The Royal Engineers Journal

VOL. LXIII JUNE, 1949

CONTENTS

"Go To It"	Major J. S. R. Shave	105
Archimedes and the Design of Fort Euryalus	A. W. Lawrence	131
Construction Parties in Turkey	Colonel K. W. Merrylees	139
Demonstration of the Mechanical Truck Discharger and Track Handling Crane (Patented)	Major R. S. Hotston	143
The Maiden Voyage of the "Yam Seng"	Major J. W. Bossard	145
The French Camp at Castillon	Major J. L. Nicholson	156
Chief Engineers of England		158
Hathazari Airfield Specification	The E.-in-C., in India, 1947	159
The Commonwealth at War	Major-General A. C. Duff	162
The Ordnance Survey in the Near East	Lieut.-Colonel H. E. M. Newman	168
Ack and Quack	"Battledress"	182
"Positive Anchored" Pre-stressed Concrete Sleepers	Lieut.-Colonel W. B. Sykes	185
Morale	Major-General A. C. Duff	187
Book Reviews, Technical Notes		192

Published Quarterly by
THE INSTITUTION OF ROYAL ENGINEERS
CHATHAM, KENT
Telephone: Chatham 2669

THE ROYAL ENGINEERS JOURNAL

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

VOL. LXIII CONTENTS JUNE, 1949

PAGE

1. "Go To It." The Story of the 3rd Parachute Squadron, Royal Engineers By Major J. S. R. Shave M.C., R.E. (*With Photographs and Sketches*) 105
2. Archimedes and the Design of Fort Euryalus. By A. W. Lawrence, Professor of Archaeology at Cambridge (*With Sketches*) . . 131
3. Construction Parties in Turkey. By Colonel K. W. Merrylees, O.B.E., M.I.Mech.E. (*With Photographs*) 139
4. Demonstration of the Mechanical Truck Discharger and Track Handling Crane (Patented). By Major R. S. Hotston, R.E. (*With Photographs*) 143
5. The Maiden Voyage of the "Yam Seng." By Major J. W. Bossard, M.B.E., R.E. (*With Photographs and Sketches*) 145
6. The French Camp at Castillon. By Major J. L. Nicholson, O.B.E., R.E. (*With Sketch*) 156
7. Chief Engineers of England. (*With Photographs*) 158
8. Hathazari Airfield Specification. Submitted by The E.-in-C., in India, 1947 159
9. The Commonwealth at War. By Major-General A. C. Duff, C.B., O.B.E., M.C. 162
10. The Ordnance Survey in the Near East. By Lieut.-Colonel H. E. M. Newman, R.E. (*With Sketch*) 168
11. Ack and Quack. By "Battledress" 182
12. "Positive Anchored" Pre-stressed Concrete Sleepers. By Lieut.-Colonel W. B. Sykes, R.E. (T.A.) (*With Sketch*) 185
13. Morale. By Major-General A. C. Duff, C.B., O.B.E., M.C. . . . 187
14. Book Reviews 192
    - The Other Side of the Hill . . . . . M.C.A.H.
    - War as I Knew it . . . . . M.C.A.H.
    - Military and Political Consequences of Atomic Energy K.H.T.
    - British Army Journal . . . . . R.E.B.
    - Prestressed Concrete . . . . . N.W.
    - History of the Great War, Vol. II . . . . . C.C.P.
    - History of the Great War, Vol. III . . . . . C.C.P.
    - Rockets and Space Travel . . . . . R.E.B.
    - Paiforce—The Official Story of the Persia and Iraq Command, 1941–6 . . . . . E.M.E.C.
    - Wellington College—The Founders of the Tradition C.C.P.
    - Bougainville and the Northern Solomons . . . C.C.P.
    - The Keeping of Regimental Accounts . . . R.G.A.
    - The B.S.P. Pocket Book . . . . . C.C.P.
15. Technical Notes 203
    - Prestressed Concrete
    - A New Self-Propelled Mobile Crane
    - Gas Shielded Welding Process
    - New Aluminium Bascule Bridge
    - Some Applications of Aluminium Alloys to Structures
    - Sound Insulation of Cavity Party Walls
    - A 150-ton Floating Crane
    - Control of Variations in Quality of Concrete and its Effects on Mix Proportions
    - Re-impregnation of Overhead Line Wood Poles by Cobra Process
    - The Revised British Standard 449 for the use of Structural Steel in Building (1948)

THE COUNCIL OF THE INSTITUTION OF ROYAL ENGINEERS

(Incorporated by Royal Charter, 27th February, 1923)

Patron—HIS MAJESTY THE KING

President

Maj.-Gen. Sir Eustace F. Tickell, K.B.E., C.B., M.C. 1948

Vice-Presidents

Maj.-Gen. H. B. W. Hughes, C.B., D.S.O., O.B.E. 1948

Maj.-Gen. A. D. Campbell, C.B., C.B.E., D.S.O., M.C. 1948

Elected

Col. T. F. Hood, O.B.E., T.D. 1946

Brig. K. M. Papworth, O.B.E., M.C. 1946

Col. S. A. Stewart, O.B.E. 1946

Col. G. C. Clark, O.B.E. 1946

Brig. R. Llewellyn Brown, C.B.E. 1947

Lieut.-Col. T. Burrowes, O.B.E. 1947

Maj.-Gen. Sir Horace E. Roome, K.C.I.E., C.B., C.B.E., M.C., Col.-Comdt., R.I.E. 1947

Major L. MacL. Young, M.B.E., M.C. 1947

Brig. E. F. E. Armstrong, C.B.E. 1948

Brig. A. G. Bonn, C.B.E., M.C. 1948

Col. H. E. Pike, C.B.E., D.S.O. 1948

Lieut.-Col. W. B. Sykes 1948

Maj.-Gen. C. A. West, C.B., D.S.O., M.C. 1948

Col. F. C. W. Fosbery 1948

Ex-Officio

Col. L. O. Clark, O.B.E. ... ... A.A.G., R.E.

Brig. B. C. Davey, C.B.E. ... ... Comd., S.M.E.

Brig. R. Gardiner, C.B.E. ... ... D.Tn.

Brig. L. D. Grand, C.I.E., C.B.E. ... ... D.F.W.

Brig. C. de L. Gaussen, M.C. ... ... D/E.-in-C., W.O.

Col. H. P. Cavendish, D.S.O., O.B.E. ... ... Comd., Chatham Wing, S.M.E.

Col. C. E. A. Browning, M.C. ... ... Comd., Ripon Wing, S.M.E.

Corresponding Members

Major-General K. Ray, C.B., C.B.E., D.S.O., *Union Defence Force, South Africa* ... ... 1st January, 1949

Lieut.-Colonel A. R. Currie, D.S.O., *D.F.W., New Zealand Military Forces* ... ... 1st January, 1949

Colonel H.W. Love, O.B.E., *Chief Engineer, Canadian Army* ... ... 1st February, 1949

Brigadier J. Mann, D.S.O., *E.-in-C., Australian Military Forces* ... 1st March, 1949

Secretary and Editor R.E. Journal

Brig. C. C. Phipps, C.B.E., M.C. ... ... 13th January, 1945

Bankers

Lloyds Bank, Ltd., Cox's and King's Branch, 6 Pall Mall, S.W.1.

8,350. 1.6.49.

Photo 1.—Captain T. R. Juckes with the Royal Family and Brigadier James Hill. Bulford Fields, May, 1944.

Photo 2.—Captain E. L. Fox explains things to General Montgomery.

Go To It, The story of the 3rd parachute squardron royal engineers 1,2

"GO TO IT"

THE STORY OF THE 3rd PARACHUTE SQUADRON, ROYAL ENGINEERS

By MAJOR J. S. R. SHAVE, M.C., R.E.

FOREWORD

DURING the latter part of 1942, a new division was rapidly taking shape in the South of England. The '6th Airborne Division,' as it was called, was destined to play an important part in the liberation of German occupied Europe and in the conquest of Germany itself.

The units of the Royal Engineers in the division comprised the following :—

H.Q.R.E.
3rd Parachute Squadron, R.E.
591 (Antrim) Parachute Squadron, R.E.
249 Airborne Field Company, R.E.
286 Airborne Field Park Company, R.E.

This narrative largely concerns the 3rd Parachute Squadron but is also the story of the divisional engineers and, in part, the story of the division. It is dedicated to those officers and men of the division who lost their lives in Normandy, the Ardennes and Germany. If it should help to preserve their name and the deeds they accomplished, it will have achieved its purpose.

A glossary of terms and abbreviations is printed on the folding plate at the end of this story.

CHAPTER 1

NOVEMBER, 1942—JUNE, 1944

For the men of the 21st Army Group, " D " day of 6th June, 1944, was the culmination of many long months of the most exacting preparation. The story of the 6th Airborne Division is typical of those of many other famous formations who later fought by its side in Europe.

The close of 1942 saw the formation of the 6th Division and an influx of volunteers for parachuting and gliding. Although many men had to be sent out to reinforce the 1st Airborne Division, which at that time was in action in N. Africa, Sicily and Italy, the end of 1943 saw the division almost complete. Training had progressed from the individual stages to full scale brigade and divisional exercises. In February, 1944, exercise " Co-operation," staged by the 3rd Parachute Brigade, commanded by Brigadier James Hill, D.S.O., M.C., saw an entire parachute brigade group dropped on a single dropping zone (DZ) for the first time. That exercise gave a good indication of what the capabilities of the division were going to be.

In N. Africa, the exploits of the 1st Parachute Brigade had earned from the " Africa Korps " the nickname of " Red Devils," for the wearers of the maroon beret. The example they set was an inspiration to the new division, and much of its training was done on the same lines as that of the 1st Division.

Moreover, the lessons learned in N. Africa were utilized to their full advantage. The corner stones of training were discipline and physical fitness. Although it was hardly possible to exceed the feats of endurance set up by the pioneers, we did try to equal them. Tests, such as the fifty miles in twenty-four hours carrying full equipment, were passed by nearly all ranks. Exercises were always carried out without blankets even in mid-winter. Loads gradually increased until it seemed that we were carrying everything but the kitchen stove.

A striking thing about the division was the personal contact maintained between the G.O.C. and his Brigadiers and all ranks at lower levels.

Major-General Richard Gale, C.B., D.S.O., was held in reverence by reason of his magnetic personality, bluff humour and devotion to the division he was creating. Frequently officers and N.C.Os. would assemble in the Garrison Theatre at Bulford, to hear an address by the divisional commander or a brigade commander. Every man knew as much of what was going on as most officers in heavier formations. At the same time, security was of high standard and most stringently enforced.

Upon occasion, we were lectured by the Airborne Corps Commander, Lieut.-General Sir F. A. M. Browning, K.B.E., C.B., D.S.O. Known as the "Boy," General Browning's associations with the division were very close. Although to us he was almost a deity, his personal touch was felt by all.

The division was closely concentrated around the Bulford–Larkhill area, and so all ranks were able to gain a wide knowledge of many units other than their own. Everyone had friends in all arms of the service and officers had a good working knowledge of all senior members of the formation. In this manner was effected a cohesion and combination of effort of very high standard.

The Air Side

The closest co-operation was maintained with No. 38 Group R.A.F. Transport Command, and later with the U.S.A. Air Transport Command. The development of the technique of carrying and dropping parachute and gliderborne troops progressed rapidly. The days of a flight of Whitley aircraft dropping a troop or platoon on a small zone, were very soon over. The Whitley had done excellent service but it had serious limitations, discomfort on a long flight being only one. The Dakota largely superseded the Whitley, Albermarle, Stirling and Halifax, while Dakotas, Halifax's and Stirlings were used as glider tugs. This was a great improvement as far as comfort, numbers carried, and ease of dropping were concerned, but a lot of the fun went out of things. There is much more thrill and excitement jumping through the hole in the floor of a Whitley on a troop exercise than in stepping out of the door of a Dakota during the mass descent of two parachute brigades and an air landing brigade. Changing conditions were cheerfully accepted as the inevitable, the stake at hand concerned the welfare of nations, not the tastes of the individual.

The airborne side was carried out with such care, repetition and attention to detail, that it became second nature. Things had to be so, since the task on the ground could not be jeopardized in any way by uncertainty in the air. The outsider would be astonished at the meticulous care given to the briefing and preparation for even the smallest exercise. Charts, large scale maps, models, aerial photos, mosaics and every form of intelligence were so beautifully prepared by the various "I" staffs, that the lowest private knew the part of country into which he was about to drop, as well as, if not better than, his own home town.

The Individual

The divisional motto of "Go To It" was religiously maintained on and off duty. Heart and soul were put into both training and administration. Off duty the mediums were sport, ale and generally what was termed "getting around." Thanks to the generosity of the overworked Southern Railway, special trains to and from Waterloo made week-end leave possible. The "Bulford Special," after a brigade "thirty-six hour" pass, became an institution. As Major J. C. A. Roseveare, D.S.O., R.E., once put it, "Bags of work, bags of leave and bags of overseas." Another descriptive remark was passed by Lieutenant Howard Hugget, a visitor from our friends the 101 (U.S.) Airborne Division, who referred to us as "A regular bunch of characters,"—very pleasant when heard in his musical drawl.

The Americans

During 1943 and early 1944, we were in constant contact with our American counterparts, the 101st and 82nd Airborne Divisions. Although at first their appearance and methods seemed a little strange to us, we soon found them to be really first-class. On exercise "Co-operation," we found ourselves tactically outmanœuvred by their parachute infantry who were acting as enemy. Brigadier James Hill, commanding the 3rd Parachute Brigade, held them in high esteem, and what went for him, went for us all. The individuals whom we met off duty and by means of inter-attachment of personnel, we judged to be some of the finest chaps one could hope to meet.

The opinions thus formed, and the impressions gained before "D" day, were later proved time and again. No member of the 1st or 6th Divisions will ever forget the examples set by these Americans in Normandy, at Eindhoven, Nimejgen and Bastogne, or the performance of the 17th Division, which dropped across the Rhine alongside the 6th Division in March, 1945. They were tough, those men with glider and parachute badges on their G.I. hats. Beneath the surface their system was the same as ours, discipline and physical fitness—Discipline the only road to Victory.

Developments in Training

Throughout our training, the introduction of new gadgets was continuous. The chief changes occurred in our technical equipment, in particular with regard to dropping them by parachute. The introduction of the kitbag into parachuting helped to solve many of the problems involved in getting our heavy stores to the ground in sufficient quantity to be of any use to us.

The idea of the kitbag is as simple as the results were effective. A 12-ft. cord was attached to one's harness at one end while on the other end was a large kitbag loaded with anything up to 60 lb. of stores. The cord was folded, and stowed in a pocket on the side of the kitbag. The latter was then strapped to the right leg by means of a quick release attachment. Having stepped out of his Dakota, the jumper would wait until his 'chute was fully developed, then after pulling the quick release he would lower the bulky bag to the end of its cord. Down he would come at increased speed owing to the weight of the object dangling below him. Reaching the ground first, the bag would relieve the jumper of its weight and so he could make a normal landing. During the period in which we were learning "kitbagging," the "DZ" was no place to stand around on, unless one wished to feel the effect of a kitbag "candling" (dropping freely) from 500 ft. During a brigade mass descent, these things came down like giant hail. We soon learned, however, and it was regarded as a shameful thing to "candle" one's kitbag.

Not all the ideas we tried out were a success. One very amusing one was the introduction of dark glasses on a squadron exercise (Boldness) to simulate dropping and operating at night. On this occasion the drop took place within sight of Stonehenge and we had a number of spectators. After the scheme the squadron received a congratulatory letter from a "high quarter," who said it was the best exhibition of stick jumping he had witnessed.

The exercise was won by the side which cheated most. Since it was a very warm day in the summer of 1943, I am sure the spectators had a much more amusing time than we who were floundering around, almost blind, in the heat of the sun.

The long cold winter of 1943 drew to a close and we began to feel we were definitely getting somewhere with our work. The spring found us going at it harder than ever. Towards the summer of 1944 the training of all units began to develop along special lines. It became apparent that someone had a definite clue as to the nature of our tasks in the invasion which we knew must be coming off sooner or later.

At that time England was disfigured in many places by ignorant and impatient people chalking and painting their slogans, such as "Second Front Now," on nearly every blank length of wall. How petty those people seemed, we knew well that things were not nearly ready and that every minute was precious to us. Sections of the Press were clamouring for the "Second Front" and these same sections would have been the first to condemn our Generals if the invasion had failed because of premature launching.

April and the beginning of May were marked by the unceasing passage through our area of vast convoys of American armour and equipment, en route to Southampton and the concentration areas in the south. In the middle of May our training eased off to such an extent that we realized that something was about to happen. Then almost overnight we found ourselves whisked away and shut in tented camps adjacent to our airfields. Here we were to spend the rest of our time in England, leaving it only to go to the fortress of Europe, although to which part of it, as yet, we had no idea.

The first few days inside the transit camp were very pleasant, the weather was perfect and there was plenty to keep us busy at work and play. The day that briefings began, the camp was sealed and nobody could pass in or out unless on very high authority. Our camp was at the new Air Transport Command field of Blakehill Farm near Swindon. We all felt a great desire to spend an evening out in the town in order to discuss, over a jug of English ale, the momentous event that was coming to pass. However, it was easy to enter into the spirit of the thing and the strictest security was maintained by all. The knowledge that we were sharing one of the greatest and most widely known secrets of all time, was a big thrill in itself.

The Last Days

On 28th May, the briefing room was opened to us and the following days were spent in exhaustive briefing and final preparation. The briefing material was as nearly perfect as months of the most patient painstaking labour could make it. The detail was incredible, and many lives must have been risked to obtain it. One Sapper task of 3rd Squadron was the destruction of a line of bridges along the River Dives. We were given scale models of each bridge which showed nearly all the constructional details ; we also had many aerial photographs of these objectives, taken from both sides within less than 200 ft. of the bridges. For more general briefing we had a large model of the whole area executed in minute detail. There were maps of all scales, photographs, mosaics, and also plans of the German defences for miles around.

Staff work of that nature was commonplace at that time but was still the deciding factor in the defeat of the Germans and the Japanese.

By 3rd June, we knew the place—Normandy, the name of the operation—"Overlord," and every detail of it; what we had still to find out was, when was "D" day? On the 4th June we received orders to load the containers on to the aircraft and to fit 'chutes to them. Thus we knew that the following day was "D" day and that we had passed our last night in England for some time to come. We knew this because we were due to take off on "D-1" before midnight, and the 'chutes would not be fitted until "D-1" in case they became damp. However, the rain and a rising wind soon damped our boosted spirits and the same evening we took the 'chutes from the containers and put them inside the aircraft. "D" day was postponed for twenty-four hours, we could hardly believe it at first.

5th June proved to be a lovely day and we repeated yesterday's performance with great care. The rest of the day was spent in trying to take our minds off coming events. Church services in camp were well attended by all denominations. Letters were written and handed in, to be posted two days after our departure. Our new address was to be B.W.E.F., which, so far as I can remember, stood for British Western Expeditionary Force and seemed quite romantic to us then. Clothing and equipment was packed and re-packed with loving care. Every pocket of our smocks, battle dress, jumping trousers and web equipment was nearly bursting with scores of different items of every conceivable nature.

In the evening, after a good meal, we carried all our kit out on to the parade ground and there dressed up. "Fit to kill" is a very apt description of our appearance half an hour later. Before moving off to the airfield we were addressed by the O.C. and the Supreme Commander's Order of the Day was read to us.

On many airfields in the south of England similar scenes were in progress. On our field were drawn up fifty sleek Dakotas bearing the black and white recognition stripes we had painted on them. On other fields one could see masses of gliders, Horsas with their dragonfly appearance, little Wacos alongside great bullnosed Hamilcars used for carrying our light tanks. A spectacle whose magnificence was equalled only by the airborne landing which followed. I believe the Rhine operation included the biggest airborne lift of the war, but on "D" day we had something like 3,600 aircraft in support of the invasion.

To every aircraft and glider on our field came a three-ton lorry. Out of each, slowly piled anything from a dozen to fifteen men. I say slowly, because these chaps were so heavily laden that they could not move any faster, or at least, would not until their feet touched France. Aided by friendly W.A.A.F. and ground crews, the parachutists carried their loads to their respective aircraft and began to fit their statichutes.

Here a word of praise to those "Back Room Boys" of airborne warfare, the parachute packers, instructors and ground staffs who worked so hard to prepare us and to speed us on our way. The packers have an especially warm place in our hearts, they were mostly W.A.A.Fs., but there were also male packing sections attached to formations. At Ringway, during our training, we had seen them at work and had seen the results of it at Tatton Park, these results had developed in us a blind confidence that nothing could shake. The number of casualties which have occurred through faulty packing is so few that it can be completely disregarded. Most of the accidents which happen can be directly attributed to the carelessness of the jumpers themselves, in easily occurring faults such as bad exits, incorrect 'chute fitting, or lack of

muscle control. The widespread affection for parachute packers makes itself known in many of the songs of airborne forces, a verse of a typical example goes like this :—

" I'd like to find the W.A.A.F. who put a blanket in my chute,
'Cos I ain't gonna drop no more."
(To the tune of " John Brown's Body ")

Such was our confidence in our statichutes that we did not understand why the Americans used a system of dropping with two 'chutes, one of which was a ripcord pattern strapped to the chest to be used if the statichute did not function. We were so loaded when we dropped that we could not have carried the extra 'chute anyway.

The Take Off

The task of lifting a battalion group from an airfield in a very short space of time, is no small one. We had long practised our airfield procedure, however, and everything ran smoothly. " Half an hour to go—Emplane "—the order could be heard coming down the line of Dakotas. Sitting and standing groups of black-faced men stubbed out their cigarettes and lined up in " stick order." The emplaning drill was carried out and each man painfully clambered up into the fuselage, aided by the R.A.F. dispatcher. Kitbags were dumped by the door and each number took his assigned seat—odd numbers to port, even to starboard, with number one nearest the door.

Ten minutes or so were spent in getting as comfortable as possible and preparing for a long cold flight. Chewing gum was stuffed into mouths which were already feeling too dry for comfort. Each man was trying to look as if he felt on top of the world, whilst saying to himself, " Take your last look at English soil and at the W.A.A.Fs., you've nearly had it now chum."

The engines had to be well warmed up, and with a spluttering cough each one broke into a steady heartening roar. Soon the 'drome shuddered to the din of a hundred motors. The steps were taken in and the pilot gave the order, " Take off stations." The brakes off, the ground began to glide past the open door as we taxied up the tarmac. " Keep forward until we are well up and don't smoke until we are clear of the 'drome."

At exactly ten minutes to eleven the engines sprang into full life and we were racing along the runway. Faster—faster, up came the tail and in the dim twilight we had our last glimpse of the 'drome as it fell away below. In every mind the thoughts ran " We are off, with a one-way ticket and no transport to bring us back."

The flight was to last just under two hours, we were to drop at 0050 hrs., ten minutes to one on the morning of 6th June. Ours was one of the first big flights to run in " H " hour, the time of the actual seaborne assault, was set at 0700 hrs. We were to drop at " H–6 hrs. 10 mins."

The Divisional Engineers

At this point in the narrative the spotlight moves from the whole to a part of the 6th Division, that is, to the Divisional Engineers and particularly to the 3rd Parachute Squadron, R.E. Although it is my intention to be as impersonal as possible, since I served with the 3rd Squadron, it is really the only part of the division about which I can write in any detail. The remainder of the picture is built up from intelligence which is available to most officers in a formation and from experiences whilst serving under command or in support of the various brigades and battalions in the division.

A few short paragraphs will suffice to give the reader a working knowledge of the Divisional Engineers.

Lieut.-Colonel F. H. (Frank) Lowman, D.S.O., M.B.E., R.E., as our C.R.E. before " D " day, directed our training and perfected our planning through all the weary months which preceded the invasion. He quietly won the affection of everyone and, although he was too busy to spend as much time as he would have wished on the training with us, we could always sense his hand behind the scenes. He dropped with us on " D " day and went through a most difficult period, having lost both his Adjutant and I.O. during the landing. He commanded us in the field until badly wounded in the month of July, when he was evacuated to England. Our new C.R.E., Lieut.-Colonel J. R. C. Hamilton, D.S.O., R.E., guided us through the remainder of the Normandy campaign and thence in the Ardennes, Holland, and across the Rhine, remaining with the formation until March, 1946. He rapidly won and held the respect of every member of the divisional sappers and gained a very wide reputation. One of his characteristics was the habit of appearing suddenly to the foremost sapper officer who would perhaps be engaged in some small but difficult task, harassed by various well meaning but not very helpful officers of other arms. Although the appearance was sometimes a little shaking, its effect was as rapid as it was beneficial. One would find the intentions of the various high ranking officers directed elsewhere and usually one or two carefully worded questions would either provide the clue to some knotty problem or show one something essential that was being omitted.

H.Q.R.E. contained only two other officers, both of whom had the misfortune to be dropped wide on " D " day and taken prisoner. The Adjutant, Captain Jack Maynard, and the Intelligence Officer, Lieutenant John Shinner, were strong, likeable characters. Old members of the division, they had worked very hard indeed on the staff during the whole of the planning phase, at the same time taking sufficient part in all our activities to become generally known and liked. Theirs was one of the toughest portions that can befall any member of an airborne force, but nearly a year later when they were liberated in Germany, they still possessed the spirit of " D " day. Their preparatory work was of tremendous help to us during the early days in Normandy.

Under H.Q.R.E. came four units :—

3rd Parachute Squadron, R.E., supporting 3rd Parachute Brigade.
591 (Antrim) Parachute Squadron, R.E., supporting 5th Parachute Brigade.
249 Airborne Field Company, R.E., supporting 6th Air Landing Brigade.
286 Airborne Field Park Company.

A Field Park Company organizes the stores, mechanical equipment and workshops for the whole of the Divisional Engineers, so it is behind most of the tasks undertaken by the other units in the field. Commanded by Major J. R. Waters, with Captain Peter Dickson, M.B.E., as second in command, our " Park " was never short of work. Supplying the demands of three avid squadrons is a thankless task.

With the 6th Air Landing Brigade worked 249 Airborne Field Company, commanded by Major " Sandy " Rutherford, with Captain " Mike " Clive as second in command. A heavier unit than the Para. Squadron, 249 Squadron could undertake larger tasks during the initial phases of an operation, before the Squadrons received any of their sea " build up." The platoon commanders were Captains " Jock " Neilson, " Geoff " Woodcock, and " Jack " Bence.

The Para. Squadrons were queer organizations by normal sapper standards. They had a very high percentage of officers and an extremely low scale of transport. During the first phases of an operation all their stores and explosives

had to be carried on their backs or dragged on trolleys, in addition to all the usual kit, equipment, weapons and ammunition. In our units we had many tests of ideas and much new equipment was produced with a view to easing this burden, but we used little of it in action. Our best tools and equipment were the standard army ones, which we somehow always managed to get to the spot.

591 Squadron had Major P. (Andy) Wood as its commander and Captain Gordon Davidson as second in command. Captains R. F. (Fergy) Semple, M.C., Tony Jackson and Frank Harbord as troop commanders. Each troop had four subalterns as section commanders, each section consisted of an officer and nine men. This unit suffered a severe setback during the early hours of " D " day, when Major Wood was dropped wide and taken prisoner, three more of his officers sharing the same fate. These were Tony Jackson, Keith Best and Tony Olivera. Keith actually roamed around the German lines for several weeks before capture.

Gordon Davidson was a prisoner for many hours, but after a very rough time managed to escape and take over the Squadron. Thus it was left to " Fergy," as senior captain, to command the unit during the first critical phase of the operation. That their initial tasks were accomplished, reflects great credit on him and upon all members of his Squadron.

The 3rd Parachute Squadron was the senior R.E. unit in the Division, and was formed from 280 Field Company in November, 1942. Very close were its connections with the 1st and 2nd Squadrons in 1st Airborne Division, since, during the early stages of its life, the unit sent out most of its trained personnel to these units as reinforcements. The 1st Division was operating in N. Africa at that time. This " milking " of most of its trained personnel was a great handicap to the building up of the unit, since it meant constant repetition of work for the few responsibles who were left behind.

I served with the 3rd Para. Squadron, and in it I met as fine a body of men anyone could hope to meet in a lifetime.

Our Squadron Commander, Major J. C. A. Roseveare, D.S.O., R.E., was one of the originals from 280 Squadron. He commanded the unit through bad times and good, training and operations, until it was finally merged with the rest of the Divisional Engineers to form the 3rd Airborne Squadron in June, 1945. " Rosie," as he was known throughout the formation, was a water engineer commissioned into the Corps during the early part of the war. He saw service in France with the 3rd Division of the B.E.F., and so was one of the few men in the Squadron who wore the 1939–45 star. A small man with flowing locks, bushy moustache and piercing eye, he commanded respect by his astute mentality, authoritative manner and control of basic English.

In its early days, the second in command of the Squadron was Captain Æ. J. M. Perkins, a charming personality who was later taken prisoner after being wounded at Arnhem, when in command of the 4th Para. Squadron, R.E. He left the unit upon receiving a majority in May, 1943, and Captain Allen Jack, the commander of No. 1 Troop, took over. At this time there were two troops in the Squadron under Allen, No. 1 Troop had completed a month of infantry training and was now getting down to its demolition training in real earnest. A rapid stream of freshly trained parachutists from Ringway, enabled No. 2 Troop to be completed only a month behind No. 1 Troop. By July a third troop was on the way to completion and a fourth envisaged as a reinforcement troop. From this time until Normandy, the troops were commanded by Captain E. L. (Freddy) Fox (No. 1), the late Captain T. R. (Tim) Juckes, M.C. (No. 2) and Captain J. G. (Geoff) Smith (No. 3).

Freddy Fox was one of the most widely known members of the unit. A lovable, extremely talkative and sociable personality of great drinking prowess, he had the *entrée* to more messes than one would have believed possible.

Tim Juckes was undoubtedly our greatest soldier in all senses of the word. He devoted his every waking moment to the training of No. 2 Troop, with tremendous effect which could still be seen a year after he was killed in Normandy. A brilliant organizer, possessed of tremendous physique, Tim led the pack of the Divisional Rugby fifteen, of which the late Lance Sergeant "Taffy" Jones, also from No. 2 Troop, was another outstanding member. Of Tim, Brigadier Hill was heard to say in Normandy, "One of the finest leaders in the Division," to which I have only one comment to add—after he had gone it was always so very hard to live up to the standard and example he had set and to which he had trained us. He had as keen a sense of duty as could be found in any man.

Captain Geoff Smith of No. 3 Troop was the O.C. of the 3rd Airborne Squadron, R.E., at the time of writing. From 1943 to 1946, Geoff had not spared himself in the service of the 3rd Para. and 3rd Airborne Squadrons. To quote Sergeant "Bill" Poole, R.E., for a long time Geoff's Troop Sergeant, Geoff was, and is, "a real toff."

The fifteen other officers will appear in due course. Our home was the R.A. Mess in Bulford, which we shared with the Light Regiment, R.A., the 43rd Worcestershire Yeomanry and also with the Anti-Tank Regiment. A Sapper/Gunner mixture is not always satisfactory; however, it went down well with us and we were proud to number the Gunners amongst our friends. Together we established a reputation for wild parties and consumption of alcohol. It was our custom on auspicious occasions, to hold dinner parties at the "Bath Arms" in Warminster. There we gathered after each of our three operations and again when Allen Jack left us to become O.C. of 591 Squadron. After attacking a delicious meal accompanied by quantities of delectable draught "Bass," we would nearly all give a speech in honour of those members of our band who, for one reason or another, were no longer with us. The evening would be prolonged by the singing of the numerous songs which all parachutists know so well, and would finish with a roaring version of the "C.R.E." in which the kindly and hospitable staff of the inn would join.

Another favourite haunt of the officers of the R.A. Mess was the quaint tavern at Old Sarum, known as the "Old Castle Inn." Here again it was the hospitality of the innkeeper and staff which added perfection to the atmosphere. I think that in our recognized haunts we were well thought of, despite the effect which a heavy burden of troops is bound to have on a war-weary population.

So we played our part in the life of the Division before its first operation. Hard working and hard living beside the various other arms, brought us very close to those with whom we were to be working, living, fighting and perhaps dying later on. In particular we came to know the battalions with which we were to carry out our first operations. No. 1 Troop was affiliated to the 8th Parachute Battalion, No. 2 to the 9th and No. 3 Troop to the 1st Canadian Parachute Battalion.

At the end of our training, we were so well versed in our invasion tasks that we felt supremely confident that, with a little luck, nothing could go wrong and none could prevail against us. A month later we had learned many more lessons to even greater effect.

CHAPTER 2

OPERATION "OVERLORD" AND THE CAMPAIGN IN NORMANDY

(see Folding Map at end)

Like all things for which one waits a long time, the "Second Front" came unexpectedly and, according to our calculations, some two months late. Realization often belies the anticipation of an event, but not so in this case, the simple, awe inspiring majesty of it was evident from "D" day onwards.

Operation "Overlord," as the landing was known, took place on the strip of coast between Ouistreham, at the mouth of the River Orne, some seven miles from the city of Caen, and the Cherbourg peninsula. The brunt of the initial assault fell equally on the British and Canadian forces on the left, and the Americans on the right. In brief, the strategy was as follows :—

Airborne troops would first seize and hold the high ground which controlled the flanks of the beaches. The ensuing seaborne assault had Caen as its first major objective and Cherbourg as its second. Caen was meant to fall on "D" day to British and Canadian troops, and then as soon as they had built up sufficient strength ashore, the Americans would fan out to the right and racing up the Cherbourg peninsula, would capture that great port before the enemy had destroyed the docks. While the Empire forces held on to the bastion of Caen and the line of the Orne, new American armies would pour into the beach head through Cherbourg. When sufficient strength had been amassed, the allies would burst out and, using Caen as their pivot, deliver a right hook which it was hoped would destroy the German Army.

The 6th Airborne Division was dropped on the eastern flank of the invasion force, and it is from there, between the rivers Orne and Dives, that my picture of the ensuing operation comes. We had our own little bridgehead on the east bank of the Orne, but saw a lot of what occurred in the main one.

To lighten the burden upon the reader's imagination, here is a broad outline of the plan for "Overlord" as it affected the division :—

The 6th Airborne Division was placed under command of I Corps for the operation. The Corps plan was to land two Infantry Divisions—the 3rd Canadian and the 3rd British—as the assaulting seaborne force. The seaborne assault would take place between Gray-sur-Mer and Ouistreham. The task given to 6th Airborne Division was as follows :—

Firstly, to capture the bridges across the Orne and Canal de Caen at Benouville and Ranville and to establish bridgeheads on each side of the obstacle. Also to destroy the guns of a heavy coastal battery near Merville.

Secondly, to seize and hold the area between the Orne and Dives rivers north of a line drawn roughly from Troarn to Caen. This area extending right to the coast, contained a ridge of high ground, which, if held by the enemy, could dominate the beaches for miles up the coast. Having secured a firm base east of the Orne, the division was to stop any enemy reserves approaching from the south-east and east.

1 S.S. Brigade (Commandos), was to come under command of the 6th Division after it had carried out its landing by sea.

The plan which Major-General Gale evolved to deal with these tasks was as simple as it was bold. The 5th Parachute Brigade, under command of Brigadier Poet, had the task of seizing the bridges and of securing and holding a wide area around them. The 3rd Parachute Brigade, under command of

Photo 3.—Prelude to "D" Day, March, 1944.

Photo 4.—Prelude to "D" Day, March, 1944.

Go To It, The story of the 3rd parachute squardron royal engineers 3,4

Photo 5.—Pegasus Bridge over R. Orne.

Photo 6.—Gliders beside Pegasus Bridge.

Go To It, The story of the 3rd parachute squardron royal engineers 5,6

Brigadier Hill, would destroy the coastal battery and demolish a series of bridges along the Dives from Troarn to Varraville. It would then hold a position on the high ground from just north of Troarn to Le Plein. No. 1 S.S. Brigade, having crossed the canal and river, would base itself on Le Plein and mop up the coastal sector as far as possible up to Cabourg. Owing to the shortage of aircraft, the whole division could not be put down in one lift, so the 6th Airlanding Brigade had to follow on later in the day. It would come down at 2100 hrs., on zones cleared for the gliders by 5th Para. Brigade. It would take over the defence of a sector on the south side of the division which would include 5th Brigade's area, the latter going into reserve in the Ranville–Le Mariquet area.

Needless to say, the whole was dependent upon a complicated air plan. It was the R.A.F.'s responsibility to get us there, no mean task to accomplish.

How the Sappers Fitted into the Plan

R.E. tasks were numerous in the assault phase, involving the use of both para. squadrons and parties from the field company and the field park company.

The Orne bridges would be taken by a *coup de main* party in six gliders, which would include a detachment from 249 Company.

591 Squadron was to be split up, a troop with 9th Para. Battalion of 3rd Para. Brigade, to assist in the demolition of the coastal battery, and the remainder with the 5th Para. Brigade to clear the anti-landing obstacles from the glider Landing Zones (LZs).

An advance party from 286 Company would fly in with the airlanding Brigade, bringing with it an airborne bulldozer.

The most interesting engineer task was allotted to the 3rd Para. Squadron, this was the demolition of five bridges along the River Dives. These were at Troarn, Bures, Robehomme and Varaville. The 8th and 1st Canadian Para. Battalion of the 3rd Brigade would cover the Squadron while this demolition belt was effected, then having laid two minefields, the Squadron would concentrate with the rest of the Brigade on the Le Plein feature.

As engineer tasks go, they were all good ones and of the types we had been training for almost from the start. As a whole, the divisional engineers were eager to get at them and felt honoured at being given such an important part to play.

It is now a matter of history that on 6th June, 1944, the 6th Airborne Division accomplished all its objectives although sorely handicapped in most cases by wide dropping. The following personal account of part of it will give some idea of the exciting time we had on that day. It has been seen that the various troops of the Para. Squadrons were split up amongst the Infantry for the operation, the distribution was as follows :—

With the 8th Para. Battalion were Nos. 1 and 2 Troops of the 3rd Para. Squadron. No. 1 intended to destroy the large road bridge at Troarn and No. 2 the two smaller ones at the village of Bures some distance below. No. 3 Troop was allotted to the 1st Canadian Para. Battalion for the task of blowing down the road bridges at Robehomme and Varaville.

The author flew in with No. 2 Troop and was fortunate enough to remain with it unscathed for the whole operation.

6th June, 1944

The scene opens at midnight on 5th June, the setting is the interior of a crowded Dakota which is one of a formation of fifty, ploughing their way through the summer night carrying a battalion group to Normandy.

I was stick commander of this aircraft and also, being the only officer jumping, I had to go No. 1 in order to release the containers. The whole stick numbered fifteen, of which the first five carried kitbags. Our 'plane carried six container loads of trolleys and explosive in its bomb racks. Each container carried a delay action device which would bring it near the centre of the stick after release, provided that we could get out of the 'plane quickly enough.

The atmosphere inside the still brightly lit fuselage, was one of forced cheerfulness. Our faces made an unpleasant and—so we hoped—fearsome appearance, but they were dead white beneath their coating of burnt cork and cocoa powder. Each man was a walking arsenal, camouflaged from top to toe. We possessed as much confidence as anyone else would have under the same circumstances, plus a little more.

Chain smoking, and chewing gum, we did all sorts of things to pass the time, that interminable two hours before dropping. During the first hour, conversation and singing were fairly normal and one could not have distinguished between this flight and that of a training drop. The tension gradually increased, however, and I shortly found myself trying to take my own and everyone else's mind off coming events, by shouting songs, talking as much as I could and repeating orders which everyone already knew by heart.

The moon, which later on flooded the Normandy countryside rather more than we had wished for, was just rising. By its light we could dimly make out the ground below and the shapes of the aircraft around us, with their flaming exhausts and bright windows. We caught our only sight of the sea as we crossed the coast; there can have been few men in all those aircraft who did not offer up a small prayer at that time. Occasion then indeed to say to oneself, " when shall I see England again ? "

Each aircraft which had not a full load of containers, carried a 250-lb. bomb which was to be released as we crossed the French coast in order to give the impression that we were on a simple bombing mission. For that reason also, we were flying at some 2,000 ft. during the later stages of the journey, instead of at our usual 600 odd.

" Forty minutes to go," came over the intercom from the pilot. " Hook up and inspect each other." The two rows of men who had been sitting in almost total silence for the last few minutes, were galvanized into action as I passed on the order. Here at least was something to do, no sooner had they done it and reported each man " O.K.," than the lights went out. After a moment's confusion, I had to ask for them to be switched on again so that we could adjust our kitbags.

" Twenty minutes to go," found us sitting in darkness with, it seemed, the moon above, the sea below and only the aircrew to comfort us. A great bunch of men that crew, and supremely confident of being able to carry out their part of the task ahead. " You'll be bang on," said the navigator to me, " It's a piece of duff." I thought a lot of those chaps at that time and do now, but I consigned them to the uttermost depths a few minutes later when I found that we had been dropped on the wrong " DZ."

The R.A.F. had a very tough job that night and I later realized that it would have been impossible to have dropped every stick " Bang on." It is not easy to find one field among so many when one is passing swiftly above them. To find it at night, in fairly rough country in the face of accurate German light flak, with the ground half obliterated by the initial " pranging " of our " heavies," is well nigh a superhuman task.

Although I looked down several times during the crossing, I saw no ships. We knew they were there, however, some had been at sea for days, steaming

slowly towards the beaches. Now the men aboard them would be looking up at the armada passing overhead and wishing us "All the very best, and happy landings." They would be relying on us to do something towards easing their formidable task. We were relying upon them to get through to us before the German reactions became too much for our light arms to cope with.

Our supporting formations were some of the finest in the world; they included: the commandos of the 1st and 4th S.S. Brigades, the 3rd (British) Division, the 3rd (Canadian) Division and would be followed up by the 51st (Highland) Division.

All these things flashed through my mind as we approached France. I was rather startled to hear, "Ten minutes to go," and then the French coast was in sight. Here we had our first taste of fire-crump! "What the hell? Flak—the B——s are shooting at us." We could see the winking bursts on all sides, and could hear their steady "whoof-whoof," but so far as we could see there were no casualties amongst the aircraft.

We hardly heard the five minute warning, but I found myself half standing, half crouching in the door with one hand near the container switches, the other clutching my kitbag and my eyes glued to the red light. For a fleeting moment we saw the holocaust of the French coast, writhing under the saturation bombing, the flaming guns and the vast pall of smoke over the blazing ruins of the coastal resorts.

Ask any parachutist to tell you what the worst thing about jumping is and the answer will nearly always be "The five minutes standing at 'Action Stations' before going through the door." When I looked round at my stick I could see this awful strain in the frozen expressions on their faces. Standing there watching that unsympathetic red light, I experienced a moment's panic, after possibly two of those interminable minutes had dragged by I noticed to my dismay that the quick release of my kitbag had been pulled. "Oh hell, never mind, I shall have to jump with the wretched thing loose in my hands," I thought.

