North-west, after a drawing by Hollar, 1620



QUEENBOROUGH CASTLE: Ground Plan. 1361. Traced from a drawing in the Hatfield MSS. by A. W. Clapham.

Photo 1. Queenborough Castle.

normal mediaeval castle, rectangular and three-storied, was altered to circular with its storeys reduced to two, except in the towers, where height was kept evidently to cover the moat, which lay beyond a concentric outer wall. This new design will have been to render the masonry less vulnerable to cannon, since although angular faces were already giving way to rounded (on account of engine-missiles and mining), high walls with flanking towers otherwise served better against assault.

Comparison with Beaumaris, built sixty-five years before, shows Yeveley's outer court to have been a refuge for the countryside; its 300 yds perimeter, devoid of flanking towers, could never have been manned by the garrison, but was intended to be held by the countrymen themselves, armed with bows; while the inner ward was for handgun fire support covering the "glacis", or in the extreme a final keep. This militia (*fyrd*)[7] policy was expressed contemporarily—

"the good of the realm of England, whereof the might standeth most upon archers, which be no rich men. . . . We shall be a prey to all our enemies (unless) we be mighty of ourself, which might standeth most upon our poor archers. . . . Wherefore the making poor of . . . our archers shall be the destruction of the greatest might in the realm".[8]

The sophisticated arm, the armour plated knight, was giving place to the unsophisticated yeoman; and Yeveley had foreseen that the handgun would augment the longbow. It was as though today the sophisticated tank were giving way to the unsophisticated guerilla; and "poor", which then meant unable to buy a weapon, would now have the inverse counterpart of lacking in guerilla aptitude, "too civilized".

His originality points to strength of character. Gunpowder had then only some twenty years trial in the field. Conservative opinion will have argued that cannon were more frightening than lethal, there was no cause to fear a second Jericho; more men would be entailed to repel assault; the enemy would want all his shipping for conventional arms. It was as though a modern Yeveley had, in 1939, declared the Maginot Line obsolete because of the tanks invented in 1916: he would have been right, but orthodoxy would have scoffed, as it actually did—"Only a Sapper could produce so mad a plan".[9]

The threat continued; so Rochester City Wall was strengthened in 1368, and a round gun-bastion built at its north-east corner. There is no record of Yeveley's concern in this, but it seems likely to have come under his scrutiny; however in view of uncertainty, its description has been placed in the *Glossary*. The particular interest is that its gun-slits are predecessors of the loopholes later used by Yeveley; the pattern evidently gave inadequate protection and was discarded, it probably figures in Hollar's sketch of Queenborough.

1377 saw a formidable increase in French hostility: Rye was sacked, and piracy became so acute that the Mayor of London manned a fleet at his own expense to check it. Canterbury was exposed to raiding from the Thames estuary, Whitstable Bay lying but six miles distant to the north-west; in consequence its derelict Wall had to be rebuilt. The task must have been given to Yeveley, for he was already engaged on the Cathedral, and the style resembles other works of his. The problem was unpromising. There were the remains of a Roman Wall, used as a quarry for building stone, it had never been systematically planned but straggled round an overlong perimeter; while funds as usual were short. Yeveley however turned it into "the earliest known (fortification) in this country designed specifically for defence with guns,"[10] so it warrants study. His solution was patriarchal. Despite finance he built an impressive Gate, to inspire pride (so it would seem);[11] while on its exposed flank he made a short line of "pill-box" towers for handguns, strengthening the Wall between them with probably a temporary wooden stockade, and clearing both the Ditch and the field of fire.

The West Gate is a massive structure. Its towers have three floors and parapeted roofs; the ground floor walls are 5 ft thick, to withstand cannon fire, the upper ones slightly less, all are loopholed for handguns with openings like inverted keyholes, the

vertical slit perhaps for the escape of vent fumes. The weapon's pattern is material; it was an iron tube about 27 in long and 1¼ in bore, divided by a vent into an 18 in barrel and 9 in powder chamber; behind was a metal stock, bound with wooden slats.[12] The muzzle necessarily protruded from the loophole, while the butt rested on a masonry interior cill; the narrow embrasures precluded traversing, though the fixed lines of fire could be varied slightly. The West Gate fire-plan, when all three floors' loopholes are superimposed, shows a concentration of fire towards the right front, the greater danger. Behind this front the Wall-towers' fire-plan cannot now be fully determined, owing to dilapidation; but from the towers built round the Cathedral precincts in 1386, their main role can be judged as enfilading the Wall; frontal fire was little, being provided instead by archery from the parapets. Fire-plans are in the *Glossary*, also structural details; they show lines of handgun fire only, without the archery overlay; they are curiously like the German development of machine-gun fire in 1917, when the British tendency had been to rely upon rifle frontal fire. This use of the handgun for flanking fire seems to have come through Yeveley, as Welsh Border fortification does not evidence any clear archery precedent; it may have been occasioned by the very narrow field of fire beyond the Wall, only 110 ft, due to encroachment by houses.[13]

The Gate consisted of a pair of towers with a portcullised doorway between them; behind, on a vault over the road was a guardroom, joined to the Wall by a footbridge which could be removed in an emergency, isolating it. In front, and along the Wall on either side, the river was deepened by mill-sluices, covered by handguns from the Wall. At the Gate the river was crossed by a drawbridge; further along, where a branch of the stream went through the Wall, access was closed by a "water-lock" of three portcullised arches guarded by a pair of towers. All Wall-towers were two-storeyed with parapeted roofs, their lower walls 4½ ft thick, designed as gun-rooms, with lighter walled ward-rooms above. The whole system was to withstand raiders supported by artillery (it could not sustain severe attack); and what is remarkable is that this was done before artillery had come into effective use against masonry, and while handguns were still experimental; it evidences great foresight.

As a sidelight, although the West Gate has inverted loopholes only, in subsequent work (Cooling, Carisbrooke, Saltwood) they are duplicated with cruciform arrow slits; the impression is given that at first Yeveley felt sure the weapons would be forthcoming, but later found otherwise. A detail at West Gate worth notice is that the loopholes covering the gates, though apparently facing each other, are actually aligned to fire slightly inwards; as the range is but 12 ft, it may be that blunderbus pellets were contemplated.

In the 1378 Wall-towers the upper floors were reached by ladders from within, through hatches which acted as smoke flues for central hearths (or braziers); in those of 1386 however access was made from the Wall parapet outside, but with means for isolating the towers in case the enemy gained the Wall,[14] turning them into extempore strong-points. Fireplaces with chimneys were added to the principal quarters (an early provision of the amenity), and sanitary chutes.

In 1381 the defences received a rude test from Wat Tyler's mob, when the city was entered easily; and in London the unfortunate Archbishop Sudbury, who was paying for the work, was murdered. The need for a keep within the perimeter was realized; so in 1386, as well as the Wall's continuation, the Norman castle was renovated, a reminder of what internal security can demand.

Carisbrooke Gatehouse, heightened for handguns in 1380–3, lay within Yeveley's area of control and thus is likely to bear his touch. Here the loopholes covering the portcullis are inclined forwards onto the drawbridge's bankseat. At this same period (1379–85) Southampton Town Wall, facing the quay, was converted into a handgun battery;[15] there are eight loopholes, mostly at 30–40 ft intervals, intended maybe for volley firing; their sometimes presumed cross-fire must be doubted.

Should it be felt that too much initiative is being claimed for Yeveley, and that local commanders' orders and assistants' advice are being ignored, the reverse is

supposed: he will have gleaned widely. In what follows, however, certain small consistencies will be noticed; consequently it is pleasing to think that no matter whence his ideas, he was endowed with competence to assimilate wisely.

1379 saw a severe French raid up the Thames, which ravaged from the Medway to Gravesend; accordingly in the next year Yeveley had orders to build two Thames defence towers (design unrecorded), and Lord Cobham gave him the task of fortifying his manor of Cooling. Cobham had just begun to build a new Hall, and Yeveley made this the genesis of an Inner Ward; photo 2 is a reconstruction of its front, by Lieut-Colonel E E N Sandeman; as it was practically contemporary with Canterbury, it is of especial interest in illustrating his style for the inception of the gunpowder era. The area round the old house became an Outer Ward, for the countryside; both Wards were given walls about 20 ft high, surrounded by moats crossed by drawbridges with strong gatehouses behind them. Each Ward had corner towers, the Outer south-west one being duplicated to form the Gateway, the rear of which was covered from the Inner Ward to flank any penetration. All corner towers and gatehouses were loopholed for handguns, though the Outer Gate had two archery slits as well, covering the far end of the drawbridge.

A fire-plan is in the *Glossary* (*Cooling*); it shows only half of the towers' purpose, since the rest are ruined; in general they were aligned to enfilade the far side of the moat, to break up assembly for assault. All of the Inner Ward towers and those of the Outer Gate had machicoulis, as though a heavier attack than at Canterbury were anticipated; whether the Outer Ward corner towers had them is uncertain, perhaps expense forbade it. The loopholes present several problems, examined in the *Glossary*: three types are to be seen—plain porthole, inverted keyhole, and "Rochester" wide slit. Some reason has to be offered: perhaps gunner opinion desired the plain port, as a precaution against stone splinters from the keyhole slit, while the "Rochester" was too exposed; all three were employed however, in different positions, since the matter was as yet experimental.

An enamel plaque on the front of the Outer Gate deserves notice; it declares—"Knoweth that beth and shul be that i am in help of the cuntre(-folk); in knowyng of whyche thyng thys is chartre and wytnessyng."
The defence was for the People, the native English spirit of the Common Good.

Its efficacy was tested in Wyatt's rebellion of 1544, only to show "Man proposes, God disposes". The rebels numbered 2,000, mostly countrymen but augmented by some royal deserters and six cannon captured the day before. For the defence Lord Cobham also had countrymen, but his armament was ludicrous—only five handguns, four pikes, and otherwise blackbills, his demand on the Queen's stores not having been met. Wyatt bombarded the Outer Gate and made a diversion on another side, causing Cobham to retire into the Inner Ward; there, when several men had been killed and the rest were losing heart, he and his sons stood behind the Gate until it was too shattered to stand an assault, and then surrendered. *Pour encourager les autres* he was sent to the Tower!

By 1383 a serious threat of invasion was developing, which caused Saltwood Castle to be strengthened. An 1154 bailey existed, reasonably safe but fashioned more as a residence than for sustained defence. Yeveley was called upon to make it more secure. He seems to have concluded that it could not be adapted to withstand a cannonade, only a coup-de-main; accordingly he made its main defence an outer ward (probably on the site of an existing one), to cover the seaward half of the castle, whence lay the primary danger. He gave it a stone wall 15 ft high, with towers at the corners and a gatehouse on its landward side. An unprotected wall of the castle, weakened through mullioned windows, he covered by damming a stream to form a small lake; and in turn he covered the dam by a wall-tower loopholed for handguns. Thirdly he extended the old gatehouse between the castle and outer ward, providing it apparently with arrow slits,[16] and making it unusually high to command a wide view. Except for the wall-tower mentioned, no building was designed for handguns, only for archery.