By this time we had come down to about 700 ft. in preparation for the downward glide over the "DZ." We now had a new experience, as something definitely anti-social spat past the door; it was "tracer" coming from the L.M.G. posts in the region of our "DZ." No one was hit but the "kite" took evasive action which nearly had the stick on the floor, a frenzied clutch saved me from making a premature exit. We soon steadied up again and the slackened speed told us that we were now really at "Action Stations."

"All ready chaps, see you down below," then on came the green light and my hand depressed the container switches; clutching my kitbag I went through the door like a sack of coals. The green light winked a malicious good-bye to each man as he tumbled past it into the moonlight.

Whoosh—away I went into the slipstream. The reassuring jerk of the opening 'chute was followed by the searing of the kitbag cord through my gloved fingers, and another jerk as it snapped. By this time I was simply fuming with the humiliating thought of having "candled" my kitbag on "D" day. However, I saw where it fell and retrieved it later. More tracer came smacking past and I ducked—not that any effort on my part would have stopped any of it. Before I was ready for it I saw it was time to prepare for a landing, then—bump, I was down and quickly out of my harness. So far so good. Exultantly I stood up to look for the container lights and the rest of my stick. I was down again a bit "sharpish," as something unhealthy cracked past my head. "You b——s won't live to fire much longer," I thought grimly.

Up again, I dashed to the nearest green container lights. The first inkling I had that everything was not as it should be, was the discovery that there were

dozens of green lights about instead of only the six from our containers. At the container I was greeted by another burst from the same L.M.G. I realized he was shooting at the light and so quickly smashed it. Much to my relief I saw a figure doubling up, " Hello Green, thank God I've found someone, where are the rest ? " The words tumbled out as fast as I could speak. " Oh, sir, they are spread out for miles." Saying no more we swiftly carried out our container drill and began to erect a trolley in order to load it with explosive. We were joined by Sappers Hurst and Dickson. Leaving them all to it, I made an attempt to find out where we were. Another figure stumbled up across the ploughed field we had fallen on, and asked me the way to the 7th Para. Battalion R.V. " Sorry, I can't say," I replied, as I realized to my dismay that we were on the 7th Battalion " DZ " at Ranville, instead of the 8th Battalion " DZ " at Touffreville, some four miles away. We were in for a longer walk to our objective than we had bargained for.

I'm afraid I cursed the R.A.F. then, but apologized later when I saw a Halifax running in, flaming from end to end. There were no 'chutes around it so I concluded he was doing a second run in with an unreleased container. To my relief I saw three 'chutes come out as it careered overhead. Dispatcher—navigator—wireless operator, but no sign of the pilot. Just before it passed from view, I saw it turn over on its back and plunge to earth.

Laboriously dragging our laden trolleys—two had been erected—we made our way across the ploughed field to a small track where I retrieved my kitbag. Turning down this track we made for a wood some 200 yds. away. By this time the " DZ " was quiet except for the rallying horns and other signals. Much to my relief, we found more Sappers where the trees met the track. Here it was that the O.C. (Rosie), had formed a small R.V. and was collecting up what he could of the Squadron. " Hello, Johnny, good show, what have you brought in ? " was his cheery greeting. Tim was there with Alan Forster, Tony Wade, Andy Lack, Dave Breeze and about thirty or more chaps. I was even more delighted to find that Corporal " Dick " Powell, with Sappers Martin, Fairhurst, Woodman, Cambell and McKenna, all the missing members of my stick, had found their way to this spot.

" Rosie " quickly organized us, and after holding a rapid " O " group, we set off in the direction of Touffreville, en route for our bridge objectives at Troarn and Bures. We left a lot of valuable explosive and stores on the " DZ," but we could not have carried and dragged any more than we already had in our groaning trolleys.

Our strength on that march was about 40 per cent of what it should have been. We had enough stores to make some sort of a job of the demolitions, however, and a determination to complete the tasks even though the whole of Rommel's army lay between us and the Dives. Accompanying us were about twenty personnel of the 8th Battalion and some field ambulance personnel who should also have dropped on the 8th Para. Battalion " DZ " ; they had landed in a glider with a jeep and trailer. That jeep was destined to play an important part in the completion of our tasks.

Sweating with excitement and exertion, and cursing the weight of the trolleys, we passed swiftly through the villages of Herouvillette and Escoville, without seeing a soul in the streets. Twice during momentary halts, I saw figures in the windows and said in my best French " *Nous sommes Anglais, où sont les Allemandes ?* " The answers were in a voluble patois which was quite beyond me, so I gave up. I think the Frenchmen were merely obeying the German curfew laws that night and most of them thought that we formed part of the anti-invasion exercise which, by ill chance, happened to be in progress in Normandy at that time.

The final R.V. of the 8th Battalion after the end of the day's work, was a big road junction on the Escoville–Troarn road. This lay on our route at the top of a very long hill. By the time we reached it we were ready for a breather and it was here that "Rosie" decided to halt and split up into two parties, leaving the R.A.M.C. and 8th Para. Battalion personnel to watch our excess stores and to make an all out dash for the bridges instead of trying to contact the rest of the 8th Battalion who would have long ago left their "DZ." The plan was that Tim Juckes and such members of No. 2 Troop that were present, should slip down through the forest to Bures, some three miles away. "Rosie" himself would take the jeep and make an attempt to get to our priority objective, the big bridge on the highway beyond Troarn.

After a rapid division of the explosive, "Rosie" set off with Dave Breeze and half-a-dozen determined escorts. In the trailer behind them was a heavy load of the special charges we had brought for this job.

Throughout this phase of our move we could hear the sound of constant battling on all sides, but by good fortune we were not attacked once. More Dakotas and a few gliders were coming in over us and it was then that we witnessed the piece of R.A.F. heroism previously referred to.

The O.C. with Dave Breeze, Sergeant Hannah, Lance-Sergeant Irving and Lance-Corporal Knight, Sappers Moon and Peachey, disappeared in a cloud of dust, their jeep bristling with automatic weapons. We formed up again and were soon "bashing on" down the road in his wake. A short distance along this road, we turned left to plunge into the forest of Bures. Not many days later I was to regard these woods with a deep hatred, even then I confess I felt none too easy hurrying along the gloomy rides. We were really in no danger but had vivid imaginations, despite this we all felt supremely confident of being able to hand out more than we should take from any Germans we might stumble into.

It took us just over an hour to find our way through the forest to the side road beyond which followed the course of the Dives. Turning along this we found the small village of Bures, and in its outskirts, an officer and some of the covering party of snipers allotted to us by the 8th Battalion. Very pleased to have found each other at last, we proceeded towards the river. As we neared the bridges we heard a colossal "whoof" from a mile or more upstream. A small cheer gave vent to our feelings as we realized that "Rosie" had blown the Troarn bridge; this was about 0500 hrs.

Wasting no time we set to work at preparing our bridges for demolition. The river here was only some 50 ft. wide and the bridge my section had to deal with, was a small one carrying a light road. Some 400 yds. downstream was a heavier railway bridge, to which the remainder of our party went with Tim and Alan Forster. We had worked for some twenty minutes when Tim returned to tell me not to blow as soon as it was prepared as two snags had cropped up. The first was that downstream towards the railway bridge, a glider lay half in and half out of the stream. Inside the glider was its pilot with both legs broken and a jeep and anti-tank gun. This glider was, I believe, one of the six whose objective had been the Orne bridges. The crew of the gun, having tried to extricate their jeep and gun from the tangled mess inside the glider, had made the pilot as comfortable as possible and set off towards their objective some seven miles away.

The other snag was that the railway bridge was a heavier and more difficult task than had been anticipated. It was Tim's intention that the Troop should blow this bridge first, withdrawing over ours which could then be blown.

About this time a jeep, driven by Tony Wade, arrived. This welcome transport was turned into a temporary ambulance in which the glider pilot was

taken away to the 8th Battalion, now established up in the forest a mile behind us.

Tony Wade had been sent back from the bridges to find Andy Lack who had been in charge of a trolley party. The party had fallen behind because several of the Sappers pulling it were suffering from injuries sustained on the "DZ." On the way Tony met a jeep and trailer with a small detachment of No. 1 Troop. This detachment had landed correctly with the 8th Battalion and had been sent off to Bures by the C.O. Tony attempted to reach the Troarn bridge in this jeep but returned to Bures after being told by civilians that it would be impossible for him to get through Troarn. He then followed the course of the river on foot, as far as the Troarn bridge. He found the bridge demolished and saw where the jeep used by the O.C. and party, had been ditched. The story of the demolition of this bridge will be found on page 122. Since there was no sign of life nearby he returned to Bures.

My section (No. 6) had prepared their bridge in just over an hour and the next three hours we spent in keeping a watch alongside the half-dozen snipers, and also in trying to salvage the gun and its tractor from the half submerged glider. Unfortunately, although we worked hard at it for an hour or more, the chains, by which the combination was lashed down, had become so tangled and strained as to defeat our efforts. At approximately 0900 hrs., Tim told us to withdraw to our own bridge in preparation for firing.

The Troop now withdrew up the lane into the village, evacuating the inhabitants of threatened dwellings as it did so. The railway bridge went up with a terrific thump, fired by Alan Forster, who then came back across our bridge. I at once lit our fuses and we retired to cover behind the houses. Two minutes later a mighty crash told us that we had accomplished both our objectives ; both demolitions were satisfactory and we finished by 0930 hrs. This was some four hours later than we had hoped, but in view of the unexpected events, we thought quite justifiable.

Now Tim showed what a born leader he was, by ordering us to sit down in the village street and have a breakfast from our assault rations. Having posted sentries we relaxed for half-an-hour to brew our "Compo" tea, chew oatmeal tablets and get each other's stories of the drop. In those stories alone there was enough to fill a book.

While we were smoking and talking, the villagers, who by now had lost their first shyness, were very anxious lest in our seeming folly we should allow the "*Salles Boches*" to fall upon us and destroy us. Tim, however, was fully aware of the risk and knew that it was outweighed by the need for a short rest.

The tale our Troop Sergeant had to tell was one of the best. He, Sergeant Docherty, a big, rawboned Scot, had been the last jumper in my aircraft and had fallen at the edge of a wood, some 500 yds. from me. To his surprise he found himself near a German L.M.G. which was firing "rapid" across the "DZ." He had time to kill one German with his rifle fired from the hip, before the other two ran into the trees with their gun. Docherty gave chase, with throttle wide open, but lost them. He was stalking down a path in disgust when he spotted another figure and had "drawn a bead" on it, when fortunately he recognized it as Corporal Green.

When all had eaten, we moved off in search of the 8th Battalion, whom we joined at about 1200 hrs. Lieut.-Colonel Alistair Pearson, D.S.O., M.C., we found, had received a nasty wound in the hand but refused to leave his command. He at once organized us with a platoon of his men to go through Troarn, to increase the size of the demolition there. The plot was as follows. The party would march to Troarn, clear the town of any slight opposition

and then, having posted a picquet to keep the route open, would dash on down to the bridge. After further demolishing the bridge, the demolition party would return via the same route collecting the picquet on the way through. The party was organized under the command of Captain Tim Juckes, as follows:—

Protection	No. 1 Platoon 8th Parachute Battalion commanded by Lieutenant G. Brown.
	Detachment R.E. under command of Sergeant Shrubsole.
Demolition party	Jeep and trailer carrying explosives and Lieutenant Tony Wade with six Sappers of No. 1 Troop.
Rearguard	No. 6 Section of No. 2 Troop commanded by Lieutenant J. S. R. Shave.

By 1400 hrs. the Force was in Troarn and some rapid eviction of snipers was in progress. All went well and very soon the demolition party was through and on its way to the bridge. My section took up a position on some high ground behind the houses of the main street in order to cover the rear and right flank. Here it was we received a taste of true French hospitality. It was a scorching afternoon and the joyful inhabitants brought us wine to ease our thirsts; they would have given us their meagre all if we had allowed them.

I wonder what happened to those good folk? Little did they, or we, realize what frightful destruction was looming over their town. Two and a half months later, as we advanced through the ruins of it, I felt a lump in my throat at the sight of the horrid shambles. It was not long before we heard a bang and knew that the demolition had been increased in size. Soon afterwards the jeep carrying the demolition party returned and we set off for the 8th Battalion position in the woods. There we arrived at about 1630 hrs., to find that the battalion had moved on to its final position at the big road junction previously mentioned. We therefore retraced our march of the early morning, and arrived at the road junction where the 8th were busily "digging in." My section remained at this junction while the rest of the troop moved on up the road to Le Mesnil and there rejoined the squadron.

The task of the section was to lay a minefield across the road junction; this we did as quickly as we could blow holes in the road surface in which to set the mines. These mines had been recovered from a jettison drop and had been placed by the side of the road at this spot by other Sappers during the day. Laying those mines was a slow job and by the time we had finished and marched the two miles to the Le Mesnil cross roads, we had had quite enough for our first, solid twenty-four hours in action. One o'clock on the 7th June found us digging holes in the wood where Squadron and 3rd Brigade H.Q. were situated. We were there in all some four hours, then after "stand to" we made our way some 300 yds. to the other side of the cross roads and commenced to dig in with the 9th Battalion. Our position was part of "C" Company area and we came under command of Captain Robinson who was one of the few officers left to the 9th Battalion at that time. It was some two years later that I heard from "Robby" the story of his adventures on "D" day, and since they might so easily have been linked with ours, I will tell it in brief here.

Like many of the 3rd Para. Brigade, Robby was dropped wide, and soon found himself making his way towards the Le Mesnil cross roads with a party of some thirty-five parachutists, the most senior of whom was Brigadier Hill himself. When daylight overtook them they were still well out in the enemy area towards Cabourg. From the air, as a body of men well out in the

enemy territory, they were a legitimate target for the flight of Liberators which, by great misfortune, happened to come across them on the line of march. The horrors of the following scene can be imagined. It is sufficient to say that when a very dazed and unhappy Robby came to, he at first thought that he was the only survivor of the party. However, he managed to sort out four more semi-conscious souls and leaving all the rest for dead, they once more set off towards the cross roads. This was definitely not their day out, since, shortly after, they were surprised and taken prisoner by some well armed and very aggressive Germans who, in their pleasant manner, proceeded to make them walk a very long way. How Robby missed being set free by us I don't know, since he told me that at 1230 hrs. that day he was marched down the road past Bures, through Troarn and into the country beyond the town. At about 1600 hrs. he managed to escape and made his way to Le Mesnil. So much for Robby's adventures ; although I did not know him very well then, I can remember the impression his firm, but almost gentle manner, made upon me.

We dug and worked hard and our camouflaged positions were ready soon after mid-day. From then on we tried to rest and " watched our front."

During the short breathing spell which followed, we had opportunity to discuss the events of the previous day. One of the chief topics was the story of the Troarn bridge.

The Troarn Bridge

After leaving us at the road junction, Major Roseveare drove steadily down the main road towards Troarn in his heavily laden jeep and trailer. All went well until the party neared the outskirts of the town, then they ran into a wire road block through which they began to laboriously snip their way with a pair of wire cutters. While the last strands were being cut, two of the party moved up to the next cross road to see if all was clear. At this juncture along came an unsuspecting German soldier on a push bike, he was knocked off his machine and then dispatched by a burst of Sten. Unfortunately the firing and the noise made by the German, roused the alarm in the town. The party piled into the jeep and off they went " hell for leather " through the town. From various doorways German soldiers appeared and let fly at the swiftly moving jeep. It was apparent to " Rosie " that he and his party were definitely unwelcome and he put his foot down even further, while four Sten guns and a Bren returned the fire with interest. The road out of Troarn on the far side, led down a long steep hill. As the jeep and trailer careered madly down it, a Boche ran out in front and mounted an L.M.G. in the centre of the road; he quickly thought better of it, however, and returned to the pavement. As the jeep went farther down the hill, bullets from this gun passed overhead in streams.

At the bottom of the hill the party discovered that Sapper Peachey was missing with his Bren gun, and they surmised that he had either fallen or been shot off during the descent of the hill. Sergeant Hannah was, by this time, perched on the tow bar between the jeep and trailer ; he swore that if he had not been there the trailer would have been lost. Sapper Moon was also missing—he had been left behind at the cross roads near the road block.

Roaring on a mile farther down the road, the party reached the objective and came to a stop. Working at top speed they had the specially prepared charges laid in five minutes and blew the bridge. They abandoned the jeep and returned across country to Le Mesnil, where they joined up with the 3rd Para. Brigade at the cross roads.

The rest of the Squadron had been even less fortunate than ourselves with regard to the drop and difficulties encountered in reaching their objectives. Most sticks were long ones and those men jumping towards the end of sticks found themselves landing in Ranville. Enemy were "thick on the ground" in Ranville and there were many instances of Sappers being cornered and escaping. Many enemy were killed by isolated groups and individuals. Sergeant Jones of No. 2 Troop killed eight enemy with their own weapons. Sapper Thomas of No. 2 Troop, although shot at and wounded during the drop, killed three enemy with his grenades.

No. 3 Troop was the most widely scattered of all. Its task was to drop on a "DZ" north-east of Varaville with the 1st Canadian Para. Battalion. From there they had to locate bridges at Varaville and Robehomme and destroy them. The troop, commanded by Captain Geoff Smith, was dropped largely in the flooded area to the east of Varaville and in the village itself. The floods varied up to a depth of 3 ft. and ditches contained over 6 ft. of water.

Lieutenant Jack Inman collected twelve Sappers and managed to salvage three containers of explosive. They made their way across an extensive flooded area to Varaville. The "going" was almost impossible and they were forced to abandon some of their stores. Reaching Varaville, the almost exhausted party encountered Lieutenant Baillie with five Sappers and 200 lb. of explosive. Ted Baillie successfully prepared and effected the demolition of the Varaville bridge, whilst Jack Inman set out towards Robehomme with the remainder of the party. On the way the party met Captain Smith, Lieutenant "Bev" Holloway and three more Sappers. Geoff went to Varaville while the remainder proceeded to Robehomme—they were forced to take to the fields to avoid the enemy in Bavent. Carrying the explosive on their backs, they ploughed on through the floods, arriving at the bridge at 0900 hrs. There they found Sergeant Poole, who had dropped close by and had already produced a cut in the bridge with explosive collected from individual Canadians in the vicinity.

At 1100 hrs., after a short rest, the party set to work to improve the extent of the demolition. They soon found themselves involved in a sticky battle with a body of Germans who arrived in lorries. With Bren guns blazing and with the aid of the Canadians, they managed to beat off the attack and completed the enlarged demolition at 1300 hrs.

The bulk of No. 3 Troop remained out with the parties of the Canadian Para. Battalion until the close of "D plus one," by which time most of them were able to rejoin the Squadron at Le Mesnil.

In conjunction with the blowing of their bridges, No. 3 Troop were given the task of destroying a culvert at Le Hoin near Robehomme. The culvert was concealed by the floods, so Lance-Sergeant Wren and seven Sappers blew two craters in the road near Le Hoin.

Squadron headquarters was established alongside H.Q. No. 3 Para. Brigade at 0400 hrs. on "D" day. The O.C. made personal contact with Lieut.-Colonel Lowman at H.Q.R.E., early the following day.

Chapter 3

LE MESNIL CROSS ROADS AND THE BATTLE OF BREVILLE

The Defence of the Cross Roads at Le Mesnil

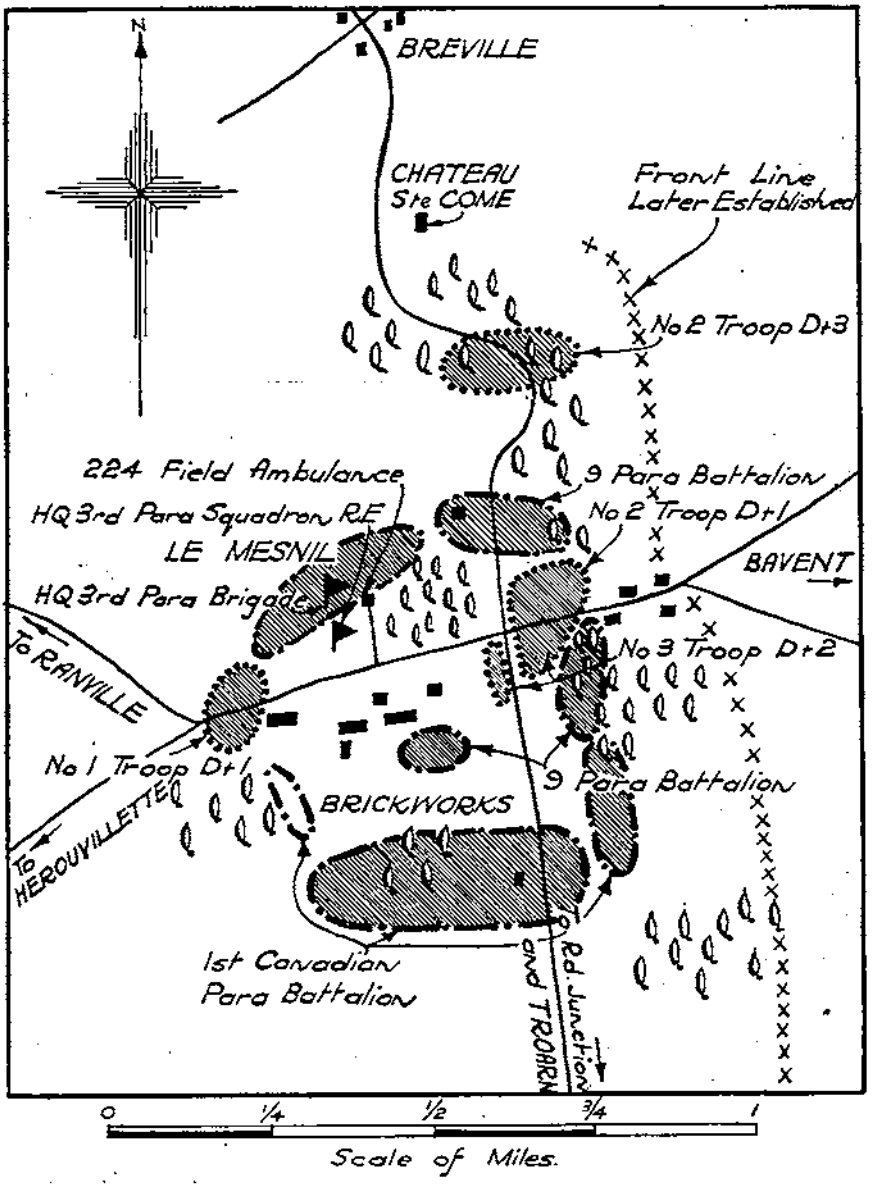
The first sight I had of the enemy in broad daylight was at about 1500 hrs. on 7th June. A movement some 300 yds. away in the direction of Breville, disclosed a small German recce patrol. Since they were obviously on the lookout for us, we lay still and watched their progress without disclosing our position. The patrol was then chased away by the troops on our left and we saw them no more. We knew that we should not have to wait long after this recce, and we were right.

At 1700 hrs. we were brought to our toes by the homely chatter of a " C " Company Bren in the position we were supporting. We were behind and to the left of " C " Company, and it was a few minutes before the battle worked its way around to us. A few yards down the road towards Bavent, was a small hamlet whose houses extended right up to the " C " Company position. The Germans occupied a commanding house and from it proceeded to give the 9th Para. Battalion a very hot time—they were good those Germans, but not quite good enough. The battle went on for most of the evening but the only real excitement we got out of it was when a zealous sniper worked his way up a ditch some 80 yds. to our left front and proceeded to use our slits for target practice. Such behaviour was all very well, but we were not being paid for that sort of work and so Lance-Corporal Hurst, my L.M.G. group commander, picked him off with one rifle shot. As soon as the attack had been driven off, we occupied that ditch and took him as our first prisoner—he was only wounded in the leg. To my surprise we found the man was terrified, and when his pals were retreating he yelled as loud as he could for them not to leave him. This thug was a corporal and sported a Russian campaign ribbon ; however, I suppose we did look a bit rough in our grime and sweat and two-day-old camouflage. Little did he know that we were a bit shaky ourselves until he had been relieved of his Schmeisser machine carbine. I used the weapon for the rest of the campaign.

After the attack had died away at 2030 hrs., I remember thinking " now the thing we have always been told about the German, is that he is very methodical. Today he has made a small reconnaissance, a recce in force at about company strength at dusk, and now it's a 'dead cert' he will really come round about dawn."

During the night No. 6 Section lay in that ditch whilst on the field behind, between us and the cross roads, Squadron H.Q. led by Sergeant Shrubsole, laid a minefield. This " minebelt," as it was called, extended across the Bavent road to the position held by the rest of No. 2 Troop which lay behind Robby's men. We had no sleep, since we were guarding the minelaying party and, in any case, we were too worked up to go to sleep yet. Throughout the whole time the party was working behind us, the darkness was split by the continual streams of tracer issuing from the enemy outposts up the Bavent road. We were too green still to realize that this was just another unpleasant habit of the enemy, resulting from his blind " squirting " at fear. We thought he was shooting at us and kept fairly close to the good earth. For hours the imperturbable Sid Shrubsole directed his small party in the laying of that belt of mines.

LE MESNIL CROSSROADS — JUNE 6TH-9TH '44.



The manner in which he wandered up and down the open field, quietly getting the job done, put great heart into me and, I feel sure, into the members of the working party. It was strange to see the Squadron office staff doing this kind of task; I don't suppose little Sapper Galletly, De Jong and Corporal Hooper forgot that night in a hurry.

The minelaying was completed as dawn came into the sky, but before it could be marked and wired off from the home side, things began to happen. The time was 0530 hrs. and just as we were feeling relieved that a minebelt now lay between the enemy and the important cross roads, we heard a noise that almost froze us to the earth on which we lay.

One had read much about the German rocket projector used extensively on the Russian front; it was called the "Nebelwerfer," but more widely known as "The Sobbing Sisters." Our chaps called it by the same names as the siren at home, "Moaning Minnie" being the mildest name. The noise we heard for the first time that eventful morning sent all the horrors of the ages running up and down my spine. It began as six awful long-drawn-out shuddering groans, followed by a ghastly warbling which came hurtling through the air towards us with the speed of an express train. As this noise, like the knell of doom, reached its horrid climax, the six heavy rockets burst all around us. I really thought we had "had it" for a moment, but when I looked round and saw that there were no casualties amongst either us or the infantry, I thought, "Hmm, not so bad after all." The considerate Germans certainly gave us a good battle inoculation that morning, with everything well laid on and all the trimmings.

Again the noise came, with it the singing of Schmeissers and the ripple of Spandau machine guns. One thing we soon learned about German weapons was their rapidity of fire, which far exceeded the rates of our own, but for all their rapidity of fire they were not so efficient as our "Bren." The method the enemy used in these attacks was simply designed to swamp us with lead. The attack was preceded by groups of men all squirting out bullets from Schmeissers ; they were given very good covering fire and had the support of mortars in addition to the "Sobbing Sisters."

The 9th Battalion went into action all around us with such good effect that we saw very little of the enemy until the attack was nearly over. Our view to the front was limited to 100 yds. of open field with a tall hedge and trees the other side of it and the house previously mentioned.

Our troop L.M.Gs. were sited down the road some 50 yds. to our right, there they had a good view of most of what went on that morning. Manned by Sappers Green, Tillbrook, Hurst, Reynolds, Smith (G.) and others, they chattered steadily throughout the action. The fire which came back at them was the most intense we ever experienced, and could not be compared with the proverbial swarm of bees, being much louder and more consistent.

"C" Company must have "bought it" again in that action. I never knew what their casualties were. For hours that morning Sergeant Docherty maintained a constant supply of Bren magazines to our guns. In one very exposed position we had to lob them over a hedge from a prone position into the slit trench the other side. At one critical phase it appeared to us as if "C" Company was being overrun, snipers had again occupied the house across the road and were inflicting heavy casualties. Some genius, I have a suspicion it was either Tim or Docherty, produced the answer in the form of an obsolete anti-tank rifle which had some fifteen rounds of ammunition to its name. Sapper Reynolds took this weapon forward as near as possible to the house, and fired every round slap through it into the snipers' positions—we had no more trouble from that quarter.

The battle now turned in our favour, but not before another tragedy had occurred. At the height of things, a field ambulance jeep suddenly appeared from the direction of the cross roads and made straight for the unmarked minefield beyond which lay some wounded of both sides. It was a sheer impossibility to stop it in time and in a flash it was converted into a flaming mass of wreckage. The devil himself must have been aboard that jeep since the mine ignited the petrol tank and the driver and other occupants were turned into human torches. Did those medical orderlies get decorations ?—I wonder —they certainly earned some.

This action was ended by a superb bayonet assault by the Canadian Para. Battalion on our right. We saw them hurtle across the road some 200 yds. down, flinging smoke grenades and " thirty-sixes " as they went. The already sorely tried Germans simply melted before that yelling bunch of black-faced demons, and we had our first clear targets of the day as they swept across our front.

During the lull which followed, we were relieved of our position by No. 3 Troop. We retired some 300 yds. into the Le Mesnil brickworks where a mess tin full of " compo " stew awaited us. It was the " M and V " which we found very monotonous in later days. On that occasion it was without doubt the best meal we had ever eaten. It was whilst eating this that we began to feel really tired—our first square meal since leaving the transit camp, several chaps fell asleep over it. After our lunch we moved across the road to Squadron H.Q. and dug in. Our slits were deeper this time—much deeper.

One hundred yards away from us 224 Para. Field Ambulance set up their M.D.S. in the small chateau whose grounds we were occupying. The surgical team, that is the remaining surgeon and his orderlies, set up a theatre in one of the stables since there was no room in the house.

That night we had a little sleep and a foretaste of the unceasing mortaring and shelling that the Le Mesnil area was to experience for the next two-and-a-half months. It remained the hottest corner of the divisional area for the rest of our stay in that part of Normandy and if ever a man wished to learn the meaning of " a war of attrition " he had but to spend a day or two there.

The following morning No. 6 Section was sent off down the Troarn road to be attached to the 8th Battalion, so we missed the ensuing critical period at Le Mesnil and the bloody battle of Breville. However, the rest of the troop were there, and we had plenty of fun on our own with the 8th Battalion, so we had no complaints.

Critical Days—9th–14th June

The Germans made a rapid recovery from their surprise of " D " day and by the 9th June, heavy counter offensives were the order of the day. An example of the intensity of their initial reactions to our presence was the fact that the troops which attacked us on the 8th June had bicycled some forty miles from their billets up the coast, in order to be thrown against us the same day. The heaviest engagement of the division was centred round Breville and reached its height on the 12th–13th June. Before describing the action, I will give a picture of how things went with the 8th Para. Battalion during this phase.

With 8th Para. Battalion in the Forest of Bures

The 8th Battalion was still some two miles from the cross roads, down the Troarn road, and formed a long salient along the main road which was flanked by the forests of Bures and Bavent. Despite our comparative isolation, we felt a sense of security in this position since it was plain that, as yet, the enemy had only a very faint clue as to our dispositions in this area. Sitting in, and behind these dense woods, Lieut.-Colonel Pearson maintained the initiative to such effect that nearly a week later patrols were still being sent into enemy territory on a wide scale.

Two days after we joined the 8th Battalion we had the joyful experience of lifting the mines we had laid across the road here on " D " day, to allow the passage of a battalion of the 51st Highland Division. We also lifted some booby traps we had laid on our first day with the battalion. The troops who passed through us were the 1st Gordon Highlanders ; they occupied a brickworks farther on down the Troarn road. The intention was that a second battalion, the 5th/7th Gordons, would pass through them and occupy Touffreville. The operation went off without a hitch, but the next day we had the disappointment of seeing the 1st Gordons being withdrawn. The ambitious placing of this battalion out in the blue, had apparently been regretted almost at once, and it seemed clear to us that things behind were not as happy as they might have been. Had we but known it, the division was passing through its most critical phase in the campaign.

Alistair Pearson gave us little time in which to dwell on what may or may not be happening behind. Despite the very painful hand wound he had received on " D " day, he pursued an audacious policy of offensive patrolling on as large a scale as his depleted battalion strength allowed. On one side of the road we straddled, lay the forest which fell down to the Dives, while to the other side lay the villages of Escoville, Touffreville and Sannerville, some 300 ft. below in " No man's land." Behind us we had two miles of open road to Le Mesnil.

Patrols went everywhere seeking out the enemy, and we Sappers were included in three of them, all of which took place at night. On one patrol we cratered the road which ran alongside the river on the far side of the forest from us and was the only line of communication the Germans had in that area. The other patrols were given the task of inspecting the demolition at Bures, and if possible, to report on the state of the Troarn bridge which the enemy was known to be repairing. These passed not without incident since the enemy was probing with strong fighting patrols to find out where we were. To inspect the demolitions we went out in small parties of four men with no intention of fighting if we could avoid it. Once we had a brush with a small enemy patrol at the Bures bridges, luckily a grenade did the arguing for us and we all arrived back at the battalion after scattering.

Behind the screen of woods, with our patrols appearing from all sides, it must have been very difficult for the enemy to pinpoint our position. The battalion mortars would sooner or later give the game away, however, and we could not expect to rest undiscovered indefinitely. On our third day with the unit we began to receive the occasional attentions of a 10-cm. mortar, an S.P. gun or an infantry gun. My section lay in a ditch in the direct line between our own mortars and the enemy, so we were bound to have our share of anything nasty that came over. One afternoon when we were all resting from the labour of the previous night, we suddenly received some unwelcome visitors from the German lines—I think that on this occasion they were shells from the infantry gun. One of these small shells landed slap in our ditch, it

struck the side some 2 ft. above the spot where Corporal Powell was lying. We had divided the ditch into sections by means of earth walls and so Powell was the only casualty, although I lay only 6 ft. away in the next portion of the trench.

The explosion and ensuing groan from Dick Powell, galvanized us all into action. Before the smoke had cleared, someone was dashing off for a stretcher and we were giving Dick what first-aid we could. He was hurt badly in both legs and one foot, but from that time until he left the battalion R.A.P. about an hour later, he lay smoking in his placid manner without a word of complaint.

We felt the loss of Dick very strongly, I especially since I had found him a steadying influence in difficult times. The section had lost a good friend, one who could be efficient but very nice about it the whole time. Since there was no other N.C.O. in the section, Sapper Hurst was given a stripe and became the second-in-command.

On the 15th June, we were ordered to rejoin the Squadron at Le Mesnil; at the same time the 8th Battalion were withdrawing to a new location about half-a-mile up the road. We were pleased to be rejoining the Squadron, although sorry to be leaving the 8th Battalion of whose work and personnel we thought a great deal. I hope we were of some use to them and that they thought the same things of us. We found No. 2 Troop some 400 yds. from the cross roads, along the road towards Breville; they were pleased to see us and had obviously been through a hard few days in our absence.

Upon this day our Squadron moved down into the quieter area near the Orne, and took up its position in a small quarry at Ecarde. The Commandos were also located in the area of Ecarde. From this quarry we were to operate for the next two months, but we did not realize it then. During the evening we were able to meet many friends we had not seen since leaving England, and gleaned many stirring accounts of their adventures since the drop. The events which affected many of them, had occurred during our stay with the 8th Battalion and were centred on the battle of Breville.

Breville

A glance at the map will show that the area held by the division at this time, took the form of a salient. The northern side of the salient was held by 1st S.S. Brigade from Franceville Plage through Sallenelles to Breville and by 3rd Para. Brigade on through Le Mesnil to the big road junction on the Troarn road where lay the 8th Para. Battalion. The south side of the salient was held by the 5th Para. Brigade and 6th Airlanding Brigade.

From 8th June until 10th June, the enemy maintained heavy pressure on the north side at Sallenelles and Breville and on the south side against Herouvillette in the 12th Devon and 2nd Oxford and Bucks areas. Some penetration was achieved and the enemy remained in Breville, so causing a gap between the 1st S.S. Brigade and 3rd Para. Brigade.

Nos. 1 and 2 Troops of the Squadron were positioned to the rear of the 3rd Brigade H.Q., on the Breville side, in support of the 9th Para. Battalion. On the morning of the 10th, a heavy attack developed through the Breville gap, N.W. towards Le Plein, and S.W. across the glider "LZ" towards Le Mariquet. The attack towards Le Plein was driven off by the Commandos with great loss to the enemy. The attack towards Le Mariquet was more successful until it reached the 13th Para. Battalion's position in the Le Mariquet–Ranville area, here severe losses were inflicted by the 13th who held their fire until the enemy was very close. At this time, Nos. 1 and 2 Troops were given some good targets by enemy crossing their front. This

day's fighting clearly showed that the German intention was to sever the salient by pincers from north and south. That afternoon a counter attack was made from the Le Homme area by two companies of 7th Para. Battalion and a Squadron of the 13th/18th Hussars with their Sherman tanks which had crossed into the bridgehead that afternoon. The enemy was driven back to Breville after losing over a hundred prisoners. Two hundred enemy dead were counted in the sector afterwards.

During the battle, the 51st Highland Division were arriving in the bridgehead and the 1st Battalion 5th Black Watch was put under command of 3rd Brigade to attack Breville on the morning of 11th June. This attack met with murderous opposition and failed, the Black Watch withdrew into 9th Para. Battalion area.

Early on the 12th, further enemy attacks from Breville were supported by tanks and continued all day. By evening our troops were having to fall back from forward positions. Action was fast and furious and mixed up in it were Nos. 1 and 2 Troops with the 9th Battalion. A counter attack by one company of the Canadians was led personally by Brigadier Hill and eased the situation. At this stage Tony Wade was somewhat surprised at being asked to go back to Brigade H.Q. to fetch some PIAT bombs, it was the Brigade Commander himself who gave the order. On this occasion Lance-Sergeant Irving of No. 1 Troop carried out the action which earned him the M.M. A very strong fellow and first-class weapon training instructor, Jock Irving was expert at handling the PIAT. When a massive Tiger tank came lumbering in the direction of No. 1 Troop, he grabbed up a PIAT and attacked it. He dodged around the hedges, sending over PIAT bombs to such good effect that the bewildered crew of the Tiger decided that they had seen enough for one day, and withdrew.

By the evening of the 12th, the division was very tired but it was imperative that the Breville gap be closed. It was decided to attack the village the same night. The 12th Para. Battalion, with a company of the 12th Devons and a squadron of 13th/18th Hussars under command, carried out the attack and successfully captured the village, or the heap of rubble which remained of it. This re-opened the road from Le Mesnil to Breville, Amphreville and beyond, and gave the division a respite from the bitter fighting in which it had been ceaselessly engaged since the early hours of 6th June.

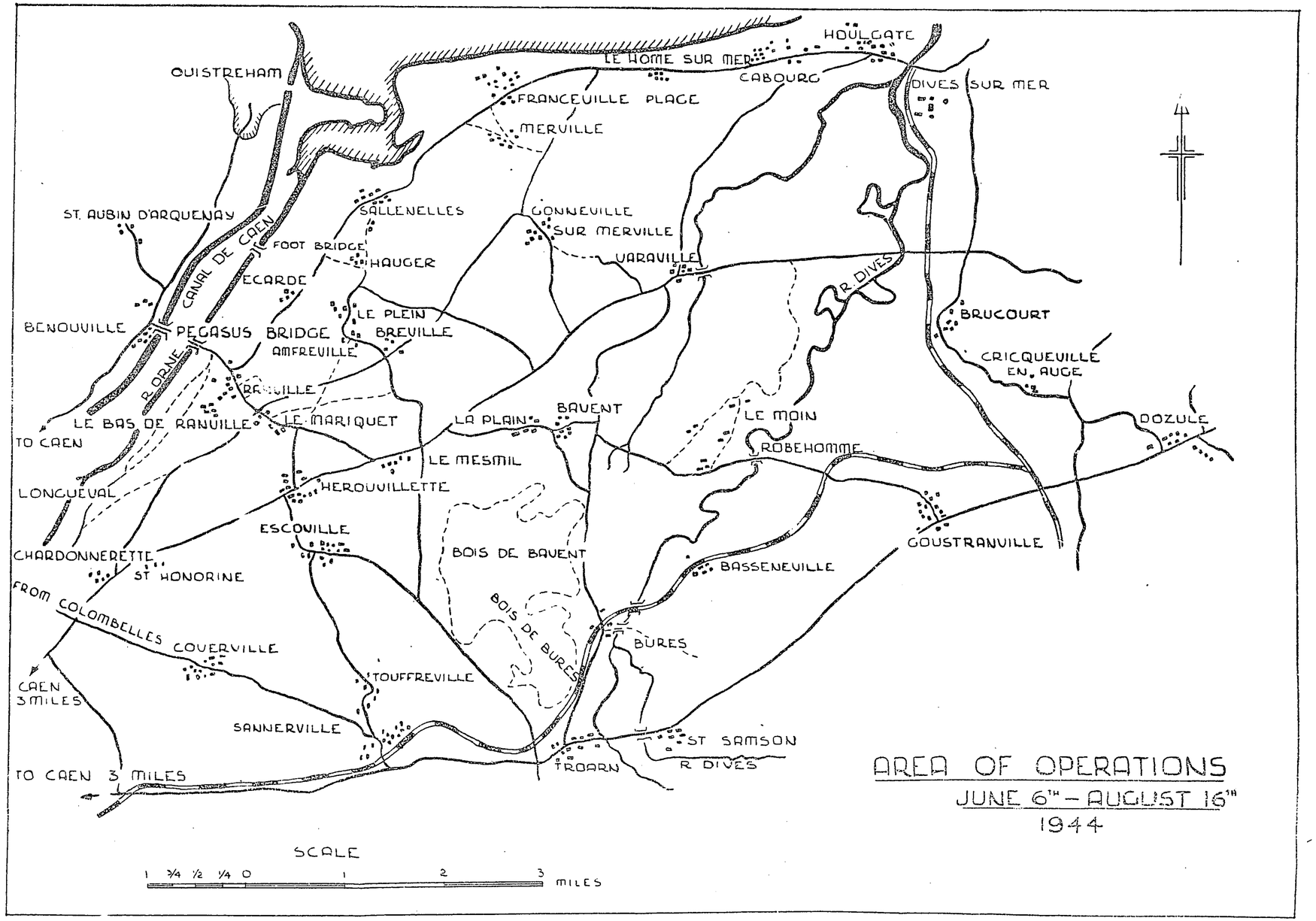
Some incredible sights could be seen in and around Breville after its reoccupation, none of them were pleasant and most were extremely gruesome. The most horrific struggle had taken place at the Château Ste. Come which stood on the outskirts. At the entrance drive squatted the shattered hulls of two Shermans and nearby was the wreck of the anti-tank gun which had knocked them out.

The Squadron suffered a number of killed and wounded during this battle, and the days preceding it. One officer, Dave Breeze of No. 1 Troop, was taken prisoner and they also lost Sergeant Hannah, who stopped a lot of mortar fragments and had to be evacuated on " D plus 2." Any Sapper might be proud to say " I was at Le Mesnil with 3rd Para. Squadron, R.E." Not only should he be proud, but he should also be very thankful and remember for a moment all the fine fellows who went there but did not come back.

(To be continued)

GLOSSARY OF TERMS AND ABBREVIATIONS

B.A.O.R.	British Army of the Rhine.
Bazooka	American anti-tank weapon which fires a rocket.
B.L.A.	British Liberation Army.
Blower	Slang term for wireless set.
B.W.E.F.	British Western Expeditionary Force.
C.C.S	Casualty Clearing Station.
Compo	Composite rations. Forms of canned, dehydrated, compressed and concentrated foods. Packs vary from the twenty-four-hour "Assault Pack" containing food for one man for one day, to a pack which contains sufficient food to feed fourteen men for two days.
Dak.	Dakota—troop-carrying aircraft.
D.R.	Despatch rider.
DZ	Dropping Zone—a clear space into which parachutists can drop, or stores may be dropped.
Gong	Slang term for decorations and medals.
L.C.A.	Landing Craft Assault.
L.C.T.	Landing Craft Tank.
L.S.I.	Landing Ship Infantry.
LZ	Landing Zone—clear space on which gliders may land.
M.D.S.	Medical Dressing Station.
O. Group	Orders Group. Any group of junior leaders to whom a commander gives orders.
O.P.	Observation Post.
Para.	Parachute or Parachutist.
P.B.I.	Poor bloomin' infantry.
PIAT	Projector Infantry Anti-tank.
Pigeon	A rumour.
R.A.P.	Regimental Aid Post.
Rockphoon	Slang term for rocket-firing Typhoon aircraft.
R.V.	Rendezvous.
Schu	Small anti-personnel mine buried in the ground.
Soft skinned	Adjective normally applied to lorries etc., to distinguish them from armoured vehicles.
Sommerfeld track	Type of wire mesh track used for temporary roadways.
S.P. Gun	Self-propelled gun.
Stick	The group of men who jump from one aircraft, or a number of bombs released from one aircraft.
Stonk	Slang term for salvo of mortar bombs, or shells.
U.X.B.	Unexploded bomb.
"Y.M.C.A." drop	Parachute jump when training for parachuting only. A Y.M.C.A. van is usually in attendance on the DZ; jumpers go to it after the drop and are given tea.



AREA OF OPERATIONS

JUNE 6TH – AUGUST 16TH

1944

ARCHIMEDES AND THE DESIGN OF FORT EURYALUS

By A. W. LAWRENCE, PROFESSOR OF ARCHAEOLOGY AT CAMBRIDGE

(Reprinted by permission of the Editor of the *Journal of Hellenic Studies*)

THE argument of this paper is that the ancient Greek fort on the Euryalus[1] at Syracuse was designed afresh by Archimedes, who is recorded to have been the chief military engineer or scientific adviser to his native city before and during the siege by the Romans which ended in 212 B.C. with its fall and his death.

The fort lay outside the populated area of Syracuse though within the walls. The original Greek colony had been confined to an island between the southern and eastern harbours, but soon the town extended on to the mainland of Sicily; the ground to the west was swampy, hence the suburbs eventually spread far up the Epipolae hill to the north. This hill forms a triangular tilted plateau, 3½ miles long, which slopes towards the island, but is surrounded elsewhere by a cliff, except at the inland extremity where it joins on to higher country. Since the cliff afforded a strong line of defence, the town walls were eventually carried all round the edge of the plateau, making them 17 miles in circuit. This great extension was the work of the tyrant Dionysius I, in the year 402 B.C. and later; the need for it had been demonstrated twelve years earlier, when the Athenians camped on Epipolae and almost starved the town into surrender. The strongest part of the fortifications was necessarily at the inland extremity of the plateau, the one place where nature provided no obstacles. Here the highest ground runs off to the west in a ridge that rises into two gentle mounds, one of which was called Euryalus, meaning the "wide nail" (or wart). The town walls included only one of these summits, and upon it stands the fort in question, overlooking one of the main gateways of the city.

The defences of Euryalus compose by far the most elaborate piece of ancient fortification in existence. But there is abundant evidence that the works do not all date from the same period, and that the design was changed in the course of time. Scholars have tried to correlate the various stages of construction and reconstruction with episodes in the history of Syracuse, but the tendency has been to ascribe the major part of the remains to Dionysius, in the belief that he rebuilt his original defences during the course of his reign. Corroborative evidence has been sought in a comparison[2] with some rather similar but considerably less advanced fortifications at Selinus, outside the North Gate, which were formerly identified with a reconstruction by Hermocrates in 407 B.C.—five years before Dionysius started to build. But Gàbrici, in recent excavations at Selinus, found reasons why those works should be dated much later, and that would agree with what is known of the development of Greek military architecture. Gàbrici puts these defences not much earlier than the destruction of Selinus in 250 B.C., and since they are definitely earlier in style than the more efficient works at Euryalus, there is no longer any reason to date the final reconstruction of Euryalus before 250 B.C. The latest possible date for any part of Euryalus is 212 B.C., and the improvement it shows, compared with Selinus, is sufficiently marked to justify dating most of the fort about that time.

[1]The fullest account and the only authoritative plans are those of the life-long student of the ruins, L. Mauceri, in his illustrated monograph, *Il Castello Eurialo nella Storia e nell' Arte*, second edition, 1939. I ought to state that I have not revisited the site since I formulated my theory.

[2]Collingwood, *Antiquity* 1932, 262, pls. I–IV.

On that assumption, Euryalus was built or rebuilt nearly 190 years after Dionysius had put walls around the plateau. During those two centuries, siege warfare was greatly developed ; indeed old-fashioned fortifications made a poor showing against the methods of Demetrius the Poliorcetes (Stormer of Cities), a couple of generations before the Roman siege of Syracuse. But Syracuse stood out against Marcellus for nearly three years, and fell only by treachery. It is reasonable to suppose that its defences had been brought up to date at Euryalus, which was the point of greatest danger ; the old fort could not otherwise have been found impregnable (Livy, xxv. 25).

The main outlines of the plan at Euryalus were dictated by the shape of the ground (Figs. 1, 2). The western corner of the city walls projects as a long salient, following the ridge that joins the plateau to the interior of Sicily, and this salient is entirely occupied by the fort, which comprises two enclosures lined with barracks (K, G). The buildings would have provided sleeping accommodation for perhaps a hundred men, and no doubt a garrison was maintained here even in times of peace, to prevent surprise. For Euryalus stands five miles from the heart of Syracuse, the densely populated island, at a height of 500 ft. The remoteness of the site ought, one would think, to have induced Dionysius to keep it guarded, and the planning of the enclosures might easily be contemporaneous with his plateau walls of 402 B.C. A set of water-spouts in the form of lions' heads was found near the west end of the western enclosure, and appears to belong to that period ; however, there is no definite evidence that he did in fact incorporate the salient ridge within his city walls.

About a hundred yards to the north of the barracks lay the entrance to the city (M), a double gateway with a thick pier in the centre. One of these two doorways (21) was eventually blocked up ; and in the earliest design there had been three doorways instead of two. These changes show that the original defences became insufficient, as siegecraft improved. The gates are set well back in a re-entrant of the wall, so that an enemy force attempting to break in the doors would expose their sides and even their backs to fire from the walls. There are many analogies to the scheme in early Greek gates, and the design can reasonably be ascribed to Dionysius. But there are few analogies to the outworks (22) through which the road to the gateway was made to bend ; not less than three spur-walls were built outside the gates, encroaching on the approach. One, or at most two, of such would have been enough to block the enemy from using a battering ram on the wooden doors, or to break the line of fire of incendiary missiles which might burn them away, as well as to allow the defenders to gather secretly for a sortie that would surprise the enemy. The purpose of so many spurs must have been to block the fire of ballistas, too ; the stones thrown by these engines might easily knock away one spur-wall, but by the time the next was exposed the defenders could have started putting up another barrier, as was the accepted method.

Now siege-engines on the catapult principle are recorded to have been invented at Syracuse in 399 B.C., when Dionysius was still building his fortifications there. He used the new weapons in the following year, when he laid siege to Motya. But they were small engines, not capable of throwing heavy missiles ; their function was merely to keep up a barrage of light missiles, which would force the Motyans to take cover instead of manning the battlements. It seems as though Alexander may have been the first to introduce engines for throwing big stones ; he used them in 333 B.C. in his siege of Tyre. Accordingly there is no reason to attribute the outworks at Syracuse to Dionysius, if they were built mainly as a protection against a heavy type of engine. Nor do we have to date them very soon after 333 B.C., for the introduc-

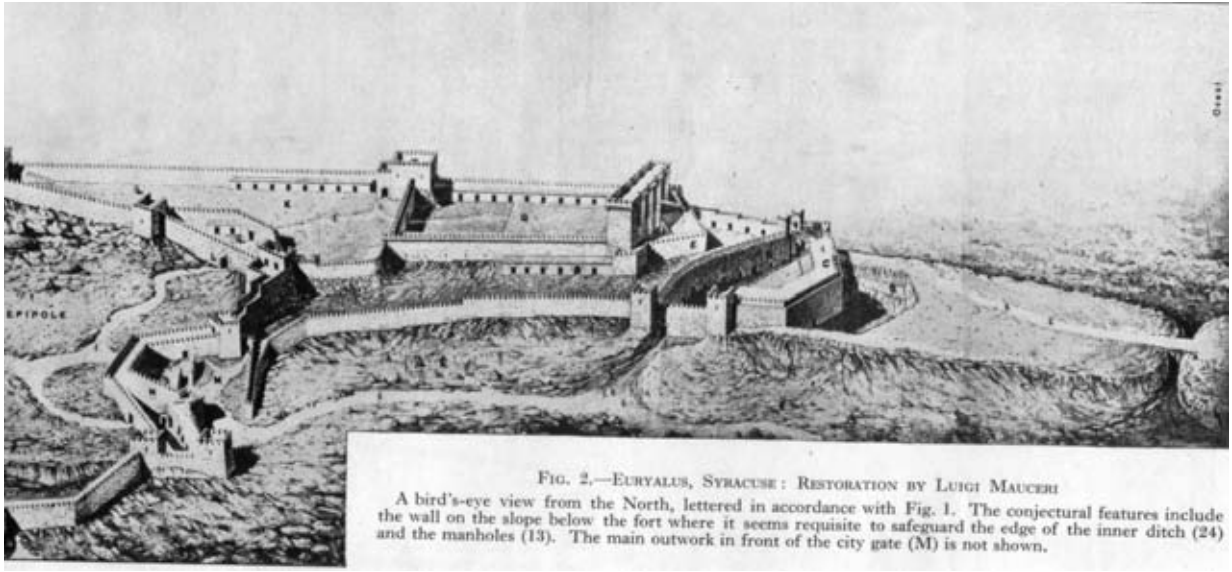


FIG. 2.—EURYALUS, SYRACUSE: RESTORATION BY LUIGI MAUCERI

A bird's-eye view from the North, lettered in accordance with Fig. 1. The conjectural features include the wall on the slope below the fort where it seems requisite to safeguard the edge of the inner ditch (24) and the manholes (13). The main outwork in front of the city gate (M) is not shown.

Archimendes and the design of fort euryalus 2

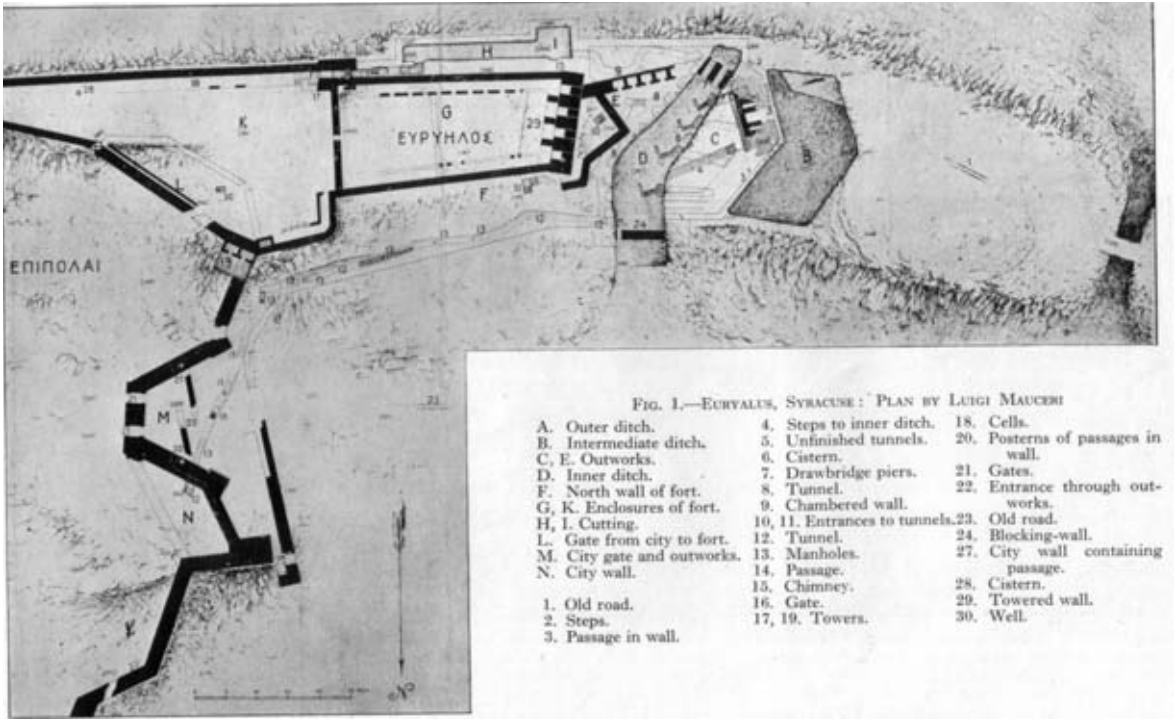


FIG. 1.—EURYALUS, SYRACUSE: PLAN BY LUIGI MAUCERI

A. Outer ditch.
B. Intermediate ditch.
C, E. Outworks.
D. Inner ditch.
F. North wall of fort.
G, K. Enclosures of fort.
H, I. Cutting.
L. Gate from city to fort.
M. City gate and outworks.
N. City wall.

1. Old road.
2. Steps.
3. Passage in wall.
4. Steps to inner ditch.
5. Unfinished tunnels.
6. Cistern.
7. Drawbridge piers.
8. Tunnel.
9. Chambered wall.
10, 11. Entrances to tunnels.
12. Tunnel.
13. Manholes.
14. Passage.
15. Chimney.
16. Gate.
17, 19. Towers.
18. Cells.
20. Posterns of passages in wall.
21. Gates.
22. Entrance through outworks.
23. Old road.
24. Blocking-wall.
27. City wall containing passage.
28. Cistern.
29. Towered wall.
30. Well.

Archimendes and the design of fort euryalus

tion of a weapon is not always countered by the immediate invention of the antidote. The ballista gave cause for a revolution in siege warfare only exceeded by the invention of gunpowder, and there may have been a similar time-lag in re-designing fortifications against each of these new weapons. Both the use of siege guns and the mounting of guns in fortifications had been normal practice[1] for well over a hundred years before a completely new style of layout was devised, though from half-way through this period walls of traditional plan were being built thicker and lower to resist gun-fire. In the same way, the mounting of ballistas in Greek fortifications may have become normal practice soon after their first employment in 398 B.C., but the rapid capture of town after town by Demetrius Poliorcetes shows that ballistas, and the penthouses and stages that were moved forward under cover of their fire, were not opposed by an efficient style of fortification even a hundred years later, a generation after Alexander's demonstration at Tyre. As a matter of fact, anti-ballista defences are rarely found on Greek sites, and the reason must be that they were developed only a short time before domination by Rome put an end to Greek warfare. There is some ground for suspecting that the out works at the Syracuse gate were never completed, in which case their final design is not likely to be appreciably older than the beginning of the siege in 213 B.C.

While the re-entrant of the gate was so strongly defended, the fort on the salient attained a relatively greater measure of security, by a lavishing of ingenuity and labour. The fort's western enclosure terminates at its outer end in a most peculiar wall (29), which contains five oblong towers (two at the corners and three in between), each of the towers being linked with the next by a lower and thinner platform. The plateau continues westward as a tongue of high ground, which is intersected by three trenches or "dry ditches." Between the towered wall and the inner ditch, and between that ditch and the next lie extremely ruinous outworks. But the scantiness of the remains has resulted to a great extent from some parts of the outworks having never been completed, at any rate in stone; they may have been hastily finished in mud-brick, which, on this exposed site, would have disappeared without a trace. The cutting of the ditches certainly was not completed. Part of the evidence for that assertion is visible in the restoration, where, in the intermediate ditch, the letter "B" is imposed on a shelf of rock which was obviously meant to be cut away. But this ditch was also going to be generally deepened from some 23 ft. to 30 ft., to match the inner ditch (D) as is known from the fact that some unfinished underground passages would have emerged in its side at that level. The outer ditch (A) was barely begun.

The sides of the tongue between the inner and outer ditches are composed of rough slopes, and no doubt the scheme provided for quarrying them to the perpendicular. The stone thus obtained would probably have been used to build a wall round the edge of the tongue, where, in the meantime, the defenders would have needed to put up a temporary breastwork to give themselves cover. Back of the intermediate ditch the reconstruction shows a permanent wall along the edge; in some places, however, this also seems to have been left incomplete. There is considerable doubt, too, whether the outworks behind either the intermediate or the inner ditch were ever completed. Altogether it seems extraordinary that anybody should attribute the entire system of ditches and outworks to Dionysius, thus assuming that they were left half-finished for nearly two centuries, during which Syracuse

[1]At least in England, which seems to have the oldest dated gun-ports, at the Westgate of Canterbury, built in 1380, a few years after the English had been driven out of France with the aid of siege guns (O'Neil, *Proc. Hampshire Field Club* xvi. 1944, 56).

had to withstand invasions by the first-class powers of the age, Carthage and Rome. The only valid argument for such an assumption would be that all these defences had become obsolete almost as soon as they had been begun and therefore were abandoned before completion.

In reality, Euryalus gives the nearest parallel to the up-to-date scheme of defence laid down in a handbook of siege warfare written by a contemporary of Archimedes, Philo of Byzantium.[1] Some of the resemblances were noticed by the German general, Schramm, but I am not aware that anybody has drawn the conclusion that the date is much the same, and that Euryalus must have been re-designed after the innovations in siegecraft of Demetrius Poliorcetes. Philo directs that a fortification must be safeguarded externally by not less than three ditches, each 105 ft. wide at the least, and by outworks behind the two inner ditches. He is thinking of dry ditches dug in earth; since those at Euryalus are rock-cut with perpendicular sides they did not need to be so wide, and the 73 ft. of the intermediate ditch—the only one completed—would have made it a greater obstacle than an earth ditch of his minimum width.

The series of underground passages, cut in the rock, is a unique feature of Euryalus (Fig. 3). Each measures well over 6 ft. high and wide. Some communicated with the inner ditch, opening in its scarp from a corridor parallel with the ditch and a few feet within the rock. Other passages lead from the same area in the opposite direction, into the fort or to the ground just outside, and even as far as the city gate—this last having presumably been cut for convenience in moving troops quickly. Some unfinished passages lead from the outer scarp of the inner ditch towards the intermediate ditch.

The only purpose yet suggested for making passages to the ditches was to provide a means of attacking the enemy if he entered the ditch, which might otherwise have given him cover from the defenders' fire. But the wall (24) that blocks the end of the ditch commands its floor. A more cogent reason is expressed by Philo; his text, as the manuscripts have preserved it, directs the planner of a fortification on firm ground to provide against enemy attempts to fill in the ditches, by making them "perfectly dry and with tunnels at suitable spots for the besieged to clear out the material as it is thrown in, whether by day or by night." In marked contrast, there are instances in earlier Greek history of a race between the enemy who spent the day filling in a city's ditch—there was only one, as a rule—and the defenders who were unable to clear it out except under cover of darkness. The editors of Philo remembered Thucydides and have therefore emended the text into an injunction to the defenders to clear out by night what the enemy put in by day; consequently the relevance of this sentence to the tunnels at Euryalus has escaped notice.

Another of Philo's rules is to leave a space of 100 Greek feet between the wall and the inner ditch. At Euryalus that distance would have been excessive, because the tongue of high ground is so narrow that the defenders would have been exposed to fire from the flank. For the same reason, the width of the inner and intermediate ditches had to be restricted, to about 52 ft. and 73 ft.; Philo requires 105 ft. (reckoning his cubit at 18 in.; it might have been 17½). But the interval between those two ditches, though irregular, corresponds fairly well to Philo's minimum requirement of 60 ft. He requires

[1]He refers to meeting friends of the then dead Ctesibius, so the date of composition cannot be appreciably before 250 B.C., or after 200 B.C.. Latest edn. by Diels and Schramm, *Abhandlungen der Preussischen Akademie der Wissenschaften* (Berlin) 1918, *Philosoph.-hist. Klasse* 16, with German translation of emended text and largely fantastic diagrams.

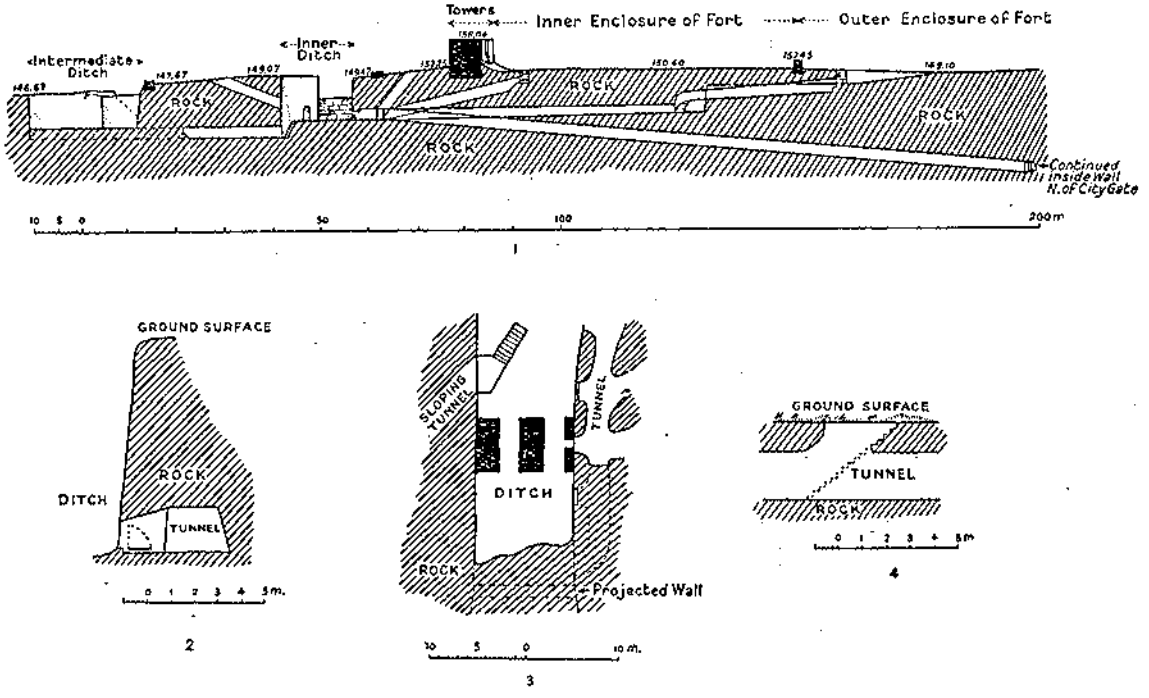


FIG. 3.—EURYALUS, SYRACUSE: THE TUNNELS (after A. Schramm, R.M. XL pl. II)

1. Section, West-East. 2. Section at east face of Inner Ditch showing method of closing doorways. 3. Plan of south end of Inner Ditch showing bridge-piers and projected extensions of ditch and tunnels. 4. Section of tunnel (12) showing temporary steps to manhole (13) for clearance of excavated material.

the same minimum interval between the intermediate and outer ditches, but at Euryalus these were almost certainly intended to be much farther apart, whatever may have been the projected width of the outer ditch; it is now about 23 ft. wide, and 286 ft. distant. The design thus compensated for placing the inner ditch so close to the wall and for cutting it so narrow.

The total distance from the wall to the far edge of the outer ditch comes to about 585 ft. according to the plan, compared with Philo's minimum of roughly 535 ft. That distance, Philo says, will put the wall at the extreme, and outside the effective, range of the most powerful ballista, the type which could throw a 50-lb. stone. And in fact the ditches and outworks of Euryalus were anti-ballista defences. Philo is emphatic that no wall can stand once the enemy comes near it; you must, he says, plan your fortifications with multiple ditches and outworks in order to keep him out of ballista range of your wall. If he has succeeded in bringing his ballistas into range, they will give covering fire for him to run forward penthouses or trenches from which he can undermine your wall or knock a breach in it with a ram to supplement the battering from his ballistas. Your best chance in such a case is to bring your own ballistas into play.

Provision for defence by ballistas was also made at Euryalus, and on a scale found nowhere else. The front of the fort could mount a whole battery of ballistas, on the five towers and the four intervening platforms. The height of the towers was over 40 ft., and the range was thereby so lengthened that the outer ditch could be sited at a greater distance from the wall than Philo advocates.[1] The ballistas on the towers could then hit the enemy beyond the ditch, while if the enemy managed to put his ballistas near its edge (necessarily at ground level), the Syracusan battery would have been safely out of their range, and even the outwork between the intermediate and inner ditches should have been beyond the reach of stones that could effect structural damage. Supposing the ballistas were raised 42 ft. above ground (which is probably an under-estimate), their stated effective range would be extended by about 40 ft. preserving maximum horizontal penetrating power, while the requisite 50 ft. could be achieved by lowering the angle of projection.[2]

The science of ballistics did not exist in antiquity, and the extreme range from the tower tops could only have been ascertained by experiment. Unless that had been done already at some other site, one or more of the towers had to be completed and a ballista fired from the top, before the outer ditch could be marked out on the ground. That may explain why this ditch remains so

[1]Apparently he did not contemplate placing heavy ballistas above ground level; indeed Greek towers are generally too weak to stand such a strain.

[2]I am indebted to Dr. D. H. Wilkinson, Fellow of Jesus College, Cambridge, for this calculation. "If we assume that the projector has zero size, and if we neglect air resistance, then the optimum angle of projection is 45° when fired from the ground. On firing from 42 ft., the optimum angle becomes a very little under 43°. The difference in ranges is then about 40 ft. The gain in range obtained by altering the angle of projection when firing from the wall is about 1 ft., it thus being unlikely that any alteration would be made. It is thus seen that the increase in range is not great enough. If we assume a finite size for the projector, the gain in range becomes even less. If we take air resistance into account, the maximum range is obtained by lowering the angle of projection. This causes the projectile to strike the ground at a smaller angle than before, and hence gives a greater increase in range for a given increase in height of projector above the ground than for the 45° case. The 50 ft. increase in range thus becomes possible (fired from ground, range 535 ft.; fired from 42-ft. wall, range 585 ft.). The stated increase in range enables one to estimate the initial angle of projection (which is not the same as the angle of impact), this being reasonably in agreement with that expected for maximum range with air resistance. It thus appears likely that this weapon was adjusted to give maximum horizontal range, and not maximum horizontal penetrating power."

much narrower and shallower than the others ; it could not be begun till the range was determined, and since the other ditches remained unfinished at the time of the final siege by the Romans we may surmise that the whole scheme was a recent project and obviously the outer ditch could not be excavated with the Romans in close proximity. On the other hand, the towers would have lost most of their value without a ditch at extreme range to keep them safe, hence it is clear that the towers and this ditch must be contemporary in design. Since the intermediate ditch is likewise unfinished, it must have originated at the same time. The outwork (C) between it and the inner ditch clearly depends on the existence of both ditches, and cannot be older than either. There is evidence of a projected extension of the inner ditch southwards, where more tunnels were to communicate with it, and it has been noticed that the completed tunnels to this ditch were not smoothed like those that lead towards the intermediate ditch ; the inner ditch must therefore be largely, if not entirely, of the same time.[1] The outworks behind the inner ditch could to some extent have served to protect the barrack enclosures before the towers existed, but seem an integral part of the same scheme and almost certainly were never finished.[2] To sum up, there are grounds for the conclusion that everything from the towers to the outer ditch inclusive originated as part of one final design, dating just before the siege of 213 B.C., with the possible exceptions of parts of the inner ditch and inner outwork, and also of the four platforms that link the towers.

For these almost square platforms are not bonded into the towers—which, however, means little, for the Greeks habitually avoided bonding their towers to the curtain, in order to localize any breach. From the plan one might think them relics of the original wall of the fort, built by Dionysius, and indeed their thickness, 10 ft., is the same as that of the city wall. But they seem to have been built after the towers ; they may conceivably represent a reconstruction of an old wall, necessitated perhaps by the insertion of the towers. As for their function, it is reasonable to assume that engines were placed on the platforms, although these did not afford space for the heaviest ballistas. The ground there stands 50 or 60 ft. higher than any spot below the tongue where the enemy might come near, and the range from the platforms, which

[1] A wooden drawbridge crossed the inner ditch on piers of masonry ; the fact that pillars of rock were not left when the ditch was excavated is taken by Schramm as a needless case of extra labour, only excusable on the supposition of an uncompleted change of plan. But masonry was more reliable. The sortie was an essential element in Greek defensive warfare, especially as Philo describes it, and for this purpose even a large number of underground passages would form a poor substitute for a short bridge, in case the enemy should obtain a footing across the intermediate ditch. The length of the bridge thus determined the width of the ditch it crossed, and not *vice versa* ; at this south end, the inner ditch narrows to 30 ft. compared with 52 ft. at the north end.

[2] Collingwood's belief that the chambered wall (9) was left in process of demolition can scarcely be reconciled with Mauceri's leisured observations (*op. cit.* 44). This wall, or viaduct, was demonstrably, and naturally, built after the completion of the towers on which it abuts, to afford means of access from them to the bridge—and presumably to the pointed outwork (10) at its side, which must have accommodated ballistas. " Beneath the walls and outworks, emplacements should be prepared to take the largest weapons possible and to the greatest number " (Philo, 32). The pointed outwork did not command the floor of the ditch, as would have been the case if it were not meant as an emplacement, and the ballistas there would have had a wider arc of fire, though at shorter range, than those on the towers. Mauceri's theory that the pointed outwork is a relic of the original wall of Dionysius' fort, and contemporaneous with the ditch (*op. cit.* 40, pl. IV), is thus untenable ; the shape, moreover, is without parallel in early Greek walls but comparable to that finally adopted for an angle salient in a Greek fort at Samaria, which was first built about 110 B.C. (Crowfoot, Kenyon and Sukenik, *The Buildings at Samaria*, 1942, 28, 118, pl. IV).

were 11 ft. tall, was thus much longer than the enemy's. The field of fire from the battery included all the approach to the city gate ; since the towered wall runs at a slant across the ridge, even the engines at its south end could be brought to bear upon much of that ground, which had to be kept clear at all costs. Accordingly the construction of the towers as separate buildings did not seriously decrease the battery's fire-power, although the four smaller of the nine engines were placed on the lower platforms, while the shock of the recoil from the five 50-lb. ballistas was taken more safely by buttressed pillars than would have been the case with a single unified mass of masonry.

If, then, the towers, ditches and outworks compose one design, and that of just before 214 B.C., it is natural to ascribe them to Archimedes who is known to have supervised the defences of Syracuse. But we should also consider the evidence they offer of their author's mind. The final scheme at Euryalus displays a special sort of ingenuity, which, to me at least, suggests that a scientist was responsible. The modern parallel to the position Archimedes held is the employment of scientists for the planning of methods and means of warfare, and it is relevant to inquire how their habits of thought do in practice differentiate their work from a Staff Officer's.[1] The scientists, when confronted with a problem, look for the principles behind the facts by analysing the experiences of the past in the endeavour to tabulate statistically the factors which caused success or failure and so to define, as far as may be expedient, the laws governing that type of warfare. Consequently their solution, even if it did not take the form of a single comprehensive plan, would have the clarity of an *ad hoc* design, in which each part had been given such shape and place as would specifically fit it both to perform its individual function and to act in conjunction with the other parts. In contrast, the solution propounded by the Services has too often been a haphazard bundle of expedients. The analytic mind tends also to devise things so faithfully apt for their purpose as to seem almost ridiculous ; hence common parlance in England during the bombardment by Hitler's new weapons described these inventions of German scientists as " diabolical toys."

Now the entire scheme at Euryalus is planned as an entity in every detail ; it fits together, and with the ground, like clockwork. The minor details are so ingenious that they appear slightly ridiculous, because of the designer's insistence on perfect suitability for their purposes. A striking instance is the manner in which the underground passage communicates with the inner ditch (Fig. 3. 2). A passage debouches, a few feet within the rock, into a transverse passage, parallel with the scarp of the ditch, and linked therewith by a series of doorways. Each doorway rises at the threshold above the floor of the passage, forming a sill, while the ceiling slopes down into the doorway. The wooden door did not hinge against the side in the usual way but dropped flat on the floor of the passage. To shut it, all that was needed was to pull it up, and jam the top against the sloping ceiling and the bottom against the sill. Then the enemy could not pull the door towards the ditch without first chopping it to pieces, and could not push it inwards once the defenders had wedged it in place with bars or spears.

The whole scheme testifies to an analytical mind of the highest quality, and accords with the reports of Archimedes' brilliance in the line of " Operational Research " during the siege.[2] Even if partly fabulous, the traditions establish the military ingenuity of Archimedes. By the end of the

[1] I have, in what follows, combined my own observations with the views of my scientific colleagues at an Operational Research Section of the R.A.F.

[2] T. L. Heath, *Works of Archimedes*, p. xvi ; W. W. R. Ball, *Short History of Mathematics*, p. 65.

siege, it is said that a few pieces of wood and rope seen coming over the walls were enough to make the Roman soldiers run away, shouting "There's that old man again."

The fact is beyond dispute that Euryalus is worthy of his reputation. The design should be approximately of the time of Archimedes; it agrees closely with the specifications of the manual of fortification by Philo, who was his contemporary, and it seems to be more advanced than the works at Selinus that are now plausibly dated to the period when Archimedes was a young man. No imitations are known, as is only to be expected if Euryalus was one of the latest of Greek defences, built shortly before the general *pax romana*; Roman forts of the next three centuries are laid out on earthwork principles which are incompatible. The only reasonable explanation of why Euryalus was never finished is that the modernization of the fort had not long been put in hand before the beginning of the siege which resulted in the Roman annexation of Syracuse and so removed all further need for defences. Because of the firm alliance which had existed between Rome and Syracuse since 263 B.C., there had been no expectation of a siege before King Hiero's death in 215 B.C., but thereafter this most vulnerable spot of Syracuse must have received special attention from those who were making preparations for war, and in particular from their chief consultant, Archimedes. There can be no definite proof that he re-designed the fort in 215–213 B.C., but a formidable mass of indications leads to that conclusion, and I know of none to the contrary.

CONSTRUCTION PARTIES IN TURKEY

By COLONEL K. W. MERRYLEES, O.B.E., M.I.MECH.E.

IN the *R.E. Journal* for December, 1945, Brigadier Hull gave an account of the formation and early work of the Construction Parties in Turkey. His account ended with the change in policy and chief objective from military roads in Thrace to the construction of airfields in western Anatolia, which had already been started in the Balekesir area, south of the Sea of Marmora, by No. 2 Construction Party.

During the working season of 1941, roughly from April to October, the airfield projects of the original programme, modified to some extent by reduction in size of runways and hard standings, were completed. The base for the parties was at this time at Izmir (Smyrna) and a considerable amount of plant and equipment had been collected there for airfield work near Izmir and Bandirma, in fact one of the most popular exhibits at the Izmir Fair that year was a working demonstration by a sample of each of the available machines, a suitable area of waste land near the Fair having been allocated to the parties for this purpose.

As the programme of work came up for complete revision during the winter months the activities of the two parties, which did not total more than sixty men, were limited to overhauling plant and equipment and later moving to new bases as the plan developed.

Thus far, the military roads in Thrace had been given a good start, but these roads were now entirely in the hands of the Turks and proceeded very slowly during the subsequent summer working seasons, and probably not at all during the winter. As further inspections by members of the British parties were not encouraged by the Turks, it is not known if the original project was ever completed.

In the winter of 1941 the plan was expanded considerably. The main project was for assistance to Turkey by air and land forces should the Axis forces approach or attack the Turks holding the defence lines in Western Thrace. The Construction Parties were given the tasks of (*a*) improving communications from Middle-East to Western Anatolia, (*b*) preparing sites for various bases and depots and (*c*) making a number of new airfields and improving the ones already completed.

Two changes in party organization now took place. The Izmir and Bandirma parties moved to Afyon Karahissar, a place well known to many British officers as one of the big P.o.W. camps of the 1914–18 war, and the two parties then became an enlarged single party (No. 2). Afyon is no winter resort, as it is 3,000 ft. up on the Central Anatolian Plain and is almost treeless, bleak and extremely cold, but fortunately sufficient accommodation was made available near the town until a hutted camp could be constructed.

In addition an entirely new party (No. 1) was formed and sent up from Middle-East and based on Mersin, a small port with an open roadstead on the south coast, not far from Tarsus.

After the plan had been approved by the numerous Turkish departments concerned the necessary contracts had to be made with the Turkish P.W.D., the Nafia.

Brigadier Hull has described some of the difficulties inherent in dealing with the Turkish authorities, and these difficulties varied in degree with the different departments and officials, and also, as a whole, with the Axis successes or failures, working up to a maximum when Turkey was almost surrounded and the Axis nearly to the Caucasus and to the borders of Egypt. In these circumstances it is not unnatural that the Government of a neutral country, which would be almost wholly dependent on one side for adequate support against the other, should be very wary of committing itself either way and would be particularly careful not to give too open support to what must have appeared then to be the losing side. This attitude multiplied the difficulties of getting approval for plans and permission to start anything new and, backed by a centralized administration which encouraged every minor official to insist that the most unimportant decisions should always be "referred to Ankara," introduced the most exasperating delays. G.H.Q. in Cairo could bring little or no pressure to bear to assist and the success of our negotiations was largely due to the efforts of the Military Attaché, Major-General Arnold, who was indefatigable in overcoming the almost automatic reaction of all officials of "Yok!" (No!) to each and every proposal.

In spite of delays, and what appeared to be in many cases active obstruction, the work on the ground began in July after a loss of three months of the working season and with the harvest still ahead. Since Turkey was not at war the normal annual routine still held. Except in the coastal areas the winter climate stopped all outdoor work and the working season began in April and finished in October. Most of the outdoor labour, in the absence of the great majority of able-bodied men of military age, had an active interest in the harvest and none would remain to work out of doors during the winter. Except when the central plateau was sufficiently frozen and still without too much snow, movement, away from the railways, was, in the absence of any

Photo 1.—Old wooden bridge on Taurus road, near Ulukisla.

Photo 2.—Class 70 R.C. bridge replacing wooden bridge.

Construction Parties In Turkey 1,2

Photo 3.—The new Taurus road passing through the Cilician Gates, on Alexander's route to India.

Photo 4.—Replacement of an old stone arch bridge by a Class 70 R.C. structure on roa in Taurus mountains.

Construction Parties In Turkey 3,4

metalled roads, almost impossible. Deep mud in the winter became deep dust in the summer, and there was only a period of a couple of months in the spring when heavy cross country traffic was possible at all.

By July actual construction had started on thirteen airfields by No. 2 Party and on the roads and bases by No. 1 Party. The task of this latter party was to prepare a road approach to the Central Plateau from the coast at Mersin, to prepare depots and bases and to make a second small port on the coast near to Mersin. Access to Anatolia from Syria or from the southern coast was virtually limited to the railway which had been built by the Germans, largely with P.o.W. labour, in the 1914–18 war as part of the Berlin–Baghdad Line. The construction road, which must have followed Alexander's route very closely, had been allowed to fall into disuse and disrepair and was impassable at a number of places in April. The alignment was, however, the obvious one for a new main road and work was begun in July on the 153 kilometres from Mersin to Ulukisla, a small town at 4,500 ft. where the railway leaves the Taurus Mountains for the Central Plateau. As the object of the road was to supplement the railway, and as it would be the only link with Middle-East if any of the seven miles of tunnels in the mountains were damaged or blocked, Class 70 was specified and consequently every bridge had to be replaced and forty-eight new bridges and 391 culverts built.

By mid-December, when work even on the lowest sections had to stop, nearly 100 km. were complete and the remainder so far advanced that it could in emergency have carried the designed load of 600 tons a day. In addition, a small lighter wharf had been built at Susanoglu, about twenty miles west of Mersin, and the road between the two places improved.

No. 2 Party had had much the same starting troubles with the new airfields projects and had, in addition to Nafia, to deal through the Air Ministry and the Ministry of Defence. Five all-weather and nine fair-weather (i.e., grass runway) airfields were either completed or wholly constructed between July and November.

Again a winter programme of overhaul of the hard-worked machinery and transport was arranged and also a leave programme to Middle-East for the 240 officers and men. It appeared at this stage that the 1943 programme would be little more than a finishing off of the 1942 projects, but by March orders were received from Cairo for an even greater programme for the next season, and once more the tiresome business of urging the various Turkish departments to action had to be undertaken.

No. 1 Party's task now included, in addition to the completion of the Taurus road, a Class 70 road from Tarsus, on the Mersin–Taurus road, to Iskanderun (Alexandretta), which was connected by two French built roads to Syria, and an extension of the Taurus road for about 10 km. to a proposed site for a base, this making a total of nearly 200 km. of reconstructed, or what was really new road, since only earth tracks existed before and the alignment across the Adana Plain was on difficult black cotton soil. Compared with these the additional projects for the building of bases and camps near Ulukisla and at Afyon were minor works.

No. 2 Party at Afyon were presented with a much increased programme which included aircraft pens at all the forward airfields and camps and more hard standings at all the sites, but the whole programme of large projects on sixteen airfields was rightly considered more than the 105 officers and men could control, and a new party, No. 3, with an establishment of 140, was imported from Middle-East and set up a camp at Balekesir.

In this working season, with its earlier start, nearly all the tasks would have been completed had it not been for the failure of the Turkish Railways

to move materials punctually. Much of this delay was apparently caused by the mass of Axis war materials from North Africa, which was being presented to Turkey and which was stacked on every railway station platform up and down the country.

By November, 1943, when only a few Turkish contracts were still running, but while the Ulukisla and Afyon bases were still being erected, the war situation had changed and orders were received to " stand fast " while maintaining an appearance of continued activity. Axis action against Turkey no longer appeared probable and after the " Cairo talks " preparations for Allied advances led to the order for more fighter airfields on the south-west coast of Anatolia near Mugla, using Sommerfeld track on grass for speed in construction.