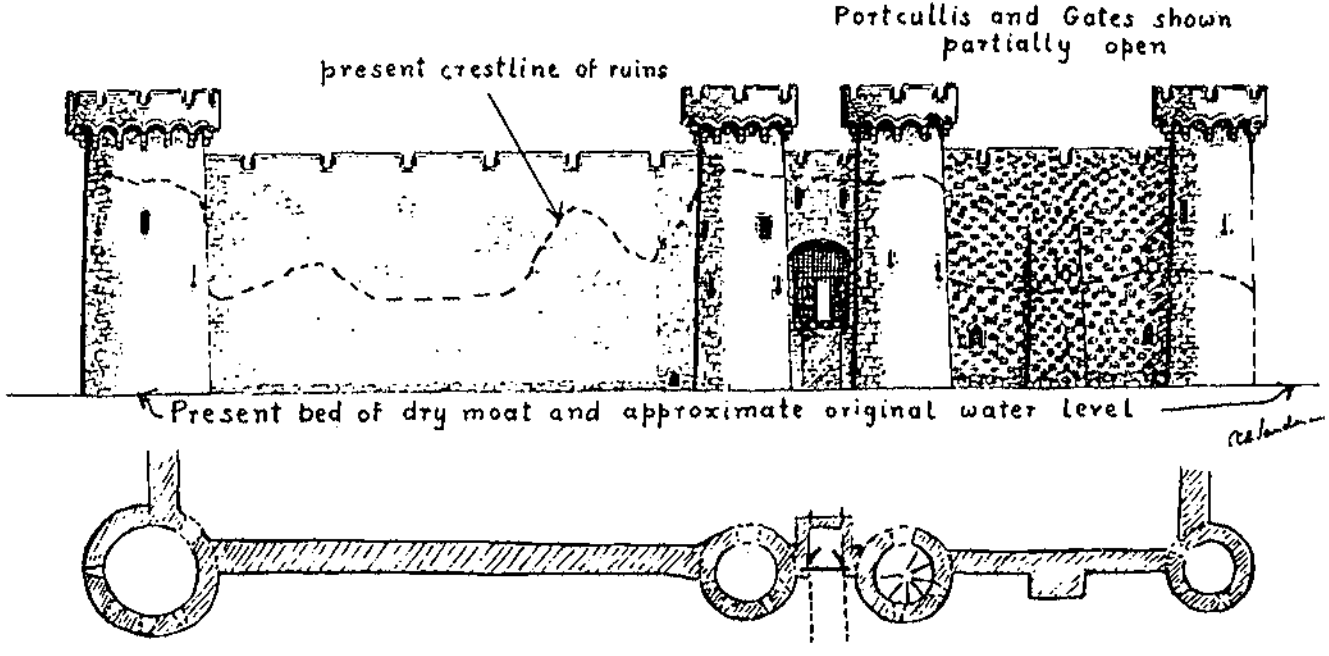


Photo 2. Cooling Castle. Sketch by Lieut-Colonel E E N Sandeman, OBE, RE (Rtd).

In the light of the Cooling plaque, the keynote to Saltwood appears to be the Outer Ward for the countryside, strong enough to repel a lightly armed attack; if that were penetrated, though, the rest would fall, as the 1154 castle was too elongated for protracted resistance. This precedence of the countryfolk's ward is noticeable, for the Archbishop who owned the place was an arrogant man. The impression is gained that Yeveley persuaded him that his security rested in their's, and he spoke to him as an Englishman voicing the spirit of the times.[17] If this is so, it reveals the kindly firmness of his nature.

Bodiam, built in 1385, lay at the inland head of tidal water on the Rother; it will have been intended as an assembly point for local defence. It was an entirely new castle, illustrated in photo 3, and is as beautiful a work as has been built. Surrounded on all sides by an artificial lake, it was proof against a coup-de-main. The main entrance faced the rear, reached by a removable wooden bridge to an island outwork, whence a drawbridge led to the castle; the first bridge was at right-angles to the second, and was flanked from the battlements. At the front of the castle, facing the river, was a sally port similarly connected with the bank by a removable bridge. The castle's function thus was to form a rendezvous for local militia; action would be beyond its walls, as, when numbers were strong enough they would go out and attack the enemy, trying to cut him off from his ships. The 1377 orders for Sheppey instance the system—

". . . one beacon . . . continually watched, as well by day as by night . . . Also that the watchmen of the beacon of Sheppey be from time to time warned and charged that as soon as they can espy any vessels of the enemy coming with sails or oars toward the said shore, it shall be set fire to, and the people warn the countri-(-side) around to come with their force, each to succour the other to withstand their enemies".[18]

Proof against a coup-de-main, though, has to be qualified: there was always a risk of internal failure, as happened at Canterbury against the Danes in 1011, and could happen to modern military installations under cold-war contingencies. A slip from the straight and narrow on the Welsh March may show the type of danger.

Photo 3. Bodiam Castle—North Front.

Ludlow Castle was virtually assault proof; the enemy was a marcher lord, and one of his knights chanced to gain the love of the lady's maid—"a very pretty damsel". While the lord of Ludlow was away she sent the knight an invitation; then, letting down a cord from a window she pulled up a leathern ladder, up which he climbed, and they had a good time. Unbeknownst to her, however, the knight had arranged for an armed party to follow him; the castle fell, and although the girl killed him for his treachery (and herself also) the harm had been done, ending in the whole Border being set ablaze. The engineer factor of safety thus has to include philandering, war h & c.

Yeveley was next engaged on continuing Canterbury Wall round the Cathedral precincts, 1386, and on renovating the Castle. This is his last known military work, except for additions at Winchester Castle.

Yeveley's military accomplishment is the more outstanding in that it was done concurrently with producing a world's masterpiece in civil architecture. There must be some common denominator; and it seems to be that he understood English character and built for the best in it, which in turn brought him militarily the Black Prince's confidence, enabling scope for his initiative. The quality of his defence work can be seen today in spite of six centuries' dilapidation, yet the suddenness with which it bloomed is remarkable, suggestive of there having been a long background now forgotten. Within three years of being taken into royal employ he designed a fort that anticipated the effective era of cannon by 150 years; so too, before the handgun was effective he designed a defence line resembling the German system of 1917; and when our modern tardiness to recognize new weapons is considered, his perception becomes the more distinct. He was typical of Prevision and Provision.[19] The novelty he introduced risked money, yet he was allowed scope; he must have inspired confidence, and the reason for this offered here is that he and the Black Prince "spoke the same language".

What that language was can be traced in his works for the Prince: it was the mediaeval code of Manliness, the English sense of the Common Good tinged with idealism. It is evidenced in the Prince's familiar motto "I Serve", and is corroborated by the roof boss Yeveley carved in his chantry above the altar, "Fortitude",[20] given pride of place over even his Princess, the Fair Maid of Kent. The two virtues Duty and Fortitude together with Wisdom and Understanding formed a quartet looked upon as cardinal for Manhood,[21] they were interdependent as "four sisters, and never separated". Of Wisdom it was said—

"She taketh counsel over things that she purposeth, calling to mind things past, pondering therein with things present, that she may the rather prevent the danger of things to come."

Herein we see Yeveley's foresight: it was bred in him. Understanding his fellow men is manifest in his architecture, as John Harvey has pointed out so discerningly; it is reproduced in his military works through small touches to give a pride in service. And what is so satisfying to an engineer's eye is the sign that he had watched tactical needs carefully; times might become critical, men were to be given a fighting chance.

There is cause therefore for his memory as a military engineer to be kept green; and Harvey's assessment of his civil work can be applied equally to his wall-towers and castles—

"The very kernel of his greatness is that he did for our architecture what Chaucer did for our language, giving to it a special character which was altogether national. (But it was) cut off after a bare 150 years. All that can be done now is to study the truncated fragment which time has spared, to appreciate its beauty, and to learn the lessons it can teach the present and the future."

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[1] B H StJ O'Neil, *Castle and Cannon* p 19.

[2] J H Harvey, *Henry Yevele* (1944), p 77, and cf, pp 54–55; also his *Henry*

Yevele Reconsidered in *Archaeological Journal* CVIII, copy in the R E Library in *Glossary* (*Harvey*). He has since revised the spelling to Yeveley; while for Stenton's association of it with the village Yeaveley, see too *Glossary* (*Harvey*).

[3] G Templeman, *Invasion 1384–5* in *Essays in Honour of L R G Ritchie*, copy in *Glossary* (*Templeman*).

[4] *R E Journal* September 1964 p 348, Philip Sporn reviewed by F T S.

[5] See *Glossary* (*Yeveley*).

[6] Yeveley's responsibility is assumed from his being "devizer of the masonry of the king's works" at Westminster and the Tower of London, and his having taken precedence over John Box who was appointed master-in-charge at Queenborough. The picture in A A Daly's *History of Sheppey* is to be rejected; it is an inaccurate reconstruction from Hollar's.

[7] See G Trevelyan, *History of England* (1929), pp 227–8.

[8] Sir John Fortescue (fifteenth century) quoted in E Wingfield-Stratford's *History of English Patriotism* (1913), I p 65.

[9] *R E Journal* September 1970 "Correspondence" Brig P StB Sydenham.

[10] A R Dufty, *Archaeological Journal* CXIX, extract in *Glossary* (*Dufty*).

[11] See Hilary Turner, *Town Defences* pp 92–4, extract in *Glossary* (*Walls*).

[12] An example is in the Tower of London (on loan, 1973); contemporary illustrations are in *Glossary* (*Handgun*).

[13] See Glossary (*Field of Fire*).

[14] Cf Conway Castle, R A Brown, *English Mediaeval Castles* (1954).

[15] D F Renn, *The Southampton Arcade*, in *Mediaeval Archaeology* VIII; extract in *Glossary* (*Renn*).

[16] It has been refronted during the last century.

[17] Cf E Wingfield-Stratford's *History of English Patriotism* I ii *The End of the Middle Ages.*

[18] Privy Council writ to the Sheriff of Kent, 7 June 1377.

[19] The particular Royal Engineer who voiced this maxim was regarded as eccentric, but the 1917 enemy classed his Corps sector as the best defended on the British front.

[20] See *Kent Life*, June 1974.

[21] See *Glossary* (*Yeveley*).

Visit of the Chief of the General Staff to the RSME

THE Chief of the General Staff, General Sir Peter Hunt, GCB, DSO, OBE, ADC visited the RSME on Monday the 4 March 1974. This was the first visit of a Chief of the General Staff to the School. The last similar visit was by the Chief of the Imperial General Staff, Field Marshal Sir John Harding, in 1954.

On arrival at 10.30 am, General Hunt was met by the Commandant, Brigadier J I Purser, OBE, and inspected a Quarter Guard formed from a Junior NCO Cadre run by 24 Field Squadron RE. The majority of the men on the Guard were from that Squadron, but it also included men from the Depot Regiment RE.

After meeting the Engineer-in-Chief, Major-General M E Tickell, CBE, MC, the CGS was briefed on the role and organization of the School by the Commandant, after which he toured the Technical Training Group. Whilst in the Technical Training Group he visited a number of the trade training shops and met a variety of students including Ghurkas, a Nigerian, a Kenyan and a student from Sri Lanka.

The CGS went on to visit the WOs' and Sgts' Mess Brompton, where he met representatives of the staff and Long Course Students. While at the Mess he presented

Long Service and Good Conduct Medals to WO2 G Hoult, WO2 B Walker and Sgt A J Pink.

After an informal lunch in the REHQ Mess he crossed the River Medway, by M2 raft, from Thunderbolt Pier to Upnor and tried his hand at the controls during the crossing. At Upnor he met members of the Junior Leaders Regiment RE on training and saw groups constructing a Medium Girder Bridge, making improvised rafts and launching Heavy Floating Bridge Piers. He also saw a Class 1 Combat Engineer Course constructing a Class 16 Air Portable Bridge and raft.

The CGS completed his tour of the RSME by visiting the Plant, Roads and Airfields School, where he saw a number of courses training on earth moving plant. He also toured the new Materials Technology Laboratories of the School and the Mechanical Training Section where he met students on courses under instruction.