By February it was clear that no further projects would be ordered and, except for the tidying up, the work of the Construction Parties was over. It was also clear to those in Turkey that the Turks still had no intention of abandoning their neutrality, but, in spite of this, a " war " H.Q. started to arrive in Ankara and the parties passed to the control of the Chief Engineer of this " force," and when he departed, after a few wasted weeks, they came under the control of a single C.R.E. for the process of closing down.

One of the minor difficulties which was always cropping up was the necessity of keeping up the complete secrecy of the parties, even when it was quite clear that the Axis agents knew a great deal about them. The German Consul at Adana, Herr Hoffmann, for instance, found it necessary to inspect frequently the old 1914–18 German graveyard on the Taurus road, and he always photographed the work and talked to the Turkish workmen and staff on these journeys. Also, all the men of the parties were outfitted in Cairo by the same firm with grey flannel trousers and greenish tweed coats. As they seldom wore hats, and as no Turk ever dressed this way, it was always possible to identify a member of the parties in a crowd or at a considerable distance. On occasions members of the parties advising the Turks on airfield construction on the sites even found themselves among the Axis technicians busy erecting German aircraft.

The small groups supervising Turkish contracts at the more distant airfields sometimes became isolated single men, but in spite of acute language difficulties the men always managed to liaise satisfactorily with the locals, both officially and privately, and socially troubles never occurred. One corporal on leaving was given what amounted to a civic send-off and Anglo-Turkish relations generally must have benefited considerably from the presence of the parties.

A minor and necessarily entirely unofficial activity of the parties was the assistance given to help interned Allied airmen and others across the border into Syria, or to embark on Allied ships delivering stores, and in no case was there a failure due to errors by members of the parties. The Turkish authorities at Ankara did not appear to bother unduly provided the operation was carried out neatly and secretly, and the same probably applied to Axis internees who had an easier exit via Black Sea shipping in the Bosphorus.

At the time of maximum activity, during 1943, the parties totalled nearly 400 officers and men, with 200 items of plant and 600 load-carrying vehicles. In all, thirty airfields and 350 km. of Class 70 road were constructed and camps and bases prepared. Owing to the very adverse rate of exchange, the work appeared to be very costly, but it seems probable that the £9 million sterling spent on contracts alone was an insurance premium which, since it helped to keep Turkey neutral, was very well spent.

DEMONSTRATION OF THE MECHANICAL TRUCK DISCHARGER AND TRACK HANDLING CRANE (PATENTED)

By MAJOR R. S. HOTSTON, R.E.

A demonstration of the mechanical truck discharger was held at Portfield Tip (British Railways Southern Region) on the 20th January, 1949, to illustrate some of the many duties for which the equipment could be utilized.

The demonstration was arranged by the manufacturers, Messrs. William Jones Ltd., and members of War Office branches attended, including Transportation, D.F.W. and D.E.S., also members of the Transportation Centre, together with a course of officers and representatives from R.E.M.E.

The site at Portfield, near Chichester, is a railway tip where a disused gravel pit is being reclaimed ; the original pit had been excavated to a depth of 20–30 ft., and the whole of the site was flooded to an average depth of 7 ft. when the reclamation project was commenced by the old method of unloading railway wagons by hand.

The Railway Executive decided for economic reasons to introduce the mechanical truck discharger and track handling crane. Instead, therefore, of unloading all over the site in heaps, as had been done by hand, a new through embankment was driven right across the site, capable of taking one siding with sufficient room for the mechanical discharger to operate. This produced a long unloading face and opened up the site for mechanical discharging.

During the demonstration it was seen that the material being unloaded consisted of loco ash, hardcore, lime or water softeners, vestry rubbish which covers all classes of refuse including straw and even such objects as old mattresses, and occasionally truck loads of rotten fruit rubbish from the market. The mechanical truck discharger handled all these materials, many types of which form great obstacles to hand unloading, either because of their nauseous nature or their difficulty in handling.

It was observed during the course of unloading that there was no damage to rolling stock. This argument is often put forward as an objection to the introduction of mechanical appliances. As proof of this, during the past twelve years, during which mechanical truck dischargers have been used by British Railways, there have been no complaints on this point, and a quick turn-round of wagons has been achieved.

The truck discharger is basically a standard excavator (Wolf Priestman in the example seen) with a special jib incorporating a swan-neck to allow the machine to reach over the side of the railway wagon. The rigging is similar to that of a skimmer: instead of being equipped with a shovel, a flat blade is fitted. This blade pushes the material to be discharged out of the wagon—with dropside wagons the machine will empty the wagon completely, with centre door wagons it leaves some material in the corners, and although this material must be discharged by hand there is a great saving in time and manpower.

When the material has been unloaded and the train withdrawn, the mechanical truck discharger reaches over the track and pushes the material down the bank ready for the next load.

The next duty of the mechanical truck discharger on the tip site is track slewing. A qualified operator can fit the slewing attachment in approximately two minutes. This consists of pulling the drag rope through the carriage over a sheave in the form of a return loop into which is fixed a snatch block with a rail-slewing hook. The jib is then lowered with the blade attached and a bridge is formed with the hook resting on the outer rail ; track can be slewed anything up to 8 ft. on one pull. The force of this pull will amount to anything between 4–6 tons. Where the complete siding has to be slewed it is usually sufficient to loosen the fish plates and slew 2–3 ft. at a time until the track is in the desired position. The slewing operation renders the services of a gang of twenty to thirty men unnecessary, so that the whole tip can be run very economically.

The ideal site conditions for this class of work, are basically where a long siding can be slewed outwards on an easy curve so that the built-up face can be continually extended. The travelling of the mechanical truck discharger during the unloading process, up and down the unloading bay, consolidates the tipped material to such an extent that a far greater tonnage can be placed into the same area, thus the results are very much better for the ultimate use of the ground whether it is for buildings or sidings.

The type of rolling stock normally discharged is a cross section of all types of common used wagons to be found on British Railways. The mechanical truck discharger can discharge any type of wagon in which there is a door which opens at floor level.

From experience best results are obtained from the full drop-side ballast wagons, where tonnages up to 300 tons per hour can be discharged from trains made up of these wagons. The capacity is reduced in the middle opening door type and still further reduced in the " pigeon-hole " door type.

The following are the figures giving discharge efficiency :

(*a*) Ballast type	100 per cent efficiency
(*b*) Middle door type	90–95 per cent efficiency
(*c*) Other types	80–85 per cent efficiency

The equipment when discharging replaces a gang of twenty to thirty men on normal work, which has sometimes to be increased if awkward materials are being unloaded, resulting in a saving of costs as well as in organization of manpower.

Trimmers who follow the mechanical truck discharger to trim from the corners to the middle of the wagons are employed on other duties on the tip when not trimming. Four to six trimmers per equipment should be sufficient to deal with the most awkward mixed trains.

In conclusion it can be said that there are several other operations which the equipment can perform with the truck discharger jib and blade, and the universal basic machine itself can, by changing the jib, be used with any other type of excavator equipment.

Photo 1.—Jib rigged with flat blade for discharging.

Photo 2.—Jib rigged for slewing.

Photos by permission of Messrs. William Jones, Ltd.

Demonstration Of The Mechanical Truck Discharger and track handling crane (patented) 1,2

Photo 1.—Where *Yam Seng* was built—amidst the chaos and confusion of a Chinese waterfront.

Photo 2.—Bows on—"all good, sound, solid stuff."

The Maiden Voyage Of The Yam Seng 1,2

THE MAIDEN VOYAGE OF THE "YAM SENG"

By MAJOR J. W. BOSSARD, M.B.E., R.E.

"HAVE you ever designed and built your own ship?" This is the story of how it was recently done at Singapore, and with the aid of two men and a girl, sailed home to Portsmouth.

Almost everyone asks "Whatever made you start?" The answer quite simply is "Desire and Opportunity." Not that I would advise you to try it as a pastime. It proved to be an immense task and one to which you need to devote your whole time. This was denied me. I was an intensely busy officer, working at a pressure at which I had rarely worked before. Often during construction I visited the slipway but once a week when once a day was insufficient. As a project it had all been most carefully worked out. There was nothing haphazard about it. It had to be perfect, since I could not afford to have it otherwise. It wasn't until I came to buy my small stores such as shackles, blocks and cordage that I came unstuck. They were almost unobtainable and prices were fantastic. I owe much to the kindness of so many, particularly among my brother officers who, as the ship grew, gave me a host of things that made the fitting out a possibility.

"Opportunity" was perhaps the biggest factor since "Desire" was merely the result of a wish expressed during my youthful sailing days that if ever I went East I would build a boat of first class timber and sail it home. Perhaps also there was a certain amount of latent enthusiasm prompting me. When I look back I realize how fortunate I was in that "Opportunity." I suddenly realized that there "It" was and would never be so again. I had saved £3,000 during the Burma Campaign—merely because I could not spend it. Each month my pay and allowances were paid into my bank in Bombay, from which little or nothing was paid out. I went on leave back to India once. Conditions of travel were so appalling that I never went again. Many others similarly took only one leave, and my next leave in two years of jungle warfare was that taken in England in October, 1945. I was a rich man!

In Singapore in March, 1946, I was a Lieut.-Colonel, Commander Royal Engineers, and amongst many things controlled a sawmill with two or three thousand tons of timber of excellent quality. I asked my Chief Engineer for permission to use what I needed on repayment, and it was given. In Balestier Road there was a colossal salvage dump covering acres of ground and containing a mass of things one wanted. From there I got many items including scrap lead for my keel. I was on good terms with Soon Onn, a Chinese merchant who owned an extensive slipway and placed all his facilities at my disposal.

It was too easy! As soon as I appreciated that it was a possibility I started. I drew drawing board, squares and instruments from my drawing office and I worked many many hours after midnight and faired up a lovely hull. It was to be my dream ship. I took it to Soon Onn for his opinion and approval. It was on a Sunday morning and how well I remember it. We sat at a rickety old table on a ramshackle jetty in Beach Road. There were about twelve of us, including several of Soon Onn's workmen—laughing, jovial folk with a gay sense of humour. Only Soon Onn and I spoke English. We drank

coffee and passed the time of day amidst the bustle and the thousand and one smells of a real Chinese waterfront (see Photo 1). When the usual greetings were over I produced my drawing. They all took one look at it and threw up their hands in horror. First one and then the other seized a pencil and reshaped the hull to his ideas. They chattered and gesticulated and the result of their deliberation was that my effort wasn't much good, and I had better try again. I left with my work of art completely bespoiled.

It was then that Desmond Walsh, another Colonel in the Royal Engineers, heard that I was trying to design a yacht and gave me that excellent little book called *Cruising Yachts* by T. Harrison Butler. I read it through and through until I knew and understood what he was trying to impart. I borrowed a Planimeter from the local Survey Unit and added it to my collection of instruments and started again. I roughed out the sketch of a hull with its interior fittings, approximately to scale and with a 30 ft. water line. I quickly decided that I needed an extra 5 ft. and the *Yam Seng* became 35 ft. L.W.L. Once more I became just one of the hundreds of yachtsmen who have done the same thing hundreds of times. With my water line fixed at 35 ft. I decided my beam should be one-third of it and the draught 6 to 7 ft. I estimated my freeboard at 3 ft. 6 in. allowing a 25 degree angle of heel. I sat myself in a comfortable chair in a relaxed position and measured myself—the distance from my seat to the floor; the height of the top of my head above my seat; and perhaps the most important the height of my line of sight in the sitting position. I set all these measurements out on my drawing. If the cockpit seat was to be at deck level then I had the most comfortable depth for the cockpit floor—17 or 18 in. I drew in the line to represent it. I drew in my sight line 2 ft. 6 in. above the deck at the cockpit and said my stem and bow must not come above it. Amidships I set up 12 in. for the gunwale and decided that my cabin windows must come just above it if I wanted to see out. I drew a line for the cabin floor 5 ft. 9 in. below the centre of the windows and allowed 6 ft. 3 in. headroom. This brought the cabin roof line to just the right height above the deck. I did the same in the galley and forecastle, except that I restricted the headroom to 5 ft. 9 in. I now had the principal dimensions that represented the limits within which I could build, all set out at a scale of ½ in. to 1 ft. I sketched in the sheer plan of what I thought she should be, and turned to Harrison Butler and followed his directions slavishly. I spent many many hours trimming off the after sections and filling out the bow sections until I had the right answer. Whatever the angle of heel the displacement fore and aft was the same. Each water-line plane was a good streamlined shape and the whole faired up perfectly. I took it to Ives and Godet. They were two sailors I had met, one a Brazilian and the other a Bermudan; both with a vast experience of ocean sailing. Godet had only one criticism. My keel was level at the bottom. He said it would be much better for it to be lower at the stern post—it was so much easier to get her off if ever aground. So I lowered it 6 in. and the draught became 6 ft. 6 in. Soon Onn and his merry men were much impressed. I was rather surprised at this because nothing could have been less like a Chinese Junk, and I had never seen a drawing in use by them. From the analytical way they studied it and broke it down, it was most obvious that they were very able to read and understand one. The problem of a foreman or other form of supervision was discussed and Soon Onn produced Fong Ah Choon. I engaged him under contract to see the job through for a thousand dollars. In many ways he was something of a dead loss and influenced the job but little. He was always having leave or going sick. "Could he have a week off to bury his wife?" "Yes!" "Could I give him £200 advance

towards expenses ?" "Certainly not," I would answer and then, like a fool, give it to him. Six weeks later "Could he have leave to bury his wife ?" "But you buried her last month !" "Oh no ! That was my brother's wife."

With the lines of the hull approved I could concentrate on the internal layout and the details of design. In addition to making the most of every available inch of space I needed to know the weight and final position of everything in order to work out the location of the centre of gravity, and from it decide on the weight and position of the lead keel. I will not describe the hours of patient toiling over the drawing board, trying to put my ideas of the ideal layout into practice ; trying to fit everything into the hull so that when launched and loaded it would float to the designed water line. I soon found that the engine installation was to be the biggest factor. It was to be my largest mass and concentrated weight, and to balance it I had the fuel and water tanks, chain locker and cable, the lead keel, and mast and rigging. I had already written to many firms in England for an engine to receive a similar answer from each—delivery from twelve to eighteen months. This was a shattering blow because without an engine the voyage was off. I tried everywhere without success and in desperation I finally allowed ¾ ton for the unit and carried on with my design. By and large the remaining loads would be evenly distributed throughout the ship and would cancel each other out.

The time had now come to obtain the official blessing necessary for the voyage before I committed myself too heavily. I applied for permission to undertake the voyage. It was referred to the War Office who agreed, subject to the following conditions. I had to signal my acceptance of them :—

(1) The voyage will NOT repeat NOT be classed as duty in case of accident.
(2) The officer will commence his leave on day of sailing.
(3) Entitlement to Army Pay and Allowances and Temporary Rank will cease 66 days after embarkation (the 66 days was the balance of leave due to me after allowing for a normal passage, disembarkation leave, end of war leave, etc.).
(4) The officer to make his own arrangements for all port formalities en route.
(5) Refund of equivalent passage money may NOT repeat NOT be claimed.
(6) The officer to report to A.G.7 the War Office on arrival ready for immediate posting within four days of landing.

They gave me considerable thought, particularly number five. I accepted them because I had no choice. I could now start building. I took a chance on the engine and in August, 1946, the lofting floor was laid and the hull drawn out to full size. By the end of September the keel was laid and the great venture had begun.

I had to get an engine ! I combed Singapore for a second-hand one and almost bought a Benz six cylinder for $3,500. If it had been in running order as promised when I went to see it I most certainly would have done, so desperate was I becoming. It wasn't ready so I was perhaps lucky. Petrol engines were available everywhere. Hard pressed as I was I would not consider them. The fire risk I considered too much of a hazard. The thought of it always horrifies me. However tight all unions are ; however careful everyone is, petrol so often gets into the bilges and floats under the floors out of sight on the bilge water. A careless match or cigarette end—and "whoomf" she is alight from stem to stern. There are other considerations. In a Diesel engine fuel consumption is less and engine speeds are slower. No

separate ignition system can fail. Almost the only failure possible is in the fuel supply, usually caused by an air lock. If you have a model fitted with bleeding screws even that is cured in as short a time as it takes to get your screwdriver and open and close the screws, one for each cylinder feed. Don't be put off with the thought of a highly complicated piece of machinery. A Diesel is simplicity itself. They start easily in any weather. They run beautifully and are a joy to listen to.

Someone came forward and said they could get me a Southern Cross engine from Australia. It would cost £830 with delivery in three months. I almost bought that, but when I obtained details of its size (it was 20 h.p.) I decided it was too big. I would need to make extensive alterations to my layout. So I turned it down.

By mid-1947 the lack of an engine was presenting a serious problem and daily became one of greater magnitude. And then I had one of those strokes of good fortune that occasionally come one's way. I had written again to England, trying a little blackmail, pointing out that if firms would only send me an engine the voyage could be used as an advertising stunt. They were all very sorry—that is all except one, and that one replied that they already had three engines on their way out to their agents, Malayan Motors. If I cared to see them they might be willing to let me have one. The engines appeared to be just what I wanted and they, the firm, would write to Malayan Motors at once. I went immediately to be told that all three were sold to Merton Brown the marine architect. "Perhaps I would like to see him?"

He was most helpful. The three engines were the right horsepower, sixteen (I wanted one horsepower per ton of displacement and *Yam Seng* was 17 tons) but they were without reduction gear. This meant that the propeller would run at 1,200 revs. per minute, instead of a larger one at 600. It was far from ideal but as he pointed out it was my best and probably my only opportunity. He was willing to let me have one and I paid a ten per cent deposit and left, feeling much happier than I had done for the past two months. It was to cost $3,500, but who cared! About one month later my telephone rang and Merton Brown was on. "Could I come and see him? The engine had arrived." I was in his office within ten minutes. Only one engine of the three had been shipped and it was being unloaded at Port Swettenham. It was the model with the larger propeller and the reduction gear. There had been an increase in price and it would be $3,950. "Did I still want it?" I think I danced a jig in his office that morning.

It came in a lorry to the workshops and I fussed round like a boy with a new toy whilst it was being unloaded. The crate was opened and there it was—to me, an engineer and its owner, a thing of great beauty. We checked it over and assembled the oil and fuel tanks and fixed up a temporary water supply. A few turns of the starting handle to check that the injectors were working, then a quick swing and in with the compression lever, and away it went. Quite a crowd of us looked on, much impressed with its performance. It would open up to 1,200 revolutions per minute without vibration and cut down to 80 without stopping. It was good and I was well pleased. I wrote Merton Brown his cheque and took it to him with many thanks.

So many enthusiasts that I have since met, both at home and abroad during the voyage, have been most insistent in their requests that I should include all my problems, however elementary. It must be remembered that I am no authority on the subject. I am an engineer and not a yacht designer, and this is my first experience in anything of this nature. The Pundits will probably read this with something akin to horror. The fact that I completed it, and with the help of a stout crew "got away with it" should, I think, be put down

to beginner's luck. Be that as it may I now have a very excellent and comfortable sea-going craft made of the best Eastern timbers and very soundly constructed. I have been asked many times whether I would now like to alter the design and layout after my experiences at sea. The answer quite honestly is "No!" Except to make adjustments that could not be done in Singapore, simply because things were not available, I am well content. All our cooking was done on a single burner paraffin pressure stove, mounted in a home-made gimbal, supplemented when we reached Ceylon by the purchase of the old-fashioned "Beatrix" lamp. Marshall of the Yacht Haven at Hayling Island is now fitting a gas cooker. I must admit that if ever I designed and built another it will be an all steel construction, and the fore deck would be stepped up 6 or 9 in. This would give me ample headroom in the forecastle where at present I cannot quite stand upright. In Alexandria I met the *Southwards* with the Schmidtts from Luxembourg—an all steel ketch of Dutch construction, flying the Belgian flag. She had had her share of tough going and literally never made a drop of water. She wasn't even fitted with a bilge pump. I was much impressed. Apart from the dryness factor the very simplicity of her construction appealed to me greatly as an engineer.

I must return to the hull. As you may well imagine I had studied the lines of many craft. To me the cut of stem and stern are the first things to catch the eye. There are various theories to account for the numerous shapes you see. A straight stem is said to be the best for going to windward. Long overhangs give you increased water line when heeled and an increased maximum hull speed. I think a straight stem looks ugly and a long prominent bow makes for a wet and dirty ship. So, bearing in mind my object—to sail eight or nine thousand miles home to England—I chose the happy medium and restricted the curve of my stem so that the minimum number of joints was necessary in building it up to suit the grain (see Plate I and Photo 2).

I imagine a canoe stern is the ideal, both from a constructional point of view, and for smoothness of hull and flow. I fancied the counter—mainly because I wanted the extra deck space behind my gallows, and also wanted the space underneath in which to rig my wheel steering. Partly too, perhaps, because I think it more pleasing to the eye. Again, I do not like the long overhang because they slap the water so much. I readily admit they look lovely if well shaped but I cannot see that they serve any practical purpose. So I again chose the happy medium—one that would give me all I wanted and a firm anchor for my permanent backstay (see Plate I and Photo 3).

I deal now with the constructional problems that arose. The first—whether the timbers should be steamed and bent, or made up? To obtain grown timbers in anything like the wood I wanted, in fact in any wood, was well nigh impossible. So steamed they had to be. None of my native craftsmen had any experience in this type of work so they had to be taught. We found that the size of timber that we could steam and bend was limited to 2 in. × 1½ in. and they were placed at 12 in. centres. Even then those amidships had to be sawn down the centre in order to take the sharp bend at the bilge—rather like a laminated strip in two sections. As the cut was down the "neutral axis" it in no way impaired their strength. Some of my more knowledgeable friends were afraid bent frames would distort in a heavy sea and the ship would "work." I took care of this by fitting 3 in. × 3 in. mild steel angle frames completely round the inside of the hull and under the deck at each bulkhead (see Photo 4). Many are the times that I have been thankful that I did, lying on my bunk on the way home, listening to the seas smashing against the ship and wondering, amazed, that man could ever put wood and nails together to withstand it.

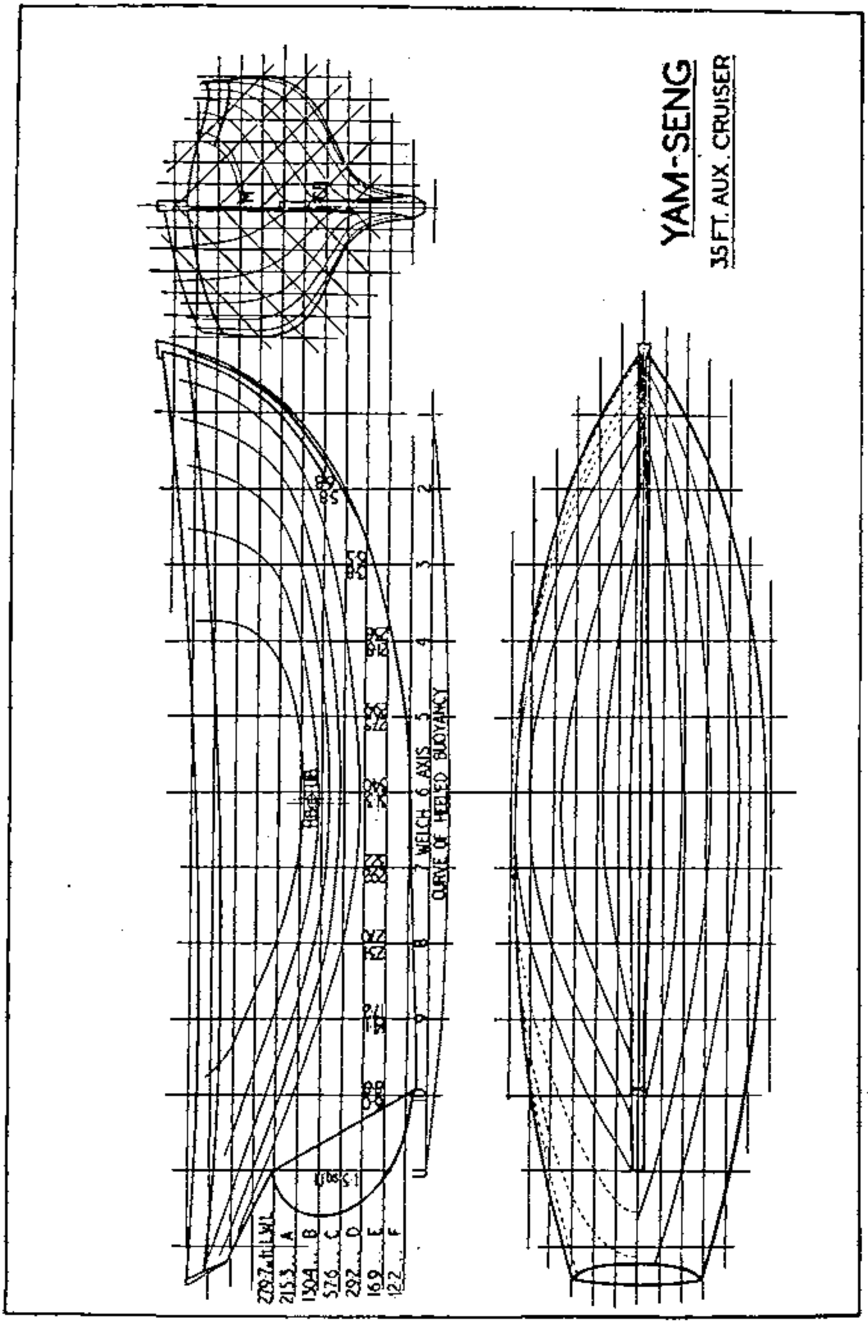


Plate 1

Photo 3.—A view of the stern and deadwood.

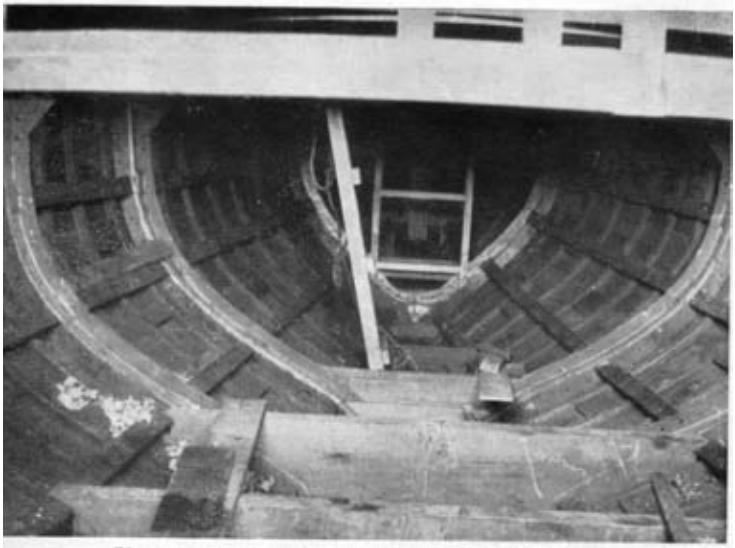


Photo 4.—Internal construction showing mild steel angles.

The Maiden Voyage Of The Yam Seng 3,4

Photo 5.—On the slipway—waiting for the engine.

Photo 6.—The Launching—Sunday 26th, October, 1947.

The Maiden Voyage Of The Yam Seng 5,6

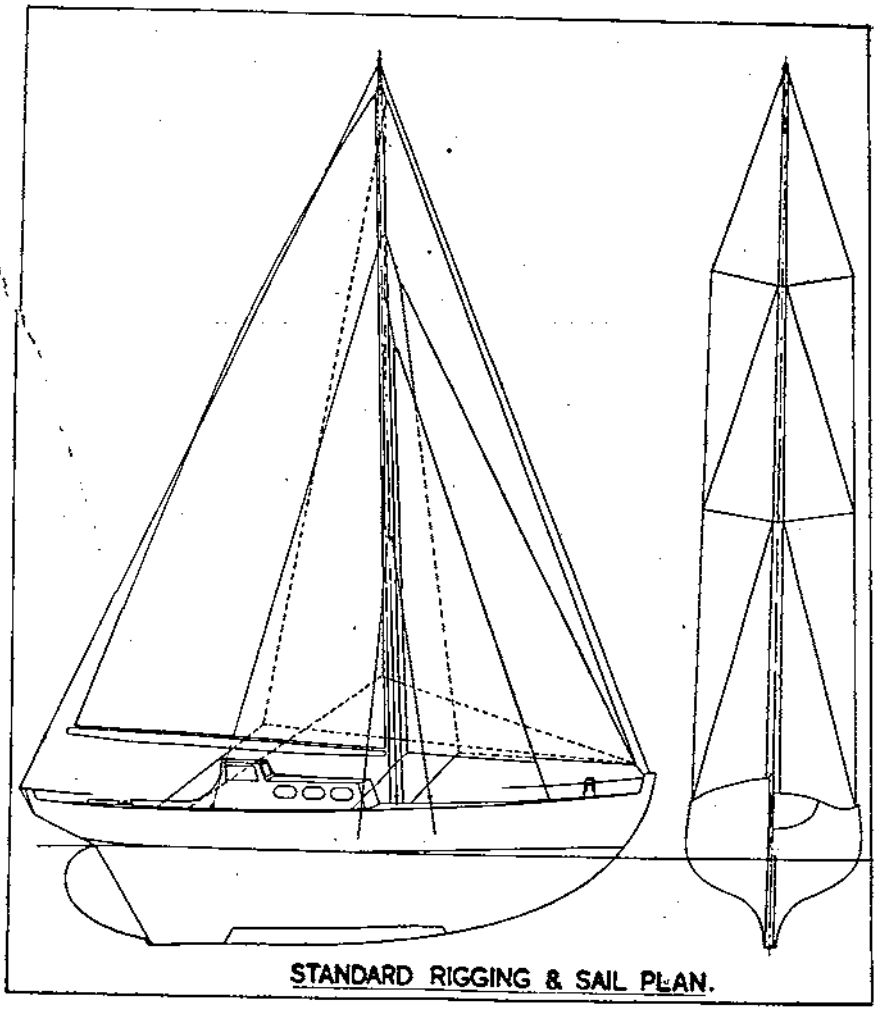


Plate 2

The second concerned the bracing of the structure in a fore and aft direction. The shell of a hull looks terribly thin and inadequate before the deck is laid and the gunwale fitted. What I had to do was ensure that any shock to bows or stern would be transmitted throughout the boat and not localized in any one spot. I carried the mast between two main beams 9 in. × 4½ in. so that it passed through a central bridgepiece that dovetailed them together. The king plank of 9 in. × 2½ in. led from the stem and was let into the foreward of the two main beams. At each bulkhead I provided a beam of 9 in. × 4½ in. From the after mid-beam I fitted a 9 in. × 2½ in. either side of the cabin, shaped to give the curve to the cabin sides and cockpit combing, and tied into the beam aft of the cockpit. From this I added a central 9 in. × 2½ in. aft to the counter. At the bulwarks I fixed a further 9 in. × 2½ in. from stem to stern bolted to each deck beam. Each of these timbers was rebated to facilitate laying and caulking the deck. All of them were in Chenghai, a hard and very durable Malayan wood, all good, sound, solid stuff.

The third—that of placing the bulkheads—was largely a matter of trial and error when designing the layout on paper. Firstly I fixed a watertight bulkhead fore and aft to prevent any possibility of flooding the ship if bows or stern were damaged. Both these compartments were fitted with a pipe to the interior of the ship to enable them to be pumped or drained out at will. In this way it would be possible to control the amount of water there and prevent any tendency to settle by the bows or by the stern. From the stern, forwards, I had to house the engine in such a way that it was aft of the rear cabin bulkhead, but could be started by hand from inside the cabin. That fixed its position within limits of 2 or 3 in. In the cabin I wanted a 6-ft. berth and a locker both port and starboard. For this I allowed 9 ft. Somewhere in the setting out of the engine a few inches were lost and the cabin became 8 ft. 6 in. long. Forward again to the galley, wash-up and lavatory. This had to be a happy medium between restricting the galley or the forecastle. So many ships that I have seen have had cramped and badly set out forecastles. My forecastle is 9 ft. long and between its forward bulkhead and the forward watertight bulkhead I have a large locker divided in two. The upper half is the food store and the lower half the chain locker. The general result is that I have fairly spacious and generous accommodation for a ship of its size—sufficient to cause considerable surprise to all my visitors. By constructing each bulkhead of two skins each of 1 in. timber laid diagonally opposite, I accomplished the bracing of the hull athwartships, and I doubt that anything in timber could be stronger.

The next problem was the design of my sail plan and the standing and running rigging (see Plate 2). All the way home people commented that my mast is rather far aft. I cannot see that it makes any difference. The essential feature is the relation of the centre of sail effort to the centre of the area of underwater resistance. If you wish to sail with a little weather helm (and I consider it advisable so that the tendency of your ship is always to come up into the wind), then the centre of sail effort must be slightly aft of the centre of resistance. In the *Yam Seng* it was fixed for 18 in. but I made an appalling error. I forgot to include the area of the rudder when considering the centre of underwater resistance and it wasn't until we were actually hanging the rudder that the horrible thought occurred to me. However, the area was insufficient to make all that difference and in practice I still have a touch of weather helm. To be quite honest I have never since bothered to re-check the distance between the two centres accurately. If the centre of sail effort is foreward of the centre of resistance then the ship will have lee helm and

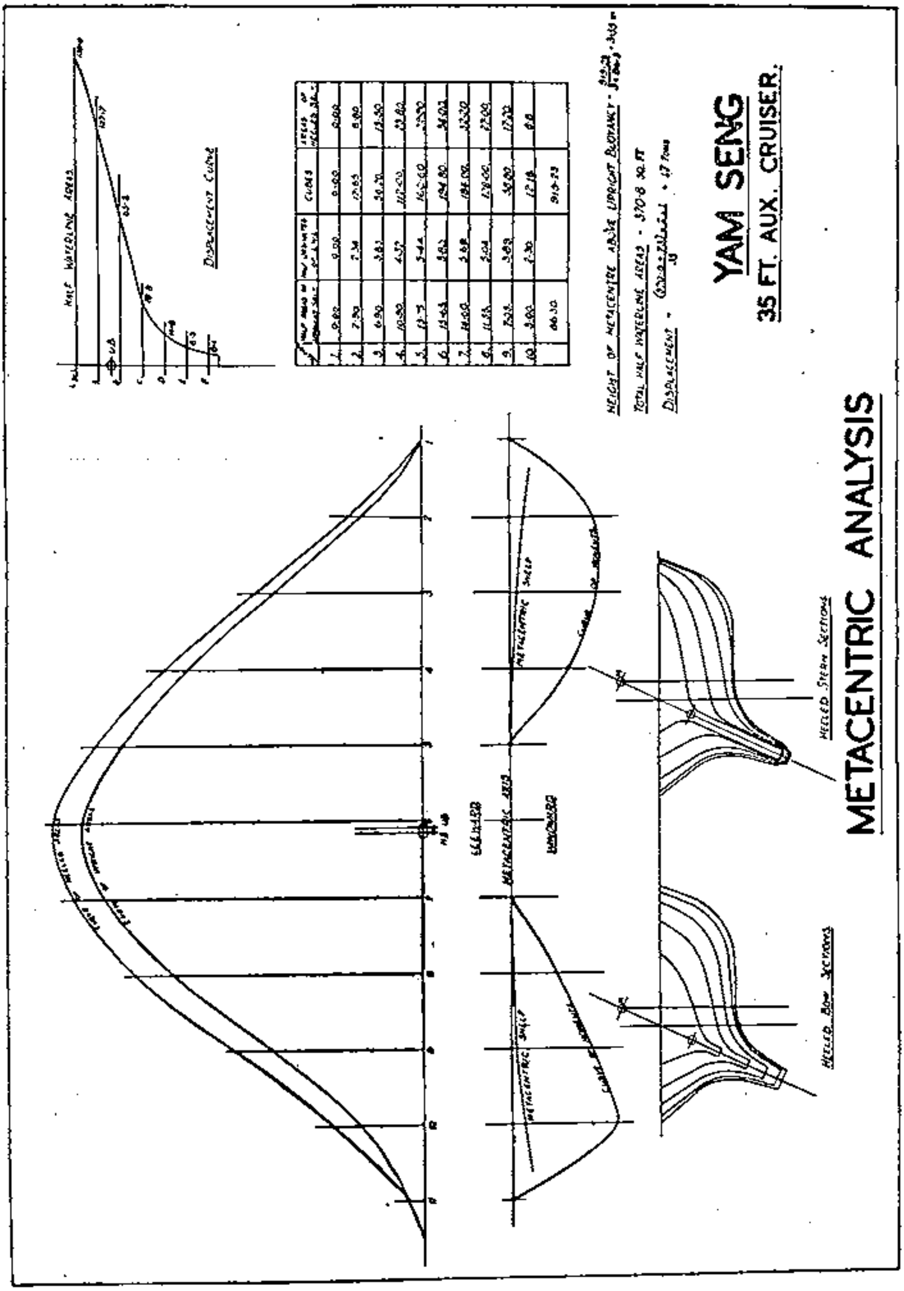

YAM SENG
35 FT. AUX. CRUISER.
METACENTRIC ANALYSIS
HEELED STERN SECTIONS
HEELED BOW SECTIONS
LEEWARD
WINDWARD
METACENTRIC SHELF
DISPLACEMENT CURVE
HALF WATERLINE AREAS

Plate 3

you will be forced to hold her to the wind constantly because of her tendency to fall away. You will appreciate that if the two centres are close together a very small sail adjustment will make a very considerable difference to steering. If she shows an inclination to come into the wind then a pinch on the foresail sheet will increase the load forward and so move the centre of sail effort forward. Similarly taking in the mainsheet will move it aft. Consequently you can set your sails and tiller to a constant wind and the ship will sail itself. We had one period of three days in the Indian Ocean, sailing to a fresh N.E. monsoon without touching sails or steering, maintaining a constant course—grand sailing!

You will also appreciate that the relation between the two centres should remain constant. If not you will spend your time adjusting your steering, or sails, or both for various angles of heel. If you have set your sails and course to a given wind the centre of sail effort is fixed and the only alteration to the relationship between the two centres must therefore come from the hull—that is by the movement of the centre of resistance. Many of you have sailed the craft that pulled like a horse when heeled; that almost stood you on your ear at every puff of wind when trying to hold it on its course. Therefore the centre of resistance should remain unaltered throughout any sailing position. That, surely, is the golden rule. To comply with it your hull must be balanced so that, as your ship heels, the displacement forward is the same as the displacement aft. The hull that is a metacentroid is such a one, and of such I have tried to make *Yam Seng* (see Plate 3). In practice she will heel 20 degrees to a wind in quiet water without altering course 1 degree. I think you will agree that it is "fair enough." If you doubt it come and try her. Where the theory does break down in practice is in an ocean going swell, and I do not know the answer to it. In a swell the weight and way of your ship causes her to dip so that she does not sail on an even keel, and I make no claims for any special performance. As I have never been ocean sailing before I can make no comparisons.

The mast as it is looks well. On paper the centre of sail effort is a few inches aft of the centre of lateral, or underwater resistance, and in practice the ship steers admirably. At times I have found steering before a strong following wind and a heavy sea very tiring and probably the position of the mast has something to do with it. Perhaps all ships are the same under similar conditions. I do not know. She was designed to run with double jibs, like Marin Marie's *Winnibelle*, but shortage of canvas and cash have so far prevented me fitting and using the second one. The old, old story—"What a ship I would have if I had the money." With my mast fixed my main beams were located. From those the bulkheads were located, since the after main beam carried the forward bulkhead of the cabin. Somewhere I lost 6 in., perhaps in thickness of materials. It didn't really matter, but it does introduce a word of warning. Long before you cut your first timber or even order it, check, re-check and check again all your paper work. Unless you do, you bid fair to either wasting a lot of material, or giving yourself a sick headache, or both later in your programme. All this preparatory work takes months and you have to fight that incessant urge to get something started, if only to have the keel laid. See that every detail—I repeat, every detail—ties up in all respects with the next. This is not one of the cases where you cross your bridge when you come to it. You simply make sure that the bridge is there ready for crossing. I, like many others, have had my bitter moments. I have always considered scarfed joints in planking a weakness. I butt jointed mine with a butt strip behind them, filling in the space between the ribs. In Eastern construction you lay your keel, set up your section moulds on it,

and plank your ship to the moulds. You leave out the garboard strake and a plank at the bilge and then timber or rib the whole boat to the inside of the planking, fastening as you go. The men had not been given details of the bulkheads, and I appeared on the slipway after an absence of several days to find the planking progressing at an excellent rate and beautifully done. The butt joints were perfect. I asked if the joints agreed with the position of the built-up timbers at the bulkheads. I can see the fall of Fong Ah Choon's face to this day. The result was that several joints had to be altered and the planks scrapped—an expensive lesson with timber 1¼ in. thick at $300 per ton. After that we fitted temporary butt strips.

Building progressed rapidly. Some days I was fortunate enough to visit the slipway daily. At other times I was only able to go once a week, usually on Sunday morning. On these mornings it was always fun. Crowds of Chinese would sit round in the quiet of the morning when all work had stopped ; sit by the hour chattering amongst themselves of the ship that was going round the world. They were very impressed with her shape and beauty, so different from their junks. What impressed me most was their honesty. Thieving and looting were rampant all over Singapore, and my boat builders left expensive timber and tools everywhere. Yet the only item I lost in the whole period was a rough timber ladder. I'm certain that even that had only been borrowed and may have floated off in the tide. As my capital outlay became larger I began to worry about the risk of loss by fire or storm. I decided to insure her against such risks but the premium asked was fantastic. I then considered the insurance for the voyage. No firm would undertake it for a premium of less than 8 per cent. As she would be worth every penny of £5,000, that meant £400. When launched my receipts for cash expenditure already totalled £2,350. Allowing £500 for the cost of the voyage I was " broke," and I came away without insurance—at my own risk.

There were the days when things went well and those when things went wrong. One such day was the day when the mast I had been given by Soon Onn was being trimmed down and we opened up a cavity running right up through the centre that completely ruined it. I tried everywhere to obtain another. When the delay threatened to stop the project altogether I went up into the Malayan jungle for a week-end and struggled through scrub and forest until I found a suitable tree. I took a picture of it and asked the forestry people to cut it out for me and arranged for it to be shipped back to Singapore. When it was cut down I received a message that it was only 55 ft. long and I wanted 58 ft. So I went to the sailmaker and had the luff of the mainsail shortened by 2 ft. When the " stick " arrived at the slipway it was 58 ft. long !

There were the days when progress was so slow that I thought my men were on a " go slow " strike. There were also days when I appeared for the first time for a week to find so much done that it seemed impossible that it could be so. I need not have worried. They worked like beavers and the quality of their work was of the best. Day by day she grew, and day by day her fame was spread abroad. Hundreds came to see her and many brought me presents of things they thought would help—one a binnacle, another a compass, a third a pair of binoculars. Whenever I was stuck people like the Singapore Harbour Board, Mr. Ackerman of Ackerman & Watt, Mr. Merton Brown and Chew Peng Yam came to my aid. When I look back I realize that to them I owe my successful voyage. I could never have bought all the things they gave me—things that were urgently needed. I had simply exhausted my funds when the time came to leave.