Visit of the Chief of the General Staff to the RSME

Fortifications and Works

PART ONE—FORTIFICATIONS

BRIGADIER H E HOPTHROW, CBE, ERD, C Eng, FI Mech E

INTRODUCTION

IN 1973 the Architectural Press published *Architecture of Aggression* written by Keith Mallory and Arvid Ottar based on historical research undertaken by the University of Bath. It was reviewed in the *Royal Engineers Journal* of December 1973. Described by the authors as a history of military architecture in North West Europe 1900–1945, it is an excellent book notably for the description of military events influencing design and for the wealth of illustrations. The authors have had to rely on published material which for reasons of security is sometimes scanty or misleading. Recourse to War Office files and to Major-General A G B Buchanan's history *Works Services and Engineer Stores*, covering the period 1939–1945, would have been more reliable if they are now released from restricted use.

The writer of this article was intimately involved in Fortifications and Works at home and in France from 1939 to 1945. The notes which follow are based partly on memory and partly on published sources; but for the encouragement of the Editor, and the lead given by Mallory and Ottar they would not have been written.

FORTIFICATIONS

In September 1939 the Maginot Line proper ran from the Swiss–German–French frontier to Longwy[1] and in a less developed form it reached Givet on the French–Belgian–Luxembourg frontier. Northwards from there to the coast the only new defences were a single line of small emplacements and an anti-tank ditch.[2]

On arrival in France the BEF were allotted a sector between the French First (on the right) and Seventh Armies, that is from Maulde to Armentieres.[3] The C in C BEF decided to develop a defensive position in great depth and by May 1940, when the German offensive began 40 miles of revetted anti-tank obstacle and 400 pill boxes had been constructed.[4]

Apart from military and engineering problems there were considerable political overtones which became known as the "Pill Box Row" described by Major-General Pakenham-Walsh.[5] The Secretary of State for War, Hore Belisha, was a strange character whose outlook and habits were quite incompatible with those of soldiers. An early request on the first day of his visit to the BEF was for someone to shave him; a massive Guards Sergeant was detailed for the duty. He was often late in keeping appointments, particularly in the morning. From the War Office, he organized and sent over to France substantial "private armies" to perform tasks defined by him but with little or no consultation with or notice to the BEF. One of them was "X Force" consisting of five Field Companies and a Field Park Company commanded by Brigadier A Minnis, formerly RE. This force was intended by Hore Belisha to construct defences something like the Maginot Line in rear of the BEF Sector,[6] a military nonsense and an engineering impossibility in the time available.

Pill Box designs were initially provided by the War Office based on those used towards the end of the 1914–18 War. Amendments and new designs were made in the BEF resulting in the adoption of five basic styles. Mallory and Ottar report research and tests by the French of the resistance of concrete to bombardment but the writer cannot remember any information about it reaching the BEF.[7] The British designs were empirical in origin.

In all fortifications housing weapons, embrasures are a problem and a weakness. Their design must always be a compromise between an infinite field of fire and an almost infinitesimal aperture for the muzzle of the weapon.

Armour plate closures for the BEF pill box loopholes were manufactured in Britain (perhaps also in Valenciennes). Deliveries were slow, consequently they could

not be built in during construction but grouted in later. This led to an amusing incident in "A" Branch which was equipped with an elementary punched card and skewer system for recording special abilities and experiences of officers. The skewer was pushed into a hole marked grouting, the solitary card retrieved bore the name of an officer who had been in charge of, at that time, a world famous grouting project, the columns supporting the dome of St Paul's Cathedral.

General Bertschi, the Commander of the French Garrison of Lille was experimenting with a novel device for closing loopholes. It consisted of a number of hexagonal or octagonal steel boxes filled with gravel or sand. Perhaps 18 in high, closed at top and bottom, they were designed to run on rollers or ball bearings in heavy chases in the embrasure. They could be moved readily by the garrison thus opening a chosen field of fire. Bertschi's Briques, as we named them, showed promise but he could get no support from his French superiors. He had to rely on the BEF for automatic weapons for tests on the range within the fortress. The briques did not reach the stage of application.

As the Battle of France developed in May 1940 the Maginot Line was by-passed by the enemy, little use being made of the BEF's static defences. Some pill boxes were used, but later neither at GHQ Home Forces nor in the War Office was there much information about their usefulness in action; nor was there much recorded information about the effectiveness of defences in previous wars.

Following Dunkirk the defence of Britain was vital. Field defences including a plethora of pill boxes, road blocks and anti-tank obstacles were constructed. Some of the War Office and BEF designs used in France were adapted, and others in great variety devised by Command and subordinate headquarters were used. Many pill boxes due to faults in design, careless or unskilled construction and bad siting would have been useless in action (for different reasons the Germans had similar problems in the Atlantic Wall).[8] This confusion induced by the national surge of enthusiasm could not be controlled by the small military staffs available,[9] nevertheless a considerable defensive system was created.

The skills and experience of the large influx of newly recruited officers were difficult to classify and deploy. For example from information gathered from civilian sources the writer found a prominent consulting water engineer guarding a reservoir and the chief electrical engineer of one of the country's largest industrial companies in a searchlight unit where, as he put it, a knowledge of OHM'S Law seemed to be a disadvantage. Both were quickly posted to the Directorate. On the other hand there were those who overstating their civilian experiences and responsibilities, were eventually found trying by bluff to retain appointments well beyond their competence. A bizarre example was a junior officer who, professing a doctorate, obtained a staff appointment as a geologist. His lack of ability in this field provoked enquiry which revealed that his doctorate had been conferred by an obscure foreign university for a thesis on Elizabethan music!

But, to return to design. The shortcomings of the empirical approach were emphasised by an Ordnance Board Report, received in 1940–41, on a test of reinforced concrete. It described in great detail the weapon, the projectile, the range, the weather, date and time. The target was described as reinforced concrete. The thickness was given but there were no details of materials, mix, reinforcement or age. On the final page "Rounds fired—one. Result—missed".

By good fortune, about this time, contact was established with the Road Research Laboratory and its Director Dr W H Glanville (now Sir William Glanville CB, CBE). He set up carefully designed model experiments using small arms as weapons to assess the resistance of concrete to full size projectiles ranging from bullets to shells and bombs.[10] The RRL mathematician, Harris Booth, devised formulae for the complicated mathematical transition from model scale results to criteria for the design of full scale structures.

Varieties of easily erected shuttering made from readily obtainable materials were designed including brickwork laid in Quetta Bond, a bond devised by Major-

General C J S King (E-in-C) when some years previously he was rebuilding the cantonments following the great earthquake at Quetta.

Reinforcement design and manufacture even led to the bed manufacturers, but some care was taken not to reveal that one of the principal contacts traded under the name of Slumberland!

Protection from blast was a serious and difficult problem. Fortunately the advice of that great character and brilliant scientist Professor J D Bernal FRS, was readily available.

As the threat of invasion receded work on fortifications in Britain rapidly decreased but under the direction of Lieut-Colonel Wilson MC, RE (ADFW 3) the results of research were applied to the design of coast artillery defences at home and overseas.

Architecture of Aggression contains descriptions and illustrations of the German *TODT-SPEER* fortifications on the French Coast (known as the Atlantic Wall), and in the Channel Isles; massive in construction some still remain and are an impressive sight. Some withstood bombardment during the Normandy landings. Many were taken due to poor siting or the vulnerability of the embrasures. They were often sited too far forward, that is to say on the edge of the coast, they had little field of fire on land,[11] no depth and no mutual protection. By-passed by ground troops they were taken by attack from the rear. The large guns, six inch up to sixteen inch, were in heavily casemated emplacements. Striving for fields of fire, as often as large as one hundred and twenty degrees, embrasures were vulnerable. For example the 6 in guns of HMS *Ajax* and HMS *Argonaut* made direct hits inside 12 ft × 8 ft embrasures.[12] USA Rangers using flame projectors on embrasures caused flash-backs to magazines which completely capsized these massive structures.

Shortly after the landings in Normandy in 1944 Lieut-Colonel Sherwood B Smith, USA Corps of Engineers and the writer led a small US–British party to make a survey of the results of bombardment on the German fortifications. The objectives were to assess the forms of attack likely to be successful against the defences of the Siegfried Line and to measure the damage to concrete by heavy bombardment. For the latter task two scientists from the Road Research Laboratory (A C Whiffen MSc, and K L C Freeborn BSc, AMIEE), were in the party.

Sailing from Southampton the troopship was delayed as it was belatedly decided that the two civilians must be passed by Emigration Control. From the time of landing on *UTAH* Beach until their return, mistaken by US troops for Frenchmen, they were asked if they had eggs to sell or more seriously suspected as spies. In 1940 the Air Ministry's civilian Works Services ran into difficulties of this kind when sent to France to assist Air Marshal Barratt's Advanced Air Striking Force.[13] The outcome of their survey confirmed many of the mathematical correlations between model tests and full scale attack made in the Laboratory. (Colonel Smith, USA Corps of Engineers, wrote a brief account of the defences for *The Military Engineer* which was reproduced in the *RE Journal* of June 1946).

In 1945 a much larger team under the direction of Lieut-Colonel H H C Withers, DSO, RE was sent from the Directorate to survey the effects of the massive bombardment from sea and land of the German defences near Calais. The officer in charge of the survey team was Major R C Blyth, RE. An extensive technical report was produced and is now in the Corps Library. Some drawings and photographs from it of the Lindemann Battery at Sangatte and other structures are reproduced in Chapter 8 of *Architecture of Aggression.*

The Withers–Blyth survey was barely completed when on 5 August 1945 the first atomic bomb was dropped on Japan. It was quickly assumed that fortifications to resist conventional weapons and projectiles had become matters of no more than historical interest. We now read that in China and Sinai fortifications of traditional style have recently been built[14] so perhaps the efforts to establish a scientific basis for their design may yet be of some use.

The foregoing account deals with some aspects of the design of fortifications from

1939 to 1945, but expenditure on constructing defences at home was no more than one-sixth of the £175 million worth of work in the UK for which the Directorate and the Works Services were responsible.[15] Some aspects of these larger tasks will be the subject of Part Two—Works.

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[2] Major-General Pakenham-Walsh. *Royal Engineers Journal* 1961, p 497.
[3] *Ibid.*
[4] Major L F Ellis *The War in France & Flanders 1939–1940* HMSO 1953, p 21.
[5] Pakenham-Walsh *RE Journal* 1961, p 496 et seq.
[6] *Ibid.*, p 497.
[7] Mallory and Ottar, p 99.
[8] *Ibid.*, p 121.
[9] Major-General A G B Buchanan *Works Services & Engineer Stores* published by The War Office 1953, p 20.
[10] Dr W H Glanville *Wartime Activities of the Road Research Laboratory* HMSO 1949, pp 11 and 12.
[11] Mallory and Ottar, Chapter 8.
[12] (a) Major L F Ellis *Victory in the West* Vol I HMSO 1962, p 163; (b) Mallory and Ottar, p 209.
[13] Ellis *France and Flanders*, p 29.
[14] Mallory and Ottar, p 269.
[15] Buchanan, p 3.

Multispan Medium Girder Bridge Trials

MAJOR D H PHILPOTT, RE, BSc, CEng, MICE, PEng, MASCE

INTRODUCTION

20 Field Squadron RE recently carried out troop trials on Multispan Medium Girder Bridge (MGB). The bridges were in Gundolph Pool Upnor, the old dry bridging gap at Gordon Barracks, and across the Fleet at Wyke Regis. MGB is still a new bridge to some in the Corps and it is of interest to note that by the end of the trial the Squadron was adept at multispan work and yet a few members had never built single span bridges.

The anchorage of multispan bridges presents a large task using the standard ordnance pattern holdfasts and at Wyke Regis these were unsuitable in the shingle. A selection of Vinycomb anchors was used and these proved rapid and easy to install and most reliable in use.

THE TRIALS

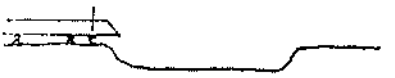
The MGB is now the standard single span equipment bridge in the Army. Recently work was carried out on a two span version using a portable pier set which is installed in the gap from the bridge itself. This principle has now been taken further and the equipment can be used for the construction of multispan bridges across dry or wet gaps. During July user trials were carried out building three-span bridges of different lengths across such gaps. For the wet gaps piers were constructed in both still water and in a fast flowing wet gap.