Then came the great day, Sunday, 26th October, 1947. Mrs. Cox, the wife

of my General, came to launch it. Charmingly and well did she do it. I stood beside her on the platform and she held the bottle in her hands and said in a loud clear voice, " I name this ship *Yam Seng*. May God bless her and all who sail in her." The bottle fell against the bow, and burst with a loud *pop*, cascading champagne everywhere. Amidst the clapping and cheers of my brother officers and friends the great little ship slid into the water. Mrs. Cox turned to me and wrung my hand. I couldn't speak. How well she understood and appreciated what a moment it was for me. We walked back on to the jetty to join the others in a champagne cocktail, and proceeded to get really merry. It was in a huge glass bowl from which we baled it out at will. It was a grand party—a fitting climax to one of the most memorable events of my life. The original planned crew was there and we had our photographs taken. One member hadn't seen the ship before. He took one look at her and said, " Not bloody likely. Twenty thousand tons for me " and went home on the *Oranje*.

In the next article I will tell you how we left Singapore much later than planned, without trials, and how we suffered in consequence.

(To be continued)

THE FRENCH CAMP AT CASTILLON

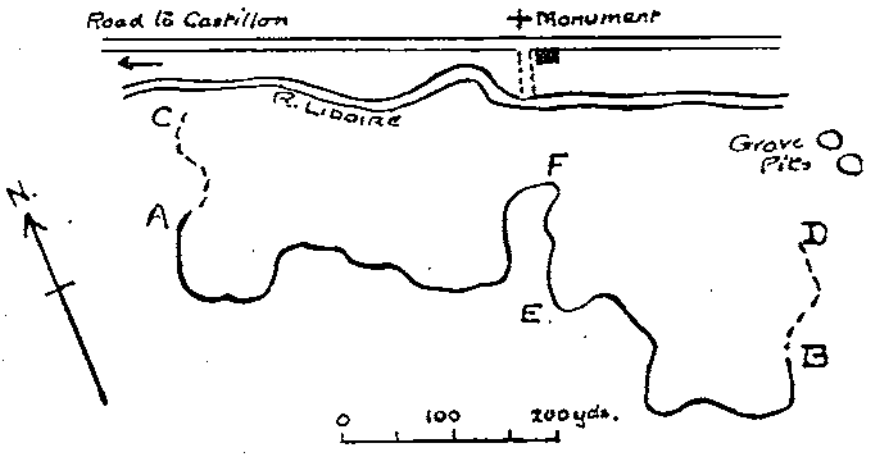
By MAJOR J. L. NICHOLSON, O.B.E., R.E.

IN his account of the Battle of Castillon, which was printed in the *R.E. Journal* of December, 1948, Colonel Burne asked for suggestions to account for the curious trace of the French camp. I have written to Colonel Burne suggesting certain explanations and this article is based on my suggestions and his comments upon them. I have also, with his permission, used certain information which was contained in the fuller account of the battle that he gave in the *R.A. Journal*.

The layout of the French camp at Castillon is an example of the application of the principles for the design of field defences which are set out in the present manuals. In selecting the site the French considered both the tactics and limitations of the weapons of those days, and the object that the camp was intended to achieve, and designed their camp accordingly.

The French army was the central one of three advancing upon Bordeaux. The English forces, commanded by Talbot, were much weaker than the combined strength of these three armies. The object of the French camp was to give a firm base from which to conduct the siege of Castillon, and into which the army could retire, if the English advanced to relieve the town. It was not intended to withstand a siege, but only to prevent the French being forced to retreat, and to defeat a sudden assault.

For these purposes the camp was very well sited. The north front was defended by the R. Lidoire, running between banks 10 ft. high. The east and west fronts were short and also partially protected by the course of the R. Lidoire on the west (the loop does not show on the plan) and by the " grave-pits " on the east. These " grave-pits " were probably either sand, clay, or gravel pits, and in existence before the battle, since the dead would have been buried either in the ditch or in mounds and not in pits. There is a burial mound known as the " Tombe de Talbot " on the battlefield.



AB. Visible Trench Line
AC, BD } Doubtful " "
E. Presumed Entrance to Camp.
F. Base of Reentrant

Artillery at the time of the battle had an effective range of about 400 to 600 yds. The camp was, therefore, sufficiently wide to enable cannon sited on the southern front to sweep the flat meadow between the Rivers Lidoire and Dordogne, interfering with the forming-up of any attacks against the south front and discouraging any attempt to march past the camp and attack the eastern front. Also the cannon were heavy and cumbersome. Once committed to defend one particular frontage, they were difficult to move. They could not be sited in depth, so that for their fire to be most effective and capable of concentration, a long front was needed. If the camp had been made square, only a quarter of the cannon of the force would have been available to defend each front, but since AC and BD were both very short and difficult to attack, all the artillery could be concentrated on the northern and southern sides. Since the River Lidoire was a very difficult obstacle, except at one ford near its junction to the Dordogne, the attackers would be forced to advance either by one bank or the other. Ample warning as to which route they had chosen could be given, and the narrowness of the camp would probably enable all the cannon to be concentrated on the threatened face in time to meet the attack.

There was, however, one serious disadvantage to the site. To the north of the River Lidoire there was some high ground within cannon range of the camp. Therefore, if the strategic situation had been different and the English had had the time to bring up cannon and settle down to a regular siege, the camp could have been made untenable.

The apparent difficulties of attacking the northern front across the river were so great that the designers must have been nearly certain that the attack would come from the south, and they therefore laid out the south front extremely carefully. In general, it is an elementary bastion trace with two bastions thrown forward to cover the curtain wall between them. The bastion at B is larger than the other, partly to narrow the gap between the rivers, but mainly to refuse the bastion at A (the one nearest to the enemy advance and therefore the probable point of attack) and so improve the enfilade fire upon it.

The southern front of each bastion is itself recessed to improve enfilade fire. Perhaps this is a little advanced for mediaeval warfare, but since the art of enfilade fire was well understood in masonry castles, why not in field defences?

The main puzzle is the re-entrant E–F. The camp was ditched and palisaded. That is known from the account of the battle. The trace of the ditch still remains, although the sectors near the river have been filled in by floods, but no trace of the parapet and palisade remains. It can be assumed that the palisade followed the ditch the whole way round the camp and also along the Lidoire front. It probably followed the ditch round the re-entrant E–F, but I believe that the mouth of the re-entrant at E was closed by a palisade as well. Therefore looking at the camp from the south on 14th July, 1453, one would have seen a continuous palisade covered by a ditch, except at the mouth of the re-entrant where there was no ditch. Somewhere in this ditchless sector, there was a gate. It looked as if this was the weakest part of the defences, and that a success here would split the camp in two.

In fact the French commander, Jean Bureau, had laid a trap. He had defended the gate from behind and not from in front. The successful attackers of the gate would find themselves caught in a narrow lane, perhaps with their storming material left on the outer palisade, fired at from both sides, and under the concentrated fire of massed batteries at F. Somewhere along the re-entrant there must have been a bridge or bridges over the ditch. It is probable that this was about halfway down rather than at F, since the cannon would be more effective firing at the flank of the attackers storming the inner gate rather than at an enemy coming straight for them.

The re-entrant had one further purpose. It enabled a powerful force of artillery to be held usefully at F, but in reserve ready to move to either flank or to establish a switch line (E–F–the bridge) should the enemy capture either the eastern or western end of the camp.

It is impossible to judge the depth or width of the ditch. Assuming that the army did all the palisading, etc., and the pioneers the digging, it might have been 10 ft. wide by 6 ft. deep, but these are probably extreme dimensions. It is probable that the defences were about equally formidable all the way round, although the east and west fronts may have been stronger so as to discourage an attack on them.

I put forward these suggestions in the hope that they may interest those who read Colonel Burne's article, and perhaps assist someone to reach the correct solution of the problem.

CHIEF ENGINEERS OF ENGLAND

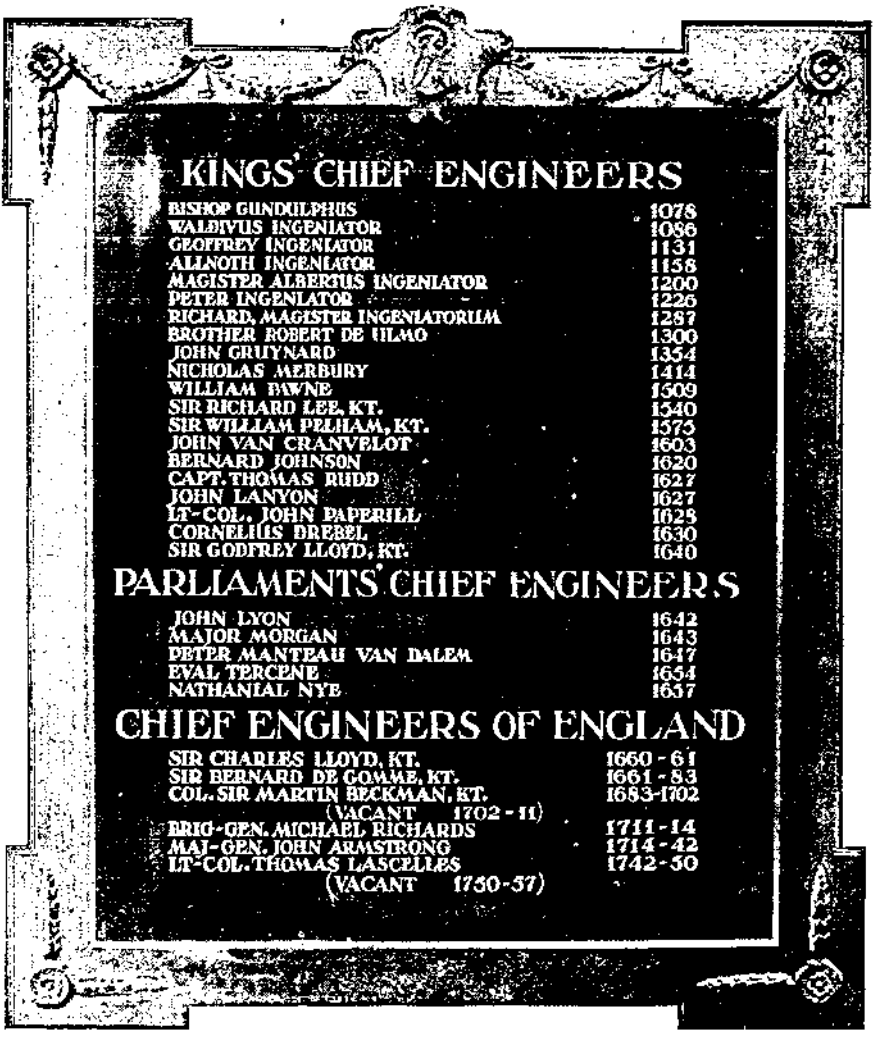
FOR many years a board with the names of the Chief Engineers of England, Inspector Generals of Fortifications, and Directors of Fortifications and Works, dating from 1627, hung in the War Office.

With the introduction of the office of Engineer-in-Chief it was decided to revise and to bring the names up to date.

A number of earlier names have been added, starting with a list of Kings' Chief Engineers, headed by Bishop Gundulphus in 1078.

These additional names, together with the names of the more recent Directors of Fortifications and Works, have necessitated having three boards. In addition, a fourth board with the names of Chief Royal Engineers and Engineers-in-Chief has also been added. All four boards are now hung in the office of the Engineer-in-Chief at the War Office.

Photographs of the four boards are reproduced herewith.



KINGS' CHIEF ENGINEERS

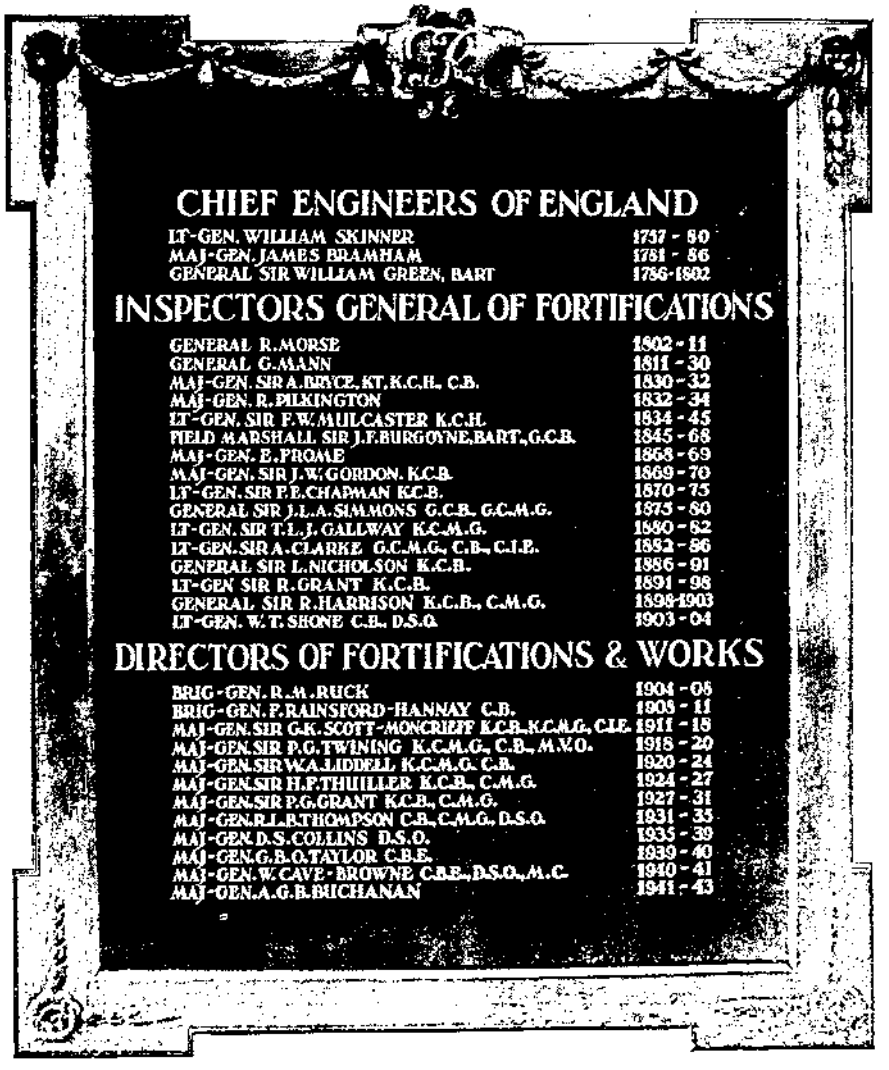
BISHOP GUNDULPHUS	1078
WALERVUS INGENIATOR	1086
GEOFFREY INGENIATOR	1131
ALLNOTH INGENIATOR	1158
MAGISTER ALBERTUS INGENIATOR	1200
PETER INGENIATOR	1226
RICHARD, MAGISTER INGENIATORUM	1287
BROTHER ROBERT DE ULMO	1300
JOHN GRUYNARD	1354
NICHOLAS MERBURY	1414
WILLIAM BAWNE	1509
SIR RICHARD LEE, KT.	1540
SIR WILLIAM PELHAM, KT.	1575
JOHN VAN CRANVELOT	1603
BERNARD JOHNSON	1620
CAPT. THOMAS RUDD	1627
JOHN LANYON	1627
LT-COL. JOHN PAPERILL	1625
CORNELIUS DREBEL	1630
SIR GODFREY LLOYD, KT.	1640

PARLIAMENTS' CHIEF ENGINEERS

JOHN LYON	1642
MAJOR MORGAN	1643
PETER MANTEAU VAN DALEM	1647
EVAL TERCENE	1654
NATHANIAL NYE	1657

CHIEF ENGINEERS OF ENGLAND

SIR CHARLES LLOYD, KT.	1660 - 61
SIR BERNARD DE GOMME, KT.	1661 - 83
COL. SIR MARTIN BECKMAN, KT.	1683-1702
(VACANT 1702 - 11)	
BRIG-GEN. MICHAEL RICHARDS	1711 - 14
MAJ-GEN. JOHN ARMSTRONG	1714 - 42
LT-COL. THOMAS LASCELLES	1742 - 50
(VACANT 1750-57)	



CHIEF ENGINEERS OF ENGLAND

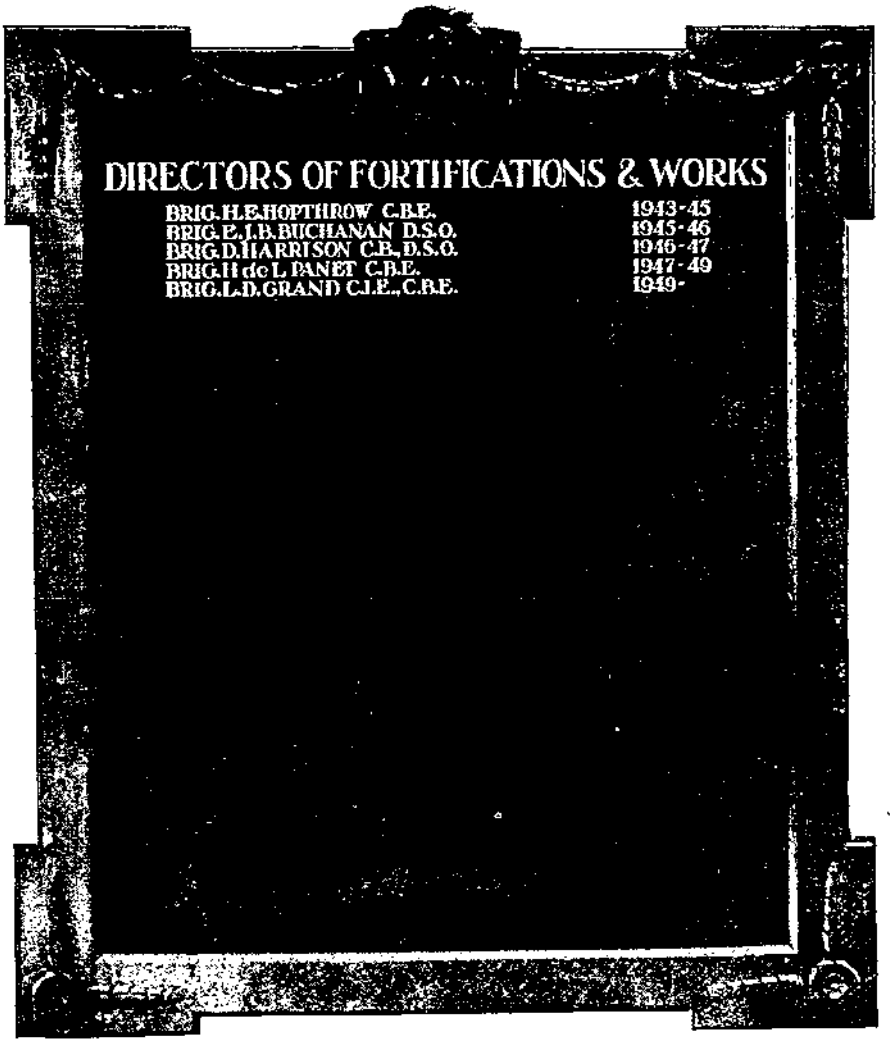
LT-GEN. WILLIAM SKINNER	1737 - 80
MAJ-GEN. JAMES BRAMHAM	1781 - 86
GENERAL SIR WILLIAM GREEN, BART	1786-1802

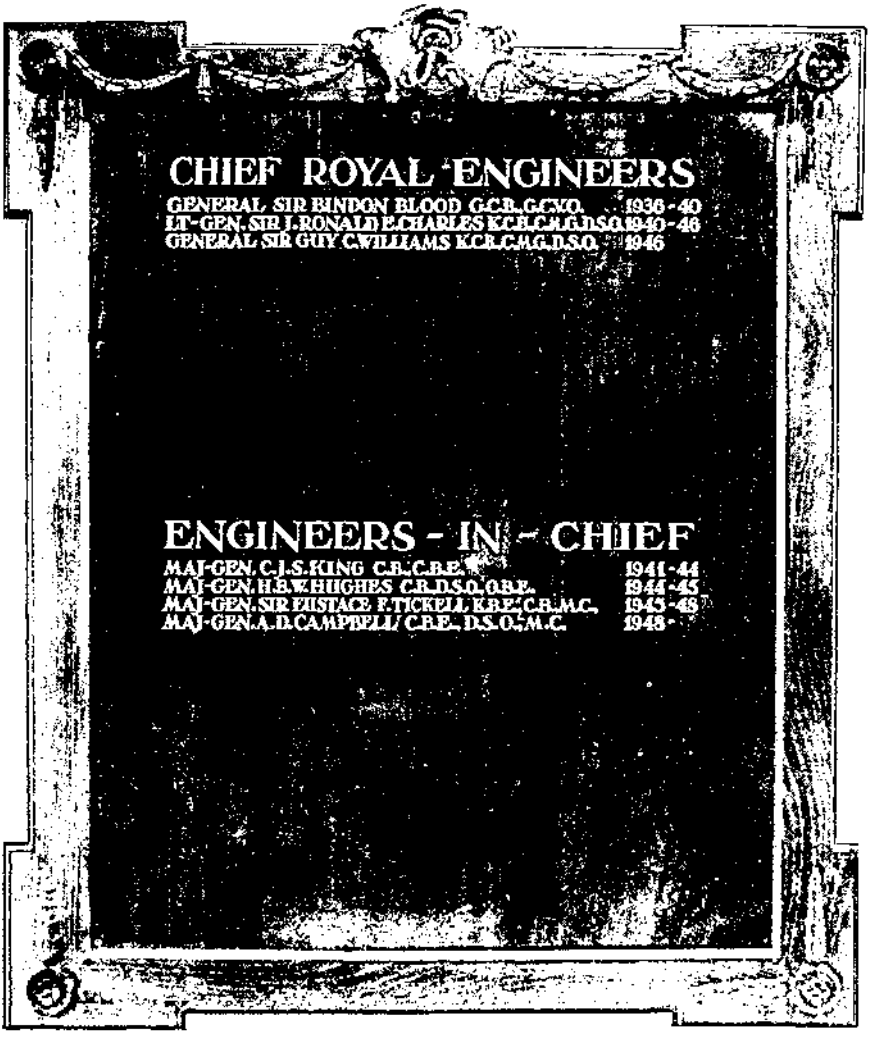
INSPECTORS GENERAL OF FORTIFICATIONS

GENERAL R. MORSE	1802 - 11
GENERAL G. MANN	1811 - 30
MAJ-GEN. SIR A. BRYCE, KT, K.C.H., C.B.	1830 - 32
MAJ-GEN. R. PILKINGTON	1832 - 34
LT-GEN. SIR F.W. MULCASTER K.C.H.	1834 - 45
FIELD MARSHALL SIR J.F. BURGOYNE, BART., G.C.B.	1845 - 68
MAJ-GEN. E. PROME	1868 - 69
MAJ-GEN. SIR J.W. GORDON, K.C.B.	1869 - 70
LT-GEN. SIR F.E. CHAPMAN K.C.B.	1870 - 75
GENERAL SIR J.L.A. SIMMONS G.C.B., G.C.M.G.	1875 - 80
LT-GEN. SIR T.L.J. GALLWAY K.C.M.G.	1880 - 82
LT-GEN. SIR A. CLARKE G.C.M.G., C.B., C.I.E.	1882 - 86
GENERAL SIR L. NICHOLSON K.C.B.	1886 - 91
LT-GEN SIR R. GRANT K.C.B.	1891 - 98
GENERAL SIR R. HARRISON K.C.B., C.M.G.	1898-1903
LT-GEN. W.T. SHONE C.B., D.S.O.	1903 - 04

DIRECTORS OF FORTIFICATIONS & WORKS

BRIG-GEN. R.M. RUCK	1904 - 06
BRIG-GEN. F. RAINSFORD-HANNAY C.B.	1906 - 11
MAJ-GEN. SIR G.K. SCOTT-MONCRIEFF K.C.B., K.C.M.G., C.I.E.	1911 - 18
MAJ-GEN. SIR P.G. TWINING K.C.M.G., C.B., M.V.O.	1918 - 20
MAJ-GEN. SIR W.A. LIDDELL K.C.M.G. C.B.	1920 - 24
MAJ-GEN. SIR H.P. THUILLER K.C.B., C.M.G.	1924 - 27
MAJ-GEN. SIR P.G. GRANT K.C.B., C.M.G.	1927 - 31
MAJ-GEN. R.L.B. THOMPSON C.B., C.M.G., D.S.O.	1931 - 35
MAJ-GEN. D.S. COLLINS D.S.O.	1935 - 39
MAJ-GEN. G.B.O. TAYLOR C.B.E.	1939 - 40
MAJ-GEN. W. CAVE-BROWNE C.B.E., D.S.O., M.C.	1940 - 41
MAJ-GEN. A.G.B. BUCHANAN	1941 - 43


DIRECTORS OF FORTIFICATIONS & WORKS
BRIG. H.E. HOPTHROW C.B.E. 1943-45
BRIG. E.J.B. BUCHANAN D.S.O. 1945-46
BRIG. D. HARRISON C.B., D.S.O. 1946-47
BRIG. H de L. PANET C.B.E. 1947-49
BRIG. L.D. GRAND C.I.E., C.B.E. 1949-


CHIEF ROYAL ENGINEERS
GENERAL SIR BINDON BLOOD G.C.B. G.C.V.O. 1936 - 40
LT-GEN. SIR J. RONALD E. CHARLES K.C.B. C.M.G. D.S.O. 1940 - 46
GENERAL SIR GUY C. WILLIAMS K.C.B. C.M.G. D.S.O. 1946
ENGINEERS - IN - CHIEF
MAJ-GEN. C. J. S. KING C.B. C.B.E. 1941 - 44
MAJ-GEN. H. B. W. HUGHES C.B. D.S.O. O.B.E. 1944 - 45
MAJ-GEN. SIR EUSTACE F. TICKELL K.B.E. C.B. M.C. 1945 - 48
MAJ-GEN. A. D. CAMPBELL C.B.E. D.S.O. M.C. 1948 -

HATHAZARI AIRFIELD SPECIFICATION

Submitted by THE E.-IN-C., IN INDIA, 1947

1. *Specification.*—The characteristics of the specification used for the runway at Hathazari were :—

(1) Formation graded and consolidated by mechanical equipment.
(2) A layer of P.B.H. (Prefabricated Bitumenized Hessian), the forerunner of P.B.S. (Prefabricated Bituminous Surfacing).
(3) A carpet of " bit-sand." (Bitumen Sand Mixture).
(4) A running surface of P.S.P. (Pierced Steel Plank).

HATHAZARI AIRFIELD

2. *History.*—One morning late in February, 1944, at H.Q. 14th Army, the Chief Engineer was asked what he could do about producing very rapidly an airfield that could be used as an Air Supply Depot during the coming monsoon. It must be near Chittagong. Thoughts first turned to the conversion of a fair-weather strip at Double Moorings on the coast as presenting least work. The idea of the specification eventually used originated while considering this proposition. This strip, however, was low and in danger of waterlogging, if not of actual flooding, under conditions of monsoon rain and high tides. A protective ditch and bund would have been necessary, and the realization of the pumping problem which this would involve led to abandonment of the idea and search for a drier site, with as little earthwork attached as possible. New ground was broken and much credit is due to the unit concerned in finding a workable site in that almost siteless country where there is little choice between swamp and hills. Moreover, the site was convenient to the railway, and we had anticipated a long road-haul as more than likely. If this site were to be used with only a waterproof type of surface, no risks could be taken with subsoil conditions. The runway was to be parallel with the foothills and just far enough off, fortunately, to avoid a flying hazard. At either end were drainage nullahs. A very deep and wide cut-off drain was first cut on the " up-hill " side and connected to the two end nullahs.

The runway, 2,000 yds., ran north and south. The runway proper and its eastern sidestrip were constructed to a cross-fall of 1 in 100 towards the east. The western strip was graded to the west. The whole had a longitudinal fall of 10 ft. from south to north. Drainage was designed to very adequate proportions.

This field was the first designed entirely on economy lines. Dispersion was not considered. A simple platform to hold one squadron of aircraft, without any more dispersion than was necessary for manœuvring, was provided and connected to either end of the runway. Very considerable parking and repair dispersals were added later, of a total area greater than the runway proper.

In the end various specifications were used for these auxiliaries, as P.B.S. became available. No one was quite sure how P.B.S. alone would behave under aircraft turning with one wheel locked, and it was considered advisable at first to be prepared to provide P.S.P. covering on standings.

The specification decided on for the runway, however, went through as originally planned.

3. *Factors.*—The factors that gave rise to this specification used were :—

(1) *Speed.*—The orders for this field, which was required as a supply dropping base for Dakota aircraft, were given in early March, 1944. It had to be " all-weather " and ready " before the monsoon," a term variously interpreted as to date, but meaning in this case before the monsoon forced the abandonment of fair-weather fields, which was normally some time in June at the latest. A runway requiring stone for its construction was out of the question ; nor could sufficient brick be produced on site in the time (brick was used on some fields in this area).

(2) *Resources*

(*a*) We had insufficient P.B.S. then coming into production but enough of its forerunner P.B.H. (Prefabricated Bitumenized Hessian) actually in Chittagong. P.B.H., unlike P.B.S., was designed only as an underlay, not as a running surface. The P.B.H. was not of first-class quality, pin-holes being common, but as it was not being used as a running surface this defect was cured by a bitumen spray.

(*b*) Adequate stocks of Bitumen of all kinds, but mostly cut-back, were available.

(*c*) There was a good loamy sand to be had from the south of the area, the presence of the loam being an advantage.

(*d*) We had Barber Greene mixers just becoming available after resurfacing the Comilla runway.

(*e*) We had stocks of Pierced Steel Plank, some in Chittagong and adequate quantities in Calcutta.

(*f*) We did *not*, however, have enough mechanical equipment, and, as this was an essential to quick work, special arrangements were approved for shipping additional plant from Calcutta in landing craft.

(*g*) C.R.E., L. of C. Airfield Engineers, was " up to the neck " and committed for some time : but owing to the situation on the Arakan front, where the call for new forward strips had fallen off, we were able to extract part of the forward Airfield Engineers to take on this new commitment.

(*h*) The Americans were interested. They spoke of sending a monster Barber Greene type mixer, but this did not materialize. They did, however, send over a bit-sand spreader and compactor and operators.

4. *Principle.*—Being forced into the situation of having to use certain availabilities in the best way possible, the specification was evolved on these principles :—

(*a*) Waterproofing the ground was essential. P.B.H., for which a speculative order had been placed in Calcutta, was untried. It could not be risked by itself as it might not prove waterproof and, in any case, a wearing surface of P.S.P. placed on it would certainly penetrate the fabric and destroy any chance of waterproofing.

(*b*) On the other hand it was not certain that a layer of bit-sand alone would remain waterproof either, as the sand available was fine for the purpose, and we had already had an anxious time with cracks developing at Comilla, where an attempt was being made to waterproof a brick runway with bit-sand.

(*c*) It was therefore decided to use a combination of the two, spraying the P.B.H. liberally with bitumen as the last line of defence, and placing a sufficient carpet of bit-sand over it to cushion the P.S.P. and prevent its edges cutting down as far as the P.B.H. At the same time the bit-sand itself would throw off the bulk of water, even if it did not remain entirely waterproof.

(*d*) As work proceeded opinions differed as to whether the P.S.P. was really necessary as a wearing surface, or whether the bit-sand would not suffice by itself.

Here again, however, risks could not be taken and it was decided to continue as planned so far as the runway at least was concerned. The runway was likely to be submitted to very heavy usage as time went on, and with all the organization of an A.S.D. established and working there, anything like heavy maintenance or repairs would cause serious delays in a vital service.

5. *General Conduct of the Work*

(i) *P.S.P.* The handling of this material presented considerable difficulties both from the point of view of weight and of its heat during the middle of the day. It was stressed that, if this material were to be used, proper unloading arrangements from railway wagons, i.e., cranes, must be arranged beforehand.

(ii) *Layout of Plant for Works.* The bit-sand was prepared with the aid of Barber-Greene drivers and mixers. These were set up on the east fair-weather strip, with a battery of bitumen boilers in close proximity. Experience proved this to be bad siting, as on completion of the laying of the bit-sand considerable delay was caused in clearing away plant and materials. The machinery should be set up, if possible, near the source of the sand or other aggregate, so that this aggregate can be served to the machine direct, leaving a lorry haul for the finished product only.

(iii) *Description of Work.* The whole of the preparation of the sub-grade was carried out by mechanical equipment. One of the first jobs performed was the cutting of side drains on either side of the 150 yds. wide airstrip, with a berm at the edge of these drains, which had to be removed later by hand. This proved to have been a mistake, from the point of view of operation, as it made it impossible for machinery to grade out fair-weather strips completely on either side. It was, however, necessary to construct the drain on the uphill side before the rest of the work was started in order to prevent flooding of the site by possible early heavy rain.

The question of attaining adequate water for compaction caused considerable worry, and it was decided to dam the nullah at the south end and force the water into one of the side drains, from whence it could be pumped on to the strip. Pumps however, were not available, but fortunately rain fell at intervals in adequate quantities to make this unnecessary. As soon as a sufficient length of the central portion of the strip had been compacted, laying of P.B.H., working north and south from the centre line, was commenced. This was immediately followed by the laying of the bit-sand premix, and this again by

the laying of P.S.P. All these operations were worked from the centre line in both directions north and south. Experiments were made in laying P.S.P. on the sand/bitumen in a compacted and uncompacted state, and it was found that the best result was obtained on the compacted premix, as P.S.P. tended to cut too far through the uncompacted premix, cutting out discs of the premix, which flaked under wear.

(iv) *Various Points.* It is essential in this type of job to have a good team of surveyors. As these were not available in the units carrying out the work, use was made of the Survey of India Survey Party which was attached. In the operation of special machinery, it is essential that properly trained personnel be available. This was not the case at Hathazari, and use had to be made of personnel of Mechanical Equipment Coy, working on the site. This improvisation resulted in innumerable breakdowns.

6. *Conclusions*

The runway as such was successful and the main reasons for this are considered to be :—

(*a*) The special drainage measures taken.
(*b*) Proper formation making and consolidation with mechanical equipment.
(*c*) The " safety-first " principle adhered to in waterproofing by employing two separate methods in conjunction.

THE COMMONWEALTH AT WAR

By MAJOR-GENERAL A. C. DUFF, C.B., O.B.E., M.C.

THE idea of the British Commonwealth at war, as opposed to the idea of Great Britain at war, is of recent growth. Less than fifty years ago the South African War was Britain's war, and it was a matter for congratulation, and possibly for surprise, that Colonial volunteers, formed into units of their own, should arrive to fight beside the British troops engaged. Their help was appreciated, for men who could shoot and ride were not too common. Though their numbers were small a valuable precedent was established and in 1914, when Great Britain's need of help was more obvious and more urgent, the Dominions found it natural that their armed forces should be used for the benefit of the Commonwealth as a whole.

April 25th, 1915, was a red-letter day in the development of the Dominion Armies, for that was Anzac Day. To the younger generation of Englishmen the name Anzac and its interpretation—Australia and New Zealand Army Corps—mean little or nothing ; to those of us who watched the shells bursting on the top of those brown and yellow cliffs, and in the blue sea at their foot, they still mean much. The landing in Anzac Cove was the first major operation executed entirely by Dominion troops, and it was an earnest of bigger things to come. Only thirty years later, in 1945, Field-Marshal Montgomery's Army Group fighting its way into Germany consisted of two Armies ; one was British, the other Canadian.

Perhaps it is partly the novelty of their military achievements which explains the pride and affection with which the Dominions regard their contingents ; perhaps it is partly due to the relatively small numbers of their populations and of the contingents which they can provide. There was little of this feeling in England during the second World War, though in Scotland it was more in evidence—probably for the same reasons. England took its army very much for granted, in war as well as in peace. A county might take some interest in the battalions of the County Regiment—if there was one ; certain formations might attract and hold public attention by their exploits—if the censor allowed them to be mentioned ; but the only strong feeling was personal and concerned individuals, not the Army as a whole. It was otherwise in the Dominions. To judge by the two contingents with which I happened to have most contact during the war—the New Zealanders and the South Africans—nothing which their homelands could do for them was left undone. Money, food, clothing, comforts, flowed in an unending stream, a stream which had its sources in passionate interest and intense goodwill. It was an illuminating experience to be in Pretoria in the autumn of 1941, when the battle in the Western Desert was swaying to and fro round Tobruk and the South African Divisions were heavily engaged ; all conversation was dominated by the latest news of them. Troops serving outside their own country cannot but be fortified by the awareness of how closely their fortunes are followed in their homeland.

The picture has faded of Great Britain waging a war and hoping for some help from the Dominions. The new picture is of the Commonwealth waging a war, although possibly some of the newer Dominions might hold themselves aloof. This unity brings with it not only a substantial accretion in manpower but also a wider and firmer foundation for strategy. It might well happen in a future war that one of the Dominions would be the primary combatant, supported by the rest of the Commonwealth ; it is imaginable that such a war might be continued and successfully concluded even though Great Britain herself had in its early stages been compelled to surrender and drop out of the fight. This new foundation for the strategy of the Commonwealth comes at a time when our strategic policy is undergoing a transformation in the light of the developments of warfare and of new political alignments. The *motif* of British strategy for the last century and more has been the security of India and the road to India, and since the construction of the Suez Canal the main road to India has been through the Mediterranean. During the first World War we managed—just managed—to keep this road open for our merchant shipping. During the second World War we failed to do so ; after June 1940, when Italy entered the war against us, our merchant shipping was debarred from using the Mediterranean route to the East and had to travel round the Cape, a journey involving a formidable increase in the mileage to be covered and only possible because we had the use of Freetown in West Africa and of the South African and East African ports. The lesson was that the Mediterranean route could only be used in war-time by the shipping of a power which controlled both shores, north and south, and not only one of them ; and if this was true in 1940 the trend of armaments since then has reinforced that conclusion.

Although the strategic importance of India has decreased, the importance of communications between Great Britain and the four old-established Dominions—Canada, Australia, New Zealand, and South Africa—is greater than it has ever been before. Now that the narrow seas have become too dangerous it is on the ocean routes that we have to rely, and this is where we are well served. To the west, once the Irish coast is passed, the ocean routes

are clear and short. It is the ocean route to the east which is flanked by a coast line of some 6,000 miles as far as Capetown. This must be the sea route in war-time from Great Britain to South Africa, India, Singapore, Australia and New Zealand, and this explains why the continent of Africa is now the foundation-stone of the Commonwealth's strategy.

Africa's first contribution to the Commonwealth's strategy lies in the simple fact of her geographical location, but she has a more active contribution to make in the form of manpower. Her only source of white manpower is in the Union itself, and though its quality is magnificent its quantity is very small. But throughout the British Colonies in tropical and sub-tropical Africa—East, Central and West—there is the indigenous population, racially Bantu with here and there a strain of Arab or Fulani, loyal, warlike, and recruitable. This is the kind of manpower which the Commonwealth needs in war-time, for her limited white manpower, in Great Britain and in the Dominions, has to meet, as the first charge upon it, the claims of the industrial effort without which the armed forces cannot be maintained. In the African Territories basic industries, other than agriculture, hardly exist, and secondary industries are still rudimentary ; so not only is the fighting material already there, in the right place, but it is not extensively earmarked for other purposes. It is nothing new that Africans should be recruited into the British Army—the Royal West African Frontier Force and the King's African Rifles have figured in the Army List for fifty years. What is new is the scale on which this recruitment has been carried out, and, newer still, the immensely increased scope of the duties which can be entrusted to Africans. As these two distinguished regiments have provided the framework of war-time expansion in the past and would provide the framework of any future expansion in war or in peace, it is worth while recapitulating something of their origin and their history.

The creation of the African Colonial Forces will always be associated with the name of the late Lord Lugard—or Captain Lugard as he then was. In the early days, when the partition of Africa was nearing completion, their *raison d'être* was clear as crystal. Many of the African tribes—in particular the great Emirates of Northern Nigeria—had substantial armed forces of their own, and when it fell to British Administrative Officers to impose law and order they had to have behind them a backing more powerful than native police ; the task required formed and disciplined units equipped with automatic weapons and artillery. Thus the African Colonial Forces came into being. The officers and senior N.C.Os. were British, seconded from their regiments ; the rank and file were African, recruited from the local warlike tribes. British and Africans alike were volunteers and were picked men. Service with the African Colonial Forces offered many attractions to junior British officers ; a good chance of seeing some active service, big-game shooting, generous pay and leave, rapid promotion for the able, and responsibilities beyond the dreams of Aldershot. The only weight in the opposite scale was the climate ; malaria was certain to come sooner or later, and the killing diseases, from blackwater to snakebite, were never far away ; but those were risks well worth taking for a period of a few years. As to the Africans, to serve in the ranks was a privilege and there were a score of volunteers for every vacancy. Inter-tribal warfare was common and gave the young men opportunities to distinguish themselves ; they were only too willing to fight under the British and obtain the advantages of pay and uniform and superior weapons. The typical African soldier not only enjoys fighting but also enjoys the pomp and circumstance of army life. Drill and guard-mounting to him are recreations something akin to his own ceremonial dances, and he calls

the parade-ground " warrin rawa "—the place of dancing. Mutual confidence and liking sprang up quickly between officers and men, and before the coming of the first World War the units of the African Colonial Forces had built up their traditions and proved their fighting qualities in innumerable little expeditions to which their black and yellow medal ribbons still bear witness.

Until the first World War they had been employed only on internal security duties ; 1914 brought a change in their rôle. In West Africa and East Africa, African troops under British command fought campaigns against African troops under German command, and had to absorb the startling proposition that a white man was not necessarily a superior being to be obeyed but might well be an enemy to be destroyed. In 1918, after the campaigns in Africa had ended with the surrender of Von Lettow, plans were made to bring a contingent of African troops to fight in Europe, but the Armistice nipped this proposal in the bud. Between the two World Wars the African Colonial Forces occupied a somewhat ambiguous position. As far as internal security was concerned the need for troops had greatly decreased as the African Territories had been brought under close administration and armed police could compete with any trouble likely to arise. Their secondary function, defence against external aggression, seemed to have disappeared once German authority had been eliminated in the African Continent. Their upkeep was expensive, and the various Colonial Governments showed little enthusiasm for providing the considerable sums of money required. It was the approaching shadow of the second World War which brought the African Colonial Forces into prominence again and possibly saved them from extinction.

They played a notable part in the second World War. During the autumn of 1940 there were concentrated in Kenya two African Divisions—composed of the K.A.R., the Northern Rhodesia Regiment, and the R.W.A.F.F. brought round by sea from West Africa—and one white division from the Union of South Africa. These three divisions fought the campaign which began in Italian Somaliland and culminated two months later in the capture of Addis Ababa and the complete destruction of the Italian Army. Then followed, for the first time, the employment on a large scale of African troops outside Africa. Three African Divisions took part in the war in Burma. To raise and maintain these large formations entailed recruiting to an extent never before contemplated, and there was difficulty in obtaining the numbers needed. It must be remembered that the physical standard of the African is very low ; his diet is never a balanced one and he falls an easy victim to the many endemic tropical diseases—malaria, bilharzia hook worm. The percentage of men rejected as unfit for military service is much higher than in any civilized community and this state of affairs can only right itself with painful slowness as the rudimentary principles of hygiene become more generally known and observed. Yet in spite of this weakness the recruiting potential of the African Territories is very great.

Coupled with the use of African troops in unprecedented numbers was their employment on duties which had been supposed beyond their powers. The adult African male, living in his native village, had only two active occupations—farming and fighting. The farming he left mostly to his women ; the fighting he did himself. It was generally believed by Europeans that his way of life and his illiteracy rendered him incapable of working as a tradesman or an artisan ; and there was no compelling reason for him to make the attempt, for work of that kind was only required in alien communities such as the townships, and in the townships such work was the prerogative of

Indian or Arab elements who were naturally disinclined to encourage competition from Africans. The war brought a sudden change. If the African Divisions were to have the artisan troops they needed—even for such simple tasks as lorry-driving—they had to be Africans: there was no other source of supply. The Army instituted or developed trades training schools, with astonishing results. There emerged a stream of drivers, fitters, carpenters, blacksmiths, signallers, wireless operators and general mechanics. Admittedly their skill, judged by European standards, was mediocre, but judged by accepted African standards it was a nine days' wonder. Thus the Army was enabled to fill the ranks of its technical and semi-technical units, and the only call on white manpower was for the supervisory grades.

In any future World War the Commonwealth will not be in a position to neglect such a handsome contribution to its resources as can be made by the manpower of Africa. War-time expansion will have to be planned in peace, and the material things required to make it possible will have to be held in readiness, preferably in Africa itself. Looking at the problem of organization, the framework—a good sound framework—is provided by the African Colonial Forces as they are today; but it is in my opinion imperative that they remain a War Office responsibility, as they are now, and should not revert to the pre-war system of control by the Colonial Office. The Colonial Office machinery is not designed to organize, train or administer an army. In the interval between the two World Wars training at the lower levels of the African Colonial Forces—platoons and companies—was excellent; higher training—battalion and brigade—was weak; and organization for war, even as late as 1936, was virtually non-existent. On the administrative side the Colonial Office system was efficient, though slow-moving, and it did provide an education for many British officers in how to get value for money. The cost of the Nigeria Regiment—in which I had the honour to serve for four years—was then running at about £200,000 a year, the whole of it found by the Government of Nigeria, and all expenses, direct and indirect, of maintaining the regiment had to be covered by this sum. Say that one year we were told by the Government that they must reduce our allotment by £20,000. What cuts were we to make? Should we sacrifice one British officer per company, saving his pay, allowances, passage-money, and contribution to pension? Or so many African ranks per company, saving their pay, food and uniform? Or should we disband one company complete? Or forego for a year the Artillery Practice Camp, saving the cost of so many rounds of ammunition and of hiring transport there and back? Or refrain for a year from adding to our small war reserves any machine guns or mortars? This was realistic training in the use of money—in England not one officer in a hundred knows the cost of weapons, and the hundredth only knows because he has lost one and been made to pay for it—but the system was inherently vicious. It split up the African Colonial Forces into penny packets, and the numbers, equipment and training of each particular packet depended upon the prosperity of that particular Colony and the goodwill of its Government. Such a system prohibited uniformity and standardization, and left the African Colonial Forces at the mercy of fluctuations in the world prices of local produce and their effect on Government revenues. One cannot expect efficiency on that basis. It is no doubt right and reasonable that the Colonial Governments should contribute largely to the cost, but their contributions should be pooled and centrally controlled.

I have written at some length about the African Colonial Forces but they are by no means the only coloured components of the armed forces of the Commonwealth. There is the Indian Army—now the Armies of India and of

Pakistan ; the Malay Regiment ; the Hong-Kong and Singapore Artillery ; and many other local levies. The African Colonial Forces, however, differ from all those in that they are located in Africa, the focus of the Commonwealth's strategy; and in Africa there are further reserves of coloured manpower, both in the High Commission Territories and in the Union itself. It is in the Union alone that strategic policy runs against political obstacles.

The High Commission Territories were extensively recruited during the war to provide units of the Pioneer Corps for service overseas, but in the Union the recruiting of coloured men was severely limited ; they were enlisted for non-combatant duties only and were not allowed under any circumstances to bear arms. The very idea of " native " troops is still anathema to the white South African. He remembers the struggles of the early settlers against an armed, hostile, and formidable indigenous population, and he dreads the political results of doing anything which might impair the dominance of the European. Englishmen do not suffer from the same inhibitions ; they do not have the same political problem on their doorstep, and 200 years of experience in India have accustomed them to making use of coloured troops and to fighting against coloured troops. But in South Africa the antipathy is still strong and bitter, and the Union Government expects—not unreasonably—that its views shall be considered and respected in any question of policy affecting Africa as a whole. There is no need to be pessimistic as to the outcome. The difficulty is of such a nature that it may be expected gradually to resolve itself ; but at present it does exist and it is no use blinking the fact. Much the same problem arises in the United States, only there the military aspect of it is less acute ; negro formations fought in the American Army during the last war and negro officers rose to the rank of General. It is interesting to observe how the same fundamental problem takes such entirely different shapes in different parts of the world. In New Zealand the Maoris are accepted as a matter of course as an integral part of the Dominion's population and of her armed forces.

What practical steps require to be taken in order to ensure that full use is made in war-time of the Commonwealth's resources in Africa and elsewhere ? The more important of them will be assured if the War Office retains responsibility and does not farm it out to other Government departments. There is, I think, one other essential development ; the British Army must learn to regard itself as a component part of the armed forces of the Commonwealth and not allow its horizon to be bounded by the garrison towns of Great Britain and the " defended ports " overseas. The ideal is that a British officer, ordered in peace or war to one of the Dominions or one of the Colonies, should not feel that he is going as a stranger to a strange land, but that he is only leaving his town house on a visit to the country house of one of his friends—a house with which he is already familiar. Before that ideal is realized much water will have to flow down the Niger and the Zambesi.

THE ORDNANCE SURVEY IN THE NEAR EAST

By Lieut.-Colonel H. E. M. Newman, R.E.

Part II.—SINAI (1868–9)

CAPTAIN H. T. BUTLER had been several times exploring in the Sinai Peninsula before he was killed at Inkerman, and on the last occasion, in 1853, had been accompanied by his brother, the Rev. Pierce Butler. In 1867, this gentleman lived at Ulcombe Rectory, Staplehurst, Kent, the while Captain H. S. Palmer, R.E., nephew of Colonel Sir Henry James, Director General of the Ordnance Survey, was commanding the Survey Division at Tonbridge. The clergyman fired Palmer with his enthusiasm, so that on 23rd June of that year he initiated, in an application to his uncle, the Sinai activities of the next few years. The original proposals were modest. Three months' leave with an assurance of retaining his present job were all that Palmer required, with permission to go in command of one or two N.C.Os. He would be accompanied by Butler, who was an Arabic scholar, the Rev. F. W. Holland, a young curate, one of the honorary secretaries of the Palestine Exploration Fund, who had visited Sinai thrice previously, and perhaps one other. The region to be surveyed lay four days' journey from Suez, extended over an area about forty miles by sixty, and included the several mountains over which disputants argued as to which was the authentic Sinai of Mosaic Law, and the several routes by which the Children of Israel might have reached it during their flight from Egypt. No more than a few astronomically determined points for the accurate laying down of the great wadies on the 1-in. to a mile scale were suggested as a beginning, which would be sufficient to awaken public interest into subscribing later for more extensive and elaborate explorations over the whole peninsula, eventually to reach north-eastwards and merge with the work of the Palestine Exploration Fund. Sinaitic maps hitherto were only sketchy or non-existent and provided no solid data on which the different schools of thought could wrangle to a definite conclusion. Each party argued from isolated premises. Their collation was essential. From 1st February to 1st May would give them ten weeks in the district, the best season for work and long enough for their purpose. Butler being " very highly connected," and possessing " some influence with the present government, Mr. Corry being his first cousin," would have no difficulty in raising the funds.

The Director General agreed to all this. The £600 which he estimated the survey would cost rather astonished Mr. Butler, but he was " not at all staggered by it " and proceeded forthwith in the intervals between periods of illness to the collection of the money required. The Royal Geographical Society had been badly treated by the Palestine Exploration Fund and were consequently loath to recognize this new venture, but their verbal approval was finally won, as was that of the Royal Society, and these made important points for inclusion in the circular which was issued to the public late in November. Sir Roderick Murchison, Sir John Herschel and Sir Henry James were appointed joint trustees, and, as in the case of the Jerusalem survey, it was required that the money should be lodged at Cox's Bank to the credit of the Executive Officer, Colonel Cameron's private account.

Expectations were not fulfilled. Less than £400 had been promised by the end of December, and the project was postponed till the next season. Plans

were then made for Butler to make a preliminary trip to Egypt between 12th February and Easter, 1868, at his own expense, with a view amongst other things to obtaining facilities from the Egyptian Government and establishing friendly relations with the P. & O. agent at Suez, through whom it was hoped provisions for the party at discount rates might be obtained; but Butler was taken seriously ill on the 5th February and on the 6th he died.

His friends agreed that the most fitting tribute to his memory lay in the prosecution of his scheme to a successful issue, but it was largely left to Palmer and the Director General to arrange for his successor. The latter considered Holland, with his first-hand experience of the country, to be a suitable man, but Palmer pointed out that he was a young curate as yet unknown, and that the Palestine Exploration Fund would have fair reason to complain if one of their honorary secretaries should direct his efforts to collecting public money for Sinai. "Unless some clergyman of eminence, who is in a position to deal with the public on Biblical grounds in asking for money becomes the acknowledged promoter and head of the project (you being the Director of the scientific part of the work) we shall fail for want of funds." The Rev. George Williams, a Fellow of King's College, Cambridge, and a friend of Butler's, who bore these qualifications, volunteered to fill the position. A compromise was struck in that Williams undertook the home, and Holland the foreign share of Butler's part of the enterprise. Palmer in consultation with Holland, who had agreed to accompany the expedition for at least the first month of the work, prepared a fresh list of necessities, including his own pay which he "set . . . at 20s. per diem as you seemed to think I had gone a little under the mark before," amounting to a total of £1,220 for what had now increased to a six months' trip, and on this basis a new circular was prepared and broadcast amongst the learned societies and wealthy public.

It was hoped in June that the Government of India would contribute to the scheme in the shape of a quantity of tents, tools and provisions (including 42 gallons of rum at 3d. a gallon); reserve supplies from the Abyssinian campaign which were being shipped back to Suez and sold at nominal prices. But they declined to do anything but sell, and the Director General would not incur any such expenditure while the amassing of the total fund remained in doubt.

In July, Mr. E. H. Palmer, a Fellow of St. John's, later professor, was introduced by Williams to the survey as a great Arabic scholar "well qualified to be of service to the expedition both as interpreter and chronicler and as a collector of information out of reach of all who are not such masters of the vernacular of the country as he is." He fully justified his place and inspired such an admiration for his abilities and intellect amongst the party that they christened him "The Pundit," and to avoid confusion in names he will be referred to as such during the remainder of this account. He agreed to go if his expenses were paid, further remuneration to be dependent upon the amount of the subscriptions and the possibility of the University contributing to the fund. This contribution (from Wort's "Travelling Bachelor's Fund") was so counted upon and talked of that the University took umbrage and only voted £200 instead of the £400 expected, and this very late, a month or two after the party had embarked. It was voted to Palmer (The Pundit), by name and the Vice Chancellor declined to pay it into Cox & Co., without explicit directions from him. Even so, it was expressly stipulated that the grant was in support of his researches in particular and not the survey in general.

In that same month of July came an application from Captain C. W. Wilson, R.E., who had commanded the Jerusalem survey party. He was most anxious to go to Sinai. "You would find it a great economy and help to the survey in all ways to send out two officers; in a place where there is so

much of interest, inscriptions, old convents, Eziongeber and other places to look for and observe, besides the surveying, you will find it almost too much for one officer on whose constant good health will greatly depend the success of the expedition." He would go without pay, as during the Jerusalem survey, and undertook to obtain subscriptions from acquaintances to the amount of £200. He and Palmer were great friends and had served together on the American Boundary Commission. Unfortunately Wilson stood a few places higher on the seniority list, so that Palmer who had borne the burden and heat of the day might have been supplanted for the more spectacular climax, nor could Palmer afford to waive his pay, so that an invidious financial distinction was raised as well. However, he saw the desirability of the strengthening the party would receive were Wilson to join it, and a bargain was made in that " all reports and letters, and generally the entire fruits of the expedition should bear our joint signatures," and that both officers should be paid in the event of funds sufficing.

Whereupon formal application was made to the War Office to sanction the employment of officers and men, and to the Pasha or Viceroy of Egypt in Cairo, although as Sir Henry James remarked, " This is more a matter of etiquette than a necessity, as anyone can visit the Peninsula of Sinai without interruption of any kind," which in these days of frontiers and passports extending to the remotest corners of the globe is a pleasing thought. The War Office could not have been slow in realizing the importance of topographical knowledge of a region abutting so nearly on our new trade route to the east, and their approval was granted, subject to the party going without pay, and merely with leave to travel. Subsequently approval was extracted for the charging of their regimental pay to the public. It was learned of the Pasha that he " cares little or nothing about the Peninsula of Sinai : he has no money to spare, but if he thought that a survey of the country would bring him any credit, and establish his fame among European nations he would very probably take the matter up. With judicious 'buttering' he might no doubt be induced to find money for a survey of the whole Peninsula, but the credit must go to him. He seems to take too little interest in his country to aid in promoting the survey for its own sake." This advice was taken, but with no success beyond permission to proceed with the work.

Although Jerusalem provided the inspiration for this second survey many points of difference will be noticed. One is this question of money. In the case of Jerusalem, although the subscription was nominally public, one individual and a few scientific societies supplied the funds. The sailing of the party was then threatened, not through lack of funds, but their disputed location and control. Now the appeal was in truth a public one, and it was lack of response and the tardy fulfilment of promises that all but prevented embarkation. In the end, about a week before departure, the estimated total, by this time about £1,870, being approached to within £300 by payments and promises, Sir Henry took " with some others the risk of losing several hundred pounds as guarantees." Furthermore, as late as the end of January, 1869, when it was realized that unsuspected contingencies and conditions would still further largely augment the estimated cost and Sir Henry provoked an unnecessary quarrel on quite mistaken grounds with Grove, the Secretary to the P.E.F., by accusing him of appropriating money for Palestine subscribed through him for Sinai, he writes " we have not sufficient funds to pay the cost of the Sinai survey, unless I and others connected with the survey (Mr. Holland and Captain Wilson) pay for it ourselves."

In the preface to Part I of the Survey, subsequently published, he wrote, " having examined the state of the fund in the autumn of 1868, and also

having received a kind assurance from Miss (now Baroness) Burdett Coutts that she would not let the project fail for want of money, I felt that we might proceed to organize and equip the party for the survey without fear of breaking down." This lady had been the original sole provider for the Jerusalem survey, and importunate siege was naturally laid to her bounty on this second occasion, to which the promise referred to above and given in a letter dated 28th October, 1868, was the gratifying outcome. Introducing his list of presentation copies of the Survey for approval in 1872, the Director General writes "In this list I have included the Baroness Burdett Coutts who guaranteed to pay any sum required to complete the work and to whom I actually returned £300 not required." Even supposing secrecy to have been imposed as a condition to this backing, as the obvious ignorance of it displayed in letters from the party in Sinai would imply, the Director General's previous pretence of his own liability is curious. The total fund finally amounted to £2,338 of which the Baroness's share was £275, the largest single subscription.

Another difference between the two surveys was the size of the party and the extent of the expert knowledge brought to bear on the problems. To those already named was added a zoologist willing to go out at his own expense, introduced on 5th October by Holland. He was Claude W. Wyatt, later described as a quiet nice fellow, but a little lacking in energy and enthusiasm for ardent work in the field.

A third difference was the undisguised Biblical and archaeological objective.

Expectations were entertained of a possible free passage to Alexandria through the good offices of Mr. Corry, who was the late Rev. Butler's cousin. This was not granted, any more than was at first the desired concession by the P. & O. Company for the party to deal with their provision depot at Suez. The privilege was said to have been withdrawn from local employees and residents on the establishment there of European retail stores. Wilson later found these stores quite inadequate for the provisioning of an expedition and the P. & O. were induced to accede to a supplementary request. Similar passage concessions were given by the P. & O. as had previously been accorded to the Jerusalem party, that is to say, £10 third and £20 first class for the single journey. One marquee and three bell tents were purchased from the War Office and sold after their return home to the Ordnance Survey at two-thirds cost price for use in Scotland. Specially procured instruments included a nautical azimuth compass from the Admiralty, barometers and thermometers for height determination, and three small 4-in. prismatic compasses from Messrs. Elliott for traverses, of which the cards were found to turn up and split in the severe climate they encountered, so that metal and vulcanite ones were sent for urgently in replacement.

The following were the N.C.Os. who completed the party:—Colour Sergeant (later Sergeant-Major) McDonald, R.E., who had previously been employed in Jerusalem, skilled in both survey and photography; 2nd Corporal (later Corporal) Goodwin, surveyor, artist, and modeller; Corporal (later Sergeant) Brigley and Lance-Corporal (later 2nd Corporal) Malings, both proficient at surveying and hill sketching. And the party embarked on 24th October, 1868, in *S.S. Ripon*.

Several officers and clergymen during the next month or two begged permission to join the party in any capacity whatsoever. The Rev. Williams went so far as to propose two sappers to accompany three amateurs for the exploration ("we don't want so accurate or minute a survey as of Sinai") of the Wilderness of the Wanderings that is to say, Tih, which lies to the north of the Sinai mountains, provoking the Director General to retort: "We have plenty of such reconnaissances as you propose . . . unfortunately

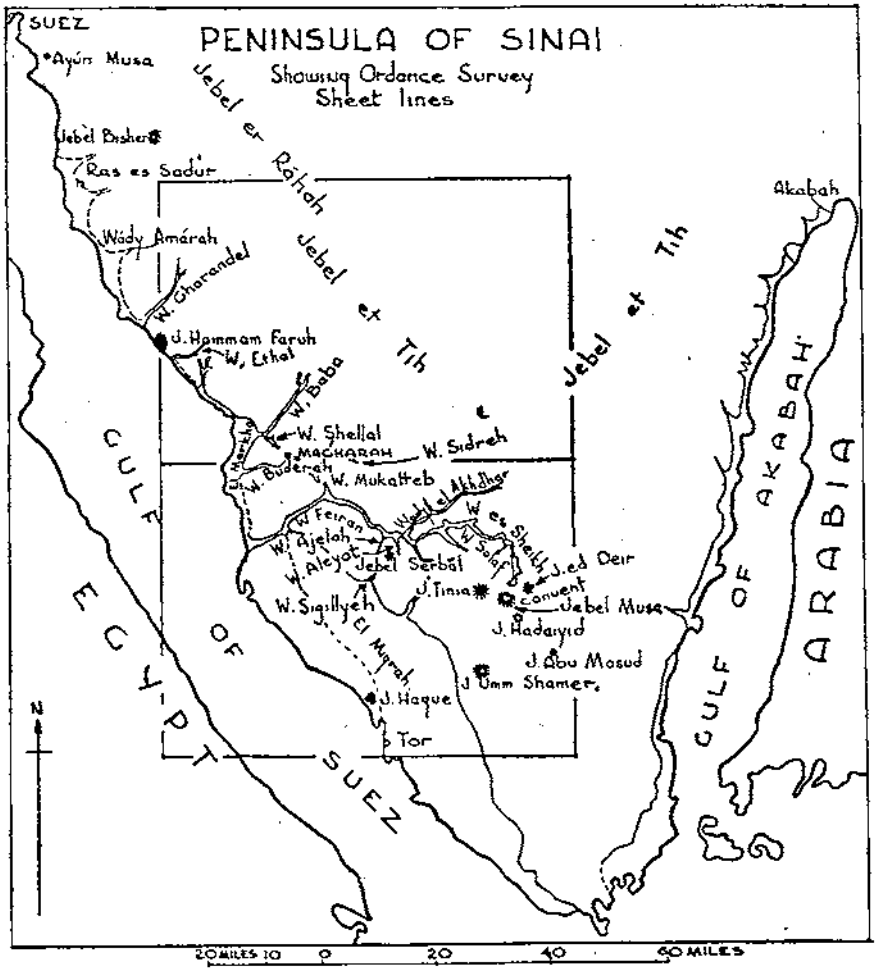
these reconnaissances have been made by men without sufficient scientific knowledge or historical information for the work . . . and I do not wish to have anything to do with the work of the several volunteers who have offered to go out."

Here is a précis of the party's instructions :—

1. "The object of the Ordnance Survey is to produce an accurate map of so much of the peninsula as can be made in the time allowed for it," beginning with the area bounded by the line Suez–Tor, and the mountain ranges Jebel er Rahab and Jebel et Tih and extending later to the northern part of the Gulf of Akabah.
2. The MS. maps of the country to be on a 2-in. to a mile scale for subsequent reduction to 1/100,000. (Actually they were published at 2 miles to the inch.)

   The special plans of Jebel Musa and Jebel Serbal (two of the principal candidates for the distinction of being the original Mount Sinai) to be drawn on the 1/10,000 or 6-in. scale with enough details of altitudes, contours and sketches that models can be made from them.

   The Convent of St. Katherine to have "every detail" shown on a scale which may need to be as large as 1/200.
3. A chain of triangles to extend from Suez to Mount Sinai, and the longitude of the telegraph station in Suez, already known, to be connected with it. Bases and their azimuths to be measured at or near Suez and Mount Sinai. Station altitudes to be obtained by direct observation to the seashore wherever possible.
4. Longitudes and some trigonometrical stations to be determined without reference to those published on the Nautical Charts, and latitudes to be observed at all principal trigonometrical stations or halting places.
5. The principal portion of the survey will be traversed with azimuth compass, or a theodolite where iron ore is suspected. The traverses to be plotted on the ground and topographical features to be sketched in as the survey proceeds.
6. Names, their spelling and interpretation to be left entirely to "The Pundit," likewise the deciphering, photographing and "rubbings" of rock inscriptions.
7. Photographs and sketches to be made of all interesting objects, "not only where the scenery is pretty." (Is this usage of "pretty" so transformed in eighty years as once to have been applicable to Sinai?)
8. Specimens of all kinds of rock and fossil to be collected, their situation, changes in formation and the dip and strike of strata to be noted on the map, also the localities of turquoise and old iron and copper workings.
9. Needle variations to be ascertained at Suez, Mount Sinai and some intermediate points.
10. "Mr. Wyatt will collect all the zoological specimens so that we may hope to have a good knowledge of the birds, beasts, fish, reptiles and insects of the Peninsula and I trust also of the plants. A collection of shells from the shores of ponds should also be made." Photographs of them all to be taken *not neglecting the commonest*.
11. Every document and every specimen to be sent to Southampton in the first place for the drawing up there of an official account.
12. Meteorological observations to be taken at Suez and at the Convent of St. Katherine throughout the party's occupation of the peninsula, the monks to read a deposited set if necessary.


PENINSULA OF SINAI
Showing Ordance Survey Sheet lines
SUEZ
*Ayún Musa
Jebel Bisher
Ras es Sadûr
Wady Amárah
W. Gharandel
J. Hammam Faruh
W. Ethal
W. Baba
W. Shellal
Magharah
W. Sidreh
W. Buderah
W. Mukatteb
W. Feiran
W. Ajelah
W. Aleyat
Jebel Serbal
W. Sigillyeh
El Murah
J. Haque
Tor
SUEZ
GULF OF EGYPT
Jebel er Rôhah
Jebel et Tih
Jebel et Tih
Akabah
GULF OF AKABAH
ARABIA
W. es Sheikh
W. Solaf
J. ed Deir
Convent
Jebel Musa
J. Tinia
J. Hadaryid
J. Abu Mosud
J. Umm Shamer
N
20 MILES 10 0 20 40 60 MILES

13. Progress and expenditure reports monthly.
14. Certain measurements in Egypt of the Great Pyramid and of the Nilometer at Cairo were required, mainly apparently, to determine the local cubit, and whether "The Double Royal Seven Palm Cubit of Karnak" had been used. The "derah," or land measure before the metre was introduced, was also to be determined.

The restriction imposed in paragraph (11) above was extended to preclude the publication of all magazine and newspaper articles other than through the Director General, lest the final official account should lose interest by forestalment. "The Pundit" had engaged to write descriptive reports for MacMillans. Frequent reports were, however, sent to *The Times* and *Athenaeum*, consisting mainly of extracts from the letters of the two officers, and at least two communications to Williams from "The Pundit" were published in the Cambridge University Gazette. Very largely their purpose was the reiteration that funds were still required.

The expedition landed at Alexandria eighteen hours late on 7th November and arrived at Suez on the 8th. Through the good offices of Captain Willoughby, the Transport Agent, the land journey for persons, baggage and stores was performed at contract rates. "The Pundit," who had proceeded ahead and had been examining manuscripts in Cairo, joined them on the 9th, followed by Wyatt on the 11th, the latter without his baggage which had been mislaid on the voyage and which failed to reach him until early December, thereby prejudicing appreciably his capacity for work. The stay in Suez was spent by Palmer in taking time and latitude observations, and by the rest of the party in buying provisions and sorting baggage into camel loads, and bargaining for the said camels, of which forty-four were required and obtained at 30s. 0d. each. This amount and the cost of provisions and hotel bill far exceeded expectations. Wilson found that the Indian Transport Service employed a mail steamer, the tug *Prompt*, to run between the town and the roads where the ships lie. A saving might have been effected on the transport of provisions if the India Office could have been induced to allow *Prompt* to make one trip from Suez to Tor, 130 miles off, where they could have been stored in bulk at the convent, never further than two days' journey from the expedition. The India Office raised no objection to her use during an idle period, but directed "that the cost of the coal expended, together with any other expenses which may be incurred on this service, will be charged against the War Department." Sir Henry James who had hoped for a free gift declined the offer.

They left Suez late on the 11th November for 'Ayun Musa, across the Fresh Water Canal, and departed finally for Jebel Musa early the following morning. The caravan included twelve riding dromedaries, of which two were for the escorting Sheikhs, and for the first three days the limbs and backs of the Europeans were very stiff indeed. The heat along the coastal plain was intense ; umbrellas, lime juice and brandy were in great demand, but the nights were cool and bracing. The Wady Gharandel was reached on the 14th, and there they spent the next day which was a Sunday. Thence onward they were climbing. On the 17th they left the glare of the chalk wadies and plains and entered the red sandstone Sarabit-el-Khadim district, and later a granite and greenstone country where the scenery improved and they found fresh drinking water. Their new goat skins had imparted a vile flavour to the only water they hitherto had to drink since leaving Suez.

It was found impossible with a large caravan to begin the small scale survey on this part of the journey ; a route sketch, in conjunction with nightly time and latitude observations, was all that was kept.

They arrived at Jebel Musa on the 21st and pitched camp in the convent valley, receiving cordial hospitality from the monks, to whom they presented gifts in the shape of a model, and the documents of the Jerusalem survey. The monks for their part provided "two rooms, one a good room for a store and for drawing in cold windy weather and the other a sort of cell for empty cases, etc." After two days of unpacking, work began in earnest on Tuesday, 24th. A base was selected in the plain of Er Rahah which had a general slope of not more than 2 deg., and this was measured next day giving three results of 6934, 6933¾ and 6934½ links. Reconnaissance provided a foretaste of difficulties to come. The mountains were exceedingly rough; on many of the peaks it was impossible to get an instrument and many of the mountains rose sheer in precipices from 1,000 to 1,500 ft. high. Sergeant McDonald, a man of high spirits and blustering ardour, found he had no head for heights and came back from his first piece of hard climbing crestfallen, which involved the officers, assisted by Holland, in all the poling and observing, when they might have been more profitably employed reconnoitring. The wooden crosses erected on many of the peaks by the monks proved of very great use as station marks, cairns having otherwise to be built and whitewashed, and the whistles provided by Sir Henry James were also found to be very useful, sounds in that still country being audible at immense distances. The area surveyed was a rectangle 4 by 4¼ miles, with its shorter axis lying north and south. It included Jebel Musa and Ed Deir, the plain of Er Rahah, and every locality of interest supposing it to have been the Mount Sinai. The observing was finished from the twenty-three stations by 9th December. There were in all thirty-one stations, all bar four 800–2,600 ft. above the camp. The instruments used in the special surveys were 5-in. theodolites, similar to those in use in Great Britain. A 6-in. alt-azimuth theodolite accompanying the party was too cumbersome other than for astronomical observations in or near the camps. One night they spent on top of Jebel Musa in order to save the time lost in going up and down, and slept in the ruined chapel of Elijah, where "a fusty old monk" taking the opportunity of going "his rounds in good company did his best to smoke us out with incense, but we killed his incense with baccy."

Meanwhile the principal features, such as the wadies leading up into the mountains, had all been traversed with chain and theodolite. Spirit levelling with the 8-in. spirit level had begun, as well as the contouring of the plain of Er Rahah at 25 ft. intervals, the only portion of the work which could be contoured. One line of levels was with difficulty carried up by means of a partially constructed road to the summit of Jebel Musa itself, and agreed to within 8 in. of the computed height. In all there were 33¾ miles of traversing, 32 of levelling and 4½ of contouring. Computations were completed by Saturday, 12th, and plotting commenced on the 14th, to be followed by examination and hill sketching, which, owing to the rigorous weather that soon set in, had to be resumed in the spring. The hill sketching was filled in on the ground with the assistance of 2¾-in. prismatic compasses and small pocket aneroids, barometric differences being checked against levelled and trigonometrical heights. The camp was a little below 5,000 ft. in altitude and even in early December 5 or 6 deg. of frost were registered every night; water and sponges were frozen hard by morning, and bathing in consequence confined to Sundays only. They lived tolerably well. Their staple meat supply was preserved, but varied occasionally by partridges, sheep and kid "wretchedly small and poor and tough as leather," and once a young well-flavoured but also tough ibex. Their only ailment was nightmare induced by heavy suetless duff, with which their Maltese cook treated what he called the "salon."

"The Pundit" had been busy collecting local inscriptions and rummaging in Arabic books, finding much of value amongst a good deal of rubbish in the convent library, despite the Feast of St. Katherine which quite demoralized the monks and retarded him not a little. His misfortune here was the previous abstraction of the Codex Sinaiticus from the library by Dr. Tischendorf, which caused the Superior of the convent to flee to Cairo on the expedition's approach, leaving that part of the library containing the most ancient documents securely locked and sealed.

"On the 12th December winter fairly broke with a desperate storm of wind and occasional showers of rain and sleet. Some of the gusts were very violent and one terrific squall brought the marquee down . . . Wilson and I, who had been working inside suddenly found ourselves struggling amid a confused mass of tent ropes and fluttering canvas, books, papers and camp stools, from which we only emerged in time to see several of the effects of the Sinai Expedition being whirled by the blast up the convent valley, with Arabs and servants in hot pursuit. Most of them were ultimately captured, but some loose sheets of laborious calculations . . . were hopelessly lost amongst the cliffs of Jebel Musa."

Very little was accomplished of the 2-in. survey during this first period at Jebel Musa; "true bearings have, however, been taken from Jebels Musa, Katherina" (8,300 ft., climbed on 17th December), "Ed Deir, Samr et Tiniyeh and Abu Mes'ud, by which most of the prominent peaks in this part of the peninsula have been fixed and their altitudes determined by angles of elevation and depression. The altitudes of all peaks ascended are determined by Boiling Point Thermometer and the Aneroid Barometer, but we find the latter can never be depended upon to 300 to 400 ft. at this altitude above the sea. Angles of depression have also been taken to fixed points on the shore. A portion of the country to the south-east of Jebel Musa has been sketched by Captain Palmer during an excursion to Jebel Hadid" (J. Hadaiyid).

The azimuth of the base was determined by observing Polaris at its upper culmination with a 6-in. theodolite from the south end, and flashes of magnesium wire at the north end.

By the time the party left for Jebel Serbal, which occurred on 1st January, 1869, five weeks more work of examination and hill sketching were estimated to remain for the spring, and most of the trig-station heights were due to be calculated at the Serbal camp. Sergeant McDonald had by this time grown more accustomed to hill work. The geology, natural history and photography had progressed satisfactorily, but no one at the convent could be trained to take meteorological observations, so that the instruments could not be left behind there.

The journey from Jebel Musa to Jebel Serbal lay through the pass of Nagb Hawa and down Wady Solaf, passing the mouth of Wady Um Takhah where the previous winter a large party of Arabs encamped on a low eminence "were one night swept away by a flood so sudden that they had not even time to escape to the mountains only 100 yds. off."

The new camp was pleasantly situated, 2,700 ft. lower than the old one, at the junction of the Wadies Aleyat and Feiran, where a forest of date palms and tamarisk, acacia and cedar trees overshadowing for two miles a cool clear stream made a pleasurable change after weeks of barren desert. They arrived on 3rd January and began work at once. As before the two officers and Holland performed all the triangulation work and the N.C.Os. the subsequent detail. The latter in fact did not begin work until the 8th January, having been delayed a few days connecting the two special surveys with a chain and theodolite traverse 28¾ miles in length with ninety-five stations,

the resulting error being 4 ft. only, compared with the true meridians at the extremities.

Jebel Serbal was even more rough than Jebel Musa. Between camp " and Serbal, about five miles, lie a mass of rough high mountains which enthusiastic travellers have called a great sandy plain; the peaks range from 1,500 ft. close above our camp to more than 4,000 ft., the summit of Serbal . . . Wady Feiran is a narrow gorge at this point rarely more than 200 yds. wide, and our base in it is only 45 chains long, and even from this we had to get away by angles of elevation of 18 to 20 deg. The valleys leading up to Serbal are so rough that it took the men a whole day to chain three miles." So rough in fact was the country generally that the chains suffered as badly as the boots. One hundred miles of measurement wore out two chains completely and one partly so, nearly twenty times the wear incurred at that time over average agricultural country in England. The granite boulders, in the Wadies Aleyat and Ajeleh especially, were said to be comparable in size with the Astronomical Observatory then at the Ordnance Survey Office, Southampton. Palmer's opinion was that this mountain could not have been Sinai because " there is no plain anywhere in the vicinity suitable to the assembling of a vast concourse of people in sight of any one portion of the mountain " and Wilson adduced six reasons for the same conclusion. The climbing though rough was not so severe as in the former survey, but the remoteness of the camp from the peaks meant that labour was not diminished. " The cold due to our high elevation, aggravated by a keen and cutting wind, was almost unendurable and we were frequently enveloped in dense masses of cloud which retarded though they did not prevent the observations." Five or six days were lost on account of rain and transport, and an abundance of haze and cloud interfered badly with the astronomical observations. In spite of everything, however, the triangulation was completed by 30th January, and a number of bearings were taken from the high peaks in order to continue the principal triangulation and carry on the longitude towards Suez. There were thirty-seven trigonometrical stations, from thirty of which observations were taken, and their altitudes (excluding the two base-line extremities) ranged from 422 ft. to 4,698 ft. above the camp. The area surveyed on the large scale was a rectangle $4\frac{1}{2}$ miles by $3\frac{1}{4}$ miles, with the longer axis running north and south, covering the west of Jebel Serbal on the south to the Wady Feiran and the hills bordering it on the north. There were twenty-nine miles of traverses and $13\frac{1}{2}$ miles of levelling. Sketching was done as a 6-in. reconnaissance based on the triangulation, but contouring was altogether impracticable. The survey was fully completed by 9th March. " The drawing (hill sketching) of Corporals Brigley and Malings is very beautiful and truthful . . . Whilst it was in progress Corporal Goodwin made a very faithful model of Serbal and the ground in front of it, and obtained a large number of sketches from various points." Sergeant McDonald's time had been chiefly devoted to photography.

" The Pundit " had completed the compilation of the local rock inscriptions in the latter half of January, so he and Holland departed for the Wadies Mukatteb, Sidreh, Buderah, and Shellal where were many more. It was here that he found the clue and solved the mystery of the Sinaitic inscriptions.

The previous difficulties had arisen from the inaccurate mis-shapen transcriptions which had been brought home. He found that " in some cases the letters are detached and bear a strong resemblance to the Hebrew ; in others they are connected by a line, and their forms being more cursive might be mistaken by an unpractised observer for Cufic . . . They seemed, indeed, to constitute an intermediate link between the ordinary Hebrew and the

Cufic." A dozen bilingual Greek and Sinaitic inscriptions cut each by the same hand confirmed this interpretation. "The inscriptions consist of detached sentences in a Sinaitic or rather Aramaean dialect ; for the most part proper names, with such introductory formulae as oriental peoples have been from time to time accustomed to prefix their compositions . . . They are the work, not of pilgrims, but rather of a commercial community who inhabited or at least colonized the Peninsula for the first few centuries of the Christian era . . . possibly until the spread of Islam." In evidence of "The Pundit's" zeal it is noteworthy that he brought home a collection of nearly 3,000 copies, embracing almost all the legible inscriptions extant in the peninsula, and having seen "Ana M'adri" (I don't know) inscribed as village names on some early maps of Palestine and having learned that an Arab will invent a fictitious name rather than disappoint his questioner, he never accepted a name in Sinai without several independent testimonies. As an instance of this work there is a Wady Ajeleh in the neighbourhood of Serbal. Allowing for the defects of transliteration it had been widely held that Ajeleh corresponded with Ejl "a calf," and this was offered as evidence that Serbal was the traditional Sinai. "The Pundit's" ear attuned by then to "the niceties of Bedawi pronunciation at once perceived that the word was Ajeleh, quick." Inquiries of "a number of the inhabitants independently why it was so called, . . . the invariable answer was, given in a tone which implied that the reason was patent to the meanest understanding, 'why, because it is a quick road to Tor,' and so it assuredly is." While collecting local names and traditions, "regardless of fleas and other drawbacks he would sit by a Bedouin fire with the Arabs for hours writing down their stories." His success at decipherment led to the Wort's fund granting him a second £200, again hedged about with restrictions : his report to be a separate volume, and his purchased MSS. to be lodged at Cambridge. "The Pundit" was indignant and pointed out the impossibility of separating his personal expenditure from that of the rest of the party, but only £200 of the total voted at £400 appear as a subscription to the survey fund.

On 2nd February Holland received an urgent recall from his rector and left for home without even being able to return to Wady Feiran to say good-bye. One of his first concerns after arrival home was to refute a letter in *The Times*, written by Mr. Bauerman, a young geologist in the employ of the Viceroy of Egypt and one time known to Wilson and Palmer on the American Boundary Commission, deprecatory of some casual geological reference in one of Wilson's letters. At the same time Holland pointed out to Sir Henry that geology was not one of Wilson's strong subjects and that his reports on geology in the Palestine Survey had been taken up by some as a handle to discredit the rest of the work.

Wyatt spent a fortnight near Tor to collect specimens on the plain of El Ga'ah and the lower country in early February, and in March made a similar expedition to Wady Gharandel. The winter was unfavourable for collecting. He left in early April to make a private journey to Jerusalem.

The two officers set out on their travels to perform the small-scale survey on 5th February, and for about ten weeks were constantly on the move. Camels, under the direction of their escorting Sheikh, were used for baggage, but no riding camels were employed between the times of the original arrival at, and final departure from, Jebel Musa.

First of all they went to Wady Mukatteb where they found "The Pundit" busy with his inscriptions and jubilant at mastering them. Six miles away, at Magharah, they explored some ancient Egyptian turquoise mines and found amongst some tablets one carved in relief giving representations of the miners

and their work. Next they followed down the Seih Sidreh to the coast, proceeding thence to the mouth of Wady Feiran, thence southward along the plains of El Migrah and El Ga'ah, skirting the base of the mountains as far as the mouth of the Wady Sigilliyeh, from which they again reached the sea coast near Tor. "In selecting this course for the survey there were two special objects: the one, to ascertain whether there were any route south of Wady Feiran by which, upon any possible supposition, the Children of Israel might have advanced into the highlands of the peninsula: the other, to investigate and report upon the phenomena of Jebal Nagus, a mountain in the neighbourhood of Tor." The route was dreary and monotonous until they came to Wady Sigilliyeh which, although a narrow chasm, 20 ft. in width at its mouth, opens out into a broad mountain glen with abundant vegetation draining the whole southern slopes of Mounts Serbal and Sigilliyeh. To reach the valley our Arabs took us over the mountain on the south side of its mouth. There was no other way, they said, through the pass, which was "all cliffs and water." Curiosity determined them to return that way, however, and they succeeded after sundry disappointments, swims and other aquatic feats. Their guide said "he had travelled with many and many a Khawajeh, but never with a Khawajeh like ourselves. Most travellers when told of dangers and difficulties ahead were content to turn aside and avoid them, but, as for us, we never paused to inquire whether there was a road or not, but straight ahead (doghri yenum) was our motto, and now we had made logs and ladders of ourselves, and come through a place which no man, Frank or Arab, had ever vanquished before."

The phenomena at Jebel Nagus was a noise, a "deep swelling note not unlike that of the Aeolian harp greatly intensified." The motion of the fine dry sand embanked in a wide gully rising for 400 ft. at 30 deg. into the mountain was found to produce the noise, which was especially sonorous and loud in the heat of the afternoon when the surface sand, preferably that which had been long undisturbed, recorded a temperature of 103° F.

From Jebel Nagus they again crossed El Ga'ah and entered the mountains by Wady Hebran, not so fine as Wady Sigilliyeh, but containing clusters of palm trees. It led to a rugged mountain pass from which they descended into Wady Solaf and thence back to Feiran, the complete tour having occupied three weeks.

They decided that a large concourse of people might have penetrated the country either via Wady Feiran throughout its course, or into the same Wady via Seih Sidreh and Wady Mukatteb. The third possible route by Wady Hebran is the usual one for pilgrims to follow from Tor to the Jebel Musa Convent, but the ascent to the watershed was the worst road seen for loaded camels.

Time, latitude and variation observations were made at nine different camps; these with the longitudes obtained from the route sketch and true bearings fixed the position of all the important points in the district examined. The prominent peaks were fixed by triangulation. To sketch the whole of this large district was not attempted, merely the laying down of the principal features. Restricted means rendering it impossible to get through a large quantity of work on the 2-in. scale, they found themselves obliged to proceed with their reconnaissance at the 1-in. scale instead.