The principle of multispan is the shuttle, (Diagram 1). It can be seen that a pier attached to the bridge is carried out over the gap, the pier legs are then lowered to support the bridge from a temporary position while further piers are brought out to behind the first by shuttling the bridge to and fro. The last pier out, the inshore one, is placed in its final position and then the process repeated to carry the piers out one

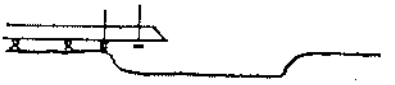
Diagram 1 SHUTTLE METHOD

1. Start bridge construction on rollers.

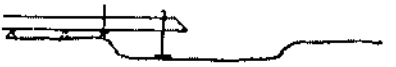
2. Start offshore pier (OP) construction.



3. Boom out OP begin inshore pier (IP).

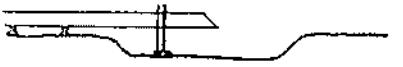


4. Lower OP beyond final position of IP.

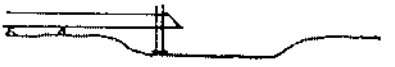


5. Boom out IP to above final position.

6. Lower IP.

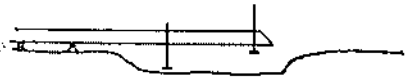


7. Boom back bridge.

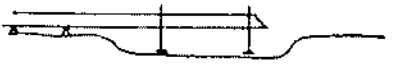


8. Lift OP.

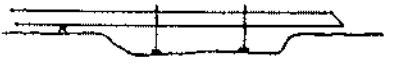
9. Boom out OP.



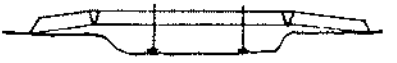
10. Lower OP in final position.



11. Boom bridge across gap.



12. Break Span.



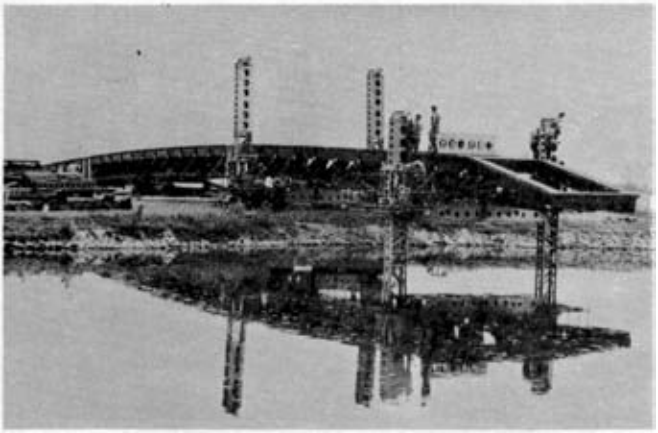


Photo 1. Gundolph Pool—Offshore pier in intermediate position.

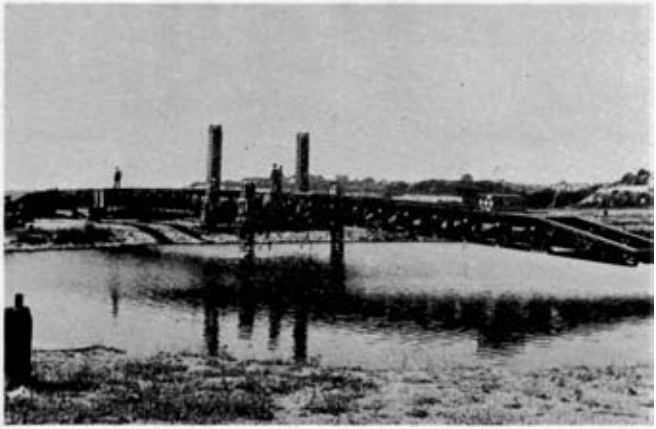


Photo 2. Gundolph Pool—Inshore pier boomed forward.

Multispan Medium Girder Bridge Trails 1 & 2

Photo 3. Gundolph Pool—Offshore pier boomed forward.

Photo 4. Gordon Gap—Bridge Commander on left (Lieut R J Little, RE).

Multispan Medium Girder Bridge Trails 3 & 4

more span. Again the last pier out is set in its final position and the shuttle then repeated for the next span. By this means the piers are carried into the gap and the piers placed in their correct positions. The final stage is to boom the bridge across the last pier to the far bank. The spans can then be broken to give a series of simply supported spans.

The components for multispan are the same as those used in single and two-span construction and consist of single-span MGB parts, a pier set, and a span junction set. All the parts can be pallet loaded and none is larger than a ten-man load.

The pier set is in the form of a portal frame and consists of a pier beam and two adjustable legs. Because the legs are adjustable the frame loses some of the rigidity which is inherent in portal design and in order to restore this the joints may be stiffened, before loading, by the use of articulators across the corners. These large hydraulic arms also allow the pier to cope with any slight changes in river bed bearing without causing undue stress in the remainder of the bridge. The legs of the pier each carry a square grillage on a ball joint. In this way the footing can adjust to any slopes in the bed. In extreme cases the pier legs can be placed on slopes of up to 1 in 2 provided foot ropes are used. The piers are supported in the gap during construction by two cables stretched across the gap. When the piers are being used as roller beams for shuttling the bridge they may be clamped to these cables.

A span junction bay is built into the two main bridge girders at the point where the span is to be broken finally. The span junction has in it an articulator similar to that on the pier. This enables it to be used to raise or lower the whole of the adjacent span. This is of particular value when the nose of the bridge has to be raised when approaching the far bank or when the construction site is restricted and the tail of the bridge needs raising to avoid grounding. They are also of use in imposing temporary hogs or sags in the bridge during construction. Whenever the span junction bays have to cross a roller assembly a link is placed in the bottom chord to avoid fouling.

As with the other components of MGB the pier and span junction sets are made of an Aluminium, Zinc, Magnesium alloy so as to reduce weights. The complete three-span bridge is carried on seventeen vehicles and trailers. This is sufficient equipment for constructing a bridge up to 252 ft.

All loads can be off-loaded at the construction site without cranes as each load is carried on a cushioned pallet which is designed to be dragged off and dropped on the ground from the load vehicle.

The development of multispan bridges has been carried out at MVEE Christchurch and it is considered that MGB will show itself to be as flexible in application as Bailey Bridging and yet lose none of its advantages in terms of weight, transport, time or manpower.

The Second Month of World War I

The interest shown in the "First Month of World War I" (March 1974 issue of Journal) *has encouraged the Editor to print the second part of the Godsell Diary much earlier than originally intended.*

Part I took the reader through the defence of the Mons Canal, the first retirement and the start of the counter-thrust towards the Marne. Part II covers the passage of the Marne, the Aisne and the first part of the battle around Missy. This is the period covered in Corps History, Volume V, pages 193 to 200.

PERSONAL NOTES JOTTED DOWN BY THE WAYSIDE

K B GODSELL, 17 FIELD COMPANY

Sunday, September 6th, 1914.

It seems quite like a Sunday, we are bivouacked in an orchard in a small village and all is now quiet. We are hearing rumours of a German Corps being surrounded

and also of a great Russian victory, 70,000 prisoners and 150 guns. The German losses at LE CATEAU must have been enormous. The Germans in a hollow in ground. Machine guns and a brigade in the streets. Infantry fired at masses of troops, 50,000 rounds. When they fixed bayonets, German infantry stopped, although only 100 yards away, and our infantry retired from the trenches. The Germans only hit two. On the 1st a German Brigade had blundered into our outposts and was badly mauled by our guns; they also lost 16 guns. Great French victory at GUISE, 2 Corps (Guard Corps) quite cut up. We got into bivouac here about 9.0 am and are at present resting and refitting, all being prepared to move at shortest notice. Horses are having a good graze in a shady orchard. Gorgeous weather continues. We moved off at about 1.0 pm and march a short distance during which we had a halt for an hour. We arrived at DAMMARTIN at 7.0 pm; here we had a meal, then moved on for 1½ miles and bivouacked for the night. A rather tedious way of covering so short a distance. Turned in 9.30 pm.

Monday, September 7th, 1914.

Reveille 3.0 am. Kicked up drivers and Section only to discover we were not starting until 8.0 am. They tried to persuade us to have breakfast but we retired to bed again until 6.0 am. Then had a wash and breakfast and waited for the move to start. We went through Courtray and Coutourmier (via POMMEUSE). The march was very tedious and the delays long and frequent. I rode on to find billets and passed old German camps and saw the damage done to houses, shops, farms, etc. Our camp was very damp, but the "Field kit" with a waterproof sheet underneath was very snug. The Padre came in to dinner (!) and swopped some good 'uns. The Germans were undoubtedly on the run.

Our lunch had been very hurried but we made up for it by an excellent dinner and a good night's rest. Some fresh tools were dished out which was a good thing as our tool carts were practically empty.

Our unfortunate Farrier Serjt had to work all night on the Field Ambulance horses as they were in an awful state and have no Farrier Sergeant.

Tuesday, September 8th, 1914.

Early start and trouble with drivers who had fed and then watered—all the horses will probably have colic but must hope for the best. Great keenness to get a German helmet. Huge delight at our advance but troops are rather tired. Halted at Done 8.45 am. Enemy's rearguard reported blocked at river crossing. Motor cyclist speared there. Guns being hurried up—no Bosch gunfire as yet. The 17th Field Co sent off under direct orders of the CRE (Tulloch) to capture 10 Germans—a great chance of having a shot but no luck—drew blank. Germans in Cyr hurrying away, hope to catch them. Preparing to bridge at ST CYR. Only one bridge left over the Marne—at LA FERTE—German baggage crossing by it. Had lunch by the side of the road, 13th Brigade attacking ST CYR. Smythe was sent ahead to reconnoitre the bridge. Little opposition encountered in attack on ST CYR. Germans driven out and we passed ST CYR. French captured 1,000 Germans. Bivouacked at GRAND MONT MENARD. Rained during the afternoon. I had to turn out for the guard 3 times during the night otherwise an excellent night's rest. Took 70 prisoners and 100 wounded. Apparently only a small force of Germans was holding us up.

Wednesday, September 9th, 1914.

Moved off to reconnoitre river towards SACCY at 6.15 am and found the bridge over the river intact. There was heavy gun fire going on all round especially on the left where the French appear heavily engaged. We passed through SACCY at 7.15 am and waited on the hill side. We then went forward. No 2 Section with the Advance Guard—up the further slope North of the Marne into a big wood where we again had to wait. I was then sent off by the OC to cut a path through the wood for the infantry but found them in fours on the far side. Part of No 2 Section under Serjt Payne were sent to help the infantry further on left to get through the wood. They met the OC and Smythe and joined in the infantry attack. I remained with the rest of No 2 Section on the road ready to assist the main advance if required. The

attack was enfiladed by the German Artillery and suffered severely. Their morale was rotten. The Cornwalls were driven back by a German counter-attack which in turn was scuppered by the 15th Brigade. A Bosch battery in the open was quickly put out of action by our howitzers and remained so all day. The Germans had a concealed battery which held us up all day by firing on the road every time an advance was attempted. We waited with tool carts, in the open, behind the wood by LE SIMON about one mile north of the Marne. We tried to get on to MONTREUIL but were greeted with a salvo of 10 HE shell from the above concealed batteries which dug deep holes and wounded 3 infantry. We returned to the clearing when I met the Colonel. Concealed batteries sited by howitzers and put out of action about 7.0 pm. Arranged to meet Singer at MONTREUIL but cyclist reported this impossible. I got in touch with Captain Lees who had remained all day at SACCY. The ½ Section with Serjt Payne, Smythe and Major Singer went into the firing line and had some good shooting and swore they hit something! (specially Hunt).