They started out next on 3rd March. Palmer went away alone for five or six days to Ras es Sadur and from there connected the survey with Suez by latitude and bearing. The triangulation was extended and 350 miles of route survey made before the end of the month, including the roads to the interior by Wadies Sidreh and Baba, the coast road from Mukatteb to Gharandel,

portions of Wadies Ethal, Useit, Gharandel, Es Sheikh and El Akhdhar, two roads which enter the Jebel Musa district from the north from Wady Gharandel, and the route from Gharandel to Wady Bisher. With the exception of a route south of Jebel Umm Shomer which was sketched during ten days in April, all the practicable routes from Suez to the interior had been visited. Astronomical observations had been taken at twelve more stations.

Altogether throughout the survey there were: eighty-one observations for time, by equal altitudes of stars or the sun, or single altitudes of east and west stars: 198 observations to fix the latitudes of thirty-six stations by meridian and circum-meridian altitudes of north and south stars, and altitudes of Polaris at any time: three observations for longitude by linear distances taken with two chronometers by separate time takers, the remaining longitudes being deduced from latitudes and bearings: seven observations for true meridian as already described for the base measurement at Jebel Musa, a similar but more complicated method being required on mountain tops: and eighteen for magnetic variation by direct observations of the magnetic azimuths of the sun and stars at low points in their courses, the latitudes and local times being known, and the true azimuths being thence computed.

The first lunar observations to be sent home were followed by instructions for their recomputation for it was found that the 6-in. alt-azimuth which had been used "had an error of telescope level which had not been discovered."

"On Jebel Hanuman Farun we were caught by a tremendous tempest (luckily just as the last observation was over) which came rushing upon us from the Gulf of Suez with astonishing suddenness extinguishing the lamps instantaneously and nearly blowing myself, instruments and Arabs into the sea." The natives believe the spot to be haunted by the spirit of Pharaoh, and the carriers lay down, too frightened to move, and so stayed till morning. "Salem our old guide though not quite as bad as the others . . . was in a helplessly nervous state, so I bade him follow me, and after a dark and toilsome scramble of nearly three hours succeeded in guiding him to the camp, a feat which so astonished him and the rest of his people as to have earned for me [Palmer] amongst the Bedawin the title of the 'jeda' (a man who can go through or over anything)." It would seem that a prolonged stay in the country might have endangered this officer's sense of modesty.

The special survey of Jebel Musa was resumed and the large-scale survey of the convent undertaken by the N.C.Os. on 15th March and finished by 17th April. Corporal Goodwin made a number of architectural drawings and other sketches and finished off his rough models on the 6-in. scale. They were of wood, covered with canvas and an exterior coating of plaster of Paris. Clay mixed with treacle was tried, but cracked and fell to pieces.

The general survey was completed on 16th April and six days later the party turned towards home. Although unable to use the tug-boat *Prompt* for provisions, Wilson nevertheless arranged for it to meet the party at Tor on 24th April, thereby to save the cost of the camel caravan and the discomfort of the hot march along the plain. They arrived at Suez on the 25th, but coming from a port on the Red Sea were placed in quarantine for five days, of which after troublesome negotiations one was excused. "The two Palmers left the ship one night and did not return to her, breaking the quarantine regulations, and as they were imposed on the Egyptian Government by the International Congress of Constantinople the French are tearing their hair and making some noise. The two law breakers are living incognito at Cairo where I hope to meet them tomorrow as I shall have to go there to explain the whole matter to Colonel Stanton," the British Consul. Wilson feared Palmer would have to quit the country quickly leaving him the Pyramids to do alone.

However the quarantine people must have been too frightened to make much noise for a simultaneous letter from Palmer in Cairo merely refers to the quarantine as upsetting their arrangements, that he intends seeing the Viceroy next day and to begin work on the Pyramids the morning after that. The most serious consequence of this "upset" was the cost of the steamship *Prompt*, steaming to and from the quarantine station, at 'Ayun Musa, and the pay of the pilot who was also isolated, which raised the price by £15, thereby exceeding that of a camel caravan which would also have proved about as quick.

Sergeant McDonald and Corporal Goodwin were retained for work at the Pyramids ; the other two were dispatched straight home with the surplus baggage.

The Meteorological instruments which had been left with Mr. Andrews, the P. & O. agent at Suez, and which had been read daily while the party was in Sinai were left there so that the series of readings could be continued through the summer.

All that is recorded of the Pyramids work is that everything was finished in " a very satisfactory manner, but I am afraid you will be disappointed in the results from the Nilometer ; the divisions are of a very rude description and not accurate enough to determine the length of the cubit."

Wilson arrived home on the 15th May, and Palmer, who stayed awhile in Italy, the week after. Thereafter came the business of compilation and publication for which the Treasury sanctioned a sum of £500.

The birds went to the Rev. Tristram of Stockton-on-Tees for identification, and he reported that all but two had been seen by him in Palestine, and that they were North African rather than Asiatic. The plants were identified by Dr. J. D. Hooker of Kew Gardens with the help of Mr. Oliver, Mr. G. R. Crotch, M.A., of St. John's College, Cambridge, undertook the coleoptera, and E. T. Wilson the diatomaceae. There was difficulty in obtaining a similar service for the fossils and minerals ; several experts were approached but declined through over-work. Holland although not fully qualified eventually completed the geological section of the report. The specimens themselves after nineteen years in South Kensington were eventually presented in 1891 to the Geological Survey.

The Survey was published in three parts. The first part " The Account of the Survey with Illustrations" was published last in March, 1872. It consists of a Preface by Major-General Sir Henry James, the Director General, and an Introduction connecting the survey with its Biblical background by the Rev. G. Williams (at this time holding the living at Ringwood) and a series of chapters each produced by the man responsible for the subject described. The second part consisted of the maps, plans and sections, and the third in three volumes contained reproductions of 150 of 300 photographs which had been taken by Sergeant McDonald. In addition thirty-six stereoscopic views were published separately in a box complete with a stereoscope.

It is fitting to quote the final " Recapitulation of the Opinions of the Survey " on the matters they were principally investigating :—

> " Passage of the Red Sea at or near Suez, and camp, after crossing at 'Ayun Musa; 'Marah' at Wady Amarah or 'Ain Hawmarah; 'Elim' at Wady Gharandel or Wady Useit ; 'The Encampment by the Sea' at the mouth of the Wady Taiyibeh ; 'The Wilderness of Sin' at the Plain of El Markher ; 'Dophkah' and 'Alush' in the Wady Feiran ; 'Rephidim' (except Mr. Holland) at Feiran ; and 'Sinai' the Musa Sufsafeh block of mountains."

ACK AND QUACK

By " BATTLEDRESS "

" WHAT do you do in the office, Daddy ? " said G. my son. G. is six and his tone sounds cheeky. I draw myself up to my full height of 5 ft. 11½ in. and prepare to emulate Old Bill when asked what he did in the Great War, Daddy. But just then a thought assails me or rather a question. What do I do in the office ? Or at any rate what can I explain to this youngster, of the important position I hold, of the problems with which I deal, of the genii who appear at my summons on the bell ? (There are three genii—one has nice ankles—but I cannot tell G. such things). But I am blowing my own trumpet ; again, I remember the exasperation, the sinking feeling when so and so appears with an armful of files, the craven attempts to dissimulate when I am confronted with having left undone that which I ought to have done.

My mind travels slowly in reverse, to morning. It is the same as five other mornings in the week. I arrive down to breakfast five minutes late and my coffee is half cold ; that is my fault, and there is no time to ask for more. I glance at the local morning paper. It is folded as usual so that advertisements are the first things to catch the eye. One is always prominent. It proclaims infallible ways of removing moles, warts and superfluous hair. I hurriedly turn over, wondering if any such process could eliminate my morning beard.

Fifteen minutes after the official hour I walk down to the office, salving my conscience with the thought that this gives the clerical staff time to adjust its hair and get its teapots in place without embarrassment. My office has been swept and garnished, the work of some unseen slave the previous evening. The great administrative machine has not yet gathered speed and nothing disturbs the initial calm while I light my pipe. I sit down and try to collect my thoughts Presently the calm is shattered ; there is the morning meeting to attend upstairs and I am already late. I hasten aloft and slink in at the tail as the others file in.

The Colonel takes the chair and ticks off a few notes in his diary.

" UNIONS have run out of spoons and can get no more through normal channels."

I note this down and think of golf, as the Colonel continues :

" The Families Camp have no toys."

I look at Welfare and think of Bramleys. My thoughts wander further but I am rudely brought back to earth. I am being addressed. I fumble and then say a few words in what I hope are crisp tones. They may be the correct answer, they may not, but the crisis is passed. How long can one thus dissemble ? Such thoughts cross my mind but there is no time for musing now and we are soon filing back to our respective chairs, great or small, in our respective offices.

The machine is now whirring and, in my absence, Bert, the office bloke, has piled my IN tray. The sinking feeling has started, but first I look at the notes I have made upstairs. " Order spoons from Bramleys " and " Speak to ADOS about toys." That seems all right, so I lift the telephone receiver and wait. There is a faint buzz of conversation and someone humming a tune.

" Number, please ? " queries a genteel voice, which somehow startles me. I have forgotten, and hastily scrabble for my list, mumbling into the mouthpiece the while. Finally I give it up.

" ADOS, please," I gasp.

" Too won oh," gibes the voice and clicks me through. But it is not ADOS who speaks. He is too well protected and a sycophant in the outer office filters his line. I wait patiently. I can do this, for it is still early in the day. At last I speak to him. We pay each other the compliments of the morning and I mention toys. There is an explosion at the other end and the line goes dead. I cross off the item in my diary.

It is time I got on with the work in my immediate neighbourhood, so I stretch out my hand towards the pile in my tray. As I do so, a step sounds in the passage outside. For an instant I am on the defensive, then I recognize the scuffing noise. It is Bert. He looks in to clear what work I have done from my OUT tray but he is unlucky, for that receptacle is still empty. As I settle down again, the phone rings. I pick up the receiver and say in the briskest tones I can assume :

" Battledress, A.Q."

That, and the tone of voice should impress any would-be inquirer! A conversation ensues. I give my advice; it is questioned.

" No," I continue, " I would not agree to your taking your official car to the Old Cocks' dance on Saturday and calling it training, you'll have to think of a better one than that."

There is a mirthless laugh from the other end, but I know, and he doesn't know that I know, that he has a pretty W.R.A.C. driver, and he is no gentleman, I think.

While I am thus speaking there is a quick, firm step outside and no knock on the door. Instinctively I rise to my feet. It is the Colonel and I hastily replace the receiver, thankful for this opportunity to frustrate any further argument by the distant voice at the other end of the phone.

I have hardly time to cast in my mind what sins of omission I have committed, when the Colonel speaks. He has a smile and a twinkle in his eye. That smile and that twinkle have saved my sanity before now and I clutch at my confidence. Questions come briskly, some I answer correctly I think, some, I say, have to be investigated. I even tender my advice and it is taken. My confidence and poise are completely restored. But while we are thus speaking there is a muffled step outside, then silence and a muffled step retreats. I know that one, it is Staff Captain Curbchain. He has sharp ears and is too tactful to enter when the great ones are *en conférence*. Not so another : there is presently a knock, unpreceded by a step—Staff Captain Rubbersole.

" Come in, come in," says the Colonel. " You may as well hear this." We discuss, we argue, while Bert, oblivious of ordinary etiquette, shuffles in and piles my tray still higher.

Presently the Colonel leaves, but Rubbersole stays. I sit down and he unfolds his problem. It is money; money for this, money for that. In desperation I look at the file he has placed in front of me, hoping for inspiration. But there is none in the printed page. There is silence for a few moments while I pretend to think up what subtleties we can propound to the gods of Whitehall to elicit more money. In reality my mind is a blank and I hope that Rubbersole does not realize this. The silence becomes embarrassing, when the tension is relieved by a slow, measured tread in the passage. It is Staff Major Cummerband. He is a gentleman of a past generation, deliberate in his ways. At his knock I bid him enter. I am past caring how many crowd in. The telephone rings again ; as I snatch the receiver, my hand trembles—money, Whitehall, Rubbersole, Cummerband . . .

"Oh, moneys is your suit," I start to say into the microphone, but a voice checks me.

"'xcuse me, sorr, wad ye be wantin' y'r caerr t'morreh ?"

"Yes, no, yes, half a moment, eena, meena, mina . . ." I have found my diary and give the voice an answer. Two pairs of expressionless eyes are still regarding me. My morale is ebbing fast ; Bert shuffles in again, piles my IN tray, looks dispassionately at my OUT tray and departs.

Rubbersole and Cummerband look at each other, who will speak first ? I sit back limply. One of them speaks, I answer, he departs. The process is repeated and I try to dismiss the events from my mind, while I furtively regard the pile in front of me. Stealthily I reach out and quietly extract a file, but there is no reaction from the passage outside. File follows file and there is an unwonted silence. I glance at my watch and find it is well past lunch time.

As I adjust my beret, my mind is numb but my feet take me instinctively homewards to lunch. I am late, but G. who has been to school, is later. In this respect he differs from other little boys, for his stomach does not rule his mind.

What a respite lunch is, and my spirits climb back nearly to normal ; half the day is done but more than half the work is still undone.

I am more punctual after lunch. It is downhill to the office and I walk more briskly than when I returned home an hour ago. I am determined to conquer that buff pile which discolours my table. I set to with grim determination. I start by delivering a frontal attack, but the bowling is awkward and I deflect a few balls. Here at long leg I place the too difficult ones. Others I score off with direct hits and the pace diminishes. Presently I am left with a small pile in front of me and several others scattered around. My thoughts are concentrated and I pen a tricky draft, but the field is closing in and recurring footsteps sound outside. I gasp, choking back a maniacal desire to fling everything into the air. But wait, it is a different step, quick, efficient, feminine ! It is that attractive redhead from upstairs. I force a smile to my bloodless lips and screw my gaunt eyes to what I hope is a twinkle. We crack a joke, some light banter passes, but she, subtle, swift, like a nurse adroitly administering an unpalatable dose, slips a sheaf of manuscript notes into my tray. I know that handwriting ; it spells immediate action.

Once more I set to, but feebly now like a spent swimmer who cares not whether he floats or sinks. The shadows lengthen, my brain reels while I flog it to action, summoning my waning wits. There is another deathly lull and I think my tormentors have departed. Beware such false hopes ! There is a stealthy shuffle and the sound of a siege weapon being prepared against my door. My hands creep upwards in an attitude of surrender, or is it prayer ? A head comes round the door followed by a diminutive body . . . I could hug that small being . . . it speaks, and a voice squeaks out the immortal words of Mrs. Mop.

"Can I . . . ?"

* * * * *

G. was not to be disarmed by my silence and returned to the attack from a different angle.

"What do you play in the office, Daddy ?" he persisted.

"Blind man's bluff." I replied.

"POSITIVE ANCHORED" PRE-STRESSED CONCRETE SLEEPERS

By LIEUT.-COLONEL W. B. SYKES, R.E. (T.A.)

THE shortage of timber railway sleepers is practically world wide, and the reason for this shortage is the International economic position, together with insufficient labour in countries where adequate and suitable timber exists. Official estimates state that Britain alone needs more than 1 million sleepers per annum, with a deficit of many millions, and other countries are in a similar position, although to a lesser degree.

Steel Sleepers are almost unobtainable these days, and this, of course, seriously aggravates the position. The only suitable substitute available (particularly in tropical countries troubled with termites) is Concrete Sleepers, and these can now be easily and rapidly produced in almost any district or country.

Many articles dealing with concrete sleepers have appeared in various publications, and past experience has shown that an ordinary concrete sleeper with mild steel reinforcement is a failure for any traffic, other than the slowest of slow moving traffic (i.e., for light siding work).

Research and experiments have been in progress for many years, to produce a pre-stressed reinforced concrete sleeper, resulting in quite important successes since the late war. To all intents and purposes these can be divided into two classes :—

(*a*) Positive anchored pre-stressed and
(*b*) Non-positive.

It is not the intention of this article to discuss the merits of the two different systems by comparison, but the writer is fairly well convinced that the positive anchored type is far and away the better for the following brief reasons :—

(*a*) Positive anchored type sleepers denote a positive anchorage to maintain the steel in tension, whereas the non-positive type is dependent on maintaining tension by adhesion of the steel and concrete bond only.
(*b*) High tensile steel drawn wire, which comprises the reinforcement, possesses a highly smooth surface, which is difficult to indent, due to manufacturing processes.
(*c*) The steel and concrete bond may be affected during the life of the sleeper by quite a few circumstances, such as fatigue in the concrete or steel, caused by constant "hammering" with continuous loads, or by the varying forces in opposition, namely contraction and expansion of concrete and steel, particularly in countries which have a rapid succession of varying temperatures.

Therefore it is thought that the positive anchored type sleeper contains many advantages, and it is a valuable contribution to the field of pre-stressed concrete. It is interesting to note that whereas the old type of concrete sleeper consumed approximately 40 lb. of mild steel reinforcement the average pre-stressed sleeper reduces this amount to 15 lb. per sleeper.

Pre-stressed sleepers are now being accepted by the British Railways for 70–90 m.p.h. traffic, and it can, therefore, be accepted that this type of sleeper has come to stay until such times as the International economic position again allows the free movement of timber and steel sleepers, and who is to say that pre-stressed sleepers will not be used even after that. The adjacent drawing gives all details of the positive anchored pre-stressed sleeper for British Standard Gauge.

A British Standard Specification (War Emergency 986–1945) covers prestressed concrete sleepers, where the anchorage of the steel is by bond alone, but revisions are in the course of preparation to cover the positive anchored type. Any type of fastening can be used for F.B. or B.H. rails, and the productive effort can allow for these variations to suit British and overseas conditions.

A modification to the existing design will be made when the steel position at home becomes less acute, as it is intended to substitute a lesser number of high tensile steel wires of larger diameter than those indicated on the drawing. The ultimate tensile stress of the wire is 100–110 tons per sq. in., and the tension on the wire is applied by a suitable straining device, to a load of 40 tons or 2·5 tons per wire. The normal concrete mix is 1 : 1½ : 3 with a slump of ¼ in., which gives over 4,000 lb. per sq. in. inside 24 hours. This rapid development of strength is due to properly controlled steam curing, of which more will be said later. The productive effort is being accomplished with a belt system unit plant, capable of producing 200 sleepers per day—i.e., 50,000 per annum.

The number of unit plants can be increased at will, and located to restrict excessive transport costs. The various components are shown on the drawing and a brief description is as follows :—

(*a*) The wire is bent to jigs and looped round the cast-iron anchor blocks: the two " bobbed " ends of the wire lie side by side in the groove of the anchor block.

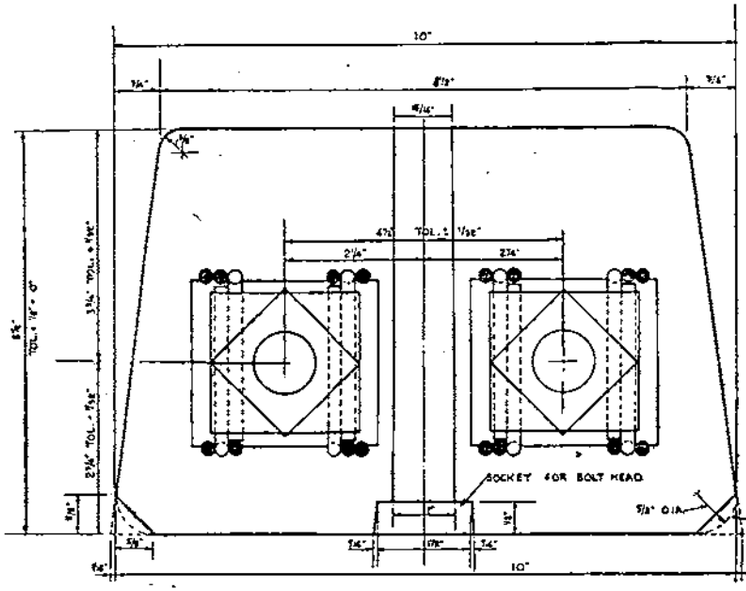
(*b*) On these ends a mild steel plate is positioned, and this, in turn, is surmounted by a standard square nut, which is screwed to the end of a tensioning bolt. Tension is applied through the bolt and thus the wires are compressed between the mild steel plate and the groove in the cast-iron block. The wedge action thus formed securely locks the wire and no slip can occur ; obviously the greater the pull on the tension bolt, the greater the wedge action.

(*c*) To facilitate production an assembly line is provided, and the moulds are in continuous movement whilst the various operations are performed. They are filled from a specially designed mixer, and throughout this operation the moulds with their concrete filling are under vibration, which can be variably controlled to ensure perfect consolidation. A stiff concrete mix with specially designed mixing arrangements, together with the vibrating elements and steam curing, all assist in providing a concrete with a compressive strength of 4,000 lb. per sq. in., in less than 24 hours.

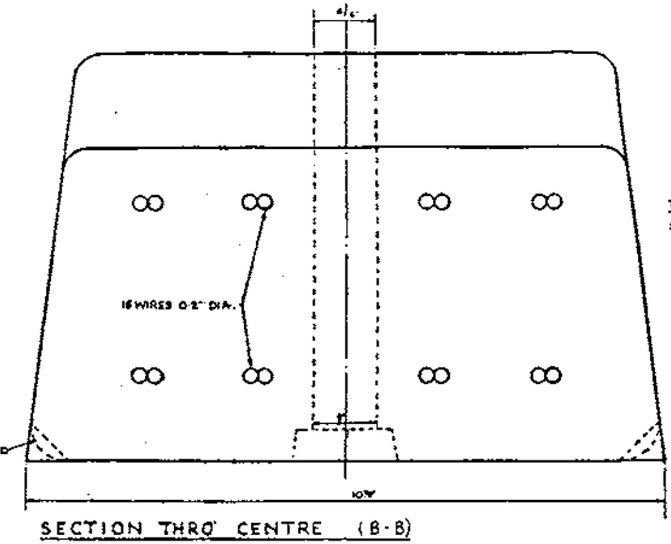
(*d*) After completing the actual assembly and filling operation, the moulds, complete with concrete, then enter a steam curing chamber which is controlled at a temperature of 160°F., and a specified humidity for a definite period. Automatic recording devices are positioned outside the steam chamber to ensure an efficient control of temperature and humidity during this operation.

(*e*) Check test cubes are made under identical conditions to the sleepers, and immediately a compressive test of 4,000 lb. per sq. in. has been obtained upon these, the tension bolts are removed, as the concrete is then capable, with the positive anchorage, of maintaining the 40 tons tension. The sleepers are then taken from the moulds, various minor operations carried out and the moulds return into production.

Sleepers are often, in trucks, ready for dispatch within 24 hours of being cast. Sleepers are tested before dispatch, in accordance with B.S.S. requirements.

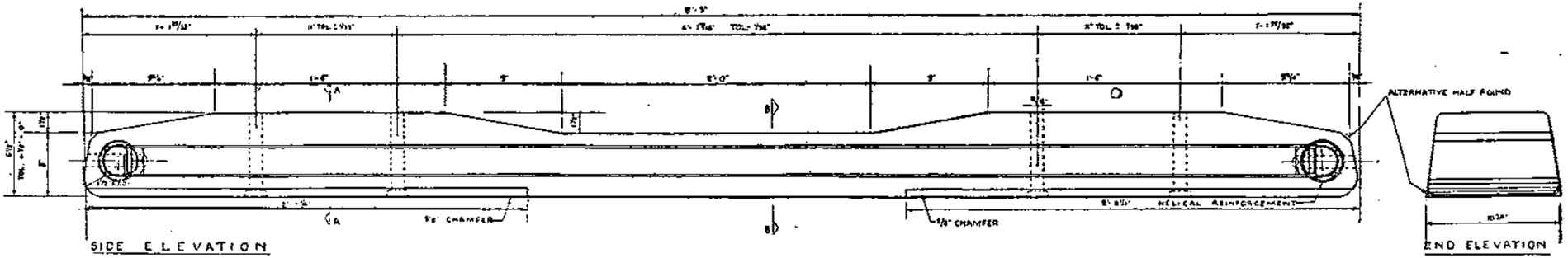


SECTION UNDER RAIL. (A-A)
SHOWING HOLE & SOCKET FOR THRO' BOLT



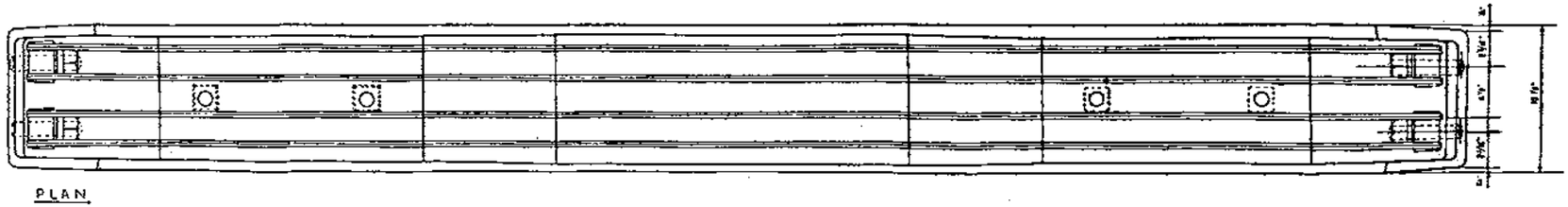
SECTION THRO' CENTRE (B-B)

TENSION APPLIED TO HT. STEEL
40 TONS TOTAL = 2·5 TONS PER WIRE



SIDE ELEVATION

END ELEVATION



PLAN

PRESTRESSED CONCRETE SLEEPERS (CLASS E) TYPE 10A
POSITIVELY ANCHORED REINFORCEMENT - 16 WIRES 0·2" DIAMETER

MORALE

By MAJOR-GENERAL A. C. DUFF, C.B., O.B.E., M.C.

THE introduction of the word "morale" into the British military vocabulary only took place during the first World War, and was accompanied by some doubt as to whether it should or should not be spelled with a terminal "e." It displaced the phrase "the spirit of the troops," which has now a very odd and old-fashioned sound. Much nonsense is still talked about morale; e.g., "high morale depends upon good rations and regular mails." A moment's thought will show the absurdity of the statement. On countless occasions the highest possible morale has been exhibited by troops in far-away outposts, in beleaguered cities, and even in Prisoner of War camps, where rations would barely sustain life and where mails were non-existent. Indeed every British officer who has seen active service knows that it is just at those times when conditions are hardest that morale tends to rise; it is at the base and in the rest camp, where material needs are on the whole adequately satisfied, that morale so often slumps away.

I would describe morale as a by-product, and I think that the main ingredients which go towards its composition are four in number. They are leadership, discipline, good administration, and *esprit de corps;* and their importance follows that order, with leadership easily first. So to discuss morale means discussing separately each of these four. I do not, however, propose to make any further mention of leadership. It is too big a subject, and most men have a pretty good idea of what leadership means and what are the essential qualities of a leader. I am speaking of leadership, not of generalship, which is one of the specialized forms of the art.

Discussion of discipline may well be prefaced by Kipling's lines:—

> "Body and spirit I surrendered whole
> To harsh Instructors—and received a soul."

That is no bad epitome of the meaning of discipline. Too much is now spoken and written about "modern discipline"—intelligent co-operation, readiness to take responsibility, and individual initiative. These are all good qualities and discipline makes a good foundation for them, but they are not themselves discipline and are no substitute for it. The essential of military discipline still lies, as it did in the days of Alexander's phalanxes and Caesar's legions, in obedience to orders, no matter what the consequences. This is the fundamental lesson which has to be learned before any body of troops can call itself disciplined.

The average recruit joints the Army with no experience of discipline of this type. The only disciplines he has probably encountered are the discipline of the home—often erratic and spasmodic; the discipline of school—designed for boys, not for men; and the discipline of the factory—a matter of money as the inducement and danger of dismissal as the spur. Once in the Army he has to adapt himself to a different way of life, governed by sanctions of a different kind. To the Army as a corporate whole he is called upon to surrender his individuality; the surrender made, his life is wonderfully simplified. He finds himself enfolded in a routine "ancient, effortless, ordered, cycle on cycle set." In the process of instilling obedience as an automatic reaction the principal agency used is close-order drill; nothing has yet been

found to rival its efficacy in making men feel that they are " members one of another " and the instruments of an authority higher than themselves.

When this fundamental lesson has been engrained further progress becomes possible. During the early stages of his training the young soldier is neither required nor invited to take responsibility for anything except himself, but when he has learned to obey orders there comes the time when he should learn to give orders. In the career of a successful soldier there are two dramatic moments—moments when he cuts himself adrift and makes a new start in a different life. The later of them is the jump from non-commissioned to commissioned rank ; the earlier, and perhaps the more difficult, is the jump from private to lance-corporal. This is the moment when he first accepts responsibility for other men as well as for himself : a responsibility which will cling to him and grow ever greater as the years pass. He has to rely on his own character and his own intelligence to carry him through, but he has one powerful aid in the discipline which tells him his place in the scheme of things and lightens the burden on his shoulders.

Discipline is an essential ingredient of morale and its particular contribution is stability. It is possible to imagine a body of troops displaying under some temporary stimulus the superficial signs of good morale yet going to pieces as soon as the stimulus was removed ; but this state of affairs is unlikely in a disciplined body, and if the disciplined body be Anglo-Saxon it is more unlikely still.

Turning to administration, there is of course a grain of truth in the " rations and mail " doctrine. Administration includes the provision of the manifold material things which an army requires to enable it not only to live but to fight, and if those material things are manifestly inadequate morale will suffer: if the food is full of maggots, or the shells do not burst. For the last thirty years, fortunately, the standard of the administration of the British Army in war has been high, perhaps because the disasters of the Crimea have lain at the back of the minds of the responsible authorities. There have been exceptions to the rule. The campaign in Mesopotamia in 1915 was one, when in the surrender of Kut and in the fearful loss of life incurred in the vain attempts to relieve it we paid the price of attempting operations patently beyond the scope of the slender administrative resources available. But the exceptions have been few, and in the second World War I cannot recall a single instance of serious failure. Nor do I believe that administrative failure when it does occur is necessarily damaging to morale. It is not the habit of British troops to cry : " *Nous sommes trahis* ! " when things go wrong ; they are usually quite ready to believe that it is due to Acts of God or the King's Enemies, even when as a matter of fact it is due to nothing of the sort. Major administrative policy is a subject exceedingly remote from those most liable to suffer by its mistakes. The kind of administration which is seen by the soldier and open to his criticism is the administration of his own platoon or company—administration so homely and so prosaic that it is seldom dignified by so stately a name. Is the duty roster fairly kept ? Are the rations decently cooked ? Does the Medical Officer take trouble over a man who reports sick ? Can the Pay Sergeant explain why a man's credit is less than he thinks it should be ? These are the things that matter to the rank and file. Classify them under administration if you like, or, if you prefer, classify them under the heading of leadership ; the two are inseparable at or below the level of a Lieut.-Colonel's command. A junior officer cannot be a creature aloof, making his appearances only in shining armour to lead his men into battle. He has to be not only their leader in battle but their father and mother at all times. If he is not prepared to do this, and anxious to do this,

he is not a good officer. Of an evening, in the tent which is the Company Officers' Mess, the Major will say to the subalterns: "Who'll pay out tonight?" or "Who'll issue rum?" The rain is pelting on the canvas. The job will take the best part of an hour. Reveille tomorrow is at 4 a.m. The subaltern who says "I will," and gets up, has in him the roots of leadership as well as of administration.

Writing of such things takes me back to Macedonia in the autumn of 1916. The company in which I was serving was in bivouac among the trees on the bank of the River Struma. We had been withdrawn into reserve after a week of almost continuous battle—the forcing of a passage across the river and the consolidation of a bridgehead on the far side. We had had some casualties, not enough to be depressing, and we had had a sprinkling of immediate awards of decorations. There was nothing wrong with our morale. In the evenings the autumn sun showed red through the trees and the mist rose slowly from the river. More than thirty years have passed since then, but I can remember perfectly well going on parade to make the rum issue—to make it, not to superintend it—and the look and the feel of the little tin mug that was used to measure out the ration, and the smell of the rum on my fingers, and the names and the faces of every one of the score of men who were my particular charge. I did not realize at the time that I was serving the best form of apprenticeship to my trade that a young officer could ask.

That is a digression, designed to illustrate the meaning of administration at the lower levels. Given good leadership, good discipline, and good administration, what other factors conduce to high morale? The answer is, I think, that the only other major factor is the subtle and elusive quality known as *esprit de corps*.

Esprit de corps is not the prerogative of the armed forces. It springs up wherever men are united in a corporate effort and share a common loyalty—it no doubt existed among galley-slaves—and its influence can be immense. "Not to let the side down" is the keynote. To the soldier it offers yet one more inducement to strive for a level of achievement higher than he could otherwise attain. The Army realizes this, and our military organization is designed to foster *esprit de corps*. There are plenty of simple and inexpensive ways of doing so: distinction in dress, idiosyncrasies of drill, the teaching of regimental history. The difficult thing to decide is just which component part of the military machine should be selected as the focus on which *esprit de corps* should centre: the battalion, the regiment, or the corps. In peacetime the choice is limited to these three, for the higher formations, such as an Army, which in war can generate intense *esprit de corps*, no longer exist. The official answer is in favour of concentrating upon the regiment, but there is room for difference of opinion.

The present regimental organization of the infantry of the line was introduced as part of the Cardwell Reforms of 1881. Broadly speaking, each county regiment consists of a depot, located in that county, and two battalions—though many regiments have recently been reduced to a single battalion and the rest seem likely to follow suit in the near future. The Army has never been altogether happy with this organization. In the first place it involved the abandonment of the old and highly-prized numbers of the regiments and their replacement by a geographical appellation. This was unpopular. "Lads of the Fifty-third" sounds better than "Lads of the First Battalion, the King's Shropshire Light Infantry"—apart from metrical considerations—and many battalions continue to this day to use their old numbers in preference to their official titles. In the second place the system has broken down in each of the two world wars which have subjected it to

test. The regiment is too small an entity to survive under war conditions. The unlucky regiment which incurs heavy casualties in each of its two battalions must be brought up to strength by drawing on counties other than its own, and its territorial character vanishes. During the second World War the Colonel of a distinguished Highland regiment remarked that the regiment might suitably be renamed "The London, Midland and Scottish." Since the war the rigidity of the regimental system has been modified by forming regiments into groups—the Light Infantry Group, the South-Western Group, etc.—and making individuals interchangeable within each group. This is certainly a step in the right direction, but does it go far enough? The logical solution is a Corps of Infantry, officers and men alike available for service in any battalion of the corps. Opponents of the idea claim that it would weaken the territorial connexion and consequently be harmful to *esprit de corps*. I doubt it; the territorial connexion is already weak, and it is surely surprising that the Infantry should be the only corps in the Army which is organized on a territorial basis—and not the whole of the Infantry at that. Other corps seems to manage very well without it: the Royal Armoured Corps, the Royal Artillery, the Royal Engineers, not to mention the two senior battalions of Foot Guards. Admittedly it would be a drastic measure, for the Territorial Army has to be considered as well as the Regular Army, but there is much to be said in its favour.

Esprit de corps in war-time is fostered by other and more potent means than stressing the regimental aspect. After the first World War it was generally accepted that the division was the highest formation in which *esprit de corps* could make itself felt, and even there but seldom: the 29th Division was a case in point. The second World War contradicated this teaching. Not only did many divisions achieve a high degree of *esprit de corps*, but many Army Corps did the same, while higher formations still, the 8th and 14th Armies, made a reputation such that every individual in them was proud to wear their distinctive flashes. Why should the lapse of twenty years have brought about this surprising change? I do not think that it can be ascribed to an improvement in leadership. Without strong and colourful leadership *esprit de corps* cannot be cultivated in so huge a body of troops as an Army, but strong and colourful leadership was not lacking between 1914 and 1918. I think rather that the change is due to the more efficient and rapid agencies now at the disposal of a Commander seeking to impress his personality on the troops serving under him. Air transport has increased his ubiquity, and the press, the broadcast, and even the gramophone disseminate what he says and what he writes. The great Commanders of the past had none of these aids, but then the number of men with whom they were dealing was relatively very small. Whatever the reason for the change, there is no denying the fact.

Esprit de corps, and especially the *esprit de corps* which can grow up in a formation in war-time, can make a substantial contribution to the morale of that formation, yet it would be a mistake to forget that it may be detrimental to morale elsewhere. Such a unit, or such a formation, although a lion in battle, may be an uncomfortable neighbour. The lion tends to expect the lion's share of anything there is to be had, and the lion also tends to look down on those whose prowess has not been so convincingly demonstrated as has his own. The process of fostering *esprit de corps* should be conducted without bringing in comparisons, necessarily odious, with others who are outside the charmed circle. The Loamshires should learn to pride themselves on their superiority over their country's enemies, not on their superiority over the Blankshires next door; but the former comparison can only be

drawn in war-time, and then on data not easy to verify, while the latter comparison invites itself in every garrison town. Rivalry of that kind can be healthy but it can also be highly mischievous. It is usually the unit which has fallen below the average that seeks to hide the fact by ostentatious scorn of its neighbours.

It may be suggested that in listing these four principal ingredients of morale—leadership, discipline, good administration, and *esprit de corps*—I have been guilty of an omission in making no reference to the justice of the cause in which a war is waged. Cromwell declared his preference for "a plain russet-coated captain that knows what he fights for and loves what he knows," but this view has found singularly little support among the great Commanders who have succeeded him. Napoleon said expressly that the justice of the cause was a matter of little moment, and his opinion is entitled to respect, for seldom have armies fought more magnificently than his in causes more wholly reprehensible. More recently Field-Marshal Lord Wavell has expressed similar views. This conflict of opinion can be understood when viewed against the background of the circumstances of the time. Napoleon was thinking in terms of war against a foreign enemy, and in a war against a foreign enemy the just cause means to most men the cause of their country. Cromwell was thinking in terms of civil war, and he disregarded love of country because it was common to both sides ; their difference lay only in the rights and wrongs, political and religious, of their respective causes. Love of country may be taken for granted as an element in the morale of British troops, and love of country is a more powerful motive than the consciousness that one's cause is judged by lawyers and divines to be the sounder one. Patriotism has been under a cloud ever since Dr. Johnson remarked unkindly that it was the last refuge of a scoundrel. When we go to war nowadays we are told that we are fighting for such abstractions as Democracy or the Four Freedoms, but can one Englishman in a thousand say off-hand what the Four Freedoms are ? By their poetry shall ye know them. An "Ode to Democracy" has yet, to the best of my belief, to be written ; it was love of country which lit the leaping flame of Rupert Brooke and illumined the calm radiance of Cecil Spring Rice, both of them looking undismayed on the sacrifice so soon to be required of them. Patriotism may ultimately give way to some wider loyalty, but not yet, nor for a long time to come.

During the second World War there was shown in England a film entitled *The Way Ahead*. It was of the nature of propaganda—or at least it was certainly produced under official auspices—though it showed none of the unpleasant characteristics associated with the word. In it was portrayed a group of a dozen recruits called up for the Army. One first saw them following their civilian occupations before the war—insurance agent, clerk in a tourist office, shopwalker, stoker, shepherd, young man about town ; then arriving at the depot and doing their recruit training ; then travelling by troopship to the Mediterranean ; and finally in action in North Africa ; all under the charge of the same subaltern and the same sergeant. It showed with wonderful clarity the development and growth of the ingredients of morale, and of morale itself, from the sowing of the earliest embryonic seed of corporate feeling to its final flowering ; and the curtain falls as the team—disciplined, resolute, full of confidence in themselves and in each other—move steadily forward and disappear in the smoke of battle. Any young officer who attended a performance of that film was shown all that he need know of the art of leadership and of the meaning of morale.

BOOK REVIEWS

THE OTHER SIDE OF THE HILL

By B. H. LIDDELL HART

(Published by Cassell & Co. Price 10s. 6d.)

Liddell Hart's latest book *The Other Side of the Hill* tells the story of the last war as seen by the German generals whom the author interviewed in captivity after it. There is also something of the inside history of the growth of the German Army between the wars.

It is, in parts, an interesting book ; and the frequent cuts at British, and indeed *all*, professional military opinion gives it that sting which one naturally associates with the author.

There are, however, many blemishes. In the first place he tells us much too much about Liddell Hart. It is, for instance, irrelevant to tell us that General Patton studied " Sherman's campaigns on the ground with my book in hand " or that General von Manteuffel " spoke to me of the impression made on him by a little book of mine . . . which appeared in 1932."

Next, there is too much repetition. In a book which is a summary of evidence some repetition is inevitable. But there is repetition in the narrative too. The circumstances of Kluge's death are set forth in three places at least ; and the different theories of defence held by Rundstedt and Rommel in the west are discussed twice. One feels that parts of the book were added to make the length demanded by the publisher. Certainly the reader would welcome a cut.

Lastly, one cannot tell to what extent the German generals' accounts of events were tempered by afterthoughts. It is well known that prisoners' evidence of their battles is not always the best. Incidentally, we are told that the conditions of the generals' captivity do us, their captors, no good : many British officers will agree with this view.

Having said this against this book, let us see what is good in it. One is staggered by Hitler's mistakes. Hitler, for political reasons, saved the B.E.F. by forbidding his armoured forces from harassing the embarkation at Dunkirk. He still hoped to make terms with Britain ; and he expected it would be easier if Britain were not humiliated by catastrophe.

In the Russian campaign there were three objectives : the destruction of the Russian army west of the Dnieper, the occupation of Moscow, and the occupation of Caucasia and the Ukraine for their oil and wheat. The second two might reasonably be expected to follow from the first ; but having failed in the first (they say the cause was mud) it was folly, with the available resources, to try for the other two at once.

Hitler was able to overrule the generals for three reasons. First he was dictator. Secondly, he had at O.K.W. (Supreme H.Q. of the Armed Forces) access to military intelligence not available at O.K.H. (the H.Q. of the armies) and he could quote this against the generals' opinions. Thirdly, he had proved himself right and the generals wrong on more than one occasion. He was right, they say, not to withdraw from Moscow in 1941. Too many soldiers had read " Caulincourt's grim account of 1812." To order withdrawal was to license panic. But he was fatally wrong to forbid withdrawal on many other occasions—in Normandy for instance.

It is prudent today for German generals to lay the blame at Hitler's door. At the time, it seems, some of them were his ardent supporters. In 1941 Bock and most of the senior generals agreed with Hitler's plan to achieve successive encirclements of the Russians. In the other camp were Guderian and " the new school of tank experts who had a different idea—to drive deep, as fast as possible," and leave encirclement to following-up infantry forces.

Hitler, and one feels that he was not alone, had a narrow view of the war. He could not understand the sea ; he was not interested in the invasion of Britain ; and he did not see the damage he could inflict on us in N. Africa.