A Corporal reported Germans in large numbers fixing bayonets in the wood. It turned out to be a blasphemous Infantry Corpl and two men who had lost their way. We bivouacked where we were in the Gunner lines and had some hot tea, bully and biscuits. The concealed battery was located by the gun flashes when it fired at an aeroplane. I had lunch of bully meat by the roadside with Mirrlees. Scare about Germans in large numbers coming in on our left. All the trouble was caused by the 4th Division not getting across the river. In the evening I rode down the road to MONTREUIL and the road was quiet and clear but I could not get right into the village. Major Singer returned to SACCY and my ½ Section missed me in the wood and went back too. We spent a good night's rest.

Strategy, French between RHEIMS and RUTHEL, Germans being hemmed in on three sides and apparently a good chance of scuppering the lot.

Thursday, September 10th, 1914.

Route:— Montreuil, Dhuay, Germigny, Gandelu, Chezy

Woke up at 3.0 am and sent to Headquarters for orders and was told to follow the column to MONTREUIL. Had breakfast and started off at 6.0 am. Trekked there and on the way I went off and inspected an abandoned German battery. 87 corpses lying round it. Pits for detachments were square, 2′–6″, and carefully concealed. Guns were not badly damaged. They had evidently tried to man handle one away. There were no dead horses near but I heard there were a lot of dead Germans in the trenches on the edge of the wood just behind which I did not see. I took a helmet and a knife steel which I put in my forage cart. At MONTREUIL I found the Major and the rest of the Company after waiting three hours. We had lunch about 11.30, bully, biscuits and jam. We then had a most trying march from DHUZY to GERMIGNY, nothing but halts and a very heavy shower. It rained from 4.0 am to 10.30 am but was hot and fine in the afternoon. We halted for a long time at GANDELU waiting for orders, etc. We were told we had 2,000 Germans killed, wounded and prisoners. Our rations are coming up very well but we hear the Germans are short of ammunition and food. We passed bits of broken up German convoy. I inspected a smashed up German limber and ammunition—the result of a direct hit—collared some SAA—an awful mess, the horses were all around in small pieces. We had great difficulty in getting into our bivouac in the dark. Had too much supper but slept well. 700 prisoners were under guard in the church. We passed several dead along the road.

Friday, September 11th, 1914.

Route:— St Quentin, Montenafroy, La Loge Auxbuenfs, Passy, Marizy, Genevieve, Chouy, Billy-Sur-Ourcq, St Remy, Hartennes.

Reveille 3.0 am and good breakfast 4.0 am. Our supplies not having turned up we are waiting. Having started off it was discovered only one section was wanted with the advance guard and the remainder of the Company remained and parted by the roadside. I had a shave and good wash, the first for four days and felt much better for it. No 3 Section went off with the Advanced Guard. We had a very cir-

cuitous route going 4 to 5 miles out of our way. Heard the story of Tullock's Pontoon! It started raining about 1.0 pm and continued until 6.0 pm. We got into a billet about 5.0 pm and had a most comfortable night. We had had lunch at 9.30 am and so were quite ready for supper at 6.0. All made a stupendous meal. Captain Herring rejoined us from the base to replace casualties. He brought 7 lbs of tobacco. Heard a lot of firing in our front probably a cavalry fight. Got to bed at 8.0 o'clock. Everyone had run very short of matches. The OC issued a very good rumour (!)

Saturday, September 12th, 1914.

Got up at 5.0 am in daylight for the first time this week. Everyone was feeling better for the good night's rest and we only wanted a little sun to dry ourselves. We were lucky to get shelter and I pity the poor blokes who were out in the open and very likely in a ploughed field. Men are complaining of diarrhoea brought on by the wet. The weather seems to have broken and it is very showery. The men are in excellent spirits this morning and many jokes are flying about. Heavy gun firing is going on to our front but we have no news. We hear that the French have relieved the English Cavalry. Porter now has to sleep by himself as he talks too loudly and violently in his sleep! We are now living on rations as Germans have cleared the country. The 59th Company are employed mending the roads. At 8.0 am we had a long halt after starting at 7.0 am. The 4th Division are now following in the rear and the cavalry are a long way in front. A heavy burst of musketry on our left front but we know nothing about it. Stopped at CHACRISE for some time, had lunch and watched battle on our left. Masses of French could be seen crossing the hill by 3 haystacks. Apparently Germans brought down an aeroplane. It started raining about 4.0 pm and continued the whole night. We had passed through the village of CHACRISE and were halted just outside in the rain for 2 hours. At 6.0 pm after dark we were ordered back and had to billet in the village. We only got our billet by turning out the RAHC on an order from the Brigade. The men were very comfortable sleeping on huge stacks of straw inside the barns. I unluckily dropped my pipe—my only one—and was quite a time without it until a sapper who had just received two new ones from home gave me one. Very fortunately the CSM on going round at lights out stepped on something hard in the straw and behold it was my pipe—great rejoicings. We had a mess in a stone room with a big open fire. The floor was soon covered with straw and an enormous fire got going by means of which we dried ourselves and went to sleep. ("Make way for the RE!" The troops then pass at a hand gallop). We spent a dry and very comfortable night. Many of the infantry were out all night and must have had a wretched time. The Gunners came back and got blocked in road—there was some lively talk. The wretched blokes had to do the best they could and bivouacked along the road. We had a mail but it was a very old one. Supplies seem to be hung up and will probably be further delayed. What an awful night we might have spent could be judged by the roads and neighbouring fields. There is every prospect of more rain and I only hope our luck in bivouac and billet will continue. The French appeared to be heavily engaged right into the night on our left. We are expecting some bridging every day but so far the Germans have not destroyed any. Saw 10 abandoned German wagons today.

Sunday, September 13th, 1914.

Got up at 3.30 am and had breakfast at 4.0 am and a very good night's rest. It was still raining and very windy. I was sent off with my Section to mend holes in the road which was in a very bad state. After a long wait we reached the forward slope of the ridge and could see the hills on the far side of the Aisne. Major Singer had gone to see what all the delay was about and came back about 10.30 and ordered the Company forward. Of course they had shoved us at the rear of the column so that the pontoon waggons and all the Company transport had to push its way past the whole of the main body and advanced guard.

On the narrow and indifferent road this was a matter of some difficulty and there were many enforced delays. We finally reach where the main guard were and here we left most of the Company transport and went forward with the men and the bridging

equipment. Before going off we unloaded any spare stores there were in the waggons. By the time we had finished unloading this stuff we had created a dump that would have done credit to any Quartermaster. How old "Screaming Sarah" had stood the strain was a marvel. We were told the cavalry were on the far side of the river and so rode up to the river bank straight away. On reaching the river we discovered a boat on the far side and a Sapper of my Section stripped, swam across, and fetched it back. It was discovered later that there was nobody in front of us and the Germans were holding an entrenched position on the hills just the other side of MISSY. By 12 o'clock No 2 Section had made a pontoon raft and had started ferrying the infantry across. We got 53 men on to the pontoon raft and nine in the boat. Each trip took 8 minutes if the party to board were ready on the bank. Later we constructed a landing bay each side by using the Weldon Trestles which accelerated boarding and reduced the time per trip to 6½ minutes. The actual place of crossing was most convenient as it was where a track, which crossed the railway by a level crossing, ran into the tow path along the river bank. The point was sheltered from observation by a belt of trees and a small copse. Pottinger was sent off on a scavenging trip and came back with four large tarpaulins and some wood with which we prepared to make two double hay rafts, each of which took 25 men (when new). The buoyancy of the hay rafts diminished with each journey until it was only safe for ten men to go on them. They both sank during the night. We continued ferrying for over six hours and got 4 battalions with mules and officers chargers, 50 RAMC and a Signal Section across. The Manchesters and DCLI were the first battalions to go over and the rate was about 350 an hour. The weather cleared up but was very windy. The river at this point was some 70 yards wide and flowed at a good rate. There was a lot of shelling going on but it was directed against some batteries in our rear and no shells fell very near. On reaching the far side the infantry advanced in open order towards MISSY under heavy shell fire but there was little or no musketry.

We bivouacked close to the bridge but were turned out at 11.30 pm to ferry the 15th Brigade across. We got them all over by 6.30 am. It was a very wet night but we were too busy to notice it.

Monday, September 14th, 1914.

We started bridging operations again after an hours sleep, getting the first line transport over which was a very slow job. We could only take 4 horses and 2½ carts at a time and it took ten minutes per trip. We had great fun with the General's horse (Count Gleichen) which jumped out of the raft and swam up and down the middle of the river for over ten minutes whilst the batman threw fits on the bank. He was at length enticed out, and on the far side, but had some difficulty in negotiating the bank. The Major got a ducking. The infantry advance appears to be good and the wounded coming back are very cheery.

The ammunition carts, when they emerge from the copse, have to cross an open space and when they reach a certain haystack they were always greeted with a salvo from the enemy's guns. However as the shrapnel is bursting too high no damage has been done. The French are pushing along the ridge in front. The infantry report the Germans to be in retreat and say they have snipers up the trees. There is still a heavy artillery duel going on all round. We were not allowed the time to build a bridge and so had to use the raft. The hay rafts justified their existence but became waterlogged after about 5 hours, (ie about 1,000 men). Horses and carts take a long time. It cleared up today after a wretched night and morning. Smythe has an awful cold and has nearly lost his voice. The horses are in a wretched state—at least the 1st Line transport horses—and I am afraid this is due to bad horsemanship and carelessness. One of the Manchester's SAA horses was one of the most disgusting things I have ever seen through ignorance on part of the Transport Officer. Our horses are prize winners in comparison. Some of the carts are very heavy and it is hard work getting them on and off the rafts, especially off, as there is no landing stage on the far side. We had a mail this morning and received letters and a parcel of tobacco, chocolate and matches which was very acceptable. Anyone would laugh to see the

care we take of our matches. We are all very much surprised that up to now, 1.0 pm, they have not fired at us, but they are beginning it now. The crossing was most carefully concealed and very difficult to locate as the trees hide it. We had some difficulty with one horse who would sit on the pontoon. We had to take him across like that but with fear and trembling in case his hoof went through the bottom. About 4.0 pm Major Singer came down and we made arrangements for the night. We arranged to doss down at the platelayers cottage at the level crossing. A guard was mounted on the raft, 4 men and a NCO, to keep it working for the wounded. Herring with my horse and forage cart came along and we got very comfortable for the night and had a good supper off bully beef and onion stew. I was on duty on the bridge from 10.30 pm to 2.30 am. At 8.45 pm Capt Kirby arrived with the 2nd Bridging Train. It took the 9th Company 3 hours to put a pontoon bridge across. At 12.30 we got orders to pack up and go down the river to the broken bridge—the MISSY-VERMOISE road. We took all our stuff down with us and found the trestles an awful drag so we hauled them on board. Of course we had to desert our comfortable billet. The journey down the river was quite entertaining. Everyone was dead tired and we did not know how far or where we were actually going. Except for the 4 rowers and NCO on duty everyone went to sleep and the chorus of snores was enough to terrify any Bosch.
Tuesday, September 15th, 1914.

At about 3.0 am we were hailed from the bank by the OC and after waking up we pulled into the shore and got ready to continue rafting. We started by taking across two battalions of infantry under heavy shell and musketry fire. The infantry were dreadful and in a very bad state of nerves but fortunately there were only a few casualties. After getting the second Battalion across we made the raft fast and left a portion of No 3 Section there to work it and look after it while the remainder of No 3 Section and my Section rejoined the Company on the main road. Herring and I left last and were sniped at all the way up the road but I think the blighter was a long way off.

At 9.0 am we had breakfast by the roadside and rested, but we had to move about 12.0 as they started shelling us. Spent the afternoon cutting down trees for a proposed trestle bridge. Got another mail, 2 parcels, 3 letters and some papers. I have had four hours sleep in the last 72 hours and am feeling rather tired. Smythe has still lost his voice. We got into good billets on the main road in a farm with all the men under cover. Only hope we stay for a bit—RAPREUX. Had a good night's rest but it poured with rain all the night. Saw Yates in the morning on the raft.
Wednesday, September 16th, 1914.

Set out to work at 7.30 felling trees. We got three down but they were all too big. The shelling continued on both sides all day. The men seem very tired. On the whole it was a quieter day than yesterday. The French are doing very well on the right and are also coming round behind the Bosch on the left. The 1st Army have also done extraordinarily well on the right where the Bosch has been counter-attacking very strongly. The 6th Division is coming up from behind and is to relieve or assist the 1st Army. There are two Indian Divisions in Paris. We had a good night's rest and breakfast at 5.30. It was a wretched morning but it cleared up about 10.0 and turned out a beautiful day. This was the fourth day of the big fight but very little progress appeared to be made by either side. Tobacco lately received was being very much enjoyed. The proposed trestle bridge which was intended to take the place of the broken bridge was causing great difficulty, as the river is 15 feet deep and 170 feet wide. The trestles in consequence are enormous. The destroyed bridge was a 3-span girder bridge. The end span which was cut was 70 feet. General Sandback, CE 2nd Army came to tea. At night I took the trestle wagons with two trestles down to the broken bridge. We had quite an exciting journey as we had to go through VERMOISE which was burning furiously and nearly falling, with two huge holes on the road which had been made by HE shell. Several shells were fired but did not come near us but caused a certain amount of consternation and alarm. We had an awful job getting the wagons turned round on the tow path but managed to do everything

successfully and got back about nine thirty.

Thursday, September 17th, 1914.

Got up at 6.30 and went out to dig trenches on the road. It was another bad day and poured with rain. My batman McBain got badly kicked on the head and had to retire to hospital. We worked on the trenches up to 12, had lunch and continued from 1 till 4.0 pm. I went off with 3 men and cut a path for infantry in file through the wood up to the hill behind on to the plateau where we found some of our old abandoned battery positions. We all got soaked doing this job. Some talk of going to MISSY. Heard a rumour of capture of 34,000 Germans by the Russians and ourselves. Had dinner and trekked off at 7.0 pm, we crossed the river by the pontoon bridge, where we had first done the rafting, and went along a country lane to ST MARGUERITE. The mud was awful, one of our tool carts got stuck in a quagmire and we had the devil of a job to get it out. After great difficulty we got to MISSY and I spent the rest of the night in a cart and was beastly wet and cold. The road leading into MISSY was very exposed and the Bosch periodically swept it with a searchlight which was disconcerting. On these occasions everyone kept perfectly still and we were not spotted.

Friday, September 18th, 1914.

We started work at 4.15 on some trenches in front of the village but very little was done owing to sniping. The enemy was shelling the old raft and the West Kents who were in a rotten little trench along the MISSY–VERMOISE road, with Lyddite. Had some men employed in preparing stakes for wire entanglement. About 10.0 am my clothes began to dry and after having breakfast of bully and biscuit I had a look round the position. There are apparently only a few Bosch in front of us who are very active with their sniping and one has to be very careful when one walks. In the afternoon we continued the barbed wire preparations. I have a second breakfast with the West Ridings and a sumptuous lunch with them. Yates was there. Menu:— liqueur, soup, boiled hen, sago, 2 wines, coffee and liqueur. What about it? At dusk Corpl Geraghty took four men to the orchard to put out some wire and prepared the walls. The infantry here were sitting behind a dry stone wall some nine inches thick, yards of which fell down whenever it was struck by a bullet. Serjt Payne took three men to put up some wire in front of the sentry post by the road tee. I took the remainder and went over to help with the trenches on the left. At 12.30 I returned with the intentions of helping Smythe but found I was not required so turned in. It was again pouring with rain. I got my boots off, the first time for 48 hours and went to sleep on some corn sacks. I now have only 17 men left out of 37 fit for duty. Smythe returned shortly but we were both woken up at 1.30 by a furious fusillade and donned boots, etc in a haste. When the firing died down we again returned to our couch. Sapper Biggs got drunk.

Saturday, September 19th, 1914.

The 7th day of the battle. The German snipers are within 200 yards but have only hit two men. We had a very quiet morning until 2.30 when their confounded big guns started again. We did a lot of odd jobs in repairing the walls and making steps, etc. All the trenches that had been dug were full of water after last night's rain. I don't like MISSY and hope to get back to HQ soon. We are subjected to sudden heavy bursts of shell fire which put the wind up everyone. One shell killed Captain McLean of the East Surreys and wounded two others and also wounded a Lieutenant and three others of another Regiment, the shell burst in the road as the party were walking along it. During the night we built up a wall and got to bed about 12. We changed our billet and left the "boulangerie" but No 1 Section kept on their cook house there. The remainder of my Section occupied a house just below the Church which was well protected from the hostile shell fire by the church and the fact that the house was situated some 20 feet below the church. In addition there was a large cellar some 20 steps deep which had two entrances. It joined the cellar of the house next door which was full of civilians, chiefly women. One cellar was occupied by a lousy woman and a whimpering child.

Memoirs

MAJOR-GENERAL A C DUFF, CB, OBE, MC

Born 11 November 1896, died 4 November 1973, at the age of 76

ALAN COLQUHOUN DUFF, Wellington and RMA, was commissioned on 10 February 1915 and within months was in Gallipoli with 65 Field Company Royal Engineers. He joined them six weeks after the landing at Suvla and stayed with them for three and a half years, through Gallipoli, Serbia, Macedonia and Palestine. "65 Company" had been formed almost entirely from Kitchener's First Hundred Thousand—"the very pick and flower of England's manhood". There is no doubt that in this environment were sown the seeds which flourished and grew to become the fruits of his later life.

A brilliant administrator and organizer, his greatest challenges were probably in the Canal Zone in 1919 when absorption of units on run down were the order of the day; in 1940 in East Africa when, with Colonel Sir Brian Robertson, he directed the administrative work of the East African Campaigns which proved to be more of a fight against nature and the lack of development of the country than against the Italians; in 1945 as Chief Administrative Officer to Field Marshal Alexander; in 1947–57 when as General Manager of Stevenage Development Corporation he was one of the pioneers of the New Town concept.

Less well known are his books; 65 RE (1920), Sword and Pen (1950), Britain's New Towns (1961) all of which are held in the Corps Library and his three novels, (written under the nom de plume "Hugh Imber"), The Spine (1929), On Helles Way (1930) and The House of Apricots (1933).

An inquisitive mind, a cool head, an ability to cope, the knack of getting his priorities right, a basic honesty (in his "65 RE" he says: "I can lay no claim to have added anything to the history of the war", in a way he was right, but it was a first class report on the experiences of the Company for the Company), these were among the not inconsiderable talents of Alan Colquhoun Duff.

To his widow, son and two daughters we extend our sympathy. EEP

Major General A C Duff CB OBE MC

LIEUT-COLONEL P C GRANT, MA, CEng, MICE

Born 20 October 1909, died 15 November 1973, aged 64

PETER COVENTRY GRANT died on the 15 November 1973 after a long illness, cheerfully borne. He remained his own inimitable self to the end.

He was born on the 20 October 1909, the younger son of Major and Mrs P G Grant, at Burgate Manor Fordingbridge. Top at his Prep, Scholar at Cheltenham, he entered second into the "Shop", for which last effort he received a rocket from his father, at that time Commandant SME.

At sports, boxing was his forte, and all those who boxed against him, whether at "Coll", the Shop, or when he was commissioned, will well remember his left hook. He didn't box at Cambridge, but later won the Inter-Services Officers light-weight in 1936, and the feather-weight in 1937. He also won the Army Officers light-weight in 1936.

Peter joined 22 YO, and thereafter did the rounds in the UK before being posted to a Searchlight Company in Singapore in the late thirties. His letters to his father in the early days of the War make, with hindsight, interesting reading, and showed sound military thinking. When the Japs came, his searchlights being useless, his Unit was employed in denying resources to the enemy, which he must have done with some considerable success, as "Mentions" for Gallantry and Distinguished Services don't come up with the rations after defeats.

Of his time as a POW, a fellow prisoner writes, "In those difficult days his sanity and steadfast view of what was right were of the greatest value to his companions. He was a man of the highest integrity and moral courage" As a result of these years as a POW, his health, as apart from his spirit, never really recovered.

After the War, Peter went to the Staff College, and on to various Staff and Sapper Appointments, finishing his military career, in 1958 as CRE London. When he was at SHAPE he had the opportunity to steep himself in the Arts and Culture of France, and these together with his life long love of music, formed the main interests for the rest of his life.

On retirement, Peter joined the Bridges Engineering Division of the Ministry of Transport (DOE), and found full scope to exercise his talents as an Engineer. A colleague in the DOE writes ". . . He built up an excellent reputation with his opposite numbers, who would seek his advice, and he became well respected for his knowledge (particularly his mathematical abilities), and good sound Engineering". He retired for the second time in 1972.

Peter in his quiet way was a great character. Woe betide anyone shooting a line on his pet subject, for Peter didn't know a little about a lot, he knew an awful lot about a lot—he always let you down kindly though. As a wit, he ranked high. Asked to take "pot luck" with a senior officer, and being regaled with a sumptuous feast in company with about ten other guests, Peter, on leaving, asked to be invited again when his host had had the time to lay something on. Once in Paris he had, yet again, to entertain a horde of Civil Servants over on a swan. He promised to take them to the best nude show in Paris. He did—to the Louvre.

In 1972 Peter married Clare, younger daughter of the late Reginald Aloysius Talbot and Mary Talbot, and all our sympathies must go to Clare. They had such a short, but such a very happy life together.

Peter's time as a POW took a very heavy toll on his health, and had it not been for this, he might well have reached the heights,

"For he was likely, had he been put on,
To have proved most royally: and, for his passage,
The Soldiers music and the rites of War
Speak loudly for him"

NAP

Correspondence

Lieut-Colonel R Jukes-Hughes MBE, RE, CEng, MICE, AMIHE
39 Engineer Regiment (Airfields)
Waterbeach Barracks,
Cambridge, CB5 9PA

JUNIOR MANAGEMENT SKILLS

Sir,—In your editorial to the March 1974 issue of the *Journal* you infer that training projects should be chosen to practise individual trades skills rather than the junior management of a formed unit. I hope I am not the only commanding officer to take issue with you on this!

Trades skills are taught on long courses at the RSME, and I think everyone would agree that our soldiers get a very good grounding there in their trades. It is my experience that they get back into the swing of things very quickly once they get onto a task requiring trades skills, even if they have been away from their trades for two or three years. It certainly pays to give them a quick refresher course beforehand whenever possible, but I believe that soldiers in UKLF units anyway get sufficient practice at their trades in the normal course of their work without the need for special trades training projects.

Junior management however is something for which our young NCO's get very little formal training, and which they have to learn to a large extent on the job. The amount of command experience they can actually get in each rank is limited both by the requirements of training and ERE posts, and by the erosion of responsibility caused by an ever increasing number of NCO posts within units. It is therefore encumbent on us all to give Junior NCOs every opportunity of practising management skills on projects and training, and to give them responsibilities above their ranks whenever possible. A squadron which is well led and properly organized should be able to carry out any combat engineering or (with technical advice) any construction project. I believe it is more important to practise its junior management skills than individual trades skills.—Yours sincerely, R Jukes-Hughes.