The generals too had their limitations. With the exception of Rundstedt, who commanded respect from both sides, the others were either " aggressive young generals, blustering and boorish " or " of a different type . . . and by no means a dominating one . . . They were essentially technicians, intent on their professional job, with little idea of things outside it."

They were not well in touch with their troops. Kluge, for instance, had to make a special five-day tour, consulting " junior officers and N.C.Os." to ascertain the feeling amongst the troops before Moscow in 1941. On our side of the hill the highest commanders knew the feelings at the front as part of their stock in trade.

There is no mention by the generals of what many junior German officers have since told me ; namely, that the Russian troops were only forced to attack across the Oder after a purge from Moscow. This has always seemed so unexpected, and yet so widespread, a belief that I can only assume that the German generals did not know of it or they would certainly have confirmed or denied it.

There are many details of interest : the results of allied interdiction of railways before D-Day ; the terrific effect of the fire of the Royal Navy at targets in Normandy ; the use of camels for supply of the German tank forces before Stalingrad ; and the value of centralized control of artillery by the senior artillery commander in the " hedgehogs " of 1942.

The account of the attempt on Hitler's life in 1944 is a full one. No one in England would have believed, though, in 1940 how little was needed then to make the generals turn against the régime. There may have been something in our " leaflet propaganda " in 1939 after all.

The Germans pay tribute to the Russian soldiers, though it is interesting to read that Russian generals captured in 1942 said that the Soviet Union was as rotten within as Germany was.

On the whole, this book might be described as a good one to take out of the library.

M.C.A.H.

WAR AS I KNEW IT

By General George S. Patton, jun.

(Published by W. H. Allen, London. Price 18s. 0d.)

War as I Knew It by the late General Patton, Commander of the United States Third Army in Europe, is a disappointing book. It was written by the General, mainly from entries in his diary, and it has been annotated by Colonel Harkins, who served on his staff.

The book is divided into three parts. Part I consists of extracts from letters, written by the General to his wife, about events in North Africa and Sicily in 1942 and 1943. (They display the keen observation of a commander and a

naïveté, not uncommon in the New World.) Part II is the account of the Third Army's career from Normandy to Czechoslovakia in 1944 and 1945. In Part III are some " Reflections and Suggestions " on the Art of War, and some anecdotes entitled " Earning My Pay."

The disappointing thing is that there are few facts that are new. Most readers, who followed the war intelligently, could trace the progress of the Third Army ; and, apart from a few dates, distances, and casualty figures the book adds little to what is already well known. To be sure, the General gives his opinions on various controversies of the time (for example, where to make the main effort in August, 1944, after crossing the Seine). But he does not discuss these problems ; he merely states his own convictions. This is a pity, for he must have known, at first hand, all the military and political factors, and all the personalities concerned.

Perhaps the most interesting aspect of the book is the light it sheds on the character of the General himself. He shows himself as a difficult subordinate. He often deployed his corps and divisions so as to force the hand of the High Command into backing him up to the hilt. (From the point of view of the Army, this may have been good enough ; but one doubts whether it was always in the best interests of the Cause.) The most flagrant instance, as the author generously admits, was on 17th December, 1944. To quote his own words : " I also directed (General) Eddy to get the 4th Armoured (Division) engaged, because I felt that, if we did not, it too might be moved to the north by higher authority. The fact that I did this shows how little I appreciated the seriousness of the enemy attack." This was on the eve of the German offensive in the Ardennes.

On the other hand, when he was forced, or cajoled, into obeying S.H.A.E.F. he certainly moved with rapidity. Here one reads at first hand how he did it.

Patton never took " No " for an answer. Corps and divisional commanders often asked him to modify his plan, to postpone his attack, or to give them more time. They were usually told that if they could not do as they were ordered they must nominate their successors. And from the results achieved one must judge that Patton was usually right.

He was a colourful personality ; first cursed, then loved by the troops he commanded. He had no use for anyone who was afraid. (He had profound contempt for newfangled ideas like " battle fatigue.") To his mind a soldier who " shirked in battle should be executed." He gives a candid account of how he struck a soldier in the face with his glove for " the shameful use of ' battle fatigue ' as an excuse for cowardice."

There are a few references to the British. He took a liking to Wilson in Cairo. One suspects he admired Alexander ; but he had no patience with Montgomery, and he pours scorn on the process of " regrouping " : a process which he associates with the commander of 21 Army Group.

Patton was a lover of horses. He knew something of history. He quotes freely from Kipling and occasionally from Milton, Shakespeare and Burns, and he had evidently, studied the life of Nelson.

In the anecdotes at the end, Patton describes various incidents during his career when he had to display moral or physical courage or determination out of the ordinary. He says on more than one occasion that it looks, in print, easier than, in fact, it was. That is really the trouble throughout the book. The author was better with his sword than with his pen. One feels all the time that this forceful and vivid General should have left this book for a more accomplished writer. Patton would be a fine subject for a biography ; and this autobiography, for such it is, does not do the subject justice.

M.C.A.H.

MILITARY AND POLITICAL CONSEQUENCES OF ATOMIC ENERGY

By F. M. S. BLACKETT

(Published by the Turnstile Press. Price 12s. 6d.)

Professor Blackett tells us that his book originated in a disagreement with his colleagues on an advisory committee. It deserves serious consideration, both because of the scientific eminence of the writer and because it is the fullest explanation and justification of the Soviet attitude to atomic energy which has been published in this country. Unfortunately the book provided ammunition for Mr. Gromyko at United Nations discussions. As would be expected from such a fascinating lecturer the argument is persuasively set out, though perhaps it suffers from some repetition.

The author first discusses the value of strategic bombing. From statistics published since the war and after, and taking into account the increased effect of atomic bombs, he concludes that there is no likelihood of bombing winning a war in a short period, or of atomic bombs enabling the United Nations to exercise effective sanctions against a major power. He argues that there is no possibility of Russia being able to subject the United States to such an attack for lack of suitable carriers, whereas America could bomb Russia by establishing bases in adjoining countries.

Chapter 8 discusses atomic power generation. The argument runs that this is of much more interest to Russia than America, since the latter has larger and better developed supplies of other fuels. The book then traces and discusses the history of attempts at control. The first report on the subject was submitted to President Truman by a committee of seven scientists under Professor Frank in June, 1945, and was followed by the Lilienthal report which first demonstrated the technical possibility of control and recommended the setting up of an Atomic Development Authority. This authority was to control and operate, as well as inspect, all major activities throughout the world. This recommendation formed the basis of the Baruch plan submitted to the United Nations, which the Russians alone refused to consider, their refusal bringing about the eventual break-up of the Atomic Energy Commission. In brief the conflict was between the American view that international control should be a going concern before existing stocks of bombs were destroyed and the Russian that the bombs must be destroyed first.

Professor Blackett ends with a discussion of the likely course of events now that the A.E.C. is dissolved. He gives reasons for thinking a war unlikely within the next five or ten years and suggests the only hope of a solution is in a general disarmament pact. The fate of disarmament conferences between wars gives one cause to doubt this. An interesting chapter is devoted to the reasons for dropping atomic bombs on Japan at a time when that country was about to collapse in any event. The author rejects the usual reasons given, such as ignorance about the state of Japan, and believes it was done primarily to forestall the establishment of Russian forces in Manchuria.

Professor Blackett supports the Russian view plausibly, but in the reviewer's opinion bases his arguments on three entirely wrong assumptions. He attributes aggressive motives to the United States, quoting various irresponsible remarks in the American press. He considers that the A.D.A. would be dominated by America and an instrument of United States policy, even going so far as to say that the inspectors of that body would act as American military agents (page 139). It is also suggested that the A.D.A. would deliberately hinder the development of nuclear power in Russia for the reason that,

under the Lilienthal plan, power stations were to be sited on strategic and not economic grounds. It is surely obvious that an Atomic Authority dominated by one nation could never be acceptable, but it is surprising that such an eminent scientist as Professor Blackett should lend weight to such one-sided suspicions.

With regard to nuclear power supply, Professor Blackett makes a mistake very common among scientists, namely of underestimating the engineering difficulties in applying scientific discoveries. Ignorance is still (March, 1949) almost complete on the subject of nuclear power stations—what materials to use, how to deal with the "ashes," even what nuclear process to employ. This ignorance will only be dispelled by many years of experiments and these have only recently been started. Russia is not without other sources of energy and even if nuclear power generation were possible today it might not be economically advantageous to use it. All methods of power production at present under consideration do no more than to replace the fuel burners in a steam raising plant by nuclear processes, the rest of which remains unaltered from current designs.

In contrast to the future possibility of power generation, the atomic bomb is here today and while it may not win wars it can bring death and destruction to thousands in a matter of seconds. With the present state of suspicion in the world, international control of atomic bombs or any other weapon is impossible. Unfortunately the book under review may tend to increase this suspicion.

K.H.T.

BRITISH ARMY JOURNAL

(Official War Office Publication)

The aim of this official periodical for officers, which is to be published half-yearly, is to increase their general military knowledge and background. It will present both official views and the unofficial views of individuals. In the first issue, published in January, seven individuals, ranging from Major-General to Private, contribute, while a further seven articles are unsigned and presumably official.

There is clearly room for a magazine with the above laudable object, particularly since so many officers do not read periodicals such as the *Army Quarterly* and the *Journal of the R.U.S.I.* Some in fact have not yet acquired the military background to appreciate much that appears in such publications, whereas the new magazine is in no sense advanced reading. Many officers, now regrettably ignorant of military matters outside their own immediate purview, will do well to read the *British Army Journal.* The essential question is will they ? Much depends on the magazine's readability, and care must be taken to avoid articles which savour too much of the official manuals.

Several of the articles could not be bettered for their purpose ; those who cannot manage to read them must be put into that hopeless category "non-reader." Two articles, however, border too much on the official manual and might be labelled "worthy but dull."

The articles which are personal accounts are those which will be the most read and remembered ; they are excellent.

The Editorial expresses the hope that many officers will contribute, and rightly adds that the success of the magazine depends on their doing so. If they do, its object should certainly be achieved.

R.E.B.

PRESTRESSED CONCRETE

By PROFESSOR GUSTAV MAGNEL

(Published by Concrete Publications, Ltd., London. Price 15s. 0d.)

The author, a member of the Royal Belgian Academy and Professor of Reinforced Concrete at the University of Ghent, is to be congratulated on a timely and most readable contribution to the growing volume of literature on this comparatively new technique.

Professor Magnel rightly considers that prestressed concrete has now reached a stage of development when it is of value to present in book form a concise account of present knowledge of the subject, to provide data and a simple method for designing structures in prestressed concrete, and to give the contractor the information necessary to ensure efficient execution of the work. This objective he most happily achieves and at the same time places in the hands of the military engineer sufficient knowledge of these civil engineering principles for their application to military requirements.

The potential military applications and implications of the technique of prestressing merit immediate consideration. Our engineer campaigns in the past have usually been conducted at the far ends of highly congested sea, rail, and road or air supply lines and against a background of acute shortages of material and transport The most unimaginative cannot fail to appreciate the military value of a system which can substitute a piece of high tensile piano wire for a rolled steel joist : reduce the weight of steel and concrete in bridge construction to 30 per cent and 60 per cent, respectively, of weights previously required for similar work in reinforced concrete construction : permit the economical construction of aeroplane hangar roofs with prestressed beams of 164 ft. clear span and only 8 ft. depth : and open up the possibilities of prestressed concrete runways of only 6¼ in. thickness of slab to take aircraft with wheel loads of 85 tons.

In Europe today prestressed concrete bridges are rapidly replacing those demolished in the war. Eight new 242 ft. clear span bridges are being manufactured for the river Marne alone. Will a small one pound demolition charge on each of the male cones of the Freyssinet system bring these giant spans crashing into the water ? Will the noiseless removal of the cast-steel wedges from the sandwich plates in the Belgian method effect the same spectacular results ? The answers to these and similar questions are doubtless already well known in Western Union headquarters and in exclusive anti-sabotage circles ; they will certainly be required to be known by all officers who might be called upon to carry out demolitions.

The possible application of prestressed concrete to field works and its effect, if any, on reducing proof thickness for either projectiles or blast presents a line of investigation that might simultaneously give some of the answers to our numerous military, and civil defence, structural problems where some form of concrete construction is indicated on account of its protective properties against gamma radiation.

Our Military Engineering Manual on Reinforced Concrete has recently been rewritten to include a chapter on prestressed concrete. Similar additions are required to our manuals on demolitions and accommodation to cover the new technique.

Is the prestressed concrete road with diagonal joints and a slab thickness reduced to some 2 in. the answer to the Class 70, two-way, all-weather, military road of the future ? Such a possibility would appear a reasonable target to aim at and would result in an immediate reduction of 80 per cent in

the total tonnage of material required by the military road builder, and effect comparable increases in speed and range or alternative economies in resources. Operation " Spearhead " of the future may well include in its Order of Battle the " Prestressed Construction Engineer Regt. R.E." The destiny of an empire and the fate of an army has frequently been held to hang by " a thread." Can we now go further and specify it more precisely as " a $\frac{3}{16}$-in. diam., high tensile steel wire, stressed to 60 tons to the sq. in." ?

To those with further interest in the subject, Professor Magnel, an engineer with English as well as Continental experience, has much to say. His clear and concise description of the basic principles and methods of prestressing put the beginner completely in the picture. His next two chapters on the design of simple and continuous beams and slabs introduce a quick and simple method of design based on a neat semi-graphical approach and give numerical examples from practice. Succeeding chapters cover laboratory tests on prestressed beams of various kinds ; tests to determine the amount of creep in concrete and steel and to establish the high resistance to buckling of prestressed members (they defy Euler and very nearly gravity !). Suitable working stresses are recommended. The final two chapters describe bridges, buildings, silos, and other structures designed and erected in prestressed concrete under supervision of the author, and also deal with precast prestressed products.

For a first edition the text is singularly free from errors, but the index is unfortunately unworthy of the book. Dimensions, weights, and stresses are given in English units, generally with the metric equivalents. The notation used is normal, with such additional symbols as are required for prestressed concrete.

N.W.

HISTORY OF THE GREAT WAR

MILITARY OPERATIONS IN FRANCE AND BELGIUM, 1917 VOLUME II

Edited by BRIGADIER-GENERAL SIR JAMES EDMONDS, C.B., C.M.G., Hon. D. Litt.

(Published by H.M.S.O. Price 30s. 0d.)

The publication of this rather belated volume has been delayed for various reasons, but now covers the important phase of the successful battle of Messines and the long-drawn-out struggle at Ypres in 1917, including the first and second battles of Passchendaele.

The volume contains twenty-nine maps, incorporating one general map in a pocket and twenty-eight smaller maps of individual operations bound in the volume as single pages. The latter are well drawn and show the details very clearly. There are also eight photographs which show the appalling weather conditions which, combined with the very heavy artillery bombardments, made all movement extremely difficult.

The reasons for continuing the operations under these very adverse conditions are explained and will be of interest to many who have not previously understood the full implications.

The Preface and Retrospect give extremely interesting facts and statements by both our own senior officers and from German records, since made available, which show that although the Passchendaele battles were not a tactical victory they were a very great strategical success and without them the French Army might well have collapsed completely.

C.C.P.

HISTORY OF THE GREAT WAR

MILITARY OPERATIONS IN FRANCE AND BELGIUM, 1917 VOLUME III

Compiled by CAPTAIN W. MILES

(Published by H.M.S.O. Price 30s. 0d.)

The publication of this volume, like that of 1917, Vol. II, reviewed on the previous page, has also been much delayed. It now completes the history of the war on the Western Front; the 1918 series having been published some years ago.

This volume deals with the battle of Cambrai and the new technique of the surprise attack without a preliminary bombardment and with the use of tanks. It explains the failure of the offensive after a most successful start.

The delay in publication has enabled further light to be thrown on the subject through information obtained from German sources.

Brigadier-General Sir James Edmonds writes a Preface to the volume and stresses some of the causes of the failure.

The general arrangement of the book is on similar lines to that of Vol. II.

C.C.P.

ROCKETS AND SPACE TRAVEL

By WILLY LEY

(Published by Chapman & Hall Ltd., London. Price 18s. 0d.)

The sub-title of this book is "The Future of Flight beyond the Stratosphere,' and to follow the author's arguments that such flight is possible it is only necessary to read his last three chapters. However, to understand them requires some preliminary knowledge of the theory of rocket flight, and such knowledge can be obtained from the preceeding chapters, in which science is nicely blended with history. The author shows ability to write for those who are neither learned scientists nor skilled mathematicians.

He compares inventions to structures such as the Eiffel Tower, rising into the sky of achievement from a number of legs. Travel in space is an incomplete edifice springing from many legs, of which the author deals in particular with four. The first is the centuries of controversy over the concept of plurality of worlds, the second is the establishment of certain natural laws (notably Newton's Third Law of Motion), and the third is the history of rocket development. His fourth "leg" is fantastic literature such as the writings of Jules Verne, for the book is concerned not only with technical progress but also with the growth of ideas which inspired it.

The first two chapters deal with the history of thought and observation which gave us our present understanding of the universe. These chapters are not strictly necessary to the main substance of the book but give historical perspective. Mixed with the history proper are accounts of fanciful writings, from the ancient Greeks to H. G. Wells. Accounts of fact and fiction are perhaps too intermingled, but there is no doubt that imaginative writings brought about general interest in inter-planetary travel and without such stimulus scientific progress would have borne less fruit.

Scientific research and fiction were in fact sometimes notably intermingled. Herschel's observations at The Cape led to a hoax in a New York daily paper,

which shows that the Press were adept at gulling the public even in 1835! This and other stories make the book entertaining as well as interesting.

The author next deals with the practical development of rockets, starting in China in 1232 and bringing the story into the present century with an account of Goddard, the mysterious American. In the course of following history he deals effectively with the basic principles of rocket propulsion.

The book goes on to developments during this century, which very largely means developments in Germany. At the focus is the Verein für Raumschiffarht, a society of scientists which was not only a sorting house of ideas but also the mentor of experiments. The author was an early member of it, as was also Valier who collaborated with von Opel in rocket-automobile experiments. Valier is described as "the instigator of this colossal nonsense," because the experiments were largely publicity stunts.

Up to 1935 the author was a leader in the rocket research of which he gives a clear account. He then left Germany; the hand of the Gestapo had fallen on the Society. He completes his survey of the past, however, with a chapter on rockets in the second World War and another of particular interest entitled "Peenemünde." Concerning defence against rocket missiles he declares there is no answer; if none is found this new weapon will be unique in history.

The last three chapters, to which reference was made at the start of this review, deal with the future. Those who read them will probably agree with the concluding sentence "The instruments needed for space travel can be built."

In a brief "Conclusion" the author faces the questions "Why should we wish to travel in space?" and "Who will pay to achieve it?" His answer to the first is "Knowledge" and to the second that one alone of the resultant discoveries might pay for everything. Though it may be a long time before his views are vindicated, what he has to say is well said and well worth reading.

R.E.B.

PAIFORCE—THE OFFICIAL STORY OF THE PERSIA AND IRAQ COMMAND, 1941–6

(Published by H.M.S.O. Price 5s. 0d.)

Note that this is the official "story" and not "history" of Paiforce. Except as an introduction, it is not a book for students of strategy, tactics, or the supply and maintenance of large forces, but an extremely readable and pleasantly got-up popular account of the events in Iraq and Persia during the war, against the background of their previous history and of the war as a whole.

The style is lively, the book abounds in individual instances and anecdotes, some not without humour. There are 137 pages, twenty-two illustrations, most of them well-selected full-page photographs, and eight maps and sketches.

Not much fighting fell to the lot of this Force. It existed for two main purposes. The first was to stop the Germans should they break through the Caucasus or approach through Syria with the object of obtaining a port on the Gulf, cutting our communications with India, and depriving us of the Middle-East oil-fields. The second and later purpose was to establish and maintain a supply route for warlike stores and raw materials to Russia.

BOUGAINVILLE AND THE NORTHERN SOLOMONS

(Published by the Division of Public Information. U.S. Marine Corps)

This book gives an excellent account of the fighting on Bougainville Island in the Northern Solomons. The main object of this particular campaign was to neutralize the important Japanese Base at Rabaul, on New Britain Island, some 200 miles away.

This was most successfully accomplished, but only after the most stubborn fighting and immense difficulties of the nature of the country, which consisted of very dense jungle and seas of mud. Very good photographs show clearly these difficulties, which must have made the supply problem a perfect nightmare.

The book is also extremely well supplied with maps and sketch plans which show very clearly the details of the various operations undertaken.

The book is a companion volume to other similar books issued by the U.S. Marine Corps entitled *The Defense of Wake*, *The Battle of Tarawa* and *Marines at Midway*, all of which give a very clear picture of the immense difficulties entailed in the fighting on these Pacific Islands.

C.C.P.

THE KEEPING OF REGIMENTAL ACCOUNTS

By MAJOR J. A. D. RICHEY

(Published by Gale & Polden. Price 3s. 6d.)

This booklet would be very helpful to an officer holding regimental accounts in that it gives a fairly complete and concise picture of regimental accounting, which is not difficult to follow.

It gives good advice on the method of keeping accounts accurately and also a workable system for ensuring that the regimental accounts do not get into serious debit unwittingly.

The hints on preparing regimental accounts for audit are practical and helpful. Points for auditing regimental accounts are also good and would be especially helpful to an officer who was not experienced in these matters.

In general the book should be a useful guide and reminder to officers, both experienced and inexperienced, in regimental accounting. However, it should not be used or quoted as an authority for official accounting.

R.G.A.

THE B.S.P. POCKET BOOK

(Published by the B.S.P. Co., Ltd., Haymarket, London. Free)

The British Steel Piling Co., Ltd., have published a very useful little pocket book, size 5 in. by 4 in. with 268 pages.

The book contains very useful information under the following headings :—

(*a*) Larsen Piling—giving all particulars of weights, strength and quantities required.
(*b*) Coffer Dams and Retaining Walls—giving particulars of design and construction.
(*c*) Driving Practice for Steel Piles.
(*d*) Details of Pile Frames, Hammers and Extractors, Winches and Boilers.
(*e*) Particulars and Calculations for Bearing Piles, including Vibro Concrete Piles.
(*f*) A number of useful general tables and formulae.

A very valuable little book for any engineer. C.C.P.

Five short chapters bring the history of Iraq and Persia up to 1939, and sketch their geographical importance. Then follows a lively account of that exciting and critical episode, during the course of which a rebellion took place in Iraq, the R.A.F. were besieged in their peace-time station at Habbania, and the British community in Bagdad were either evacuated by air or kept impounded and in a good deal of danger in the British Embassy compound. The rebellion was mistimed and the Germans were not able to support it effectively. How the situation was retrieved by a bold and active defence, and by flying troops in from India makes an extremely good story and is very well told. By April, 1941, the situation was in hand and British and Indian troops in occupation of the country.

The middle section of the book deals with the German threat in the north, and the development of Iraq as a stop. This involved the building up of an immense base, with advanced base depots and establishments, and the construction in a very short time of extensive field fortifications in the north of Iraq, from which an aggressive defence could be conducted, or an advance mounted. The large town of Mosul, for instance, was the centre of a fortified area which included thirty or more miles of anti-tank ditch, concrete emplacements for field guns as well as for smaller arms, and an underground hospital. There is also a chapter on the Force's share in the Syrian campaign.

The last part of the book is concerned with aid to Russia. The few poor roads in Persia and its one single-track railway were never designed or intended to enable goods to travel from the Persian Gulf or Iraq to the Caucasus. Yet a system of roads, rail and docks was constructed or produced by additions and adaptations which enabled *five million tons* of essential supplies to go to Russia from October, 1941, to the end of the war. The only other effective contact Russia had with the outside world was by the convoys which sailed at long intervals and great risk via the Arctic to Archangel and Murmansk.

It will be realized that this must have been very largely an Engineers' campaign, and so it was ; and full justice is done to the Corps and to the Indian Engineers and to the fine work done by them in extremes of climate and of geographical conditions, not forgetting Brigadier Gifford Hull's surprising road–rail pile bridge, with the submerging span, across the Shatt el Arab. Mention is also made of the notable contributions made by the American Army (mostly Engineers), by the Anglo-Iranian Oil Company, and by the U.K.C.C.

Further accounts of the engineering work carried out by Paiforce have been published in the *R.E. Journals* for June, 1946, September, 1947 and June, 1948.

E.M.E.C.

WELLINGTON COLLEGE: THE FOUNDERS OF THE TRADITION

By G. F. H. BERKELEY

(Published by R. H. Johns Ltd., Newport, Mon. Price 12s. 6d.)

A previous book entitled *My Recollections of Wellington College* by the same author was reviewed in the September, 1946, *R.E. Journal.*

The book now published adds further particulars of the early days of the College and will be of interest to the many Old Wellingtonians.

C.C.P.

TECHNICAL NOTES

PRESTRESSED CONCRETE

(*R.I.B.A. Journal*, dated November, 1948)

A paper on Prestressed Concrete by L. W. Elliott, A.M.I.C.E., A.M.I. Struct.E., was reproduced in the *R.I.B.A. Journal* of November, 1948.

After a historical survey, the author describes current methods of prestressing and post-stressing, followed by a brief description of actual jobs carried out. These include bridge, airport and housing work by M. Freyssinet in France, an aircraft hangar by Professor Magnel in Belgium, hangar work in India, and floor joist work in Britain.

An interesting description is given of the Swiss Stahlton floor. In this the prestressed factory-made element is a clay tile with grooves on the upper surface, in which prestressed high tensile steel wires are bedded and held by mortar. This element is then used in a normal hollow-tile cast-in-situ floor in place of the usual mild steel reinforcement.

A NEW SELF-PROPELLED MOBILE CRANE

(*The Railway Gazette*, dated 17th September, 1948.)

To meet a demand for a flexible heavy goods handling equipment a 12½-ton Coles mobile crane has been produced, which is available for petrol, electric or diesel-electric operation.

This article gives the specification of the crane and it also describes its performance. It has four motions, namely hoisting, derricking, slewing and travelling, each operated by separate electric motors which are controlled from the driving seat of the revolving superstructure. With loads of 8½ tons and under, the crane is fully mobile, but when handling heavier loads, the chassis is jacked with outriggers to provide a fixed base.

The crane is fitted with a sectional strut-type jib and travels on double pneumatic-tyre road wheels, which allow low wheel loading.

GAS SHIELDED WELDING PROCESS

(*Railway Age*, dated 25th December, 1948.)

A new welding process has been introduced in America which is to be known as the Aircomatic process. It may be used for welding heavy sections of aluminium and aluminium alloys at wire feed speeds ranging from 100 to 300 in. per minute.

Essentially this process is a form of gas-shielded, metal-arc welding but the conventional nonconsumable electrode has been replaced by a continuously fed, consumable wire. This wire is fed to the work through the barrel of a welding " gun " which resembles an automatic pistol. The filler metal carries welding current and an arc is maintained between the end of the wire and the work. Power is supplied from a standard D.C. welding generator and argon is used as the shielding gas.

These units were planned to be available towards the beginning of 1949 and, although they are at the moment only for use with aluminium, the application of the process to other metals is now under development.

NEW ALUMINIUM BASCULE BRIDGE

(*The Times Review of Industry*, dated December, 1948.)

Although aluminium has been used in the construction of at least one bridge in the U.S.A., the cost of the material generally makes its employment in such structures uneconomical.

The new Weir Bridge at Sunderland, described in the above journal, is the first real attempt at fabricating a complete bridge structure utilizing the light-weight characteristics of this metal to create an overall economy.

The bridge is a 121-ft. span, double leaf, trunnion bascule type with the pivots located at each abutment at road level. Each leaf has side girders extending back beyond the pivots, and the bridge is pivoted up and opened by means of two 25-b.h.p. motors operating through two curved racks fixed on each of the tail girders.

The alloy used, A.W.15 with an ultimate tensile strength of 25 tons per sq. in., allowed a weight saving of 60 per cent over an equivalent steel structure.

The weight saving in this instance not only reduced the dead weight of the structure, but it enabled the spans to be prefabricated for floating to the site permitting rapid erection and minimum interruption of the dock. The low weight also reflects a saving in the abutment and in the operating motors and mechanism. This saving in operating costs over a period of years would justify the initial increased first cost of installation.

SOME APPLICATIONS OF ALUMINIUM ALLOYS TO STRUCTURES

(*The Structural Engineer*, dated December, 1948.)

The author sets out by suggesting that the basic reason for the choice of aluminium alloys for building work may be one of, or a combination of, the following good qualities :—

(*a*) Low specific gravity.
(*b*) Adequate strength.
(*c*) Resistance to atmospheric attack.
(*d*) Versatility of form.
(*e*) Machinability.

Under (*a*) he mentions the large part played in aircraft design where stresses of 6.4 tons per sq. in., on a factor of safety of 5, are used for wing spans, with a consequent saving in dead weight. Travelling cranes can be designed at little more than half the weight of comparable mild steel jobs. Portability is stressed, and note made of pre-fabricated sections of huts and houses where lightness of units and ease of erection are vital factors.

Under (*b*) mention is again made of aircraft construction, whilst a specific example of an all-aluminium bridge recently built in America is quoted.

As a resistant to atmospheric attack there is no other constructional material of comparable strength to equal it. Roof glazing bars of extruded aluminium alloy give long service in roofs of engine sheds and saw mills, where, normally, corrosion to mild steel is common. Roof trusses of mild steel which had corroded through exposure to sulphurous fumes have been replaced by aluminium trusses, the latter showing no signs of corrosion. Marine atmospheres are particularly severe on the older forms of structural materials, but here again, aluminium alloys stand the test.

(*d*) *Versatility of Form.*—There is practically no limit to the form and intricacy in which extruded sections can be produced. This flexibility of form invariably leads to higher efficiency in the structure with a consequent economy in cost. Whilst hitherto the metal framework of buildings of domestic type have been concealed by the application of coverings both externally and internally, it is possible with aluminium frames to combine their decorative and structural features, so reducing the cost of coverings.

Finally, under the heading of Machinability the author claims that where much cutting and drilling has to be done speeds greatly in excess of those for steel are possible.

Throughout the paper the author makes no attempt to hide the fact that in first cost, weight for weight, the aluminium alloy is more expensive than its steel counterpart. When, however, one considers that a lighter truss means in turn lighter stanchions and footings, a lighter bridge superstructure means a reduction on the piers and abutments, a lighter crane requires correspondingly lighter gantry girders and stanchions, one must admit that in aluminium we have a material with far-reaching possibilities.

SOUND INSULATION OF CAVITY PARTY WALLS

(*R.I.B.A. Journal*, dated January, 1949.)

The problem of sound insulation of party walls is discussed in some detail. Such walls are commonly built of brickwork, dense concrete, hollow clay blocks, or light-weight concrete. Foamed slag or clinker blocks are also being increasingly used, and are among the best and cheapest materials for sound insulation. When building every care must be taken to block any means by which vibrations may be transmitted. These include: minimum use of tiers between leaves of cavity walls, 9 S.W.G. should be used in preference to the heavier twisted metal strip ; minimum mortar droppings ; a sound-proof course at the base of the walls so that vibrations are not transmitted from wall to wall through a common base, the ordinary bitumen damp-proof course being satisfactory. Where slates or engineering bricks are used as a damp-proof course on adjacent external walls, a layer of bitumen should be inserted for several feet along from the party wall to prevent indirect transmission of vibrations.

Other precautions are prevention of transmission along slab floors running underneath party walls, by the insertion of a strip of damp-proof course or breaking the continuity of the slab under the party wall. The incorporation of absorbent quilts in the cavity between the two leaves of walls built of brick, hollow clay blocks and dense concrete adds appreciably to sound proofing, but with walls of clinker or foamed slag blocks little or no improvement is obtained. Floor joists should run parallel to party walls if possible. Window lintels and sills, when within a few feet of adjacent party walls, should not bind inner and outer leaves solidly together, otherwise a path for vibrations will be provided from the inner wall of one house, via window sills, etc., and outer walls, to the inner wall of the next-door house. This will be obviated if connexions are not too rigid, such as can easily be arranged with wooden frame windows, or by incorporating a damp-proof course where solid lintels or sills rest on the walls. Special care must be taken with chimney breasts and flues incorporated in a party wall. Independent breasts should be built from ground level, with a cavity in between, up to top floor ceiling. Asbestos insulation should be provided where they join. The insulation should be continued to the ends of the party wall to prevent indirect transmission—but ordinary bitumen may be used outside the chimney itself.

A 150-TON FLOATING CRANE

(*The Engineer*, dated 18th February, 1949.)

There is at present in course of construction at Carlisle, the second of two 150-ton floating cranes, designed and built for the Admiralty to replace cranes lost during the war. This article reproduces some photographs of the first of these cranes, together with drawings, specifications and details of performance.

Hitherto the preparation of a floating crane for a sea voyage has involved a considerable amount of work and necessitated the use of shore-based equipment to lower and stow the jib on its support trestle. Likewise, upon arrival at the destination or working site, similar equipment has been necessary to prepare the crane for work. The work of preparing cranes of earlier designs for a sea voyage involves a considerable amount of time, even when operating between well-equipped shore bases, and the use of such cranes at remote harbours or working sites where heavy shore-based lifting equipment is not available, is virtually impossible.

The new floating cranes which are mounted on non-propelled steel pontoons, are entirely independent of external appliances when being prepared for a sea voyage or made ready for work. Their jibs can be lowered under their own power and stored in the supporting trestle and without assistance raised ready for work when required. In the photographs and drawings, the new design of crane is shown in both the working and in the sea-going conditions.

CONTROL OF VARIATIONS IN QUALITY OF CONCRETE AND ITS EFFECTS ON MIX PROPORTIONS

At a paper read before the Reinforced Concrete Association on 23rd February, 1949, the author F. N. Sparkes, M.Sc., M.I.C.E., draws attention to the necessity for exercising control measures in the mixing and handling of concrete. This paper is divided into two main headings " Causes of Variations " and " Controlling the Variables," the first heading is sub-divided into Materials, Handling, and Natural Agencies.

Under Materials the author draws attention to the fact that although cement rarely fails to reach the specified minimum called for in the appropriate Standards, variations in the cement quality as delivered to the job over a period may cause variations in the twenty-eight-day strength of concrete of up to 50 per cent.

The effects of aggregate grading are stressed with some importance as this affects the workability, and hence the water/cement ratio of the concrete. As an example figures are quoted from one job with which the Road Research Laboratory was concerned: with coarse aggregate of $\frac{3}{4}$-in. to $\frac{3}{16}$-in. the percentage passing a $\frac{3}{8}$ sieve varied from 4 per cent to 70 per cent ; with sand the fraction passing the No. 25 B.S. sieve varied between 30 per cent and 64 per cent. As far as this particular job was concerned it was possible to produce a concrete with a compressive strength varying from 5,050 lb. per sq. in. to 6,100 lb. per sq. in., the water/cement ratio having been adjusted to give approximately the same compacting factor. Sand normally delivered on the site usually has bulking of between 15 and 30 per cent. This may give a concrete strength variation of approximately 10 per cent.

Under Handling, batching by four various methods is given, the greatest variation occurs when batching all the materials by volume. Under normal

methods of batching by volume a variation in the concrete strength may be 40 to 60 per cent. Segregation due to bad mixing and transporting will cause variation in the concrete strength, in the worst case the strength may be reduced by 50 per cent. Compacting of the concrete is emphasized, as a small percentage of voids may give a reduction in strength of from 20 to 50 per cent.

The author then offers some suggestions as to how the variations may be either reduced or eliminated, some of the main suggestions are as follows :—

(1) Use cement for the whole of one job from one works.
(2) Ensure correct proportions of the coarse aggregate at the batching point.
(3) Batch all materials by weight and not volume.
(4) Adjust the quantity of water added at the mixer to suit the moisture content of the aggregates.
(5) Adjust the weighing of aggregates in relation to their water content.
(6) Prevent any tendency to segregation during transport and handling.
(7) Ensure adequate compaction of the concrete.

In conclusion the effects of various methods and degrees of control have been assessed to give a ratio of minimum strength to average strength in the concrete quality. By better methods of control, not only can this ratio approach closer to unity, but considerable economy in cement can be effected. This paper is a valuable contribution to the improvement of concrete in the field, and comes at a time when the demand for high quality was never so great.

RE-IMPREGNATION OF OVERHEAD LINE WOOD POLES BY COBRA PROCESS

This is a proprietory process which has reached this country from the continent where it has had fairly extensive use with good results for the last twenty years.

The process consists of introducting a special preservative solution, with antiseptic qualities reputed to be five times as effective as creosote, into the heart of the pole to be treated to prevent or arrest rot and decay due to attack by fungus.

The preservative, an antiseptic paste of high toxicity salts, contains sodium fluoride dinitrophenol, arsenious anhydride, and various cohesives ; and is injected well into the timber by a device comprising a hollow needle and pressure piston operated by a hand lever. A number of injections are made at fairly close spacing round the area of attack, or likely attack.

The main value of the process is in treating existing timbers and the main claim for it is that impregnation of the heartwood, the region most liable to attack, is effected. Ordinary pressure creosoting, especially on timbers imperfectly seasoned or naturally resistant to penetration, such as fir, larch and spruce, only provides protection to a limited depth below the surface.

Fungus growth consists of innumerable filaments of cottony vegetation which dissolve the cellulose and other organic materials contained in the timber. Growth is dependent on the presence of a certain minimum water content. The area of attack is thus normally confined to the region directly above and below ground. The absence of air in deeply buried portions prevents growth, and the lack of moisture in the parts remote from the ground protects the upper part of the pole. Re-impregnation is thus required for a distance of about 14 in. to 15 in. each side of the point of entry into the ground.

The Societé Génerale de Force et Lumière Energic Industrielle in 1944 stated that the life of a pole erected in earth varies from ten to twenty years, dependent on the quality the initial impregnation of preservative and class of ground in which it is implanted. The proprietors of this process claim that re-impregnation can extend the life by a further twelve to fourteen years.

THE REVISED BRITISH STANDARD 449 FOR THE USE OF STRUCTURAL STEEL IN BUILDING (1948)

(Published by the B.S. Institution.)

The revision of B.S. 449 is a comprehensive specification covering the recommended allowable working stresses and the superimposed loading for steel buildings, together with fabrication, erection and workmanship.

The stresses now recommended are an increase on those adopted during the war as a temporary and emergency economy measure. For comparison the stresses for mild steel given in the old standard are listed below, together with those adopted during the war period and those now laid down.

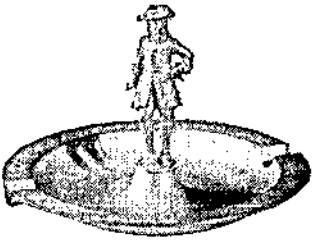
	1937 Standard	1940 War Emergency	1948 Standard
Tension	8	8	9
Compression on short columns (L/K not exceeding 20) ..	7.17	7.17	8
Bending for beams ..	8	10	10
Shear	5	5	6.5

Members subjected to a combination of direct and bending stress, such as is the case in side columns of single storey sheds, are now computed by taking each stress individually as a percentage of the allowable, the sum not to exceed 100 per cent.

Allowances for wind loads permit more exact account to be taken of the degree of shelter afforded to the structure by adjoining features and to the height of the building and its geographical location. The condition of maximum exposure in the British Isles is taken as 80 m.p.h., which is a little lower than the maximum gust ever recorded of around 100 m.p.h. in extremely exposed conditions.

Guidance is given on the effective length of columns, and the conditions of end restraint are clarified by diagrams to illustrate the end beam connexions applicable to different assumptions of effective length. Working stresses are given for angle struts, taking account of bolted end connexions to allow for the eccentricity of load application.

The Standard gives guidance on spacing and size of battens, lacing, separators and web stiffeners and covers many aspects previously assumed in commercial practice and not adequately covered in codes of practice.

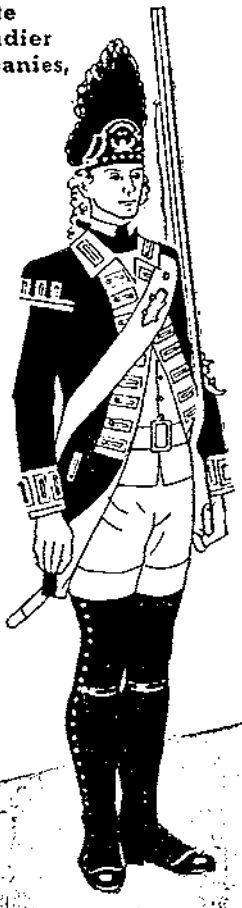


STERLING SILVER ASH TRAY WITH FIGURE IN UNIFORM OF ANY PERIOD.

THE ART OF GIVING

THE special gift which shall be a tribute to the recipient and an enduring record of the occasion requires more than ordinary care in its selection. Sometimes it is indeed difficult to find "just the right thing." The craftsmen of The Goldsmiths & Silversmiths Company have long been accustomed to the production of commemorative pieces in Sterling Silver and other precious metals.

The
GOLDSMITHS & SILVERSMITHS COMPANY LTD
112 REGENT STREET · LONDON · W1
NO BRANCH ESTABLISHMENT ANYWHERE · TELEPHONE: REGENT 3021



Private Grenadier Companies, 1768.

1768

FOREIGN *Service, in* 1768, *often meant hunger and privation. Army catering was then left largely to private adventurers who followed the Army where it was easy and profitable, but jibbed at going further afield where danger lurked, and supplies were difficult. On some distant stations the soldier had to exist practically on salt provisions as at sea.*

The soldier on Foreign Service to-day doesn't expect Army life to be soft; but he knows that at key centres overseas NAAFI *will be looking after his interests, that* NAAFI *will provide games and facilities for Sport and Entertainment.* NAAFI *can do, and pay for, all this because it is run solely to benefit serving men and women. It has no shareholders, and serves no private interests. All available profits are used to improve the lot of those who serve.*

A typical Restaurant in the new type **NAAFI** *Club for* O.R.'S. *Both at home and abroad there is a standard aim to provide high quality refreshment at reasonable prices.*

your **NAAFI**

Banking

for the Army of Today

COX'S & KING'S BRANCH of Lloyds Bank has for generations specialised in banking for Officers of the British Army. This Branch at 6, Pall Mall, besides acting as official Agents for the issue of pay and allowances, is fully equipped to deal with Income Tax, Retired Pay and Pensions. Periodical payments can be made on behalf of customers, and Overseas business of every kind transacted. The services of the Executor and Trustee Department are also available. Arrangements can be made to cash cheques at any of the Bank's Branches and Agencies at home and abroad.

The Manager will be glad to describe in fuller detail the services and facilities of the Bank to any Officer who desires to open an account.

LLOYDS BANK

LIMITED

(COX'S & KING'S BRANCH)

ARMY & ROYAL AIR FORCE AGENTS, 6, Pall Mall, S.W.1

Offices at or near all Army and Royal Air Force centres in England and Wales.