Brigadier C J Popham
Headquarters 12 Engineer Brigade
Barton Stacey
Winchester
Hampshire SO21 3NH

Sir,—Your Editorial in the *Journal* for March 1974 gives food for thought and, I suspect, will provoke correspondence in these columns. I would like to take up some of the points made about construction projects. A good project will produce wide ranging benefits both for the customer and for ourselves. Among the latter I would highlight three aspects.

The men involved will increase their trade skills and experience. The majority of such projects fall to units of United Kingdom Land Forces. In any such unit there will always be a wide divergence of trade knowledge and experience; the man near the end of his tour, competent and practised with good potential for an upgrading course; the young soldier newly arrived from a trade course needing experience and practice; the soldier recently from a tour in BAOR, where operational and training commitments largely preclude project work, in need of practice and perhaps updating. All of these will benefit in both short and long term from the training opportunities of such work.

The NCOs will widen their experience in "management". This is not merely a question of proper employment. A junior NCO whose past experience has been largely in command of a section on minelaying, demolition and equipment bridging has much to learn of the application of control to project work. Also no two projects are exactly alike and there is always some new aspect even for the NCO experienced in such work. Again both short and long-term benefits accrue from such employment.

The third aspect that I believe to be worthy of special mention is job satisfaction. A project which has taxed trade and management skills and which provides the customer with some lasting service or structure gives much satisfaction and pride. This is of considerable value to the Corps as a factor in both internal and external recruiting, long and short term.

When a choice of projects is available these points stand high as factors in the selection. There are times when such choice is not open to us, for example when a military works requirement is to be met which of itself does not give much training. This is a part of the service we must give and in most cases some of the benefits above can be obtained. As always

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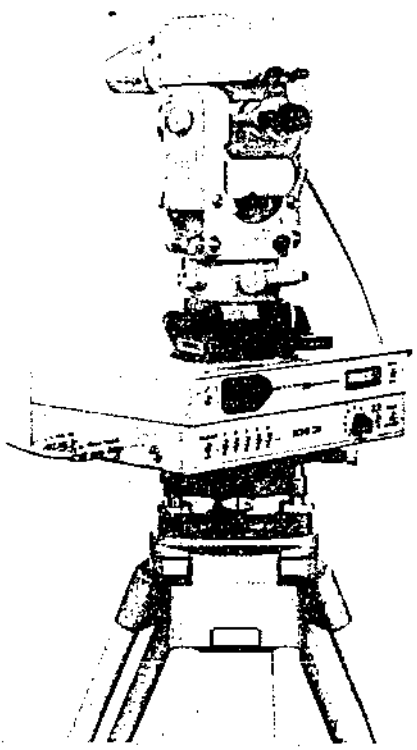

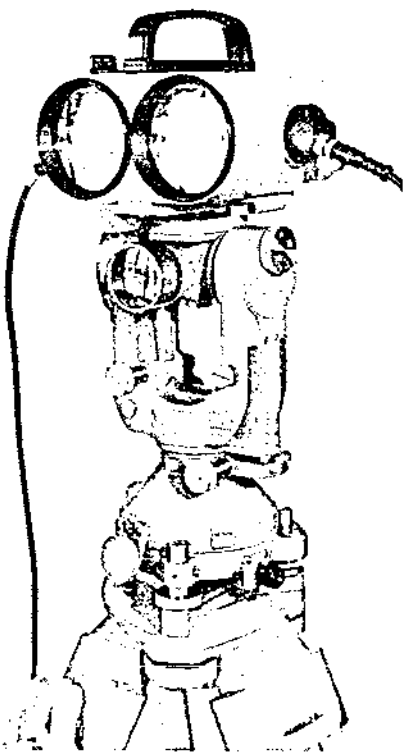

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In the Constrado publication under review Safe Load Tables are provided relating to the BS4848 standard metric angles which are the only sections for which the production has changed at this time (1973). There will be other changes, and Safe Load Tables will be produced in accord with these changes. For the present however, it is necessary to continue to employ the 1971 edition of the Handbook on Structural Steelwork for all sections *except angles* for which the tables in this new publication should be used.

As usual in Handbooks of this type the explanatory notes, dimensions and properties of the standard angles precede the Safe Load Tables which cover both struts and ties as single angles, double angles with gusset between angles and on back of angles, as well as double angles as box section struts.

This Handbook is a MUST for all concerned with steelwork design.

EEP

THE HERBERT JOHNSON WARDROBE

I AM sure that you will be interested to learn that Herbert Johnson's have just opened a new shop at 13 Old Burlington Street, where all our traditional hats and caps, both military and civilian, will be dealt with. This is not the whole story, however, as we have at the same time opened a new department there for men's clothing. The Wardrobe has a first class selection of high quality suits, jackets, trousers, shirts and knitwear, which have been chosen from all over Europe and we feel confident that our customers will find a new and interesting reason to come and visit their hatters.

This does not mean, of course, that we are leaving Bond Street, but here we have expanded our Ladies' Department, and introduced a fine range of ladies' clothing designed by Judy Hornby. There is, as always, our interesting range of accessories and gifts. There we warmly welcome our customers' wives and girl-friends, and I am sure that they too will find something of interest at Herbert Johnson.

where things went less than well rather than our moments of greatest success. This volume is invaluable in this respect; Cos, Leros, Anzio, and Cassino all abound with lessons which should form an admirable corrective towards any tendency to complacency.

The events covered by the book are a valuable reminder, too, of the truth that, except in desert warfare, infantry are the decisive arm on the battlefield. The tank, so dominant in North Africa, "sank silently in Italy to the position of a self propelled gun", while Engineers shared with the Artillery a position of first consequence as the two most significant supporting arms.

Altogether this is a volume of the official history of great importance, and with an unusual number of lessons both for the historian and the future aspirant either to high command or to positions of influence on the staff. This book is exceptionally well written and composed besides being beautifully produced; its judgements are fair and objective, but do not pull their punches. It picks out as its heroes for this part of the story, two unexpected and modest groups, the officers and men of the combat arms and the administrative services which sustained them. No one who fought in Italy will forget the quality of British administrative support in spite of the difficulties, risks, and problems requiring to be overcome. The history rightly pays tribute to that administrator of genius, a sapper, Sir Brian Robertson. Equally appropriately the book ends in the next paragraph with a moving reminder of the contribution made to final victory by the many ordinary fighting soldiers killed during this stage of the war without any real knowledge of the part they had played in achieving success for their country's arms. It is good that the Official History should so admirably, and in such perfect taste, get its priorities so signally correct.

AJW

AGGLOMERATION OF IRON ORES

D F Ball, J Dartnell, J Davison, A Grieve, R Wild
(Published by Heinemann Educational Books Ltd. Price £11·50)

This is a fine work of nearly 400 pages bringing together under one title all aspects of iron ore preparation and its reduction to iron.

Agglomeration is the making of suitably sized granules of ore by sintering or pelletizing. The aim is to reduce the total cost of iron smelting by a combination of capital cost savings and fuel savings. Blast furnaces and other smelting plant require the raw material to be of uniform composition and particle size if they are to work at maximum throughput and efficiency. The agglomeration of the particles also require energy; in the early part of this century agglomeration was merely used to render waste products usable and was not efficient, whereas nowadays it is found to be a worthwhile process for the full charge. The ores may require blending and concentrating and agglomeration is used to reconstitute the particles to a suitable size.

In a very readable way the authors have considered how iron ores came into being, what they consist of, how they are mined and transported, blended, agglomerated and finally reduced to iron. In the process they have included much of interest to the metalurgist and chemist and to process, plant and mechanical engineers.

The book is well referenced, full of line diagrams and several photographs, has a good index and the chapters are well sub-divided into sections by group headings. This book is, therefore, easy to use as a reference or text book on what has been made to sound a fascinating subject.

JAJ-B

STRUCTURAL STEELWORK HANDBOOK FOR STANDARD METRIC SECTIONS METRIC ANGLES TO BS4848: PART 4: 1972

(Published by Constrado, 12 Addiscombe Road, Croydon CR9 3JH)

The Handbook on Structural Steelwork was published in metric form by the British Constructional Steelwork Association (BCSA) and the Constructional Steel Research and Development Organization (CONSTRADO) in 1971. That edition took account of the metric equivalent values relating to imperial sections in BS 4:1972—Hot Rolled Steel Sections, and BS 449:Part 2:1969—The Use of Structural Steel in Buildings.

In January 1973 the imperial angle sections described in metric terms in BS4:1972 were replaced as standard production by the metric angles included in BS4848:Part 4:1972.

Once back on the mainland, and after the failure of the German counter attacks at Salerno, successive delaying lines, Viktor, Barbara, Bernhardt, appalling autumn weather, and finally the main winter position, the Gustav Line, first blunted and then stopped the Allied advance. By Christmas 1943 both Fifth and Eighth Armies had fought themselves to a standstill, and only the impending Anzio Landing offered a chance to break the deadlock.

Anzio, though 6th US Corps' landing took the Germans completely by surprise, failed in the event to loosen their grip on the mainfront at Cassino. It is arguable that if the Allies had ventured more boldly in the early stages of the operation, described as being like "an exercise without an enemy", they could perhaps have thrown Kesselring off balance. But Lucas, the American corps commander, a "good plain cook" of a General, was not that type of leader; the German command, too, reacted so quickly and improvised so well that it was not long before the Allies, as earlier at Salerno, were fighting desperately even to maintain their footing. The chance, if it ever existed, was so fleeting that neither Lucas, nor his superiors Clark and Alexander, ever seriously contemplated grasping the opportunity.

The rise of Kesselring had earlier coincided with a decline in the effectiveness of Montgomery as the techniques which had served him so brilliantly in the Desert became progressively less applicable in the Italian context. The chapter dealing with the planning of the Sicilian invasion gives a significant foretaste of Montgomery's increasing tendency to disagree, forcefully and even arrogantly, with his superiors; he was fortunate here, as on future occasions, to have bosses in Alexander and Eisenhower, who were prepared to tolerate his roughness in the interests of preserving his professional competence in the Allied cause.

It was a period, too, when Alexander's own touch was sometimes less than sure. Lacking the full depth of Montgomery's stark professional knowledge, Alexander depended greatly on a strong Chief of Staff. Throughout the North African campaign the austere McCreery had carried this job out to perfection; during the winter of 1943, and until the arrival of Harding in early 1944 Alexander was less well served. Harding's impact was immediate, and is well demonstrated by a brilliant appreciation of the situation in Italy submitted to the Supreme Commander, Jumbo Wilson, on 22 February 1944. It should be read and studied by all aspiring staff officers as a model of clear thought and logical deductions, leading in the early summer of 1944 to convincing victory.

Nor, after Einsenhower had left the Mediterranean to assume his even greater responsibilities in connection with Overlord, was the new Supreme Commander, Wilson, known at that stage to the irreverent as "the Wizard of Cos", particularly impressive. The history points out, pertinently but fairly, that he found it hard to grasp the purpose of operations in Italy, or how they should be conducted. He seemed to have lost his touch with the realities of war during his periods of command on the relatively calm stage of Persia and Iraq, and later in the Middle East.

In fairness, the operations for which the Allied commanders were responsible during this period were far from easy. They were bedevilled by a lack of conviction at the very top about the overall aim of the Italian campaign, by terrain admirably suited to defensive fighting, and by shortages of various kinds, principally manpower and landing craft.

Throughout the period covered by the volume the quality of the support given to the ground troops by the Allied Air Forces hardly varied. It was superb; the Allies invariably had supremacy in the air, and the German Air Force in the theatre, crippled after the North African campaign, became finally impotent to influence events. This is not to say that the Allies always used the air power available to them to the best advantage. There remained a misunderstanding of what air power could or could not achieve, the Cassino operations providing a pertinent lesson on the unwisdom of switching strategic bomber effort to tactical action in support of the land battle.

The Cassino fighting provided the nearest equivalent in World War II to the ghastly earlier battles of attrition on the Somme and at Passchendaele. Going on and on at Cassino during the grim months of February and March in 1944 seemed to me then, as a humble participant in the battle's final stages, as stupid as Haig's obstinate prolongation of the offensives of 1916 and 1917. On both occasions there were specious strategical reasons for continuing to attack, but far stronger tactical and morale grounds for calling things off and waiting for better fighting conditions. As the next volume will show, the Cassino position was never to be taken by direct assault; it was finally outflanked by French mountain divisions, properly equipped with animal transport and moving across country, who captured the high ground to the south of the Liri valley, thus forcing the Germans back to, and quickly out of, the Hitler Line.

It is, in my view, generally more pertinent to study those periods of our military history

like to command his Regiment in operations and in training as well. But in the vast areas of the Far East this is not always possible; so that all kinds of other arrangements had to be made to suit the circumstances. Each case had to be judged on its merits, and the tale became what the Author calls the "CRE Saga". One feels that the Commandant must have often had a difficult horse to ride.

Finally, at the end of the story was the heartbreaking business of the "run-down", or the reduction in numbers to a maximum permitted strength of enlisted Gurkhas. This came about as a result of world affairs, and was signalled by a statement of policy from Whitehall. With the stroke of a pen a figure was written; and the Staff Officer perhaps went off to lunch in Chessington, leaving the execution of the order to the regimental officers in the Far East. It was they who had to grapple with the personal problems that were inherent in its execution. It must have been a sad affair breaking it to the men, who had learned to love the Regiment and all that it stood for.

It is not possible in this notice to say much about the many projects that were done by the Squadrons, although they form a considerable part of the story. Far from there being no work for Sappers, it seems that any British Officer chosen to serve with the Regiment had grand experience in a succession of engineer works. There were roads, bridges, airfields, defences, water supplies and many other projects to be accomplished; and the Gurkhas, far from being too "thick" to cope with sapper work, gained in self confidence and skill as the time went by, till they became really effective. They were even called upon to help the District Engineer in Faringdon, Berks! They built a Bailey Bridge in the main street to take traffic over a sewer that was being dug there. The book includes an ample description of all these things, with good maps to show where they happened.

The reader must read all this for himself to get a sensible awareness of the personalities, the climate of opinion prevailing, and the contemporary historical background. It would have been so easy for an author to compile a dry-as-dust extract from each successive War Diary; or, at the other extreme, to weary the reader with a collection of Mess or Barrack Room yarns, some true but most of them mere travellers' tales. Yet both errors have been avoided. The Author has produced a Book (with a capital B) that carries the reader along from the early days of doubt and uncertainty, through the formative years of training and operations, to the days of fulfilment, when we can see with hind-sight how wise it was to try the "Sapper Experiment".

The Author is to be congratulated on the skill with which he handles the wealth of material that he has so painstakingly quarried from so many sources. Most of it is in the main body of the letterpress; some is in well-chosen footnotes; and some is in the numerous Appendices, some of which are literary gems, capable of standing on their own as monographs of merit. (If your reviewer may be permitted a personal note in parenthesis, he is delighted to read that he is not the only British Officer to carry through his service a cognomen coined by the soldiery of the East; and that Major Townsend Rose was habitually known as Major Transom Sahib.)

The Institution is lucky to be able to add to its series of Corps Histories a worthy story, so worthily told by its Author.

MCAH

HISTORY OF THE SECOND WORLD WAR
THE MEDITERRANEAN AND MIDDLE EAST—VOLUME V

BRIGADIER C J C MOLONY
(Published by HMSO 1973. Price £10·50)

This volume, the fifth of six in the series covering the 1939–1945 War, deals with the war in the Mediterranean between May 1943 and March 1944. It begins with the conquest of Sicily in the high summer of 1943 and ends with the failure of the last of the three grim assaults on the Gustav Line at Cassino in March 1944.

It was a tough time for the Allied soldiers at the sharp end, and, simultaneously, an undistinguished and uncertain period for the strategists and high commanders who directed their operations from further back. The Germans, after their debacle in Tunisia, progressively recovered their poise; surviving the defection of their unwilling Italian ally, they gradually steadied the position throwing up in the process a defensive commander of real genius in F M Kesselring.

The German plans for their withdrawal from Sicily were a model of their kind—simple, based on strict discipline, and involving a firm clear chain of command from top to bottom.

scarcely comprehensible without the caption; which is a great pity, because they are potentially good photographs. Finally, a sheaf of amendments flutters out of the book when you first open it. One of them is a replacement for a chapter heading that has been printed upside down. The name of the publisher, who was presumably responsible for all this—it is not the Author's province—has been omitted from the title page; but the fly-leaf tells us that the book was printed in Hong Kong, which suggests to your reviewer that finance—or lack of it—is the cause of the defects.

Having said all this, which a reviewer is bound to say if he wishes to escape the charge of promoting a fraudulent prospectus, it is a great pleasure to be able to give unqualified praise to what is written between the covers. The tale told is splendid, and those who made it—that is to say the Gurkha Sappers—may take legitimate pride in it. Moreover, they are to be congratulated on capturing so accomplished an Author to tell their story. He tells it with an elegance and rhythm that is rare in the world of the printed word today.

Like all post-World War II histories, the thread is a tangled one due to the inevitable changes that occur when an Empire is dissolved. In 1947, when the Indian Peninsular was partitioned, and India and Pakistan came into separate existence, a tripartite agreement was signed in Kathmandu between the Governments of Nepal, India and Britain, whereby "four Rifle Regiments of the erstwhile Indian Army Gurkha Brigade" were transferred to the British Service. This Agreement was apparently signed on 9 November 1947 when, as your reviewer saw for himself at the time, the Indian Peninsular was in a state of frightful turmoil. It is greatly to the credit of some unknown warrior, with a clear understanding of what was at stake, that such a far-reaching and fruitful an understanding was arrived at in a spirit of "cordiality and goodwill". But for that foresight this tale would never have existed.

When a Brigade of Gurkhas had been established as part of the British Army there at once arose what the Author calls the "Great Controversy". This Controversy existed between those who said that a Gurkha Brigade must be supported by its own Gurkha ancillary arms; and those who said it was folly to use fine infantry material in any other role. It seems to your reviewer to reflect great credit on all concerned, holding the strongest views (as they did), that the Controversy became in time the "Sapper Experiment", and that the experiment ended in such an outstanding success.

Many and great were the odds against which the Sapper Experiment was conducted. First, it was supposed that Gurkhas were too "thick" to comprehend the work of a technical corps. Of course sapper work is difficult and calls for training and common sense; but then so does the work of the Infantry, and it was soon to be demonstrated that the Gurkhas were easily capable of absorbing the excellent training that was offered by the Corps.

Next, came the matter of caste. To the Hindu Brahmin, the work of a craftsman—particularly that of blacksmith and one or two others—was anathema, and it was predicted that Gurkhas would react in a similar manner. Those who, like your reviewer, served in the Sappers and Miners will recall somewhat similar difficulties in the Hindu sections from the *Purab*; and they will be interested to read of the understanding of the British officers and the Gurkha rank and file that was brought to bear on this matter, and how happily it was settled.

Then there was the unsettled state of the Far East. The troubles in Hong Kong, the war in Korea, the Emergency in Malaya, the Confrontation in Borneo demanded infantry everywhere; and there were many who grudged allotting any Gurkha manpower to the Sappers. The GOC Malaya during 1950 went on record as saying: "There is no foreseeable role for Engineers in the Emergency"; and in 1962 in Borneo one of the Gurkha Brigade Commanders is said to have exclaimed: "What do we need Sappers for? . . . There are no minefields to breach." This sort of thing must have been very discouraging to so youthful a Sapling, still unsure of its roots.

There was also the language. In the days of the Sappers and Miners the foreign tour of a British Officer was five years; and most officers stayed longer, so that the time then spent learning the language was a much lesser proportion of his tour than today with only three years overseas. How thankful the rank and file must have been when the passing years brought back officers, who were on their second and third tours with the Regiment. Colonel Roach, we are told, was on his fourth tour when he was appointed Commandant.

The title Commandant was commonly used in the Indian Army; and in the Sappers and Miners it was the term for the Commanding Officers (Lieut-Colonels) in Roorkee, Bangalore and Kirkee. It is an impressive title, but it conflicts with the familiar CRE. And the job, too, conflicts. The Commandant of the Gurkha Sappers must be the "Father of the Regiment". He must play his part in recruitment, training, promotions and many other matters. He must do any cross-posting between Squadrons that are necessary; and naturally he would

there is a fine balance between the time occupied by such tasks and the time needed to accomplish the many training requirements of a unit.

Lastly I would like to put the "formed unit mentality" you mention into perspective. In projects within the United Kingdom, the force will normally be built upon the command and control element of a unit or sub unit. The composition of the force will depend on the requirements of the task, thus a squadron or troop(s) may at times be appropriate and at other times a special "mix" of tradesmen will be needed. For projects overseas, other factors normally dictate that a formed unit will be sent, but even in this case the trade content may be adapted. In most of the overseas countries in which projects are done there is no danger today of a "road to nowhere", there are too many somewheres with no roads.—Yours sincerely, C J Popham.

Lieut-Colonel K H Tuson CEng, FIMechE, FIEE
Pickhams
Wilmington
Polegate, Sussex

CHARTERED ENGINEER

Sir,—Stirred by your eloquent plea I venture some comments on Major Matterson's letter regarding Chartered Engineers.

In the first place, The Council of Engineering Institutions requires that Chartered Engineers should possess the equivalent of an engineering degree as well as considerable practical experience. Does your contributor seriously suggest that the majority of Institution of RE Members reach this standard, and that the Institution should run qualifying examinations? Furthermore, does the Army need or want all its engineer officers to be so highly qualified and will they pay them appropriately? Long ago, when the Corps was constructing fixed defences and introducing electric signalling, submarine mining, designing airships and starting the RFC, they *were* required in some number, and indeed two such were among the founders of today's Institution of Electrical Engineers. But we have hived off most of the corresponding activities of today; what has happened to the RE Board I wonder?

The difficulty with the Corps always was, and probably still is, its endeavour to serve two masters, contrary to Biblical injunction, and with the predicted result. As YO's it was dinned into us that we must be both first class soldiers and first class engineers, a combination only possible for the most gifted. The majority were not strong-minded enough or fortunate enough to resist the endeavours of AG7 to turn us into such paragons by not leaving us anywhere long enough to concentrate on either objective, and the result was too often mediocrity. Since our masters, the generals, were selected by soldiers and our task was to serve soldiers it was the militarily inclined who did best. One Corps General in the 30's told a gathering of junior officers that those with E&M qualifications were unlikely to get far, and about the same era a member of the IEE staff told me that no RE officer was considered suitable for membership. I am glad to see from Mr Bromfield's paper that other ranks are now thought of more highly, but it is hard to accept that officers should be held in less esteem than their subordinates.

In conclusion, who can tell me something of the career of Captain H Riall Sankey?—Yours sincerely, K H Tuson.

Book Reviews

THE GURKHA SAPPER
THE STORY OF THE GURKHA ENGINEERS 1948–1970

MAJOR-GENERAL L E C M PEROWNE CB CBE K St J
(Obtainable only through Lieut-Colonel D H Bowen MBE RE, CI Tactics School, RSME. Price £5.00)

First impressions are often deceptive, and seldom more so than the impression likely to be sustained by a reader who picks up for the first time GURKHA SAPPER by Major-General L E C M Perowne. Defects are the first things he is likely to notice. To begin with there is something odd about the paper on which it is printed. It is not particularly thin paper; but it is not properly opaque, so that as you read you are aware of other printing overleaf. Then the photographs; they are really very badly produced indeed. Some are